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United States
Environmental Protection
Agency

Economic Analysis for the Final Section 316(b) Existing Facilities Rule

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1 Introduction and Executive Summary

1.1 Background

This document (the *Economic Analysis* or *EA*) provides analytical support to EPA‟s final existing facilities rule (hereafter referred to as the final rule). This rule implements Clean Water Act (CWA) 316(b) requirements governing cooling water intake structures at existing facilities that (1) are designed to withdraw two million gallons per day (MGD) or more of water from rivers, streams, lakes, reservoirs, estuaries, oceans, or other waters of the United States, and (2) use at least 25 percent of this water for cooling purposes. The national requirements, which will be implemented through National Pollutant Discharge Elimination System (NPDES) permits, are based on the best technology available to minimize the adverse environmental impact associated with the use of cooling water intake structures.

This is EPA‟s third effort to establish CWA 316(b) requirements for existing facilities, which include primarily facilities in the electric power industry (Electric Generators), but also in any other industries where facilities meet the rule‟s applicability criteria. Because these non-power industry facilities are almost entirely in manufacturing industries, EPA refers to them as Manufacturers, but this term includes facilities in other non-power generating industries as well. EPA‟s two preceding efforts are:

1. The suspended 2004 Final Section 316(b) Phase II Existing Facilities Rule (suspended 2004 Phase II Final Rule or Phase II Final Rule), which applied to existing electric power facilities with a design intake flow of greater than 50 MGD, and
2. The 2006 Final Section 316(b) Phase III Existing Facilities Rule (2006 Phase III Final Rule or Phase III Final Rule), which applied to existing electric power facilities with a design intake flow of less than 50 MGD and existing manufacturing facilities.

Both of these rules were challenged in court and subsequently remanded to EPA for further rulemaking.

Specifically, in 2004, EPA published the Phase II Final Rule applicable to existing power facilities (69 FR 41576 (July 9, 2004)). However, in response to court rulings, including a remand order from the Second Circuit Court of Appeals in 2007, and a subsequent ruling by the Supreme Court in 2009, EPA suspended the Phase II regulation. In a later rulemaking in 2006, EPA published the Phase III Final Rule, which establishes categorical regulations for certain new offshore oil and gas extraction facilities, and establishes that 316(b) requirements for electric power facilities with a design intake flow (DIF) of less than 50 MGD and existing manufacturing facilities should be established by NPDES permit directors on a site-specific basis using best professional judgment. In 2010, the Fifth Circuit Court of Appeals accepted EPA‟s request to remand the existing facility portion of the Phase III rule to the Agency for further rulemaking.

In response to these court rulings, EPA suspended the previous 316(b) regulations and initiated development of new CWA 316(b) requirements for existing electric power facilities and manufacturing facilities. As a result of this effort, EPA published the Proposed Section 316(b) Existing Facilities Rule in April 2011 (proposed rule). Following receipt of public comments and reassessment of the regulatory options, EPA is now publishing the Final Section 316(b) Existing Facilities Rule (final rule). This final regulation culminates EPA‟s actions to re-promulgate regulatory provisions to replace the suspended 316(b) requirements.

Throughout this document, EPA refers to the suspended 2004 Phase II Final Rule, the 2006 Phase III Final Rule, and the proposed rule as previous 316(b) regulations.

This document describes EPA‟s analysis of the cost and economic impacts conducted in support of the final rule. It also provides information pertaining to legislative and administrative requirements. This document complements and builds on information presented separately in other reports, including:

- *Technical Development Document for the Final Section 316(b) Existing Facilities Rule (TDD)* (U.S. EPA, 2013x). The TDD provides background on the final rule; discusses applicability and summarizes the final rule; and documents EPA‟s engineering analyses to support the development of technology and administrative costs to facilities to implement the rule and costs to States and federal government to administer the rule.
- *Benefits Analysis for the Final Section 316(b) Existing Facilities Rule (BA)* (U.S. EPA, 2013x). The BA summarizes the societal benefits expected to result from implementation of the Final Existing Facilities Rule.

1.2 Overview of the Economic Analysis of the Final Rule

1.2.1 Facilities Subject to the Final Rule

The final rule applies to facilities in the electric power and other industries that (1) have intakes designed to withdraw two million gallons of water per day or more from waters of the United States and (2) use at least 25 percent of this water for cooling purposes (regulated facilities, or Electric Generators and Manufacturers). EPA identified the universe of Electric Generators and Manufacturers that are expected to be subject to this rule based on responses to the 2000 Detailed Industry Questionnaire (DQ), the 2000 Section 316(b) Industry Short Technical Questionnaire (STQ), and the 1999 Industry Screener Questionnaire (ISQ) (316(b) survey) developed for the previous 316(b) regulations.[1] From this survey, EPA determined that the vast majority of Manufacturers conduct their primary business[2] in the following six industries: Aluminum, Chemicals and Allied Products, Food and Kindred Products, Paper and Allied Products, Petroleum Refining, and Steel industries (*Primary Manufacturing Industries*). EPA also identified in the survey responses some cooling water-dependent facilities whose principal operations lie in businesses other than the electric power industry or the Primary Manufacturing Industries. EPA refers to these additional industries as "Other Industries", but refers to any non-generators under the broad terminology of Manufacturers.[3]

The final rule includes provisions applicable to *existing units* at these facilities as well as a provision applicable to *new units* at existing facilities. EPA uses the term *final rule-existing units* to refer to the provisions of the final rule for existing units and/or the analyses pertaining to the existing units provisions; the term *final rule-new units* refers to the provision of the final rule for new units and/or the analyses pertaining to the new units provision.

Final Rule-Existing Units

EPA estimates that 544 Electric Generators, 509 Manufacturers in six Primary Manufacturing Industries, and 12 Manufacturers in Other Industries will be subject to the existing units provisions of the final rule.

Electric Generators

EPA‟s analyses indicate that the Electric Generators represent substantial shares of the electric power industry: approximately 46 percent of total electric power generating capacity, approximately 9 percent of all electric power

1 For more information on the 316(b) survey, refer to the Information Collection Request (U.S. EPA, 2000).

2 Manufacturers may engage in more than one industry; in particular, Manufacturers often generate electricity, both for onsite use and for sale to the electric power grid.

3 These industries are: Crop Production, Mining (Except Oil and Gas), Textile Mills, Wood Product Manufacturing, Primary Metal Manufacturing, Transportation Equipment Manufacturing, and Miscellaneous Manufacturing.

facilities, and approximately 5 percent of all parent entities in the overall electric power industry *Table 1-1*). For detailed information on the electric power industry, see *Chapter 2: Industry Profiles*.

Table 1-1: Electric Generators Share of Electric Power Industry: Facilities, Parent Entities, and Total Capacity in 2011

	Electric Power Industry[a]	Electric Generators[b,c]	
		Number	% of Total
Parent Entities	2,905	159	5.5%
Facilities	6,058	544	9.0%
Capacity (MW)	1,153,044	529,463	45.9%

a. Data for electric power industry are from the 2011 EIA-860 database (U.S. DOE, 2011x) and 2011 EIA-861 database (U.S. DOE, 2011x).
b. Facility counts are sample-weighted estimates, generated using *original survey* weights. For details, see *Appendix H*.
Source: U.S. EPA Analysis, 2013; U.S. DOE, 2011x; U.S. DOE, 2011x.

As reported in *Table 1-2*, approximately half of the Electric Generators draw water from a freshwater river (283 facilities or 52 percent), followed by lakes or reservoirs (115 facilities or 21 percent) and estuaries or tidal rivers (88 facilities or 16 percent). *Table 1-2* also reports that almost two thirds of the regulated facilities (343 facilities or 63 percent) employ a once-through cooling system.

Table 1-2: Number of Electric Generators by Waterbody and Cooling-System Type[a,b]

Waterbody Type	Recirculating	Once-Through	Combination	Other	Total
Estuary/Tidal River	5	72	9	1	88
Freshwater Stream/River	102	147	29	4	283
Great Lake	4	32	2	0	38
Lake/Reservoir	36	71	7	1	115
Ocean	0	20	0	0	20
Total	**148**	**343**	**47**	**6**	**544**

a. Individual values may not sum to totals due to independent rounding.
b. Facility counts are sample-weighted estimates, generated using *original survey* weights. For details, see *Appendix H*.
Source: U.S. EPA, 1998

Manufacturers

Table 1-3 presents industry-wide facility counts and counts of regulated facilities, by industry, for the Primary Manufacturing Industries and Other Industries. The Petroleum Refining industry accounts for the largest share of Manufacturers (11 percent of the estimated regulated total), while facilities in the Aluminum, Paper and Allied Products, and Steel Industries make up the second largest category (4 percent).

Table 1-3: Industry-Wide and Regulated Manufacturing Facilities, by Industry[a,b]

Industry	Industry Total	Regulated Facilities	Regulated % of Industry Total
Primary Manufacturing Industries			
Aluminum	583	22	4%
Chemicals and Allied Products	13,138	175	1%
Food and Kindred Products	4,119	34	1%
Paper and Allied Products	4,706	194	4%
Petroleum Refining	303	35	11%
Steel	1,233	48	4%
Total - Primary Manufacturing Industries	**24,082**	**509**	**2%**
Other Industries	NA	12	NA

a. Individual values may not sum to totals due to independent rounding.
b. These are sample-weighted estimates of the number of Manufacturers, calculated using *technical weights*. This number excludes 67 facilities estimated to be at substantial risk of financial failure regardless of any additional financial burden that might result from the final rule. For details see *Appendix H*.
Source: U.S. EPA, 1998 U.S. DOC, 2009 SUSB; U.S. EPA, 2000

As reported in *Table 1-4*, EPA estimates that the vast majority (76 percent) of Manufacturers withdraw cooling water from freshwater streams or rivers, followed by lakes and reservoirs (8 percent). Almost half of the Manufacturers employ once-through cooling systems (47 percent), followed by "combination" systems (22 percent) and closed-cycle cooling systems (20 percent).[4]

Table 1-4: Number of Manufacturers by Waterbody and Cooling-System Type[a,b,c,d]

Waterbody Type	Recirculating	Once-Through	Combination	Other	Unknown	Total
Estuary/Tidal River	1	21	16	0	0	38
Freshwater Stream/River	95	185	79	34	4	397
Great Lake	0	21	10	7	0	38
Lake/Reservoir	7	13	12	11	0	42
Ocean	0	5	0	0	0	5
Total	**103**	**245**	**117**	**52**	**4**	**521**

a. Individual values may not sum to totals due to independent rounding.
b. This is a sample-weighted estimate of the number of Manufacturers, calculated using technical weights. This number excludes 67 baseline-closure facilities that EPA estimated to be at substantial risk of financial failure regardless of any additional financial burden that might result from the final rule or other considered options. For details see *Appendix H*.
b. Includes facilities in the Primary Manufacturing Industries and Other Industries.
c. Four facilities have an unknown cooling water system type.
Source: U.S. EPA, 1998

Final Rule-New Units

The new units provision of the final rule applies to *newly constructed electric power generating units* at existing facilities and *repowering of existing generating units* where the turbine and condenser are replaced. Unlike the case for the existing units provisions, EPA cannot predict the facilities at which such new or repowered units will be constructed, or the number and size of new or repowered units that will be constructed. Instead, EPA estimated the potential coverage of the new units provision of the final rule based on the quantity of electric power generating capacity that will be installed and subject to the new units provision in future years. In addition, EPA considered a range of options for the final rule"s new units provision, each of which would cover a different quantity of new units capacity.

Table 1-5 reports, for the final rule and other new units options EPA considered, the capacity that EPA expects to be subject to the new units provision of the final rule in newly constructed and repowered units. As reported in this table, Option A, the most inclusive of the new units options, and Option B would cover more while Option C would cover less capacity than the new units provision of the final rule. *Section 1.2.2* describes the coverage specifications for the new units provision of the final rule and other new units options considered.

Table 1-5: Estimated Annual Average Generating Capacity Subject to New Units Provision

Option	Affected Capacity (MW)
Option A	2,055
Option B	840
Final Rule-New Units	116
Option D	23

Source: U.S. EPA Analysis, 2013

1.2.2 Final Rule and Other Options Considered

In developing the final rule, EPA considered three options for existing units, and four options for new units.

4 Not all Manufacturers that have installed a cooling tower are classified as using closed-cycle cooling systems. Facilities with multiple cooling water systems may be "combination" systems that employ both closed-cycle and once-through cooling. Manufacturers may also list "helper" cooling towers in their survey responses, which are generally used to mitigate discharge temperatures and do not necessarily affect intake flows.

Final Rule-Existing Units

EPA considered and analyzed three options for existing units. All of the options apply to existing facilities with design intake flow (DIF) greater than 2 million gallons per day (MGD), and include impingement mortality (IM) technology-based, performance standards. The options vary by the DIF level at which the uniform IM technology standards apply and by whether facilities would be required to meet entrainment control technology-based standards, again based on DIF level. In addition, the existing units options include provisions for site-specific determination of whether entrainment technology-based standards would be required at facilities. Each option draws from one of the options that EPA analyzed for the proposed rule.

- *Final Rule (similar to Proposal Option 1 but with IM flexibilities outlined in NODA 1 and recalculated limits): IM at All Existing Facilities; Entrainment Controls for Facilities Greater than 2 MGD DIF Determined on a Site-Specific Basis*: Under the existing units provision of the final rule, existing facilities subject to this rule must comply with one of seven alternatives identified in the national BTA standard for impingement mortality. EPA identified modified traveling screens with a fish return system as the technology basis for this performance standard. In addition, entrainment controls may be established by the permitting authority on a site-specific basis for all facilities with at least 2 MGD DIF. EPA expects all regulated facilities to install IM controls in accordance with the existing units requirements by 2022.
- *Proposal Option 4: Uniform IM Controls at Existing Facilities with DIF of 50 MGD or Greater; Best Professional Judgment-based Permits for Existing Facilities with Design Intake Flow Less than 50 MGD but Greater than 2 MGD DIF.* Proposal Option 4 is the same as the final rule in all respects except that Proposal Option 4 requires only existing facilities with DIF exceeding 50 MGD to achieve the uniform national IM design/performance standard. Existing facilities between 2 and 50 MGD would remain subject to 316(b) permitting based on best professional judgment for both IM and entrainment control design/performance standard. In analyzing this option, EPA assumed that all Electric Generators and Manufacturers required to install IM controls would do so by 2022.
- *Proposal Option 2: IM Everywhere and Entrainment Controls for Existing Facilities with DIF Greater than 125 MGD*: Under this option, existing facilities with a cooling water intake with a DIF exceeding 125 MGD would be required to meet performance standards based on IM and entrainment control technology. Standards for entrainment control technology would be set equivalent to intake flow levels with closed cycle cooling. All other existing facilities would be required to meet numeric IM technology-based performance standards only. In addition, entrainment controls would be established by the permitting authority on a site-specific basis for all facilities with average intake flow (AIF) of less than 125 MGD. In analyzing this option, EPA assumed that Manufacturers and non-nuclear Electric Generators would install entrainment controls by 2025, nuclear Electric Generators would install entrainment controls by 2030, and all Electric Generators and Manufacturers required to install IM controls would do so by 2022.

Final Rule-New Units

In developing the provision of the final rule applicable to new units, EPA considered four options, each of which includes specifications requiring that new or repowered units at an existing facility with DIF exceeding 2 MGD meet technology performance standards commensurate to those required of a new facility under the 316(b) Phase I rule.[5] These standards require entrainment control technology performance equivalent to the intake flow levels that would be achieved by a closed-cycle recirculating system. Two categories of new units at an existing facility are subject to the new units provision: (1) a newly built, standalone generating unit, i.e., a unit also referred to as

5 For details on the Phase I Final New Facilities Rule, see http://water.epa.gov/lawsregs/lawsguidance/cwa/316b/phase1/index.cfm.

greenfield,[6] that is constructed at an existing facility and does not meet the definition of a new facility and (2) an existing unit that is replaced or repowered where a new condenser and turbine are built and undergoes significant modifications. In all four of the final rule-new units options EPA considered, all of the new units falling in the first category would be subject the final rule"s new units provision. The options considered by EPA vary by the definition of new units of the second category that would be subject to the entrainment controls-based performance standard. For any of the options considered, new units in the second category that would not be subject to the entrainment controls-based performance standard would instead be regulated under the provisions applicable to existing units.

In developing the final rule, EPA considered and analyzed the following four options for defining new capacity as a *new unit* at existing facilities; these options differ based on the type of modifications at repowering units:

- *Option A: Entrainment performance requirements for all standalone or greenfield new units and all types of repowered units.*
- *Option B: Entrainment performance requirements for all stand-alone or greenfield new units and only those replaced or repowered units in which the existing unit's turbine and condenser are newly built or replaced.*
- *Final Rule (Option C): Entrainment performance requirements for all stand-alone or greenfield new units, and for repowered new units where the turbine and condenser are newly built or replaced, but excluding high efficiency systems.* This option is the same as Option B, except that repowered or replaced units that meet the criteria for high efficiency systems are excluded. High efficiency generating systems, which are defined as those that achieve a thermal conversion heat rate of 7,000 Btu per kWh after being repowered, already use a considerably smaller amount of cooling water per megawatt (MW) of power generated. For example, a combined cycle generating system may use nearly half as much cooling water for the same generating output capacity as a coal-fired unit. This option recognizes the inherent benefit of highly efficient systems and is intended to provide an incentive for greater implementation of high efficiency systems. The exclusion may also apply to cogeneration systems as well, if they meet the criterion.
- *Option D: Entrainment performance requirements for all standalone or greenfield new units only*. Under this option, none of the second category of new units – replaced or repowered units where the turbine and condenser are newly built or replaced – would be subject to the performance standard based on entrainment requirements. This is equivalent to the compliance requirements for new units as analyzed in support of the proposed rule.

Throughout this document, when presenting analysis results, EPA refers to the final rule requirements associated with existing units at existing facilities as "final rule-existing units" and to the final rule requirements associated with new units at existing facilities as "final rule-new units."

For details on specific technologies considered for the final rule and other options EPA considered, see the *TDD*; see the Federal Register notice and rule language for further discussion of regulatory requirements.

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[6] The terms greenfield and standalone in this context refer to the definitions established in the Phase I Rule. Per Phase I 316(b), at 125.83: "A greenfield facility is a facility that is constructed at a site at which no other source is located, or that totally replaces the process or production equipment at an existing facility (see 40 CFR 122.29(b)(1)(i) and (ii)). A stand-alone facility is a new, separate facility that is constructed on property where an existing facility is located and whose processes are substantially independent of the existing facility at the same site (see 40 CFR 122.29(b)(1)(iii))."

1.2.3 Analyses Performed in Support of the Final Rule

Generally, in performing analyses of the final rule and other options considered, EPA followed closely the analysis approaches and impact evaluation concepts used in the analysis for the previous 316(b) analyses, including the proposed rule, and to the extent possible, relied on the same data sources.[7] These assessments, the methodologies used to conduct them, and analysis results are discussion in this document as follows:

- *Chapter 2: Industry Profiles* provides a detailed description of the electric power industry and a summary of more detailed discussions of the six Primary Manufacturing Industries and Other Industries presented in Appendices A through G of this document.
- *Chapter 3: Compliance Costs* describes components of technology and administrative costs to facilities to implement, and administrative costs to States and federal government to administer, the final rule and other options EPA considered. This chapter also calculates the industry-wide compliance costs to the Electric Power Industry, the six Primary Manufacturing Industries, and Other Industries. This chapter presents cost estimates for existing units and new units.
- *Chapter 4: Economic Impact Analyses – Electric Generators* assesses the impact of the final rule and other options on the Electric Generators segment of regulated facilities, and their parent entities, based on a cost-to-revenue analysis. This chapter also looks at the impacts of compliance in terms of increased electricity prices for households and for other consumers of electricity. EPA conducted this analysis only for existing units.
- *Chapter 5: Economic Impact Analyses – Manufacturers* assesses the impact of the final rule and other options on the Manufacturers segment of regulated facilities in terms of *severe impacts* (i.e., facility closures) and *moderate impacts* (i.e., adverse changes in a facility‟s financial position that are of lower severity than closure). This chapter also assesses impacts on their parent entities, based on a cost-to-revenue comparison. EPA conducted this analysis only for existing units.
- Chapter 6: *Barrier to Entry Analysis of the New Units Provision* assesses the cost and impact of the final rule-new units, looking specifically at how the new units provision will affect decisions to construct new generating units and/or replace or repower existing coal-fired capacity with natural gas/combined cycle capacity.
- *Chapter 7: Electricity Market Analysis* analyzes the impacts of the final rule using the Integrated Planning Model (IPM[8]) and provides insight into the effects that the final rule requirements will have on regulated facilities and on the Electric Power Industry as a whole, at the national and regional levels. EPA conducted this analysis only for existing units.
- *Chapter 8: Total Social Costs* looks at the impact of the final rule and other options considered in terms of total costs to society. EPA conducted this analysis for existing units and new units.
- *Chapter 9: Social Costs and Benefits* compares the estimated total social costs of the final rule and other options considered, to the estimated benefits. The detailed benefits analysis is presented in a separate Benefits *Analysis (BA)* report. EPA conducted this analysis for existing units and new units.
- *Chapter 10: Employment Effects* assesses national-level changes in employment in the Electric Power Industry. EPA conducted this analysis for existing units and new units.

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7 For more details on these analyses see the suspended 2004 Phase II Final Rule EA report, the 2006 Phase III Final Rule EA report, and the 2010 Proposed Rule EA report.

8 IPM is a comprehensive electricity market optimization model that assesses the impacts of environmental regulations and other economic factors within the context of regional and national electricity markets. EPA has used IPM to analyze the impacts of various regulatory actions affecting the electric power sector over the last decade, particularly Clean Air Act regulations.

- *Chapter 11: Regulatory Flexibility Act (RFA) Analysis* addresses the requirements of the RFA and assesses the impact of the final rule and other options considered on small entities on the basis of a cost-to-revenue comparison. EPA conducted this analysis only for existing units.
- *Chapter 12: Unfunded Mandates Reform Act (UMRA) Analysis* addresses the requirements of UMRA by assessing the impact on government entities, both in terms of compliance costs to government-owned Electric Generators and in terms of administrative costs to governments implementing the rule. This analysis also compares the impacts to small governments with those of large governments and small private entities. EPA conducted this analysis only for existing units.
- *Chapter 13: Other Administrative Requirements* addresses the requirements of Executive Orders that EPA is required to satisfy for this rule, notably Executive Order 13211, which requires EPA to determine whether this action will have a significant effect on energy supply, distribution, or use. EPA conducted this analysis only for existing units.

This document includes 15 appendices:

- *Appendices A-G:* provide detailed descriptions of the six Primary Manufacturing Industries and the Other Industries subject to the final rule.
  - *Appendix A: Profile of Aluminum Industry*
  - *Appendix B: Profile of the Chemicals and Allied Products Industry*
  - *Appendix C: Profile of Food and Kindred Products Industry*
  - *Appendix D: Profile of the Paper and Allied Products Industry*
  - *Appendix E: Profile of the Petroleum Refining Industry*
  - *Appendix F: Profile of the Steel Industry*
  - *Appendix G: Other Industries*
- *Appendix H: Sample Weights* describes the development and use of sample weights for the cost and economic impact analysis of the final rule and other options considered.
- *Appendix I: Energy Requirements* describes how EPA accounted for two technology-related cost and operating effects: energy penalty and technology installation downtime.
- *Appendix J: SIC to NAICS Data Conversion* discusses the mapping of the facility-level 4-digit SIC codes for which the 316(b) survey-based facility information for Manufacturers was originally reported, onto 6-digit NAICS codes for use in the current cost and economic impact analysis.
- *Appendix K: Cost Pass-Through Analysis* assesses the cost pass-through (CPT) potential for the six Primary Manufacturing Industries.
- *Appendix L: Adjusting Baseline Facility Cash Flow* describes EPA‟s development of adjustment factors to bring certain 316(b) survey-based financial data for the six Primary Manufacturing Industries to the present.
- *Appendix M: Estimating Capital Outlays* describes the analysis used to estimate ongoing capital outlays for use in the facility-level cash flow analyses for Manufacturers.
- *Appendix N: Analysis of Other Regulations* presents analysis of other environmental regulations that were recently or will soon be promulgated, potentially imposing additional costs on Manufacturers beyond those reflected in their baseline financial statements.
- *Appendix O: Economic Impact Methodology - Manufacturers* provides supporting details on the cost and economic impact analysis conducted for Manufacturers and discussed in *Chapter 5* of this document.
- *Appendix P: Analysis Using the IPM V4.10 Platform* presents result of the market model analysis conducted using an alternative IPM platform.

The following section summarizes the cost and economic impact analysis results.

1.3 Summary of Analysis Results

In reaching its decisions concerning the final rule, EPA assessed the rule"s overall cost, potential economic impacts, and expected benefits. In some instances, EPA undertook different analyses for the existing and new units provisions of the final rule. The main findings from these assessments are summarized below:

- EPA estimates that the final rule will result in total annual costs to society of approximately $297 million at a 3-percent discount rate and $309 million at a 7-percent discount rate[9], accounting for both the new units and the existing units provisions.
- EPA estimates that the rule – existing and new units provisions – will result in national monetized benefits to society of $21.2 million annually at the 3-percent discount rate, and $18.8 million annually at the 7-percent discount rate. Some potentially significant benefit categories have not been fully monetized, and thus the national monetized benefits are likely to understate substantially the rule"s expected benefits to society.[10]
- EPA examined whether the new units provision of the final rule would alter plant owner"s assessments of repowering or replacing existing coal-fired capacity with natural gas/combined cycle capacity. This analysis found that the additional cost from closed-cycle recirculating system would minimally affect the assessment of such opportunities. Only a very small percentage of otherwise economically viable opportunities for repowering or replacement would be altered by the closed-cycle recirculating system requirement.
- Under the rule"s existing units provision, EPA estimates that the majority of Electric Generators (84 percent) will incur compliance costs of less than 1 percent of revenue.
- EPA estimates that none of the approximately 500 regulated Manufacturers facilities in the Primary Manufacturing Industries will incur severe impacts (i.e., potentially close) as a result of the rule"s existing units provision. EPA estimates that 12 facilities in the Primary Manufacturing Industries will experience financial stress short of closure.
- EPA estimates that between 116 and 159 parent entities own the regulated Electric Generators; the majority of these parent entities (between 91 and 94 percent) will incur compliance costs of less than 1 percent of revenue under the rule"s existing units provisions.
- Between 110 and 327 entities own regulated facilities in the Primary Manufacturing Industries; a substantial majority (between 101 and 312 entities, or between 92 and 95 percent) will incur costs of less than 1 percent of revenue under the rule"s existing units provisions. Ten entities own regulated facilities in the Other Industries; the majority of these entities (eight entities or 70 percent) will incur costs of less than 1 percent of revenue.
- On average, across the United States, EPA estimates that the rule"s existing units provision will increase electricity production costs by 0.011 cents per kWh, causing an estimated 0.1 percent increase in average electricity prices. This impact varies regionally by electric power market area, ranging from nearly zero cents/kWh to 0.041 cents/kWh. The corresponding annual increase in electricity costs is approximately

9 EPA used these discount rates to reflect how society values cost and benefit streams that extend into the future and vary over time. See *Chapter 3: Compliance Costs* and *Chapter 8: Total Social Costs*.

10 See BA *Chapter 4: Economic Benefit Categories Associated with IM&E Reduction* of the *Benefits Analysis* for additional discussion of benefits categories monetized by EPA.

$1.24 per household; the increase in household electricity costs varies regionally by electric power market area, ranging from $0.01 to $2.85.

- EPA estimates that the rule‟s existing units provision will not materially affect national or regional electricity markets on a long-term basis. In addition, the temporary capacity loss from compliance-technology installation will not cause material reliability effects.
- EPA estimates that the final rule – including both the existing units and new units provisions – will cause an average annual increase of 213 jobs in all regulated industry segments.
- For the Regulatory Flexibility Act (RFA) assessment, EPA estimates that between 20 and 39 small entities own 39 Electric Generators. Under the rules‟ existing units provision, between four and seven of these small entities will incur compliance costs exceeding 1 percent of revenue, representing between 18 and 20 percent of all small entities that own Electric Generators. Compliance costs will exceed 3 percent of revenue for no more than one small entity, representing 5 percent of all small entities that own Electric Generators. For the Manufacturers segment, EPA estimates that between 18 and 53 small entities own regulated facilities in the Primary Manufacturing Industries, and five small entities own regulated Other Industries facilities. Under the rule‟ existing units provisions, EPA estimates that three to four small entities that own Primary Manufacturing Industries facilities will incur costs exceeding 1 percent of revenue (8 to 18 percent of small entities owning regulated facilities in the Primary Manufacturing Industries), and zero to one small entities will incur costs exceeding 3 percent of revenue (zero to 6 percent of small entities). In addition, EPA estimates that two entities in the Other Industries will incur costs exceeding 1 percent of revenue, with no entity incurring costs exceeding 3 percent of revenue. Given (1) the small absolute number of small entities estimated to incur a potentially significant cost impact and (2) the low percentage of small entities owning regulated facilities that would incur this impact, EPA concludes that the final rule will not have "a significant impact on a substantial number of small entities" (SISNOSE) within both the Electric Generators and Manufacturers segments.
- For the analyses required under Title II of the Unfunded Mandates Reform Act (UMRA) of 1995, Pub. L. 104-4, EPA estimates that for Electric Generators, the maximum cost to governments (excluding the federal government) in any one year, for compliance with, and administration of, the existing units provision of the final rule, will be approximately $66 million and that the maximum cost to the private sector in any given year (compliance cost only) will be approximately $1.2 billion. For Manufacturers, these numbers are $1 million and $0.4 billion, respectively. Thus, EPA determined that the final rule contains a federal mandate that may result in expenditures of $100 million or more for State, local, and Tribal governments, in the aggregate, or the private sector in any one year. From the UMRA analysis, EPA concluded that the rule‟s existing units provisions will not significantly or uniquely affect small governments, including Tribal governments, compared to large governments or small private entities for in either the Electric Generators or Manufacturers segment.
- EPA assesses that the rule‟s existing units provision will not cause effects in the electric power sector that would constitute a significant adverse effect under Executive Order 13211: Actions Concerning Regulations That Significantly Affect Energy Supply, Distribution, or Use.

2 Introduction to Industry Profiles

EPA identified two broad industry categories as the most reliant on cooling water in their operations and thus containing substantial numbers of facilities that will be subject to the final rule and other options EPA considered:

1. Electric Generators
2. Manufacturers – specifically six industries, the Primary Manufacturing Industries, as referred to in this document:
   - Paper and Allied Products (NAICS 322)
   - Chemicals and Allied Products (NAICS 325)
   - Petroleum Refining (NAICS 324)
   - Steel (NAICS 3311 and 3312)
   - Aluminum (NAICS 3313)
   - Food and Kindred Products (NAICS 311 and 3121).

In addition, from the 316(b) survey, EPA identified that facilities in industries other than the Primary Manufacturing Industries, including non-manufacturing industries, also use cooling water and will therefore be subject to the final rule. However, based on EPA‟s reviews of industries‟ reliance on cooling water, the cooling water intake flow of facilities in these remaining industries is small relative to that of the power industry and the six Primary Manufacturing Industries. In this document, regulated facilities in industries other than the electric power generating industry and the Primary Manufacturing Industries, are referred to as the Other Industries facilities.

EPA prepared detailed economic profiles of the Electric Power Industry and the six Primary Manufacturing Industries. These profiles review information on the industries‟ historical economic/financial performance, structure, and economic outlook, and provide insight on how the requirements of the final rule will affect them. In particular, the profiles assess the number of facilities that EPA expects will be subject to the final rule, economic activity and employment in the regulated segments, and factors influencing the ability of these industries to meet the final rule‟s compliance requirements without undue adverse economic impact. EPA also prepared a less-detailed profile of the Other Industries facilities, focusing on characteristics of the small number of these facilities that EPA identified as part of the 316(b) survey.

This chapter includes the detailed profile of the Electric Power Industry (Chapter 2A) and a summary profile for the six industries comprising the Primary Manufacturing Industries.

The detailed profiles for the six Primary Manufacturing Industries are contained in the following appendices:

- Appendix A: Paper and Allied Products (NAICS 322),
- Appendix B: Chemicals and Allied Products (NAICS 325),
- Appendix C: Petroleum Refining (NAICS 324),
- Appendix D: Steel (NAICS 3311 and 3312),
- Appendix E: Aluminum (NAICS 3313),
- Appendix F: Food and Kindred Products (NAICS 311 and 3121),

Appendix G reviews information on facilities identified in the Other Industries group.

2A Profile of the Electric Power Industry

2A.1 Introduction

This profile compiles and analyzes economic and operational data for the electric power generating industry. It provides information on the structure and overall performance of the industry and describes important trends that may influence the nature and magnitude of the final rule‟s economic impacts.

The Electric Power Industry is one of the most extensively studied industries. The Energy Information Administration (EIA), among others, publishes a multitude of reports, documents, and studies on an annual basis. This profile does not repeat those efforts. Rather, this profile compiles, summarizes, and presents those industry data that are important in the context of the final rule.

The remainder of this profile is as follows:

- *Section 2A.2* provides a brief overview of the industry, including descriptions of major industry segments, types of generating facilities, and the entities that own generating facilities.
- *Section 2A.3* provides data on industry production, capacity, and geographic distribution.
- *Section 2A.4* focuses on the electric power facilities subject to the final rule (or 316(b) facilities);[11] this section provides information on their physical, geographic, and ownership characteristics.
- *Section 2A.5* provides a brief discussion of factors affecting the future of the electric power industry, including the status of electric utility regulatory restructuring and ongoing changes in air quality regulations.
- *Section 2A.6* summarizes forecasts of market conditions through the year 2035 from the Annual Energy Outlook 2012.
- *Section 2A.7* provides a glossary of key terms used in this chapter.

2A.2 Industry Overview

This section provides a brief overview of the industry, including descriptions of major industry sectors, types of generating facilities, and the entities that own generating facilities.

2A.2.1 Industry Sectors

The electricity business includes three major functional service components or sectors: generation, transmission, and distribution, which are defined as follows (Joskow, 1997; U.S. DOE, 2012x):

- The generation sector includes the facilities that produce, or "generate," electricity. A mechanically driven rotary generator usually produces electric power. Generator drivers, also called prime movers, include steam turbines; gas- or diesel-powered internal combustion machines; and turbines powered by streams of moving fluid such as water from a hydroelectric dam. Most boilers are heated by direct combustion of fossil or biomass-derived fuels, or waste heat from the exhaust of a gas turbine or diesel engine, but heat from nuclear, solar, and geothermal sources is also used. Electric power may also be

[11] EPA used the term *316(b) facilities* as opposed to *regulated facilities* to distinguish from facilities operating in regulated electricity markets, discussed later in this chapter.

produced without a generator by using electrochemical, thermoelectric, or photovoltaic (solar) technologies.

- The transmission sector is the network of large, high-voltage power lines that deliver electricity from power generating facilities to local areas. Electricity transmission involves the "transportation" of electricity from facilities to distribution centers using a complex system. Transmission requires interconnecting and integrating a number of generating facilities into a stable, synchronized, alternating current (AC) network; scheduling and dispatching all connected facilities to balance the demand and supply of electricity in real time; and, managing the system for equipment failures, network constraints, and interaction with other transmission networks.
- The distribution sector is the local delivery system – the relatively low-voltage power lines that bring power to homes and businesses. Electricity distribution relies on a system of wires and transformers along streets and underground to provide electricity to residential, commercial, and industrial consumers. The distribution system involves both the provision of the hardware (e.g., lines, poles, transformers) and a set of retailing functions, such as metering, billing, and various demand management services.

Of the three industry sectors, only electricity generation produces the environmental impacts that are the focus of this regulation. The remainder of this profile focuses on the generation sector of the industry.

2A.2.2 Prime Movers

Electric power facilities use a variety of prime movers to generate electricity. Several factors determine the choice of prime mover in developing an electric power generating facility: the type of load that the facility will serve, the availability of fuels, and energy requirements. Most prime movers use fossil fuels (coal, oil, and natural gas) as an energy source and employ some type of turbine to produce electricity. According to the Department of Energy, the most common prime movers are as follows (U.S. DOE, 2012x):

- *Steam Turbine*: Most of the electricity in the United States is produced with steam turbines. In a fossil-fueled steam turbine, the fuel is burned in a boiler to produce steam. The resulting steam then turns the turbine blades that turn the shaft of the generator to produce electricity. In a nuclear-powered steam turbine, the boiler is replaced by a reactor containing a core of nuclear fuel (primarily enriched uranium). Heat produced in the reactor by fission of the uranium is used to make steam. The steam is then passed through the turbine generator to produce electricity, as in the fossil-fueled steam turbine. Steam-turbine generating units are used primarily to serve the base load of electric utilities. Fossil-fueled steam-turbine generating units range in size (nameplate capacity) from 1 megawatt to more than 1,000 megawatts. The size of nuclear-powered steam-turbine generating units in operation today ranges from 75 megawatts to more than 1,400 megawatts.
- *Gas Turbine*: In a gas turbine (combustion-turbine) unit, hot gases produced from the combustion of natural gas and distillate oil in a high-pressure combustion chamber are passed directly through the turbine, which spins the generator to produce electricity. Gas turbines are commonly used to serve the peak loads of the electric utility. Gas-turbine units can be installed at a variety of site locations, because their size is generally less than 100 megawatts. Gas-turbine units also have a quick startup time, compared with steam-turbine units. As a result, gas-turbine units are suitable for peak load, emergency, and reserve-power requirements. The gas turbine, as is typical with peaking units, has a lower efficiency than the steam turbine used for base load power.
- *Combined Cycle*: Turbine The efficiency of the gas turbine is increased when coupled with a steam turbine in a combined cycle operation. In this operation, hot gases (which have already been used to spin one turbine generator) are moved to a waste-heat recovery steam boiler where the water is heated to produce steam that, in turn, produces electricity by running a second steam-turbine generator. In this way,

two generators produce electricity from one initial fuel input. All or part of the heat required to produce steam may come from the exhaust of the gas turbine. Thus, the supplementary steam-turbine generator may be operated with the waste heat. Combined cycle generating units generally serve intermediate loads.

- *Internal Combustion*: Engine These prime movers have one or more cylinders in which the combustion of fuel takes place. The engine, which is connected to the shaft of the generator, provides the mechanical energy to drive the generator to produce electricity. Internal-combustion (or diesel) generators can be easily transported, can be installed upon short notice, and can begin producing electricity nearly at the moment they start. Thus, like gas turbines, they are usually operated during periods of high demand for electricity. They are generally about 5 megawatts in size.
- *Hydroelectric Generating Units*: Hydroelectric power is the result of a process in which flowing water is used to spin a turbine connected to a generator. The two basic types of hydroelectric systems are those based on falling water and natural river current. In the first system, water accumulates in reservoirs created by the use of dams. This water then falls through conduits (penstocks) and applies pressure against the turbine blades to drive the generator to produce electricity. In the second system, called a run-of-the-river system, the force of the river current (rather than falling water) applies pressure to the turbine blades to produce electricity. Since run-of-the-river systems do not usually have reservoirs and cannot store substantial quantities of water, power production from this type of system depends on seasonal changes and stream flow. These conventional hydroelectric generating units range in size from less than 1 megawatt to 700 megawatts. Because of their ability to start quickly and make rapid changes in power output, hydroelectric generating units are suitable for serving peak loads and providing immediately available back-up reserve power (spinning reserve), as well as serving base load requirements. Another kind of hydroelectric power generation is the pumped storage hydroelectric system. Pumped storage hydroelectric facilities use the same principle for generation of power as the conventional hydroelectric operations based on falling water and river current. However, in a pumped storage operation, low-cost off-peak energy is used to pump water to an upper reservoir where it is stored as potential energy. The water is then released to flow back down through the turbine generator to produce electricity during periods of high demand for electricity.

In addition to those listed above, a number of other less common prime movers are used to generate electricity:

- *Other Prime Movers*: Other methods of electric power generation, which presently contribute only small amounts to total power production, have potential for expansion. These include geothermal, solar, wind, and biomass (wood, municipal solid waste, agricultural waste, etc.). Geothermal power comes from heat energy buried beneath the surface of the earth. Although most of this heat is at depths beyond current drilling methods, in some areas of the country, magma – the molten matter under the earth's crust from which igneous rock is formed by cooling – flows close enough to the surface of the earth to produce steam. That steam can then be harnessed for use in conventional steam-turbine facilities. Solar power is derived from the energy (both light and heat) of the sun. Photovoltaic conversion generates electric power directly from the light of the sun; whereas, solar-thermal electric power generators use the heat from the sun to produce steam to drive turbines. Wind power is derived from the conversion of the energy contained in wind into electricity. A wind turbine is similar to a typical wind mill. However, because of the intermittent nature of sunlight and wind, high capacity utilization factors cannot be achieved for these facilities. Several electric utilities have incorporated wood and waste (for example, municipal waste, corn cobs, and oats) as energy sources for producing electricity at their power facilities. These sources replace fossil fuels in the boiler. The combustion of wood and waste creates steam that is typically used in conventional steam-electric facilities.

The final rule is only relevant for power generators that use substantial amounts of cooling water, and not all prime movers require substantial amounts of cooling water. Only prime movers with a steam-electric generating cycle use large enough amounts of cooling water to be subject to the final rule. This profile, therefore, differentiates between steam-based generating capacity and other prime movers, and treats the following prime movers as steam-electric:

- Steam Turbine, including generating units that are fueled by coal, gas, oil, waste, nuclear, geothermal, and solar steam (not including combined cycle)
- Combined Cycle, which includes a steam turbine and exhaust gas combustion turbine

2A.2.3 Ownership

The U.S. electric power industry consists of two broad categories of firms that own and operate electric power facilities – utilities and nonutilities (U.S. DOE, 2012x; U.S. DOE, 2012x):

- Electric utility: An electric utility (utility) is a regulated entity providing electric power within a designated franchised service area. Utilities generally operate in a rate regulation framework, in which a government regulatory authority sets prices at which the regulated entity sells generated electricity or other electricity-related services. Electric utilities have traditionally operated in a vertically integrated framework, which included power generation, transmission, and distribution. However, “generating utilities,” which are the focus of this profile within the utility segment, may provide only power generation services and not provide transmission or local distribution services. Other electric utility segments include “transmission utilities,” which are the regulated owners/operators of transmission systems, and “distribution utilities,” which are the regulated owners/operators of distribution systems serving retail customers.
- Nonutility: A nonutility is an entity that owns and/or operates electric power generating units but is not subject to rate regulation. Nonutilities generate power for their own use and/or for sale to utilities, and other entities that operate in a non-regulated pricing environment. A nonutility does not have a designated franchise service area, and does not transmit or distribute electricity.

Electric utilities can be subdivided further into three major ownership categories: investor-owned utilities, publicly owned utilities, and rural electric cooperatives. EPA identified ownership type for each electric power facility using data collected through the 2010 Questionnaire for the Steam Electric Power Generating Effluent Guidelines (the SE industry survey), and from the EIA 860 and 861 databases (U.S. DOE, 2011x; U.S. DOE, 2011x; U.S. DOE, 2009x; U.S. DOE, 2009x; U.S. DOE, 2006; U.S. EPA, 2010x). Summary discussions of these categories follow (U.S. DOE, 2012x; U.S. DOE, 2012x):

- Investor-owned utilities: Investor-owned utilities (IOUs) are for-profit, privately owned businesses. IOUs are regulated by State and/or federal governments, which in turn approve rates that allow a fair rate of return on investment. These utilities either distribute profits to stockholders as dividends or reinvest the profits. Most IOUs engage in generation, transmission, and distribution. Historically, IOUs have been most successful in serving large, consolidated markets where economies of scale afford the lowest rates. IOUs operate as service monopolies in specified geographic areas. As a condition for granting of the service monopoly, IOUs are required to serve all customers, giving them access to service under similar conditions and charging comparable prices to similar classifications of consumers. In 2011, IOUs operated 1,313 facilities, which accounted for approximately 50 percent of all U.S. electric power generating capacity.
- Publicly owned utilities: These are nonprofit, government agencies that provide service to their communities and nearby consumers at cost. They return any excess funds to consumers in the form of community contributions, or reinvest the excess funds to in plant and equipment. Publicly owned electric utilities can be federal power agencies, State authorities, municipalities, and other political subdivisions (e.g., public power districts and irrigation projects). Smaller municipal utilities, which make up the

majority of municipal utilities, are non-generators engaging solely in the purchase of wholesale electricity for resale and distribution. Larger municipal utilities, as well as State and federal utilities, usually generate, transmit, and distribute electricity. In general, publicly owned utilities do not pay certain taxes and have access to tax-free financing, giving them a lower cost of capital than IOUs. In 2011, the federal government operated 201 facilities (accounting for 7 percent of total U.S. electric power generating capacity), States owned 90 facilities (two percent of U.S. capacity), municipalities owned 866 facilities (5 percent of U.S. capacity), and other political subdivisions owned 158 facilities (two percent of U.S. capacity).

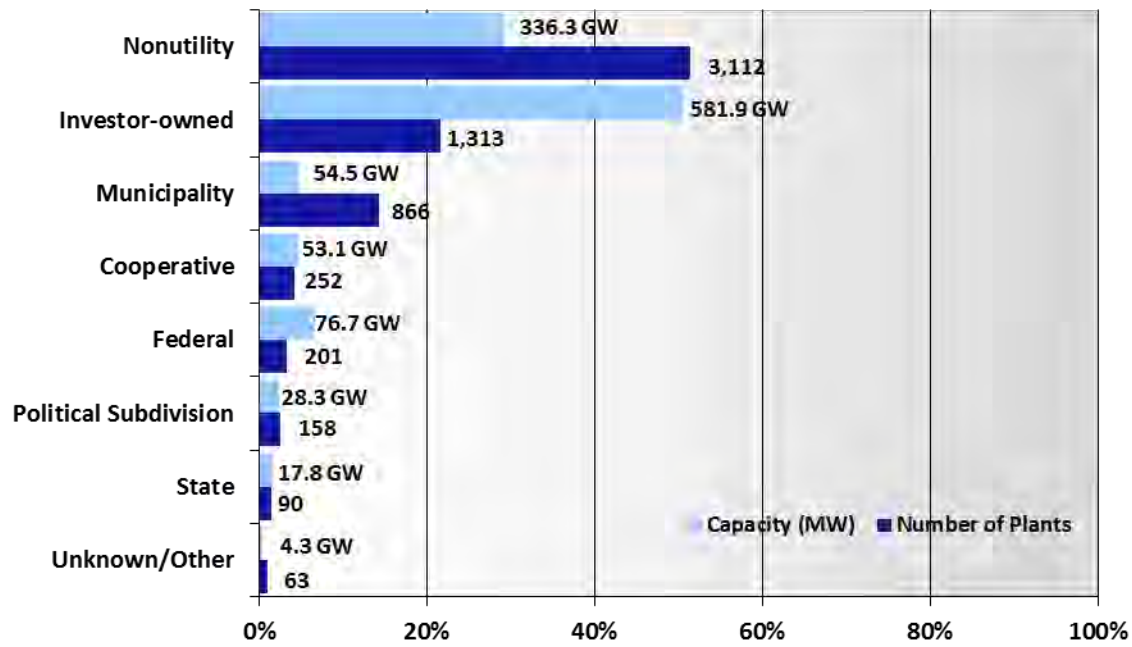
- Rural electric cooperatives: Cooperative electric utilities ("coops") are member-owned entities created to provide electricity to those members. These utilities provide electricity to rural sparsely populated areas, which IOUs historically viewed as uneconomical operations. Electric cooperatives operate at cost and, as nonprofit entities, are exempt from income tax. Cooperatives are incorporated under State laws and are usually directed by an elected board of directors. The Rural Utilities Service (formerly the Rural Electrification Administration), the National Rural Utilities Cooperative Finance Corporation, the Federal Financing Bank, and the Bank for Cooperatives are important sources of debt financing for cooperatives. In 2011, rural electric cooperatives operated 252 generating facilities and accounted for approximately 5 percent of all U.S. electric power generation capacity.

The type of entity that owns and operates electric power facilities is a key factor affecting the recovery, through higher electricity rates, of increases in production costs that may result from compliance with the final rule or other options EPA considered. As such, entity type is an important consideration for assessing the impact of the final rule and other options considered, on 316(b) facilities and electricity consumers. However, ownership type is not the only determining factor for conclusions regarding compliance cost recovery at 316(b) facilities. An additional key factor is the regulatory environment in the State where a 316(b) facility is located. Other factors include the business operation model of the facility owner(s), the ownership and operating structure of the facility itself, and the role of market mechanisms used to sell electricity.

Figure 2A-1 reports the number of electric power facilities and their capacity in 2011, by type of ownership. To determine the ownership type for each facility, EPA relied on the information reported in the SE industry survey, the 2006 EIA-860, 2009 and 2011 EIA-860, and 2009 and 2011 EIA-861 databases, and additional research (U.S. DOE, 2006; U.S. DOE, 2011x; U.S. DOE, 2011x; U.S. DOE, 2009x; U.S. DOE, 2009x; U.S. EPA, 2010x).[12] The horizontal axis also presents the percentage of the U.S. total generating capacity and facilities that each type represents. This figure reflects data for all electric power generating facilities with at least one non-retired unit in 2011 that submitted Form EIA-860 for 2011. The figure shows that in 2011, nonutilities accounted for the largest percentage of facilities (51 percent) but represented only 29 percent of total generating capacity. Investor-owned utilities operated the second largest percentage of facilities at 22 percent, and accounted for 50 percent of total U.S. capacity.

12 Prior to 2007, EIA-860 database reported ownership information at the utility/operator level.

Figure 2A-1: Distribution of Facilities and Nameplate Capacity by Ownership Type, 2011



Source: U.S. DOE, 2011x; U.S. DOE, 2011x; U.S. DOE, 2009x; U.S. DOE, 2009x; U.S. DOE, 2006; U.S. EPA, 2010x

2A.3 Domestic Production

This section reviews generating capacity and electricity generation. *Section 2A.3.1* provides data on capacity, and *Section 2A.3.2* provides data on generation. *Section 2A.3.3* reviews the geographic distribution of generation facilities and capacity.

2A.3.1 Generating Capacity

The rating of a generating unit, expressed in megawatts (MW), is a measure of its ability to produce electricity. Capacity and capability are the two most common measures. *Nameplate capacity*, which is generally greater than a generating unit‟s net summer or winter capacity, is the maximum rated (i.e., full-load) output of a generating unit under specified conditions, as designated by the manufacturer. Net summer capacity is the maximum output that a generating unit can supply to *system load* at the time of *summer* peak demand[13]; it reflects a reduction in capacity due to electricity use for station service or auxiliaries. *Net winter capacity* is the maximum output that a generating unit can supply to *system load* at the time of *winter* peak demand[14]; it also reflects a reduction in capacity due to electricity use for station service or auxiliaries. In general, aggregate net summer capacity exceeds net winter capacity (U.S. DOE, 2012x).

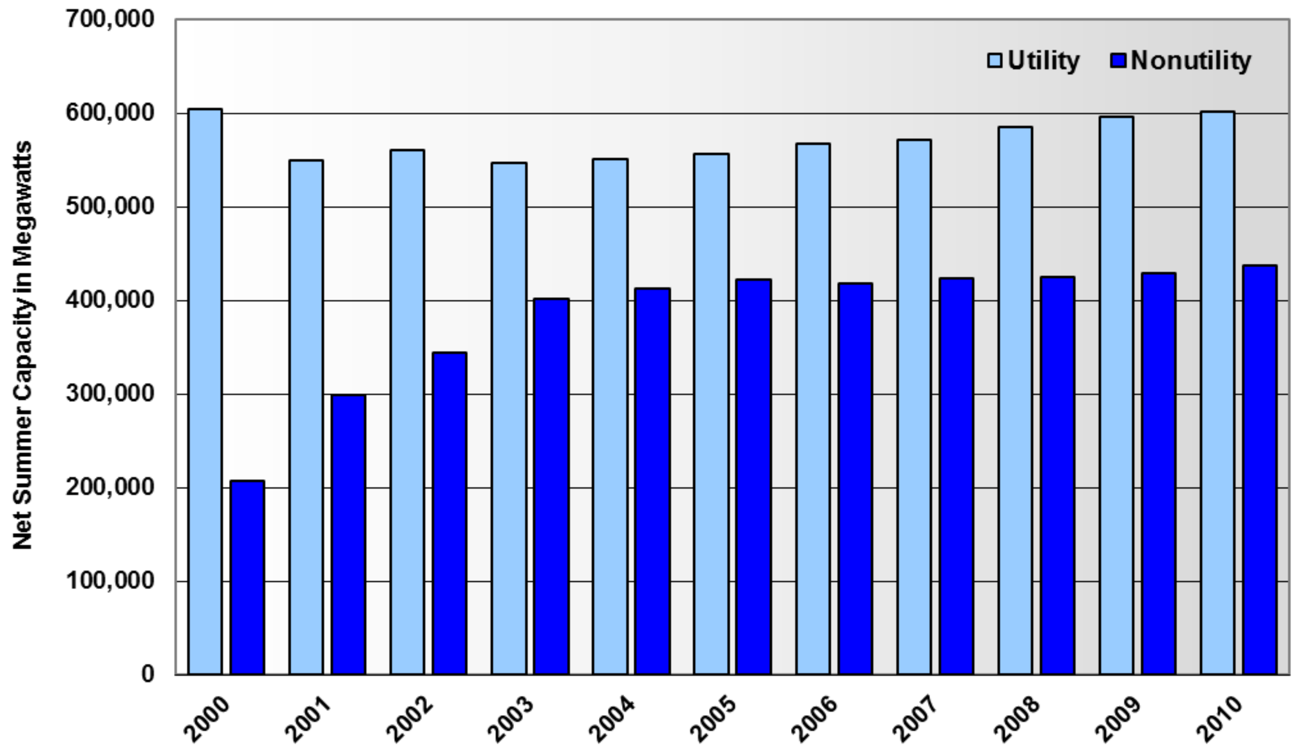
In 2010, utilities owned and operated the majority of *net summer capacity* (58 percent) in the United States, with nonutilities that own the remaining 42 percent. Nonutility ownership of net summer capacity increased substantially in the last few years, with nonutility ownership of net summer capacity increasing by 111 percent between 2000 and 2010, compared with a decrease in utility ownership of net summer capacity of 0.4 percent over the same period. This trend in the ownership profile reflects the divestiture of capacity by traditional regulated utilities to nonutility power producers to meet State-based deregulation requirements. Overall, total net

[13] In the United States, summer peak is the period of June 1 through September 30.

[14] In the United States, winter peak is the period of December 1 through February 28(29).

summer capacity increased during this period, from approximately 811,719 MW in 2000 to 1,039,062 MW in 2010 (see *Figure 2A-2*).

Figure 2A-2: Net Summer Capacity, 2000 to 2010



Source: U.S. DOE, 2011x

2A.3.2 Electricity Generation

The production of electricity is referred to as generation and is measured in units of produced energy, such as kilowatt-hours (kWh) or megawatt-hours (MWh). Generation can be measured as gross generation or net generation. *Gross generation* is the total amount of electricity produced by an electric power facility. *Net generation* is the amount of gross generation *less* electricity consumed by the electricity generating facility for operation of the power generating station, including, for example, lights at the facility, operation of fuel supply systems, and electricity required for pumping at pumped-storage facilities. In other words, *net generation* is the amount of electricity available to the transmission system beyond that needed to operate facility equipment (U.S. DOE, 2012x).

As reported in *Table 2A-1*, total net electricity generation in the United States for 2010 was 4,125 TWh.[15] In 2010, coal accounted for the largest share of total electricity generation (45 percent), despite a 6 percent decline over the 11-year period of 2000 through 2010. Natural gas (24 percent) and nuclear power (20 percent) provide the next largest shares of generation. Other energy sources accounted for smaller shares of total generation, with hydropower representing 6 percent; renewable energy, 4 percent; and petroleum, 0.3 percent (see *Figure 2A-3*).

In 2010, utility-owned facilities accounted for 60 percent of total electricity generation, with nonutility-owned facilities accounting for 40 percent. The distribution of generation between utilities and nonutilities varied by energy source, with utilities accounting for larger shares of coal-, hydropower-, petroleum-, and nuclear power-fueled electricity generation than nonutilities.

15 One terawatt-hour is 10^{12} watt-hours.

As presented in *Table 2A-1*, over the 11-year period of 2000 through 2010, total net generation increased by approximately 8 percent. Increases in nuclear -, natural gas-, renewables-fueled electricity generation and electricity generation from "other" fuels comprised most of this increase. During the same period, coal-, hydropower-, petroleum-, and other gases-fueled electricity generation declined, with petroleum recording the largest percent decline of 67 percent.

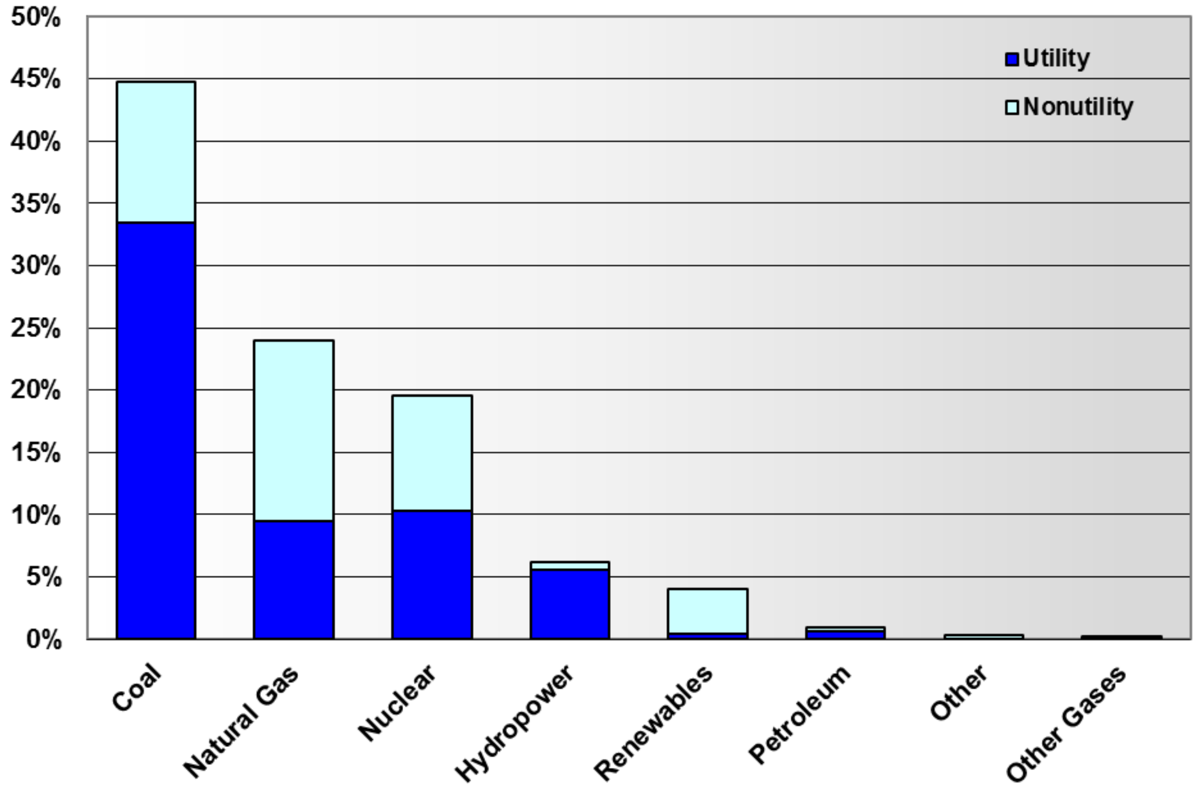
Between 2000 and 2010, electricity generated by utilities declined by 18 percent while electricity generated by nonutilities more than doubled. EIA and other analysts expect this trend to continue in the coming years, as nonutility power producers build more facilities or purchase existing facilities from traditional integrated utilities. Comparing 2000 and 2010 across all fuel-source categories, utilities generated a larger share of their electricity using natural gas (a 35 percent increase) and renewables (a 700 percent increase), even as their overall generation declined. For nonutilities, the largest percentage increase in electricity generation (689 percent) occurred for nuclear power, followed by "other" fuels and natural gas. In terms of absolute quantity of generated electricity, natural gas, followed by coal, accounted for the largest increase for nonutilities.

Table 2A-1: Net Generation by Energy Source and Ownership Type, 2000 to 2010 (TWh)

Energy Source	Utilities			Nonutilities			Total		
	2000	2010	% Change	2000	2010	% Change	2000	2010	% Change
Coal	1,697	1,378	-18.8%	270	469	74.0%	1,966	1,847	-6.1%
Hydropower	248	232	-6.7%	22	23	5.6%	270	255	-5.7%
Nuclear	705	425	-39.8%	48	382	688.5%	754	807	7.0%
Petroleum	72	26	-63.9%	39	11	-71.8%	111	37	-66.7%
Natural Gas	291	393	35.1%	310	595	91.8%	601	988	64.3%
Other Gases	0	0	NA	14	11	-19.3%	14	11	-18.9%
Renewables[a]	2	18	700.0%	79	149	89.7%	81	167	106.6%
Other[b]	0	0	NA	5	12	158.5%	5	13	168.2%
Total	**3,015**	**2,472**	**-18.0%**	**787**	**1,653**	**110.2%**	**3,802**	**4,125**	**8.5%**

a. "Renewables" include wind, solar thermal and photovoltaic, wood and wood derived fuels, geothermal, and other biomass.
b. "Other" includes non-biogenic municipal solid waste, batteries, chemicals, hydrogen, pitch, purchased steam, sulfur, tire-derived fuels, and miscellaneous technologies.
Source: U.S. DOE, 2011x

Figure 2A-3: Percent of Electricity Generation by Primary Fuel Source and Facility Ownership Type, 2010



Source: U.S. DOE, 2011x

2A.3.3 Geographic Distribution

Electricity is a commodity that cannot be stored or transported easily over long distances. As a result, the geographic distribution of power facilities is of primary importance to ensure a reliable supply of electricity to all customers. The U.S. bulk power system is composed of three major networks, or power grids:

- The *Eastern Interconnected System* covers the largest part of the United States, from the eastern end of the Rocky Mountains and the northern borders to the Gulf of Mexico States (including parts of northern Texas) on to the Atlantic seaboard. This system contains six of the North American Electric Reliability Corporation (NERC) regions, defined below (Florida Reliability Coordinating Council, FRCC; Midwest Reliability Organization, MRO; Northeast Power Coordinating Council, NPCC (U.S. component); Reliability First Corporation, RFC; Southeastern Electric Reliability Council, SERC; and Southwest Power Pool, SPP).
- The *Western Interconnected System* covers nearly all of areas west of the Rocky Mountains, including the Southwest. The only NERC region within this system is the Western Energy Coordinating Council, WECC (U.S. component).
- The *Texas Interconnected System*, the smallest of the three, covers the majority of Texas. The only NERC region within this system is Texas Regional Entity (TRE).

The Texas system does not link to the Eastern and Western systems, and the Eastern and Western systems have only limited interconnection to each other. The Eastern and Western systems link to adjacent parts of the Canadian grid system, while the Western and Texas systems link with Mexico.

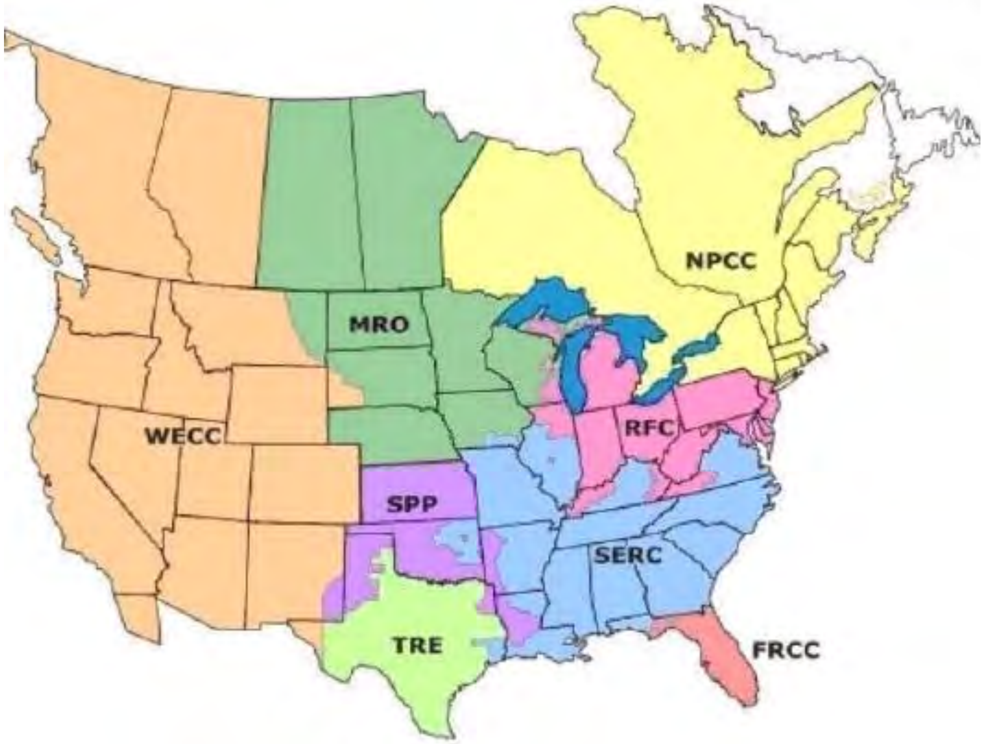
These major networks contain extra high voltage connections, which allow for power transmission from one part of the network to another. Wholesale transactions can take place within these networks to reduce power costs, increase supply options, and ensure system reliability.

Reliability refers to the ability of power systems to meet the demands of consumers at any given time. Efforts to enhance reliability reduce the probability of power outages. The North American Electric Reliability Corporation (NERC) is responsible for the overall reliability, planning, and coordination of the power grids. Electric utilities formed this voluntary organization in 1968, following a large blackout in the Northeast in 1965. NERC is organized into eight regional organizations that cover the 48 contiguous States, and two affiliated councils that cover Hawaii, part of Alaska, and portions of Canada and Mexico.[16] These regional organizations are responsible for the overall coordination of bulk power policies that affect their regions‟ reliability and quality of service. As discussed above, interconnection *between* the bulk power networks is limited in comparison to the degree of interconnection *within* the major bulk power systems. Further, the degree of interconnection between NERC regions even within the same bulk power network is also limited. Consequently, each NERC region deals with electricity reliability issues in its own region, based on available capacity and transmission constraints. The regional organizations also aid in the exchange of information among member utilities in each region and among regions. Service areas of the member utilities determine the boundaries of the NERC regions. Though limited by the larger bulk power grids described above, NERC regions do not necessarily follow any State boundaries. *Figure 2A-4* provides a map of the 2012 NERC regions, which include:

- ASCC – Alaska Systems Coordinating Council
- FRCC – Florida Reliability Coordinating Council
- HICC – Hawaii Coordinating Council
- MRO – Midwest Reliability Organization
- NPCC – Northeast Power Coordinating Council (U.S.)
- RFC – Reliability First Corporation
- SERC – Southeastern Electric Reliability Council
- SPP – Southwest Power Pool
- TRE – Texas Regional Entity
- WECC – Western Energy Coordinating Council (U.S.).

[16] Energy concerns in the States of Alaska, Hawaii, the Dominion of Puerto Rico, and the Territories of American Samoa, Guam, and the Virgin Islands are not under reliability oversight by NERC.

Figure 2A-4: 2012 North American Electric Reliability Corporation (NERC) Regions[a]



a. The ASCC and HICC regions are not shown.
Source: U.S. DOE, 2012x

Table 2A-2 reports the distribution of all existing electric power facilities and total capacity by NERC region, as of 2011. As shown in *Table 2A-2*, WECC has the largest number of facilities (1,677, or approximately 28 percent of all facilities in the United States). However, these facilities account for only approximately 19 percent of total national capacity. Conversely, SERC has the largest fraction of total national capacity (approximately 26 percent), but only 16 percent of facilities.

The final rule may affect the various NERC regions differently, in terms of impact on profitability, electricity prices, and other impact measures. These different effects result from differences in the economic characteristics of 316(b) facilities across the regions and in the baseline economic characteristics of the NERC regions themselves, together with the market segmentation due to limited interconnectedness among NERC regions.

Table 2A-2: Distribution of Existing Facilities and Total Capacity by NERC Region, 2011

	Facilities		Capacity	
NERC Region	**Number**	**% of Total**	**Total MW**	**% of Total**
ASCC	124	2.0%	2,234	0.2%
FRCC	134	2.2%	65,700	5.7%
HICC	38	0.6%	2,810	0.2%
MRO	785	13.0%	63,712	5.5%
NPCC	754	12.4%	81,223	7.0%
RFC	1,017	16.8%	254,071	22.0%
SERC	944	15.6%	297,564	25.8%
SPP	320	5.3%	71,307	6.2%
TRE	265	4.4%	99,132	8.6%
WECC	1,677	27.7%	215,290	18.7%
Total	**6,058**	**100.0%**	**1,153,044**	**100.0%**

Source: U.S. DOE, 2011x.

2A.4 Facilities Subject to the Final Rule

Section 316(b) of the Clean Water Act applies to point source facilities that use or propose to use a cooling water intake structure that withdraws cooling water directly from a surface waterbody of the United States. Among power facilities, only those facilities employing a steam-based generating technology – i.e., steam turbine and combined cycle turbine generating units – require sufficient amounts of cooling water to be subject to the final rule and therefore, are of interest to this analysis.

The following sections describe 316(b) facilities. This final rule applies to existing steam electric power generating facilities that meet the applicability criteria in section 316(b):

- Is a point source that uses or proposes to use a cooling water intake structure;
- Has at least one cooling water intake structure that uses at least 25 percent of the water it withdraws for cooling purposes;
- Has a National Pollutant Discharge Elimination System (NPDES) permit or is required to obtain one; and
- Has a design intake flow of two million gallons per day (MGD) or greater.

The final rule also covers substantial additions or modifications to operations undertaken at such facilities (final rule-new units). New units at existing facilities are addressed in *Chapter 3: Compliance Costs*.

EPA identified 544 316(b) facilities, based on (1) data collected from the 2000 Section 316(b) Industry Short Technical Questionnaire (STQ) and the 2000 Detailed Industry Questionnaire (DQ) (316(b) survey) and (2) the rule applicability requirements above (for details see *Chapter 3: Compliance Costs*).

The following sections describe the physical and geographic characteristics, as well as ownership of the facilities expected to be subject to the final rule:

- **Ownership type**: *Section 2A.4.1* describes the distribution of all facilities and their parent-entities in the industry, as well as facilities subject to the final rule and their parent-entities across ownership categories.
- **Parent-entity size**: *Section 2A.4.2* assesses the distribution of parent-entities across ownership categories by parent-entity size for the entire industry, and for parent entities that own facilities subject to the final rule.
- **Facility size**: *Section 2A.4.3* assesses 316(b) facilities based on generating capacity.
- **Geographic distribution**: *Section 2A.4.4* describes the geographic distribution of 316(b) facilities across NERC regions.
- **Waterbody and cooling system type**: *Section 2A.4.5* documents the type of waterbody from which 316(b) facilities withdraw cooling water and the type of cooling system they operate.

2A.4.1 Ownership Type

As described above, utilities fall into six major ownership categories: investor-owned utilities, nonutilities, federally-owned utilities, State-owned utilities, municipalities, and rural electric cooperatives. This classification is important because EPA must assess the impact of the final rule on State, local, and tribal governments in accordance with the Unfunded Mandates Reform Act (UMRA) of 1995 (see *Chapter 12: UMRA Analysis*).[17]

Table 2A-3 reports the number of parent-entities, facilities, and capacity by ownership type for the subset of 316(b) facilities (for a discussion of the determination of parent-entities for 316(b) facilities, see *Chapter 4: Cost*

[17] As discussed earlier in this chapter, while ownership type may affect the ability of facilities and their parent entities to recover increased electricity generation costs due to the final rule, ownership type is not a sole or a deciding factor of cost recovery potential.

Impact Analyses – Electric Generators). Overall, EPA estimates that 316(b) facilities account for approximately 5 percent of all parent entities, 9 percent of all electric power facilities, and 46 percent of total electric power sector capacity.[18,19] Investor-owned utilities own the majority of 316(b) facilities (68 percent), while nonutilities own the second largest share (11 percent). The 316(b) facilities that are owned by investor-owned utilities account for the largest share (77 percent) of total capacity subject to the final rule.

Table 2A-3: 316(b) Facilities, their Parent Entities, and Total Capacity by Ownership Type, 2011

Ownership Type	Parent Entities [a,b]		Facilities [a,b,c]		Total Capacity (MW) [a,c]	
	Number	% of Total	Number[c]	% of Total	Number[c]	% of Total
Cooperative	22	13.8%	34	6.3%	21,102	4.0%
Federal	1	0.6%	12	2.2%	24,087	4.5%
Investor-owned	63	39.6%	372	68.4%	408,959	77.2%
Municipality	37	23.3%	48	8.8%	18,722	3.5%
Nonutility	27	17.0%	61	11.2%	40,218	7.6%
Other Political Subdivision	6	3.8%	11	2.0%	9,649	1.8%
State	3	1.9%	6	1.1%	6,726	1.3%
Total	**159**	**100.0%**	**544**	**100.0%**	**529,463**	**100.0%**

a. Numbers may not add up to totals due to independent rounding.
b. EPA based ownership information for 316(b) facilities and their parent entities on information gathered through the 2010 Steam Electric industry survey, 2009 and 2011 EIA-860 and EIA 861 databases, and additional research of publically available information.
c. Facility counts and capacity values are sample-weighted estimates calculated using Original Survey Weights (for details see *Appendix H: Sample Weights*).
Source: U.S. EPA Analysis, 2012; U.S. DOE, 2006; U.S. DOE, 2011x; U.S. DOE, 2011x; U.S. DOE, 2009x; U.S. DOE, 2009x; U.S. EPA, 2010a

2A.4.2 Ownership Type and Parent Entity Size

EPA estimates that approximately 25 percent of the entities that own 316(b) facilities are small entities (*Table 2A-4*), compared to 28 percent estimated for the electric power industry as a whole, according to Small Business Administration (SBA) business size criteria.[20,21] Small entities that own 316(b) facilities represent approximately 5 percent of all small entities in the electric power industry.

The size distribution of parent entities that own 316(b) facilities varies by ownership type. The smallest share of small entities is in the other political subdivision category (3 percent), while small municipalities make up the largest share of small entities (45 percent).

EPA estimates that of 544 316(b) facilities, 48 (9 percent) are owned by small entities (*Table 2A-4*). The largest share of 316(b) facilities owned by small entities are owned by municipalities (39 percent), while the remaining 61 percent of 316(b) facilities owned by small entities are owned by cooperatives, investor-owned, nonutilities,

18 EPA estimates that 6,058 electric power facilities operate in the United States; 2,905 entities own these facilities and account for 1,153,044 MW of total generating capacity.

19 The number of parent entities for the overall electric power industry is the number of utilities/operators reported as owning/operating existing electric power facilities in the 2011 EIA-860 database (U.S. DOE, 2011x).

20 EPA determined entity size for industry-wide parent entities (i.e., not only 316(b) entities that own facilities subject to the final rule) in two steps. The Agency first used utility/operator-level electricity sales data from the 2011 EIA-861 database (U.S. DOE, 2011x) and, if sales data were not available, electricity net generation data from the 2011 EIA-906/920/923 database (U.S. DOE, 2011x) to determine utility/operator size using the 4,000,000 MWh SBA size criterion. To account for the fact that (1) the utility/operator may not be the highest-level domestic parent and (2) according to SBA, size determination for entities of certain ownership types is based on a criterion other than total electric output, EPA then adjusted counts of small utilities/operators developed from the first step. The Agency made this adjustment based on the observed relationship between electric output-based size determination and size determination based on the appropriate SBA criterion done for 316(b) universe.

21 EPA estimates that 816 of the total 2,905 entities (28 percent) that own electric power facilities are small.

and other political subdivisions. By definition, States and the federal government are large entities. For a detailed discussion of identification and size determination of parent entities of 316(b) facilities, see *Chapter 4* and *Chapter11*.

Table 2A-4: 316(b) Facilities and their Parent Entities by Ownership Type and Parent Size, 2011[a]

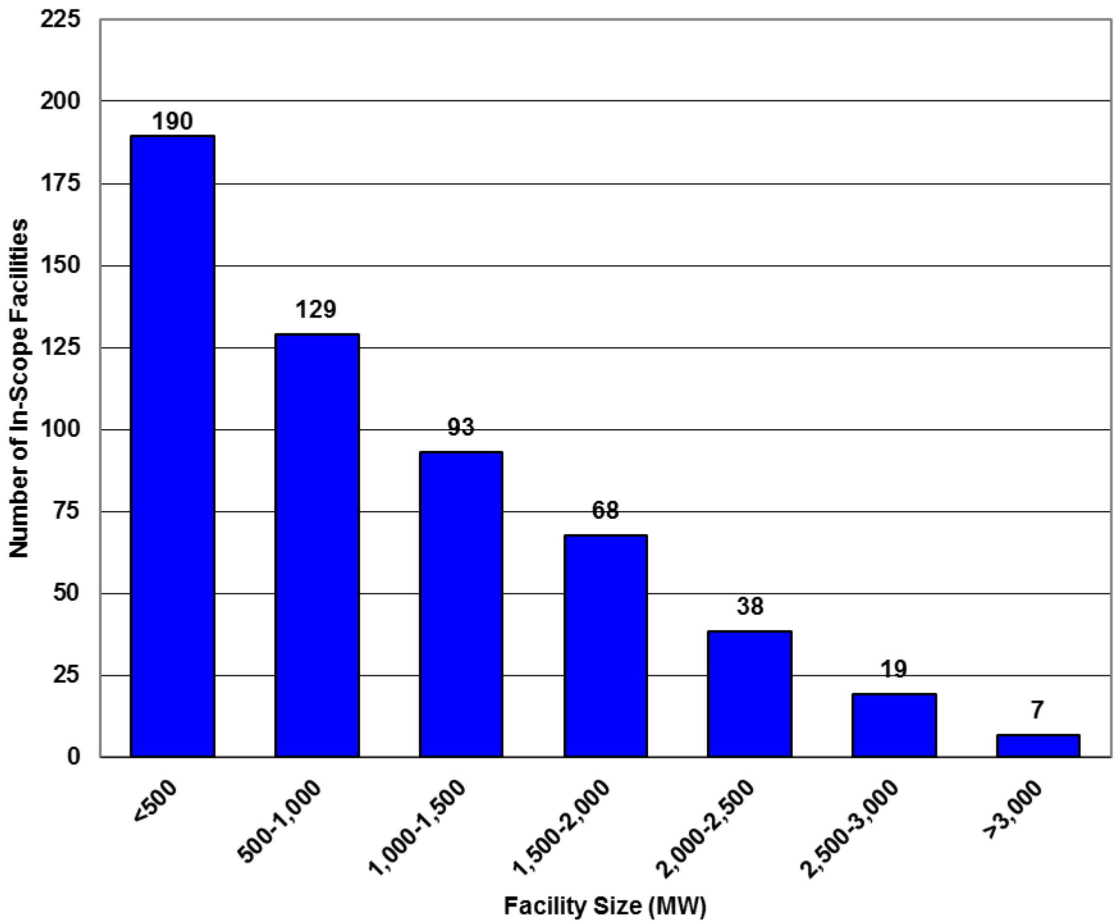
Ownership Type	Number of Entities[b]				Number of Facilities[c,d]			
	Small	Large	Total	% Small	Small	Large	Total	% Small
Cooperative	7	15	22	31.8%	7	27	34	20.6%
Federal	0	1	1	0.0%	0	12	12	0.0%
Investor-owned	9	54	63	14.3%	16	356	372	4.4%
Municipality	18	19	37	48.6%	19	29	48	39.2%
Nonutility	5	22	27	18.5%	5	55	61	8.8%
Other Political Subdivision	1	5	6	16.7%	1	10	11	9.0%
State	0	3	3	0.0%	0	6	6	0.0%
Total	**40**	**119**	**159**	**25.2%**	**48**	**496**	**544**	**8.9%**

a. Numbers may not sum to totals due to independent rounding.
b. For details on the determination of parent entities and their size see *Chapter 4* and *Chapter11*.
c. Facility counts are sample-weighted estimates, and are based on the Original Survey Weights (for details see *Appendix H*).
d. EPA based the size classification for facilities on the size of their parent entities. In cases where multiple owners own a facility, EPA assumed the facility to be small if at least one of the owners is a small entity.
Source: U.S. EPA Analysis, 2012; U.S. DOE, 2006; U.S. DOE, 2011x; U.S. DOE, 2011x; U.S. DOE, 2011x; U.S. DOE, 2009x; U.S. DOE, 2009x; U.S. EPA, 2010x

2A.4.3 Facility Size

EPA also assessed the size of 316(b) facilities in terms of their generating capacity, which is relevant because capacity is a direct measure of a facility‟s importance in meeting electricity demand and reliability needs. The majority of 316(b) facilities (59 percent) have a capacity of less than 1,000 MW, while only a few 316(b) facilities (5 percent) have a capacity greater than 2,500 MW (*Figure 2A-5*).

Figure 2A-5: Number of 316(b) Facilities by Size (in MW), 2011[a,b]



a. Numbers may not sum to totals due to independent rounding.
b. The numbers of facilities and capacity are sample-weighted estimates, based on the Original Survey Weights (see *Appendix H*).
Source: U.S. EPA Analysis, 2013; U.S. DOE, 2011x

2A.4.4 Geographic Distribution

EPA assessed the potential reliability impact of the final rule and other options considered resulting from installation downtime, by reviewing the distribution of 316(b) facilities and their capacity across NERC regions. Installation downtime occurs when facilities temporarily shut down their electric power generation for installation of certain compliance technologies. NERC regions are built around confined market areas that are meaningful for assessing the adequacy of generating capacity to meet regional electricity demand. While electricity may be imported from beyond the borders of a NERC region, the generating capacity within the region will generally be the primary source of electric supply for meeting the region"s electricity demand and for ensuring adequate supply reliability within the region. Even though reductions in capacity caused by installation downtime are usually no more than a few weeks longer than ordinary maintenance outages, electric supply reliability in a region could be weakened to an undesirable level if a substantial number of plants in a region incurred downtime at the same time. As a result, reviewing the number of facilities that may incur downtime and their electric power generating capacity can provide insight into the potential impact of the final rule, or other options considered, on regional electric supply reliability.

As reported in *Table 2A-5*, NERC regions show considerable differences in the number of 316(b) facilities and their capacity *and* the percentages of facilities and capacity represented by 316(b) facilities. 316(b) facilities have the greatest share of *capacity* in the RFC region (58 percent of total RFC capacity), followed by SERC (55 percent of total TRE capacity); consequently, the potential downtime effect in these NERC regions is likely to be the greatest. 316(b) facilities have the smallest share of capacity in ASCC, (1 percent of total ASCC capacity), followed by WECC (20 percent of total WECC capacity); therefore, the downtime effect in these NERC regions is likely to be of less consequence. Not all of the 316(b) facilities will experience downtime; therefore, this assessment may overstate the percentage of facilities and regional capacity affected by downtime.[22]

Table 2A-5: 316(b) Facilities and their Capacity by NERC Region, 2011

NERC Region	Facilities			Capacity (MW)		
	Total Number of Facilities	316(b) Facilities[a,b] Number	316(b) Facilities[a,b] % of Total in Region	Total Capacity	316(b) Capacity[a,b] MW	316(b) Capacity[a,b] % of Total in Region
ASCC	124	1	0.8%	2,234	31	1.4%
FRCC	134	24	18.1%	65,700	34,523	52.5%
HICC	38	3	7.9%	2,810	1,189	42.3%
MRO	785	60	7.7%	63,712	28,220	44.3%
NPCC	754	59	7.8%	81,223	40,596	50.0%
RFC	1,017	140	13.8%	254,071	146,689	57.7%
SERC	944	136	14.4%	297,564	162,838	54.7%
SPP	320	40	12.5%	71,307	29,490	41.4%
TRE	265	41	15.5%	99,132	42,612	43.0%
WECC	1,677	39	2.3%	215,290	43,276	20.1%
Total	**6,058**	**544**	**9.0%**	**1,153,044**	**529,463**	**45.9%**

a. Numbers may not add up to totals due to independent rounding.
b. Facility counts and capacity are weighted estimates calculated using Original Survey Weights (for details see *Appendix H*).
Source: U.S. EPA Analysis, 2012; U.S. DOE, 2011x

2A.4.5 Waterbody and Cooling System Type

As reported in *Table 2A-6,* approximately half of the Electric Generators draw water from a freshwater river (283 facilities or 52 percent), followed by lakes or reservoirs (115 facilities or 21 percent) and estuaries or tidal rivers (88 facilities or 16 percent). As reported in the table, most of the regulated facilities (343 facilities or 63 percent) employ a once-through cooling system.

Table 2A-6: Number of 316(b) Facilities by Waterbody and Cooling System Type[a,b]

Waterbody Type	Recirculating		Once-Through		Combination		Other		Total	
	Number	% of Total	Number	% of Total	Number	% of Total	Number	% of Total	Number	% of Total
Estuary/Tidal River	5	3.5%	72	21.1%	9	19.3%	1	16.7%	88	16.1%
Freshwater Stream/River	102	69.2%	147	43.0%	29	61.6%	4	66.7%	283	52.0%
Great Lake	4	2.7%	32	9.3%	2	4.2%	0	0.0%	38	7.0%
Lake/Reservoir	36	24.7%	71	20.7%	7	14.9%	1	16.7%	115	21.2%
Ocean	0	0.0%	20	5.9%	0	0.0%	0	0.0%	20	3.7%
Total	**148**	**100%**	**343**	**100%**	**47**	**100%**	**6**	**100%**	**544**	**100%**
% of Total	**27.2%**		**63.0%**		**8.7%**		**1.1%**			

a. Numbers may not add up to totals due to independent rounding.
b. Facility counts are weighted estimates calculated using Original Survey Weights (for details see *Appendix H*).
Source: U.S. EPA Analysis, 2012; U.S. DOE, 2011x; U.S. EPA, 2000

2A.5 Industry Trends

Industry deregulation and several environmental regulations and programs have had significant impacts on the electric power industry in recent years. *Section 2A.5.1* discusses the status of industry deregulation, *Section 2A.5.2*

[22] In particular, nuclear generating facilities are not expected to incur any additional downtime for installing technology for compliance with the final rule.

discusses air emissions regulations, *Section 2A.5.3* discusses renewable portfolio standards, and *Section 2A.5.4* discusses carbon emissions regulations. All of these trends have, and/or will, affect the electric power industry.

2A.5.1 Current Status of Industry Deregulation

The electric power industry has evolved over the past two decades from a highly regulated industry with traditionally structured electric utilities to a less regulated, more competitive industry. Several key pieces of federal legislation have supported this transition. Traditionally, the industry has operated under a regulation framework based on the premise that the supply of electricity is a natural monopoly, where a single supplier could provide electric services at a lower total cost than could be provided by several competing suppliers. During the last two decades, however, the relationship between electricity consumers and suppliers has undergone substantial change, as governments and regulatory agencies recognized that electricity *generation* does not necessarily meet the definition of a natural monopoly. As a result, the federal government and States have taken steps to promote competition in generation. The objective is to achieve higher electricity production efficiency among electric power generators, while recognizing that the delivery of electricity via transmission and distribution systems remains within the definition of a natural monopoly. A key step in this effort is the required unbundling of the traditional, vertically integrated electric power business. The electricity generation business and therefore, the electric power generating assets, have been separated from the electricity transmission and distribution business. Electric restructuring has two essential aspects: wholesale access and retail access. *Wholesale access* refers to the ability of electric power generating entities – utilities and independent power producers – to access *transmission systems* to compete for wholesale markets, i.e., distribution utilities and independent marketers buying and selling electricity. *Retail access* refers to the ability of marketers and retailing businesses of utilities to obtain access to *distribution systems* to sell electricity to end-use consumers, thereby introducing consumer choice of electricity supplier (or retail choice).

The initial actions promoting competition in wholesale electric power markets began with the Public Utility Regulatory Policies Act of 1978 (PURPA), which established business terms by which certain nonutility electricity-generators – "qualifying plants" or QFs – could sell electricity to utilities. Later, the Energy Policy Act of 1992 (EPACT) made it easier for nonutilities to enter the wholesale electric power market by creating a new category of nonutility power producers – exempt wholesale generators or EWGs – which were exempt from the Public Utility Holding Company Act of 1935 (PUHCA) regulation (EEMCTF, 2007).[23] In 1996, the Federal Energy Regulatory Commission (FERC) issued Order 888. This order further promoted wholesale electric competition by ensuring non-discriminatory access by power producers to transmission services, which traditional regulated utilities continued to own. Order 888 also provided a basis for retail choice of electricity supplier, and established guidelines for the formation of Independent System Operators (ISOs). ISOs are independent, federally regulated entities established to coordinate regional electric power generation and transmission in a non-discriminatory manner.

Nearly a decade later, the Energy Policy Act of 2005 (EPAct 2005) repealed the original PUHCA of 1935, while enacting provisions to encourage investment in energy infrastructure and transferring oversight for certain consumer protection authorities from the Securities and Exchange Commission (SEC) to FERC and the States. Specifically, EPAct 2005 enacted a *new* PUHCA (PUHCA of 2005), which gives FERC, as opposed to SEC, jurisdiction over holding companies. EPAct 2005 also modified PURPA of 1978, removing some pricing provisions that had resulted in consumers paying above-market prices for some electricity. In addition, EPAct 2005 created the Electric Reliability Organization (ERO), now certified as the NERC, to enforce mandatory

[23] PUHCA of 1935 was passed by the United States Congress to facilitate regulation of electric utilities, by either limiting their operations to a single state, and thus subjecting them to effective state regulation, or forcing divestitures so that each company became a single integrated system serving a limited geographic area. In addition, PUHCA of 1935 required holding companies to obtain permission from the Securities and Exchange Commission (SEC) prior to engaging in a non-utility business and further required that such businesses be kept separate from the regulated businesses.

electric reliability rules on all users, owners, and operators of the electric power generation and transmission systems (FERC, 2006).

Key Changes in the Regulatory and Operating Structure of the Electric Power Industry

Industry deregulation continues to change the structure of the electric power industry. Some of the key changes include:

- Provision of services: Under the traditional regulatory system, vertically integrated utilities generally provided the full slate of services for generation, transmission, and distribution of electric power. Since the mid-1990s, federal and State policies have led to increased competition in the generation sector of the industry. Increased competition has resulted in separation of power generation, transmission, and retail distribution services. Utilities that provide transmission and distribution services continue to be regulated and must divest their generation assets. In the deregulated framework, entities that generate electricity are no longer subject to rate regulation and do not operate in protected franchise markets.
- Relationship between electricity providers and consumers: Under traditional regulation, utilities provided electric service to all customers within a defined geographic franchise area at prices (electric rates) approved by the regulatory commission. Consumers within a given utility franchise area were able to purchase electricity only from the utility franchised to serve that area. Similarly, electricity suppliers were not free to pursue customers outside their designated service territories. Although most consumers continue to receive power that is either generated by, or purchased and resold by, their local distribution company (LDC), retail competition has allowed some consumers – in particular, larger industrial and commercial consumers – to purchase electricity from producers other than the local distribution utility. In some instances, they can obtain lower prices than would be available through the traditional supply structure.
- Electricity prices: Under the traditional system, State and federal authorities regulated many aspects of utilities" business operations, including, in particular, their prices. Regulatory authorities set electricity prices for each utility, based on the cost of producing and delivering power to customers and including a reasonable rate of return on invested capital (i.e., under the cost-of-service framework). In the deregulated environment, competitive market forces set prices for generated electricity. Electricity sellers and buyers, who may be local distribution utilities or direct retail purchasers, negotiate through power pools or one-on-one to set the price of electricity. As in any competitive market, prices reflect the interaction of supply and demand. During most time periods, the price of electricity in a given competitive wholesale electricity market (e.g., an integrated dispatch region) is set by the generating unit with the highest energy production cost that is dispatched to meet spot market electricity demand – i.e., the unit with the highest production cost determines the "marginal cost" of production and therefore the short-run energy price (Beamon, 1998).

New Industry Participants

PURPA and EPAct set business terms by which nonutility generators – QFs and EWGs, respectively – could enter the wholesale power market. Under PURPA, utilities are required to buy power from QFs (usually cogeneration or renewable energy-based generators) in their service area, at a price equal to the avoided production cost of the buying utility. EPAct did not require utilities to purchase power from EWGs. Instead, EPAct gave FERC the authority to order utilities to provide access to their transmission systems on a case-by-case basis. However, access to the systems proved to be slow and burdensome. In response, FERC issued Order 888, which required all utilities that own and/or operate transmission facilities to file open-access transmission tariffs (OATTs) providing open, non-discriminatory access to their transmission systems. Furthermore, in 1999, FERC issued Order 2000, calling for the development of Regional Transmission Organizations (RTOs), which independently control and operate the transmission systems (EEMCTF, 2007).[24]

State Activities

The status of electricity restructuring varies across States. As of 2010, 22 of 50 States had initiated efforts to design restructured electricity markets and pass enabling legislation. However, eight of these 22 States – Arizona, Arkansas, California, Montana, Nevada, New Mexico, Oregon, and Virginia – experienced difficulties during the transition to a competitive electricity market, such as lack of competition for residential customers or substantial, unanticipated rate increases; consequently, seven of these eight States suspended the restructuring process. As of September 2010, only 15 States[25] and the District of Columbia were operating with some degree of competitive wholesale and retail electricity markets. In those 16 jurisdictions, at least part of the energy component of retail electricity prices is determined in a deregulated market. The remaining 28 States had not introduced electricity restructuring legislation as of 2010. The 35 States with regulated electricity markets host 3,985 facilities (66 percent of all U.S. electric power facilities) and 732 GW of generating capacity (64 percent of total U.S. generating capacity) (U.S. DOE, 2011x). *Figure 2A-6* provides a national map of the status of electricity restructuring.

The status of restructuring of the electric power industry is an important factor in assessing the impact of the final rule on 316(b) facilities and electricity consumers. In particular, the degree of regulation and conversely, the extent of competition in electric power generation, substantially affect the ability of 316(b) facilities to pass cost increases to consumers via electricity rate increases. *Utilities*, which continue to generate and sell electricity in the traditional regulated industry structure, are more likely to recover additional power generation costs that result from compliance with the final rule, than *nonutilities*, which may be able to recover cost increases via increased prices, but only to the extent that increased prices are supported by the competitive market. Most facilities subject to the final rule (323 of 544 or 59 percent) are located in States with regulated electricity generation markets; these facilities account for 61 percent of total generating capacity (322 GW of 529 GW) and total generation (1,570 TWh of 2,561 TWh) at facilities subject to the final rule. These facilities may be able to recover increased production costs due to regulatory compliance through higher *regulation-based* electricity rates, subject to approval by utility regulatory authorities. However, even for these generators, other factors can be important in determining the extent of cost recovery. These other factors include the business operation model of the owner or operator, the ownership structure of the facility itself, and the role of market mechanisms in dispatching production from generators.[26] The other 221 facilities subject to the final rule (41 percent) are located in States where electricity generation is deregulated and cost recovery is less certain; these facilities account for approximately 39 percent of total generating capacity and total generation at facilities subject to the final rule (U.S. DOE, 2011x).[27,28]

24 RTO is similar to ISO, with the main difference being the ability of RTO to control and monitor the electric power transmission system over a wider area across State borders.

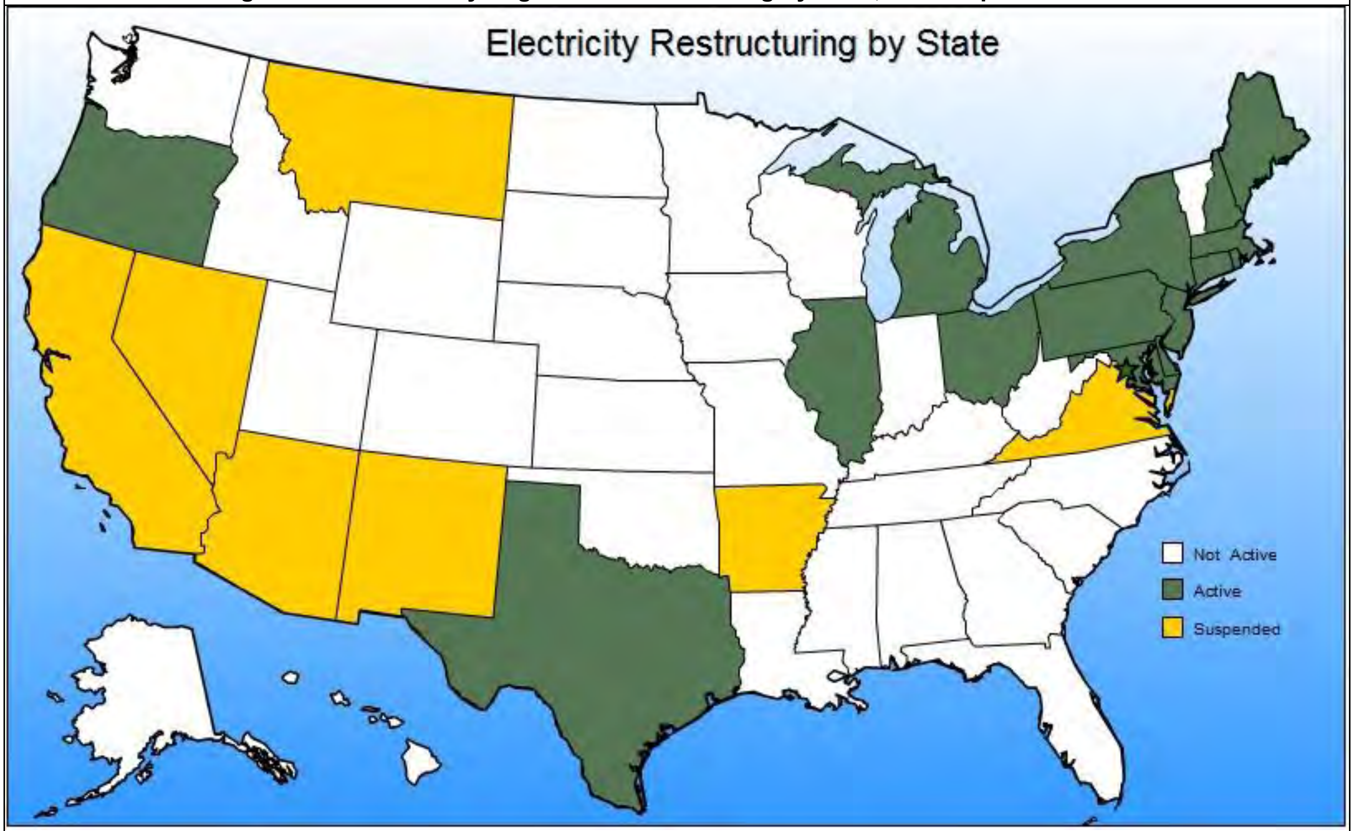
25 These 15 States are: Connecticut, Delaware, Illinois, Maine, Maryland, Massachusetts, Michigan, New Hampshire, New Jersey, New York, Ohio, Pennsylvania, Rhode Island, Texas, and Oregon.

26 As discussed earlier in this chapter, while regulatory status in a given State affects the ability of electric power facilities and their parent entities to recover electricity generation costs, it is not the only factor and should not be used as the sole basis for cost-pass-through determination.

27 Facility counts and capacity and generation values are sample-weighted estimates generated using Original Survey Weights. For details, see *Appendix H*.

28 Capacity values are from the 2011 EIA-860 database. EPA calculated generation values as a five-year average (2007-2011) using generation values from the EIA-906/920/923 database. In using the year-by-year generation values to develop an average over the data years, EPA set aside from the average calculation, generation values that are anomalously low. Such low generating output would likely result from a generating unit being out of service for maintenance.

Figure 2A-6: Electricity Regulation Restructuring by State, as of September 2010



Source: U.S. DOE, 2010d

2A.5.2 Air Emissions Regulations

A number of recent air emission regulations affect electric power generators and may change the economics of power production, the profile of the electricity market, and electricity rates. Under these regulations, power generators must meet emission limits by physically reducing air emissions via control technology, adjusting operations to reduce emissions (e.g., using lower sulfur coal or simply producing less electricity), or by purchasing emissions allowances that permit release of pollutant emissions. These regulations and programs have reduced significantly the emissions of sulfur dioxide (SO_2) and nitrogen oxides (NOx) from power generation. In some instances, these programs have caused, or will cause, changes in electric power sector operations, including:

- Increased use of lower pollution fuels
- Repowering of existing production capacity – e.g., converting traditional steam turbine capacity to combined cycle operation, which includes a steam and non-steam electricity generation capability and is more energy efficient
- Accelerated development of new capacity
- Earlier retirement of older and typically higher air pollution-intensive capacity for which substantial investments to reduce emissions are not economical to undertake.

The final rule will overlap with these ongoing air-emission regulatory programs in requiring further changes to facility operations and further affecting the economics of power production.

Phase I of the Acid Rain Program began implementation in 1995; this program has achieved significant environmental and health benefits by reducing SO_2 and NOx emissions and associated ambient pollutant concentrations. The program affects more than 2,000 electric power generating facilities powered by coal, oil, or natural gas. The program was the first air pollution program in the United States to rely on a market mechanism – allowance trading – for allocating emission reductions. Instead of a command and control regulatory approach, the allowance trading program is market-based, allocating an initial endowment of SO_2 emission credits to each utility and allowing the credits to be bought, sold, or banked (as long as emissions levels are met) for future use. The Acid Rain Program allows flexibility in selecting the most cost-effective approach to reduce emissions. While allowing flexibility in the approach to reducing emissions, the program did not implement an allowance trading system for NOx emissions. During Phase II of the program, which began in 2000, the program set a cap on the number of allowances, ensuring achievement of the intended reductions in total pollutant emissions (U.S. EPA, 2009b).

In a second market-based regulatory action, EPA promulgated the Clean Air Interstate Rule (CAIR) in 2005 to further reduce SO_2 and NOx emissions in 27 eastern States and the District of Columbia through an allowance-trading program. On July 11, 2008, the U.S. Court of Appeals for the D.C. Circuit vacated CAIR. However, on December 23, 2008, the U.S. Court of Appeals issued a new ruling that repealed the vacatur and instead, remanded CAIR to EPA but allowed key provisions to remain in place while EPA re-worked the regulation. The court noted: "allowing CAIR to remain in effect until it is replaced by a rule consistent with our opinion would at least temporarily preserve the environmental values."[29] The Court tasked EPA with modifying CAIR to address the issues in its July 11th decision (U.S. EPA, 2010b).

Promulgated in 2005, CAIR established Phase I caps for NOx and SO_2 for 2009 and 2010, respectively, and Phase II caps for NOx and SO_2 for 2015. For SO_2 allowances, CAIR relied on the same allowances and trading program the Acid Rain Program uses. However, because the Acid Rain Program did not include a NOx trading program, EPA provided new NOx emission allowances under CAIR. CAIR allows each of the 28 eastern States and the District of Columbia to decide how to achieve the specified emission reductions within their jurisdictions. EPA expects that most jurisdictions will achieve the required levels by mandating reduced emissions from the power generation sector (U.S. EPA, 2009a).

On July 6, 2011, EPA promulgated the Cross-State Air Pollution Rule (CSAPR) to replace CAIR. The rule required 27 States in the eastern half of the United States to improve air quality by reducing power facility emissions of SO_2, NOx, and/or ozone-season NOx, which cross State lines and significantly contribute to ground-level ozone and/or fine particulate pollution problems in States other than those that are the sources of the emissions. Subsequently, the Agency issued a supplemental rule for CSAPR which limited NOx emissions during the ozone-season. The pollutant emissions that these rules limited – SO_2, NOx and ozone-season NOx – react in the atmosphere to form PM2.5 and ground-level ozone and are transported long distances. This made it difficult for a number of States to meet the national clean air standards that Congress directed EPA to establish to protect public health (U.S. EPA 2011b). However, again, a court action has delayed implementation of the regulation: the U.S. Court of Appeals for the D.C. Circuit stayed CSAPR on December 30, 2011. Subsequently, on August 21, 2012, the court issued an opinion vacating the rule and ordering EPA to revert to the Clean Air Interstate Rule (CAIR) as an interim regulatory program.[30] EPA reviewed the expected impact of the vacatur and concluded that it had no material effect on its analyses and findings in support of the final rule.

Also building off CAIR, the Clean Air Visibility Rule (CAVR), finalized on June 15, 2005, requires emission controls to reduce SO_2 and NOx emissions using Best Available Retrofit Technology (BART) for industrial and power generation facilities.

The Clean Air Act (CAA) amendments of 1990 directed EPA to control mercury and other hazardous air pollutants from major sources of emissions to the air. For power facilities using fossil fuels, the amendments required EPA to conduct a study of hazardous air pollutant emissions (CAA Section 112(n)(1)(A)). The CAA

[29] State of North Carolina v. EPA, Case No. 05-1244, (D.C.Cir. 2003)

[30] EME Homer City Generation, L.P. v. EPA, 2012 WL 3570721 (D.C.Cir. 2012)

amendments also required EPA to make a finding as to whether additional regulation was appropriate and necessary, based on this study and other information. In 2000, the Administrator found that regulation of hazardous air pollutants, including mercury from coal- and oil-fired power facilities, was appropriate and necessary (65 FR 79825). On February 16, 2012, EPA promulgated the final Mercury and Air Toxics Standards (MATS) for power facilities (77 FR 9304). The rule establishes uniform national standards to reduce toxic air pollutants from new and existing coal- and oil-fired power facilities. Pollutants covered in the standards include metals such as mercury, arsenic, chromium, and nickel; acid gases such as hydrochloric acid and hydrofluoric acid; dioxins and furans; and particulate matter. Affected power facilities may use any number of practices, technologies, and strategies to meet the new emission limits, including using wet and dry scrubbers, dry sorbent injection systems, activated carbon injection systems, and fabric filters.

2A.5.3 Renewable Portfolio Standards

In many States, Renewable Portfolio Standards (RPS) require electric utilities to generate a certain percentage of power from renewable sources. States have adopted RPS increasingly since the late 1990s: as of September 2011, 31 States and Washington, DC have mandatory RPS policies, four of which have Alternative Energy Portfolio Standards. In addition, eight States have adopted non-mandatory renewable portfolio targets, leaving only 11 States with no standards or goals (PCGCC, 2011). Typically, RPS aim to achieve 1 to 5 percent renewable power generation in the first year and then require increasing percentages every year thereafter, with most States aiming for around 15 to 25 percent renewable power generation by 2020 to 2025 (PCGCC, 2009). The definition of renewable sources differs among States. Some States allow only new renewables (renewable sources built after a certain year) while others allow all renewables, new and existing. Some RPS also involve credit-trading programs in which investors and power generators decide whether to use and/or develop renewable energy-based generating capacity, or to purchase renewable energy credits to meet RPS requirements. These programs are similar to the programs used in the air emissions regulations mentioned in *Section 2A.5.2.* Eventually, RPS should result in increased competition, efficiency, and innovation among the renewable energy sectors and should distribute renewable energy at the lowest possible cost (AWEA, 1997). A more recent development in electric portfolio standards is the clean energy standard (CES), which requires that clean energy sources provide a fraction of electric sales. [31] Four of the six States that recently adopted electric portfolio standards chose to enact CES as opposed to RPS (PCGCC, 2011).

2A.5.4 Greenhouse Gas Emissions Regulations

Greenhouse gas (GHG) emissions reduction programs – in particular for carbon dioxide (CO_2) the primary energy consumption-based GHG – are beginning to surface among States and on the national agenda. In the absence of federal action, five States[32] have adopted CO_2 performance standards while another 11 States[33] have enacted utility sector cap and trade programs (PCGCC, 2012). For both the Northeast Regional Greenhouse Gas Initiative (RGGI)[34] and the Western Climate Initiative (WCI),[35] groups of States in a given region joined in multi-state programs to achieve CO_2 emission reductions. The RGGI program held its first auction of CO_2 credits on September 25, 2008. According to RGGI, the member States have capped and will reduce CO_2 emissions from the

[31] Depending on the way in which clean energy is defined, these sources may include some non-renewable electric power generation technologies.

[32] California, Illinois, Montana, Oregon, and Washington.

[33] Connecticut, Delaware, Florida, Maine, Maryland, Massachusetts, New Hampshire, New Jersey, New York, Rhode Island, and Vermont.

[34] The RGGI consists of Connecticut, Delaware, Maine, Maryland, Massachusetts, New Hampshire, New Jersey, New York, Rhode Island, and Vermont.

[35] The WCI consists of Arizona, California, Montana, New Mexico, Oregon, Utah, and Washington.

power sector by 10 percent by 2018 (RGGI, 2012). The WCI looks to reduce GHG emissions to levels 15 percent below 2005 emissions by 2020 (WCI, 2012).

In April 2007, the Supreme Court concluded that EPA has the authority to regulate CO_2 and other greenhouse gases under the Clean Air Act.[36] Though this finding has yet to result in a comprehensive set of rules concerning GHG reductions at the federal level, EPA has begun targeting certain sectors for regulation. On December 23, 2010, EPA entered a settlement agreement to issue rules that will address greenhouse gas emissions from fossil fuel-fired power facilities. Following this agreement, EPA published the Proposed Greenhouse Gas New Source Performance Standard for Electric Generating Units on April 13, 2012 (U.S. EPA, 2012a). This regulation would require new fossil fuel-fired electric power generators with greater than 25 megawatt electric power generating capacity, to meet an output-based limit of 1,000 pounds of CO_2 per megawatt-hour. EPA is evaluating the public comments on the proposed rule and has not determined a schedule at this time for taking final action on the proposed rule.

2A.6 Industry Outlook

This section presents a summary of forecasts from the Annual Energy Outlook 2012 (AEO2012) (U.S. DOE, 2012d).

2A.6.1 Energy Market Model Forecasts

This section discusses forecasts of electric energy supply, demand, and prices based on data and modeling by the EIA and as presented in the AEO2012. AEO2012 contains projections of future market conditions through the year 2035, based on a range of assumptions regarding overall economic growth, global fuel prices, and legislation and regulations affecting energy markets. EIA‟s National Energy Modeling System (NEMS) is the basis for these projections, which reflect all federal, State, and local laws and regulations in effect as of January 2012.

Electricity Demand

EIA projects electricity demand to grow by approximately 0.7 percent annually between 2010 and 2035. EIA projects this growth based on an estimated 1.0 percent annual increase in commercial sector demand for electricity stemming from increases in demand for office equipment and growth in commercial floor space in the service industries. In addition, EIA projects residential demand to increase by 0.7 percent annually over the same forecast period, driven by a growing number of U.S. households, greater disposable income, and continued population shifts to warmer climates with greater cooling requirements. However, energy efficiency improvements offset this increased demand to a degree. The industrial sector has seen declining growth rates for electricity demand since 2000 due to increased competition from foreign manufacturers and a shift by domestic manufacturers toward producing less energy-intensive goods. EIA expects this trend in the industrial sector to continue with an expected annual growth of only 0.1 percent. While electricity demand in the transportation sector currently is small, the EIA predicts a strong average annual growth rate of 4.8 percent between 2010 and 2035, driven by increased future sales of electric plug-in light duty vehicles.

Capacity Retirements

According to AEO2012, fossil fuel-fired capacity will make up the largest share of total retired capacity. Overall, EIA forecasts that 81.9 GW of total fossil-steam capacity will retire between 2010 and 2035, including 20.3 GW of oil and natural gas fired steam capacity. EIA predicts that coal will have the largest share of capacity retirements, with an expected 49.0 GW of retired capacity by 2035 (55.4 percent of total retirements). EIA also projects that an additional 6.1 GW of nuclear facility capacity will retire during this period.

[36] Massachusetts vs. Environmental Protection Agency, 549 U.S. 497

Capacity Additions

According to AEO2012, the nation will need 235 GW of new generating capacity between 2011 and 2035 to meet growing electricity demand and to offset the retirement of 88 GW of existing capacity. EIA projects that these capacity requirements will be met by natural gas, renewable energy, coal, and nuclear power sources – in the order of expected contribution. Of the new capacity projected to come online between 2011 and 2035, EIA projects that approximately 60 percent will be natural gas-fired, 29 percent will be fueled by renewables, 7 percent will be by coal-fired, and 4 percent will be nuclear energy. The increase in renewable capacity results in part from RPS, as described in *Section 2A.5.3*.

Electricity Generation

According to AEO2012, electricity generation from both natural gas- and coal-fired facilities will increase to meet growing electricity demand and to offset losses in capacity from facility retirements. EIA projects that coal-fired generation will remain the largest source of electricity throughout the forecast period. At the same time, though, EIA projects that natural gas-fired power facilities will account for much of the new capacity over the next ten years. Coal-fired generation will decrease between 2010 and 2035, reducing its share of total generation from 45 percent to an estimated 38 percent. The anticipated decrease in the share of coal generation results primarily from competition from natural gas and renewables. Also, concern regarding greenhouse gas emissions and the potential for emissions limits on CO_2 contributes to coal‟s declining share of total generation. EIA projects that the share of total generation associated with natural gas-fired technologies will increase from 24 percent to 28 percent. EIA projects that the share of total generation from renewable power sources will increase from 10 percent in 2010 to 15 percent of total generation in 2035. Nuclear power generation, however, is expected to decrease from 20 percent to 18 percent as a share of total generation.

Electricity Prices

According to AEO2012, electricity prices will rise by 3 percent between 2010 and 2035. AEO2012 projects that electricity prices will fall until 2021, due to lower fuel prices, but then will rebound in response to increased demand for energy. Although EIA projects that transmission and distribution costs will decrease over time, rising fuel costs after 2020 are expected to result in higher electricity prices; overall, average end-use electricity prices are expected to be 10.1 cents per kilowatt hour in 2035 ($2010).

2A.7 Glossary

Base Load: A baseload generating unit normally satisfies all or part of the minimum or base load of the system and, therefore, produces electricity at an essentially constant rate and runs continuously. Baseload units are generally the newest, largest, and most efficient of the three types of units. (http://www.eia.doe.gov/cneaf/electricity/page/prim2/chapter2.html)

Combined Cycle Turbine: An electric power generating technology in which electricity is produced from otherwise lost waste heat exiting from one or more gas (combustion) turbines. The exiting heat is routed to a conventional boiler or to heat recovery steam generator for utilization by a steam turbine in the production of electricity. This process increases the efficiency of the electric power generating unit.

Distribution: The portion of an electric system that is dedicated to delivering electric energy to an end user.

Electricity Available to Consumers: Power available for sale to customers. Approximately 8 to 9 percent of net generation is lost during the transmission and distribution process.

Gas Turbine: A gas turbine typically consisting of an axial-flow air compressor and one or more combustion chambers, where liquid or gaseous fuel is burned and the hot gases are passed to the turbine. The hot gases expand to drive the generator and are then used to run the compressor.

Generation: The process of producing electric energy by transforming other forms of energy. Generation is also the amount of electric energy produced, expressed in energy quantity units such as kilowatt-hours (kWh) and megawatt-hours (MWh).

Gross Generation: The total amount of electric energy produced by the generating units at a generating station or stations, measured at the generator terminals.

Hydroelectric Generating Unit: A unit in which the turbine generator is driven by falling water.

Intermediate load: Intermediate-load generating units meet system requirements that are greater than baseload but less than peakload. Intermediate-load units are used during the transition between baseload and peak load requirements. (http://www.eia.doe.gov/cneaf/electricity/page/prim2/chapter2.html)

Internal Combustion Engine: An internal combustion engine has one or more cylinders in which the process of combustion takes place, converting energy released from the rapid burning of a fuel-air mixture into mechanical energy. Diesel or gas-fired engines are the principal fuel types used in these generators.

Kilowatt-hours (kWh): A measure of electric energy generated or consumed. The amount of energy generated from one Kilowatt of fully utilized capacity during one hour. A *Megawatt-hour* (MWh) is also an energy measure and equals 1,000 Kilowatt-hours.

Load: Refers to either demand for electricity or total electricity generated.

Megawatt (MW): Unit of power equal to one million watts. A watt is a measure of *power*, or the potential to produce or consume electricity (or other energy).

Nameplate Capacity: The amount of electric power delivered or required for which a generator, turbine, transformer, transmission circuit, station, or system is rated by the manufacturer.

Net Generation: Gross generation minus electricity used by the electricity generating facility (or company).

Nonutility: A corporation, person, agency, authority, or other legal entity or instrumentality that owns electric generating capacity and does not produce or sell electricity under a rate-regulation framework. Nonutility power producers include qualifying cogenerators, qualifying small power producers, and other nonutility generators (including independent power producers) without a designated franchised service area that do not file forms listed in the Code of Federal Regulations, Title 18, Part 141. (http://www.eia.doe.gov/emeu/iea/glossary.html)

Other Prime Movers: Methods of power generation other than steam turbines, combined cycles, gas combustion turbines, internal combustion engines, and hydroelectric generating units. Other prime movers include: geothermal, solar, wind, and biomass.

Peakload: A peakload generating unit, normally the least energy efficient of the three unit types, is used to meet requirements during the periods of greatest, or peak, load on the system. (http://www.eia.doe.gov/cneaf/electricity/page/prim2/chapter2.html)

Prime Movers: The engine, turbine, water wheel or similar machine that drives an electric power generator. Also, for reporting purposes, a device that directly converts energy to electricity, e.g. photovoltaic, solar, and fuel cell(s).

Reliability: Electric system reliability has two components: adequacy and security. Adequacy is the ability of the electric system to supply customers at all times, taking into account scheduled and unscheduled outages of system facilities. Security is the ability of the electric system to withstand sudden disturbances, such as electric short circuits or unanticipated loss of system facilities. (http:/www.eia.doe.gov/cneaf/electricity/epav1/glossary.html)

Spinning Reserve: Reserve generating capacity running at a zero load and synchronized to the electric system. It is the unloaded section of synchronized generation that is able to respond immediately to serve load.

Steam Turbine: A generating unit in which the prime mover is a steam turbine. The turbines convert thermal energy (steam or hot water) produced by generators or boilers to mechanical energy or shaft torque. This mechanical energy is used to power electric generators, including combined cycle electric power generating units that convert the mechanical energy to electricity.

System: Physically connected generation, transmission, and distribution facilities operated as an integrated unit under one central management or operating supervision.

Transmission: The movement or transfer of electric energy over an interconnected group of lines and associated equipment between points of supply and points at which it is transformed for delivery to consumers, or is delivered to other electric systems. Transmission is considered to end when the energy is transformed for distribution to the consumer.

2B Summary Profile of the Primary Manufacturing Industries

2B.1 Introduction

EPA identified six manufacturing industries that use substantial amounts of cooling water in their operations and are likely to contain the largest numbers of non-power industry facilities and cooling water intake capacity subject to the final rule:

1. Aluminum
2. Chemicals and Allied Products
3. Food and Kindred Products
4. Paper and Allied Products
5. Petroleum Refining
6. Steel.

Of the estimated 589 non-power industry regulated facilities (referred to herein as Manufacturers), 576 are in these six *Primary Manufacturing Industries*, and 13 fall in a wide range of other industries, including non-manufacturing industries (*Other Industries*).

EPA profiled the Primary Manufacturing Industries[37] and the entities that own them along several dimensions to support its assessment of the economic impact of the final rule on the regulated facilities in these sectors

- Size of the industry based on value of output, value added, and number of establishments and firms
- Employment and labor productivity
- Capital outlays
- Capacity utilization
- Industry structure and competitiveness
- Competition in international markets
- Financial condition and performance.

The profiles describe how the industries have changed over time in each of these dimensions and summarize key business outlook information for the industries. The profiles also provide insight into the likely impact of the final rule on the regulated facilities, the entities that own them, and the industries, overall.[38] In particular, the profiles help EPA assess the ability of facilities and parent entities to meet the final rule‟s compliance requirements without incurring substantial adverse economic/financial impact. Key considerations in this assessment include (1) the ability of the regulated facilities to shift compliance costs to customers through price increases (cost pass-through), and (2) the financial health of the industry and its general business outlook.

These detailed profiles are Appendices A-F. This chapter summarizes the detailed profiles, including review of:

- <u>The role of each industry in the U.S. economy and key economic trends.</u> For each industry, this chapter reports historical profiles of: (1) output in terms of value of shipments, (2) employment, and (3) number of facilities and firms.

37 EPA also developed costs for facilities in Other Industries that are subject to the rule. However, EPA chose not to profile these additional industries because the 316(b) survey and other data indicate that there are very few regulated facilities and little cooling water intake capacity in any of these industries.

38 To the extent possible, the information provided for the Primary Manufacturing Industries in this chapter reflects data for the specific NAICS codes with facilities that EPA estimates will be subject to the final rule. These values may differ from those reported elsewhere in the document, where data for earlier analysis years are in the SIC framework. In these instances, EPA used less specific NAICS codes to maintain data consistency with the SIC-based data.

- Factors underlying the assessment of cost pass-through potential. To assess the potential for regulated facilities to recover compliance costs through price increases, EPA performed a market structure analysis for each industry that accounts for four factors: (1) fraction of industry output that is expected to be subject to the final rule, (2) industry concentration, (3) extent of competition in international markets, and (4) long-term historical industry growth.
- Financial health and general business outlook. EPA reviewed the following metrics for each industry: (1) capacity utilization, (2) net profit margin, and (3) return on capital.

From these assessments, EPA concluded that:

- Zero cost pass-through is an appropriate assumption in analyzing economic impact for all of the Primary Manufacturing Industries.
- Each of the Primary Manufacturing Industries would be able to withstand the compliance costs of the Final 316(b) Existing Facilities Rule without material, adverse financial impact.

The following sections of this chapter are as follows:

- Overview of the Primary Manufacturing Industries and their role in the U.S. economy
  - Section 2B.2.1: Value of Shipments
  - Section 2B.2.2: Employment
  - Section 2B.2.3: Numbers of Facilities and Firms
- Factors of primary importance for assessing cost pass-through potential
  - Section 2B.3.1: Fraction of Each Industry"s Production
  - Section 2B.3.2: Industry Concentration
  - Section 2B.3.3: Import Competition in Domestic Markets
  - Section 2B.3.5: Long-Term Industry Growth
- Factors of primary importance for assessing financial performance and general economic condition
  - Section 2B.4.1: Capacity Utilization
  - Section 2B.4.2: Current Financial Data and Industry Outlook.

2B.2 General Industry Descriptions; Role in the U.S. Economy

The Primary Manufacturing Industries vary in terms of their size and role in the U.S. economy, but as a whole, their economic contribution is substantial. To illustrate, in 2010, these industries represented approximately 21 percent of employment in the total U.S. manufacturing industry. The Food and Kindred Products Industry is the largest of the Primary Manufacturing Industries in terms of both facility and firm counts. This industry also accounts for the highest shares of employment and output, in value of shipments, of the Primary Manufacturing Industries. The Chemicals and Allied Products Industry, the second largest in terms of facility and firm counts, accounts for a relatively high share of employment and value of shipments. On the other hand, the Petroleum Refining Industry boasts a relatively high value of shipments but is one of the smaller industries in terms of facility and firm counts and also has a smaller share of employment. The Aluminum, Paper, and Steel Industries also account for significantly less U.S. output, with value of shipments for the past decades remaining around $100 billion or less. In terms of employment, among the Primary Manufacturing Industries, the Aluminum Industry supports the least employment, while the Steel and Paper and Allied Products Industries provide significantly higher levels of employment.

In the past decade, all of the Primary Manufacturing Industries experienced declining employment. Only the Food and Kindred Products Industry saw increasing employment since 1990. From 1990 to 2009, the Paper and Allied Products, Petroleum Refining and Steel Industries also declined in size in terms of facility and firm counts. In contrast, the Food and Kindred Products Industry has seen a major expansion in the number of facilities and firms. Since 1990, output increased in each of the Primary Manufacturing Industries except for the Aluminum, and Paper and Allied Products Industries. Output increased the most in the Petroleum Refining Industry, more than doubling between 1990 and 2010. The following sections review these industries" participation in the U.S. economy in terms of value of shipments, employment, and number of facilities and firms.

2B.2.1 Value of Shipments

Over the past two decades, the Food and Kindred Products Industry remained the largest of the Primary Manufacturing Industries in terms of value of shipments, on an inflation-adjusted basis.[39] The Chemicals and Allied Products Industry was the second largest for most of the period, until 2005 when the Petroleum Refining Industry surpassed Chemicals and Allied Products to become the second largest industry. On the other hand, the Aluminum Industry remained the smallest of the industries throughout this period. *Figure 2B-1,* below, displays value of shipments for the Primary Manufacturing Industries from 1990 to 2010.

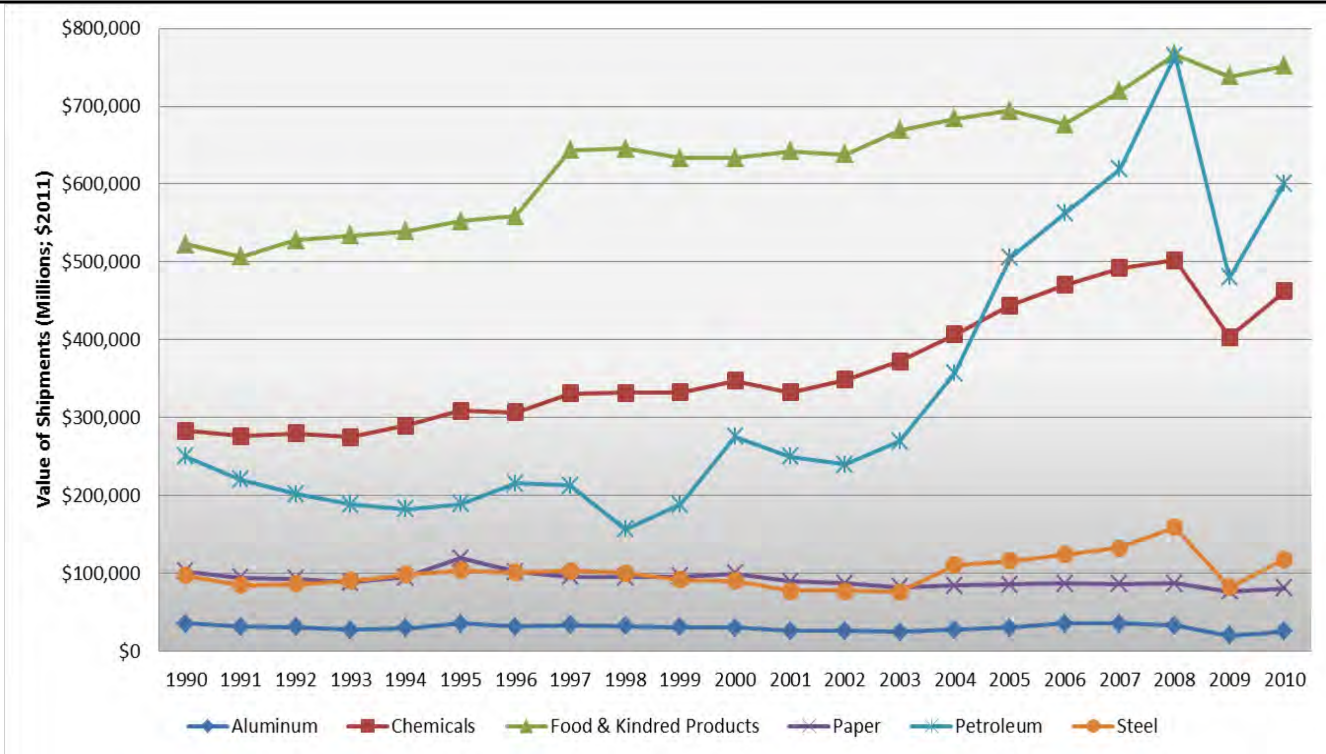
Output for two of the Primary Manufacturing Industries – Aluminum and Paper and Allied Products – declined, on an inflation-adjusted basis, from 1990 to 2010, while output for the remaining industries increased. The declining output for the Aluminum and Paper and Allied Products Industries reflects several factors, including a longer-term trend of declining importance in the U.S. economy and increasing import penetration.

All of the Primary Manufacturing Industries experienced declining output during the recent recession, but since then, have begun to recover. The declines during the recession were greater on a percentage basis for the economically cyclical industries (Aluminum, Chemicals and Allied Products, Paper and Allied Products, Petroleum Refining, and Steel), and least for Food and Kindred Products, which is a consumer-staples industry and therefore, less cyclical.

- The *Aluminum Industry* experienced an overall decline in value of shipments over the past two decades of about 27 percent. While the industry saw major decreases in 2008 and 2009 due to the economic downturn, in 2010 value of shipments rebounded with a 28 percent increase.
- The *Chemicals and Allied Products Industry's* value of shipments more than doubled (63 percent) between 1990 and 2010, despite declines in the early part of each decade. In 2009, during the economic downturn, the industry experienced a nearly 20 percent decline in value of shipments, but began to recover with a 15 percent increase in 2010.
- The *Food and Kindred Products Industry* experienced substantial growth over the two decades, with value of shipments increasing overall by about 44 percent. Intermittent declines interrupted this growth, with the greatest decline (about 4 percent) occurring in 2009.
- The *Paper and Allied Products Industry,* like the Aluminum Industry, saw an overall decline in value of shipments, of about 21 percent, between 1990 and 2010. The industry experienced a major drop in value of shipments during the recent recession, but began to rebound in 2010 with a 5 percent increase.
- The *Petroleum Refining Industry* recorded the highest increase in value of shipments between 1990 and 2010, about 140 percent. The industry saw a large setback in 2009, but began recovering in 2010 with a steep rise in value of shipments.
- The *Steel Industry* recorded an increase in value of shipments over the period of analysis of approximately 21 percent. Value of shipments for the industry declined at the beginning of the 2000s, but then saw significant increases beginning in 2004. Value of shipments declined steeply in 2009, but rose steeply in 2010.

39 All dollar values reported in this chapter are in constant dollars of the year 2011.

Figure 2B-1: Value of Shipments for the Primary Manufacturing Industries from 1990 to 2010



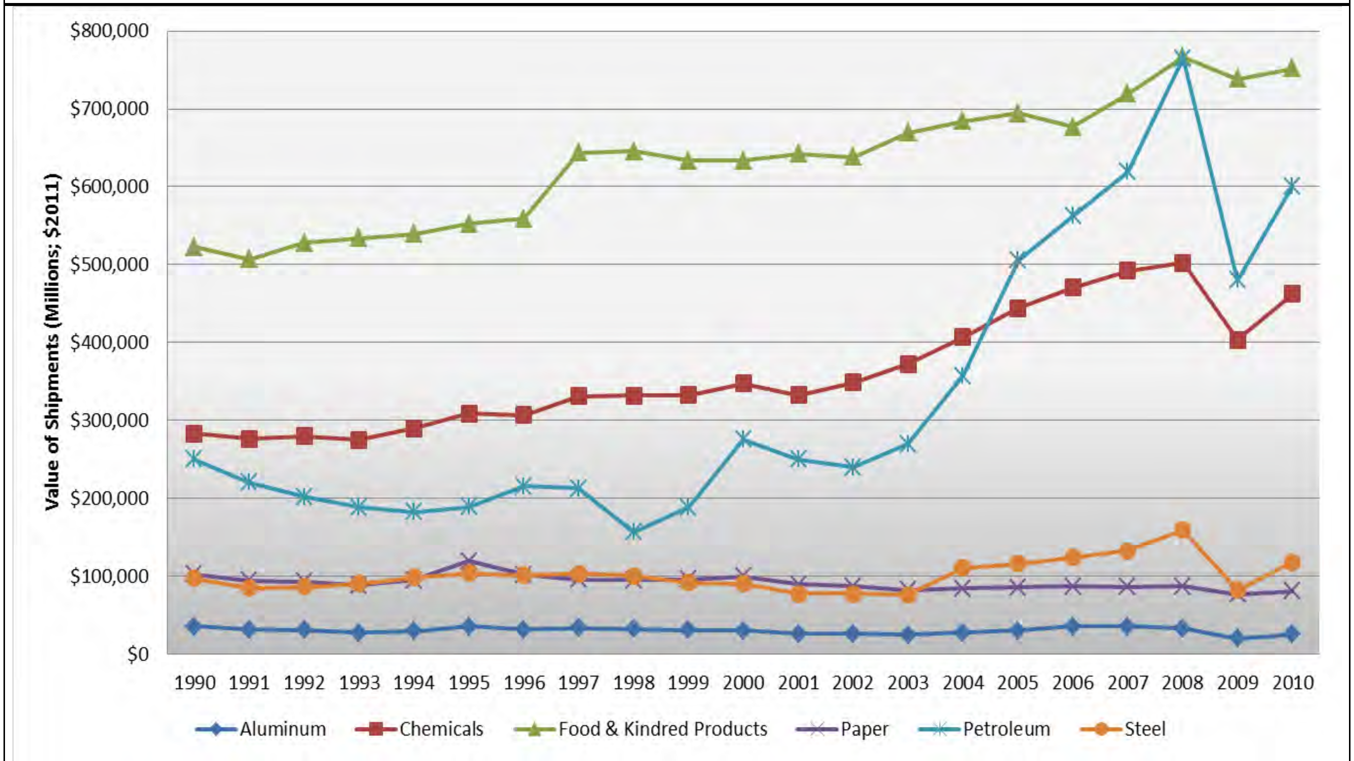
Source: U.S. DOC, 1988-1991, 1993-1996, 1998-2001, 2003-2006, and 2008-2010 ASM; U.S. DOC, 1992, 1997, 2002, and 2007 EC.

2B.2.2 Employment

Figure 2B-2 provides employment information for the profiled manufacturing industries from 1990 to 2010. In 2010, the Food and Kindred Products Industry had the highest employment while the Aluminum and Petroleum Refining Industries had the lowest. Employment levels have varied for the manufacturing industries over the past two decades, but overall, the industries have seen a decline in employment. These declines reflect increasing labor productivity, but also declining total output, in particular, for the Aluminum and Paper and Allied Products Industries.

- The *Aluminum Industry* experienced a 50 percent decline in employment between 1990 and 2010, with 2010 employment levels at 28,700 employees.
- The *Chemicals and Allied Products Industry* experienced an approximately 24 percent decline in employment between 1990 and 2010. In 2010, the industry employed 370,100 workers.
- The *Food and Kindred Products Industry* was the only profiled industry to experience an increase in employment between 1990 and 2010, about 6 percent. However, this rise was largely due to a significant increase in employment in 1997 and employment has since declined.
- The *Paper and Allied Products Industry* saw a 51 percent decline in employment between 1990 and 2010, ending the period with 110,100 employees in 2010.
- The *Petroleum Refining Industry* experienced a relatively smaller decline of 12 percent between 1990 and 2010. However, the past decade saw a slight rise in employment of nearly 2 percent, from 62,100 employees in 2000 to 63,300 employees in 2010.
- *Steel Industry* employment declined by approximately 47 percent between 1990 and 2010, with 2010 employment levels at 136,300 employees.

Figure 2B-2: Number of Employees in the Primary Manufacturing Industries from 1990 to 2010



Source: U.S. DOC, 1988-1991, 1993-1996, 1998-2001, 2003-2006, and 2008-2010 ASM; U.S. DOC, 1992, 1997, 2002, and 2007 EC.

2B.2.3 Numbers of Facilities and Firms

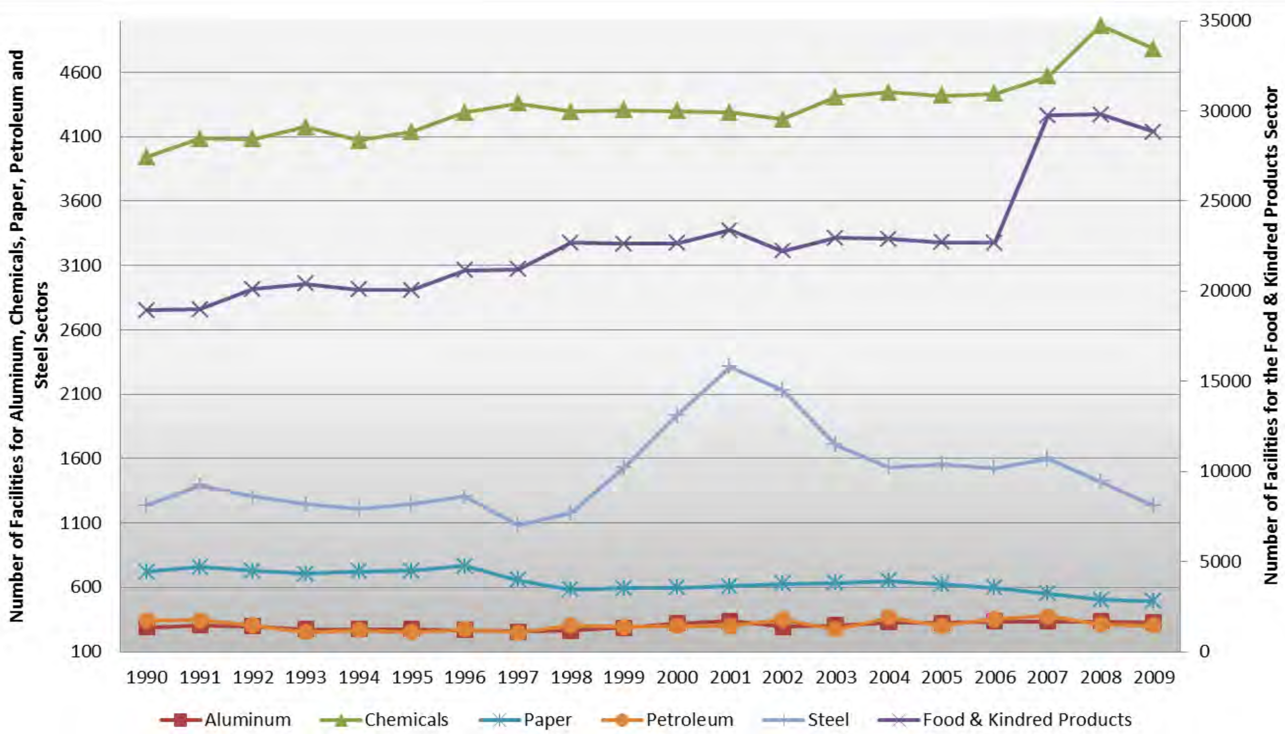
The Food and Kindred Products Industry has by far the largest number of facilities and firms, followed by the Chemicals and Allied Products Industry and the Steel Industry. The Aluminum and Petroleum Refining Industries are the smallest in terms of facilities and firms, with the Paper and Allied Products Industry being only slightly larger. *Figure 2B-3* shows the number of facilities in each industry from 1990 to 2010, while *Figure 2B-4* shows the number of firms. The industries have experienced varying changes in numbers of facilities and firms, with the counts in some industries increasing, while decreasing in others. In some instances, these changes reflect overall economic conditions – periods of economic growth and recession; in others, the industries are experiencing longer-term decline. Changes in industry concentration also contribute to changes in the number of firms and, to a less degree, facilities in these industries. See the profile appendices for discussion of these factors.

- The *Aluminum Industry* saw a 12 percent rise in facilities over the 20 years, and a slight decline, of less than 1 percent, in firms. In the past decade, both counts rose except for declines in 2002, 2005, and during the most recent economic downturn. In 2009, facility counts rebounded with a slight rise, reaching 330 facilities, while firm counts continued to decline to 230.
- The *Chemicals and Allied Products Industry* expanded between 1990 and 2009 with increases in both the number of facilities and firms (36 percent and 23 percent, respectively). In 2009, both facility and firm counts declined, ending the period of analysis at 4,800 facilities and 3,400 firms.
- The *Food and Kindred Products Industry* increased in size relative to facility and firm counts, by more than 50 percent. In 2009, both facility and firm counts declined by about 3 percent to 28,900 and 24,100, respectively.
- The *Paper and Allied Products Industry* experienced overall declines in both the number of facilities (32 percent), and number of firms (23 percent) over the analysis period. In 2005, both facility and firm counts

began declining. In 2009, the number of facilities continued to decline, ending the period with 490 facilities, while the number of firms rose to 290.

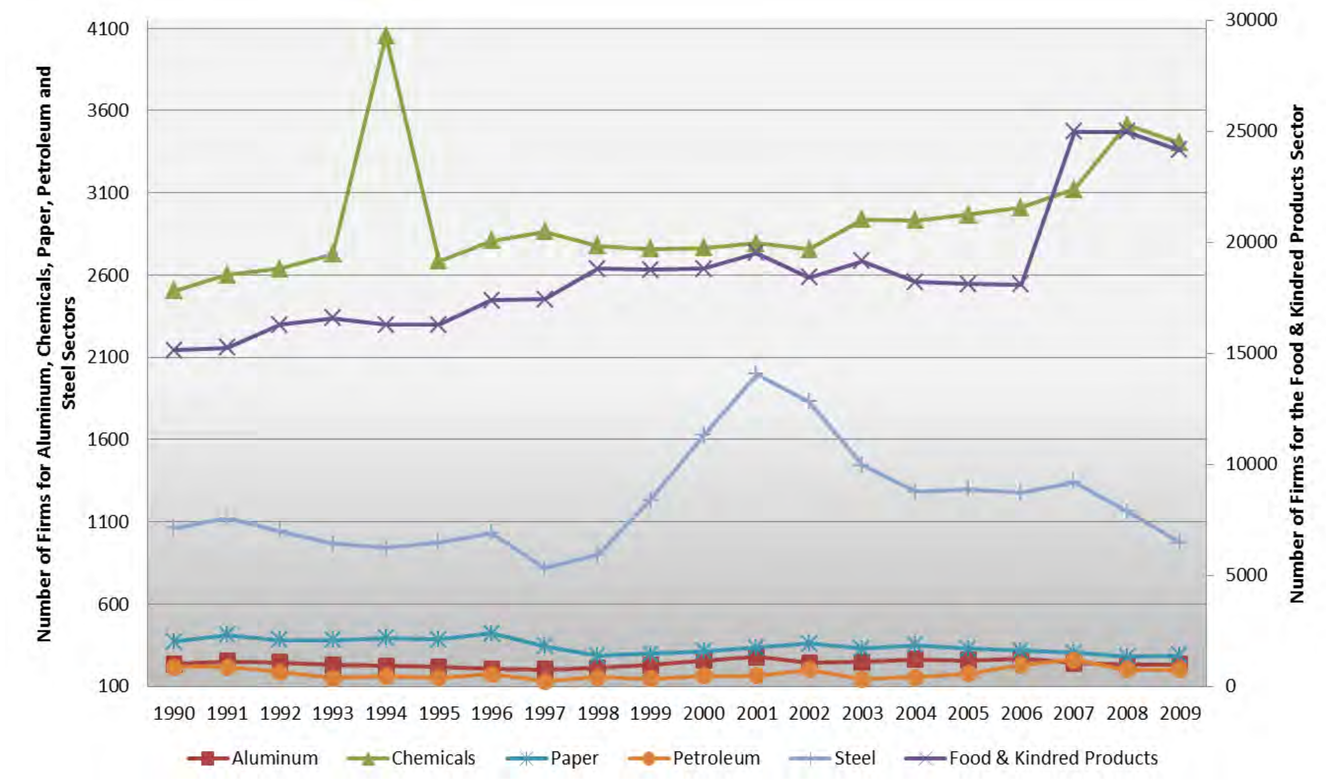
- The *Petroleum Refining Industry* also saw a decrease in the number of facilities and firms in the industry between 1990 and 2009 (11 percent and 7 percent, respectively). The industry saw major fluctuations in both facility and firm counts throughout the period, with annual declines and increases as high as 33 percent. However, the industry ended the period with a significant decline in 2008 and a lesser decline in 2009, ending the period with 300 facilities and 200 firms.
- The *Steel Industry* experienced an 8 percent decline in the number of firms in the industry and a very slight decline, less than 1 percent, in the number of facilities. In the last decade, facility and firm counts declined significantly from 2002 to 2004 and then again at the end of the period of analysis, with 1,230 facilities and 970 firms in 2009.

Figure 2B-3: Number of Facilities in the Primary Manufacturing Industries from 1990 to 2009



Source: U.S. DOC, 1990-1997 SBA; U.S. DOC, 1998-2009 SUSB.

Figure 2B-4: Number of Firms in the Primary Manufacturing Industries from 1990 to 2010



Source: U.S. DOC, 1990-1997 SBA; U.S. DOC, 1998-2009 SUSB.

2B.3 Cost Pass-Through Assessment

The extent to which regulated facilities can recover compliance costs from consumers through price and revenue increases is an important factor in assessing the economic/financial impact of the final rule‟s compliance requirements on regulated facilities and firms owning those facilities. EPA reviewed five factors, which together indicate the likely ability of cost pass-through for facilities in each of the Primary Manufacturing Industries. These include:

- Fraction of total production value in an industry that is expected to be subject to the final rule. In general, the greater this fraction, the more likely that facilities incurring compliance costs will be able to pass on regulation-induced increases in production costs – along with those other facilities in the industry that are also incurring those costs. EPA used a threshold of 50 percent to assess whether this factor would contribute to regulated facilities in a given industry being able to pass forward compliance costs as price increases.
- Degree of industry concentration. Indicates the potential for market power, and ability of facilities and firms to increase prices in response to increases in production costs
- Import penetration. Indicates the extent to which the U.S. industry – and specifically, the regulated facilities – faces competition in U.S. markets from foreign producers, which will not be subject to the rule‟s requirements. Higher competition from imports reduces cost pass-through potential for regulated facilities.
- Export dependence. Indicates the extent to which the U.S. industries compete with foreign producers in non-U.S. markets – with, again, the recognition that foreign producers will not incur costs under the final

rule. In general, the greater the share of facilities‟ revenue from foreign sales, the lower the cost pass-through potential of regulated facilities.

- Long-term historical industry growth. A factor in each industry‟s overall business outlook. Growing industries presumably face growing demand for their products, with greater potential for increasing prices in response to increased production costs. Declining industries presumably face growing competition within a declining market, with less potential for increasing prices in response to increased production costs.

Table 2B-1 summarizes EPA‟s findings relative to these industry-level factors. In the table, a "+" indicates that a factor represents potential support for an industry‟s ability to pass costs to consumers while a "-" indicates a factor that would make cost pass-through less likely. As shown in the table, none of the Primary Manufacturing Industries consistently displays strong potential for cost pass-through across the factors analyzed. For instance, the Aluminum Industry has a relatively large percentage of production in regulated facilities, though below 50 percent, and benefits from some industry concentration and minimal export dependence. However, this industry is exposed to high competition in domestic markets from international suppliers and has experienced negative long-term industry growth relative to the U.S. economy as a whole. EPA assumed that none of the Primary Manufacturing Industries will be able to pass on compliance costs to consumers. This assumption has the potential to overstate impacts to Manufacturers to the extent that facilities in some industries may in fact be able to pass some compliance costs to consumers.

Table 2B-1: Factors Relevant to Cost Pass-Through Assessment

Industry	Fraction of Production Subject to Rule[a]	Industry Concentration[b]	Import Penetration[c]	Export Dependence[d]	Long-Term Industry Growth[e]
Aluminum	-	Mixed	-	+	-
Chemicals and Allied Products	-	Mixed	-	-	+
Food and Kindred Products	-	-	+	+	-
Paper and Allied Products	-	-	+	+	-
Petroleum Refining	-	-	+	+	+
Steel	-	-	+	+	-

a. This column indicates whether the fraction of the industry‟s production that is subject to this final rule is above or below an assumed threshold value of 50 percent, with industries above the threshold marked with "+" and those below with "-." In the following discussion, EPA refers to this factor as the *Regulated Fraction*.
b. This column indicates whether the industry is considered concentrated based on the HHI for each industry, with concentrated industries indicated with "+" and unconcentrated or moderately concentrated industries marked with "-." Industries that have both concentrated and unconcentrated or moderately concentrated sectors are marked as "mixed."
c. This column indicates whether the import penetration ratio is above or below the threshold value of 28 percent, with industries below the threshold marked with "+" and those above with "-."
d. This column indicates whether the export dependence ratio is above or below the threshold value of 22 percent, with industries below the threshold marked with "+" and those above with "-."
e. This column indicates whether the long-term growth rate is above or below the threshold value of 2.46 percent, with industries below the threshold marked with "+" and those above with "-."

Source: U.S. EPA Analysis, 2013

2B.3.1 Fraction of Each Industry's Production Subject to the Final Rule

In general, the greater the fraction of production value in an industry that will incur costs from regulatory requirements, the more likely that facilities incurring compliance costs will be able to pass on those increases in production costs (***Regulated Fraction***). EPA assesses that facilities in industries with a Regulated Fraction exceeding 50 percent are likely to be able to pass on compliance costs, because a greater fraction of production in the industry is subject to rule requirements, and is expected to incur compliance costs than is not. This section describes the fraction of each Primary Manufacturing Industry EPA estimated will be subject to the final rule.[40] Overall, EPA estimates that a small fraction of total production value in the Primary Manufacturing Industries will be subject to the final rule: approximately 2 percent of facilities and 20 percent of the total value of shipments (*Table 2B-2*). The number of regulated facilities as a fraction of industry totals is small across all industries, with regulated Manufacturers in the Petroleum Refining having the largest fraction of facility counts at 11 percent. The fraction does not exceed 5 percent for any of the remaining industries.

Regulated Fractions of production based on value of shipments are generally higher, with the Steel Industry accounting for the largest share (48 percent), followed by the Aluminum Industry (46 percent), Paper and Allied Products Industry (39 percent), and Petroleum Refining Industry (38 percent). The fraction for the remaining industries does not exceed 14 percent. While Regulated Fractions for two of the industries – Aluminum Industry and Steel Industry –are nearly 50 percent, the percentage of value of shipments subject to this final rule does not exceed 50 percent for any of the Primary Manufacturing Industries. The Regulated Fractions for the Primary Manufacturing Industries all suggest limited potential for cost pass-through.

Table 2B-2: Regulated Fraction of Facilities, Value of Shipments, by Industry

		Number of Facilities			Value of Shipments (mill; $2011)[a,b]		
			Regulated[c]			Regulated[c]	
Industry	**NAICS Code**	**Industry Total**	**Number**	**% of Ttl**	**Industry Total**	**Value**	**% of Ttl**
Aluminum	3313	583	22	4%	$32,966	$15,131	46%
Chemicals	325	13,138	175	1%	$716,178	$102,914	14%
Food	311/3121	4,119	34	1%	$755,071	$16,881	2%
Paper	322	4,706	194	4%	$173,577	$66,845	39%
Petroleum	32411	303	35	11%	$601,212	$229,480	38%
Steel	3311/2	1,233	48	4%	$118,089	$57,195	48%
Total	**NA**	**24,082**	**509**	**2%**	**$2,397,094**	**$488,446**	**20%**

a. For this analysis, facility revenue was used as a measure of output for sample facilities. This includes revenues for all regulated facilities in the Primary Manufacturing Industries, excluding baseline closures.
b. To compare revenues at regulated facilities with the industry value of shipments, EPA brought revenues at regulated facilities to 2010 using industry-specific Producer Price Index (PPI) series published by the Bureau of Labor Statistics (BLS), and stated in 2011 dollars using the GDP deflator series published by the Bureau of Economic Analysis (BEA).
c. EPA estimated number of regulated facilities and regulated facility revenues using technical weights. Regulated facility counts and associated revenue exclude baseline closures and exclude 13 facilities with NAICS codes that do not fall into any of these six Primary Manufacturing Industries (see *Appendix H*).
Source: U.S. DOC, 2010 Annual Survey of Manufactures; U.S. DOC, 2009 SUSB; U.S. EPA, 2000

2B.3.2 Industry Concentration

The degree of ***industry concentration*** indicates the potential for market power, and the consequent ability of facilities and firms to increase prices in response to increases in production costs. *Table 2B-3* reports the Herfindahl-Hirschman Index (HHI), by segment, for each of the Primary Manufacturing Industries, as reported by the U.S. Department of Commerce (DOC). The HHI is a generally accepted measure of market concentration used by the U.S. Department of Justice (DOJ) to evaluate mergers: the higher the HHI value, the greater the degree of concentration and potential for market power, and the greater the potential for cost pass-through *if the regulated facilities are owned by the more dominant firms in an industry.* Based on the U.S. Department of Justice (DOJ) guidelines for evaluating mergers, an HHI under 1,000 indicates an unconcentrated market, an HHI between 1,000 and 1,800 indicates moderate concentration, and an HHI in excess of 1,800 indicates concentrated markets. The *Aluminum Industry* includes two concentrated segments and one unconcentrated segment. DOC did not report HHI for the fourth segment.

40 The values reported in this section are for the entire industries, as opposed to only the individual NAICS codes of facilities potentially subject to this final rule, to assess the ability of regulated facilities to pass on costs to consumers. As facilities subject to this regulation likely complete with facilities outside of their specific 6-digit NAICS codes, EPA reports values for higher-level NAICS codes.

- The *Chemicals and Allied Products Industry* also displays a mix of industry concentrations with three concentrated, four moderately concentrated, and four unconcentrated segments. DOC did not report HHI for two of the industry segments.
- The *Paper and Allied Products Industry* contains one moderately concentrated segment and two unconcentrated segments.
- The *Petroleum Refining Industry* is unconcentrated.
- The *Steel Industry* consists of five segments, four of which are unconcentrated. U.S. DOC did not report HHI for the fifth segment.
- The *Food and Kindred Products Industry* consists of two unconcentrated segments.

EPA concluded that facilities in only the Aluminum, and Chemicals and Allied Products Industries might possess relatively weak cost pass-through potential, based on the *moderate* concentration finding. All of the remaining industries show little potential for cost pass-through based on industry concentration.

Table 2B-3: Concentration Ratios by Industry and Sub-Industry Sector

NAICS Code	Total Number of Firms	Herfindahl-Hirschman Index[a]
Aluminum		
331311	12	NA
331312	**34**	**2,250**
331314	108	931
331315	**89**	**1,995**
Chemicals and Allied Products		
325110	**38**	**2,535**
325120	*96*	*1,415*
325131	*72*	*1,265*
325181	**36**	**2,392**
325188	396	224
325199	540	361
325211	803	400
325221	15	NA
325222	**88**	**2,071**
325311	*137*	*1,136*
325312	50	NA
325411	*385*	*1,424*
325412	763	457

NAICS Code	Total Number of Firms	Herfindahl-Hirschman Index[a]
Food & Kindred Products		
311	21,355	102
3121	3,160	483
Paper and Allied Products		
322110	*30*	*1,024*
32212	151	673
322130	77	713
Petroleum Refining		
324110	98	807
Steel		
331111	235	786
331112	20	NA
331222	237	297
331221	120	402
331210	134	436

a. Sectors in **bold** are *concentrated* based on DOJ criteria. Sectors in *italics* are *moderately concentrated* based on DOJ criteria.
Source: U.S. DOC, 2007 EC

2B.3.3 Import Competition in Domestic Markets

Import penetration, shown in *Figure 2B-5*, measures the extent to which domestic firms encounter foreign competition in domestic markets. In general, the greater the competition from imports – whose production is not subject to the final rule – the lower will be the cost pass-through potential for regulated facilities. In effect, the presence of import competition adjusts the information on fraction of domestic output that is subject to the final rule (Section *2B.3.1*): substantial competition from imports further reduces the cost pass-through potential.

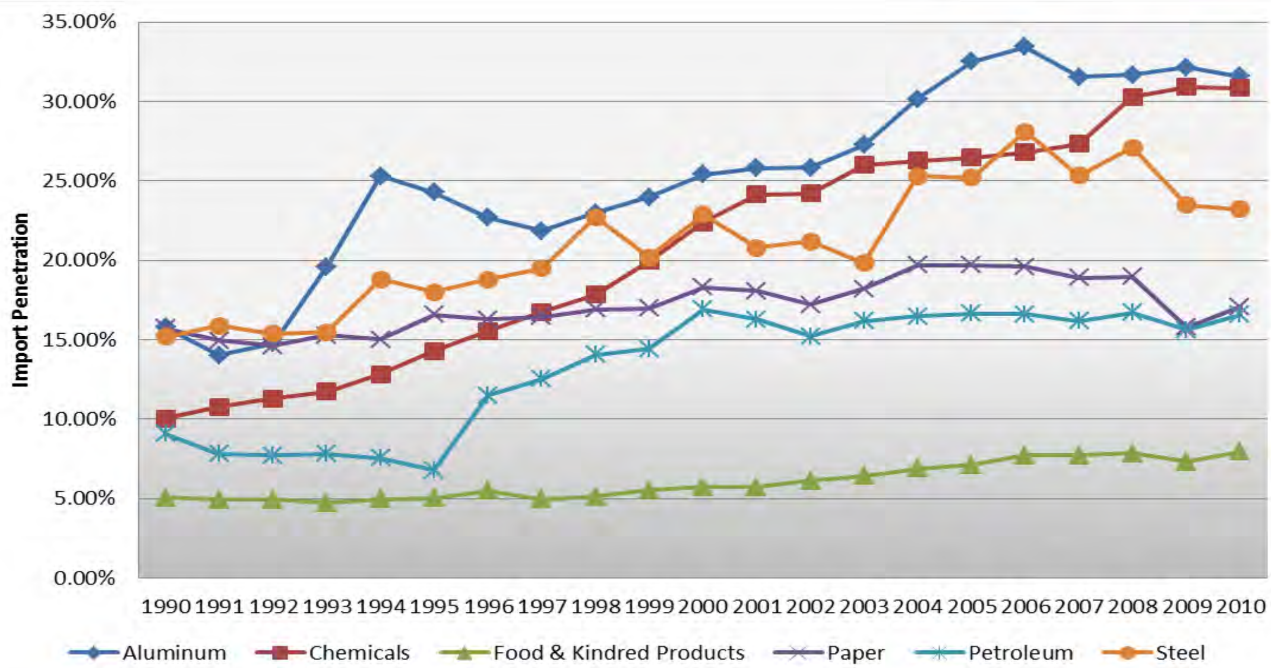
EPA calculated import penetration as total imports divided by total value of domestic consumption in that industry where domestic consumption equals domestic production *plus* imports *minus* exports. The estimated import penetration ratio for all U.S. manufacturing industries (NAICS 31-33) for 2010 is 28 percent. EPA assessed that industries with import ratios close to or above 28 percent would more likely face stiff competition from foreign firms and thus would be less able to pass compliance costs through to customers. Over the past two decades, all of the Primary Manufacturing Industries have seen a rise in import penetration.

- The *Aluminum Industry's* import penetration ratio doubled in the last two decades, increasing from just below 16 percent in 1990 to about 32 percent in 2010. The first major rise in import penetration occurred in 1994, primarily due to exports from Russian producers (USGS, 1994a). Import penetration declined at the end of the analysis period, in 2007 and 2010. However, in 2010, import penetration still exceeded the average ratio for manufacturers, indicating that the industry faces a relatively high level of competition from foreign producers.
- The *Chemicals and Allied Products Industry* experienced a continuous rise in import penetration between 1990 and 2010, except for a slight decline in 2010 of less than 1 percent. Over the past two decades, import penetration increased by more than 20 percentage points, with the majority of that rise occurring during the 1990s. In 2010, import penetration in the industry was approximately 31 percent, above the 28 percent average for manufacturers, implying that the industry faces relatively higher competition from foreign producers.
- The *Food and Kindred Products Industry* was least affected by imports between 1990 and 2010. Overall, import penetration grew by about 3 percentage points between 1990 and 2010. In 2010, the import penetration ratio was 8 percent, significantly less than the average for manufacturers, indicating that the industry is not likely to face strong competition from foreign producers.
- The *Paper and Allied Products Industry's* import penetration ratio remained relatively constant between 1990 and 2010, fluctuating between 15 percent and 20 percent. In 1990, the import ratio was approximately 16 percent and by 2010, increased to 17 percent. In 2010, import penetration in the industry was below the 28 percent average for manufacturers, suggesting that the industry does not face high competition from foreign producers relative to other manufacturing industries.
- The *Petroleum Refining Industry's* import penetration ratio generally increased over the analysis period, increasing by 7 percentage points, and ending the period in 2010 at 17 percent. While the industry has faced increasing competition from foreign producers, the import penetration ratio remains significantly lower than the manufacturing industries" average of 28 percent.
- The *Steel Industry* experienced a high level of fluctuation in import penetration between 1990 and 2010, increasing from approximately 15 percent in 1990 to 23 percent in 2010. In 2010, import penetration was below the average for manufacturers.

EPA concluded that four of the Primary Manufacturing Industries – Food and Kindred Products, Paper and Allied Products, Petroleum Refining, and Steel Industries – would see improved cost pass-through potential based on the Import Penetration factor. The Aluminum, and Chemicals and Allied Products Industries are both exposed to substantial import competition, with reduced cost pass-through potential. This observation offsets to a degree the more favorable cost pass-through finding for these industries based on the Regulated Fraction factor[41] (Section *2B.3.1*).

[41] Both industries have Regulated Fractions of nearly 50 percent.

Figure 2B-5: Import Penetration for the Primary Manufacturing Industries from 1990 to 2010



Source: U.S. ITC, 1990-2010.

2B.3.4 Export Dependence – Competition in Foreign Markets

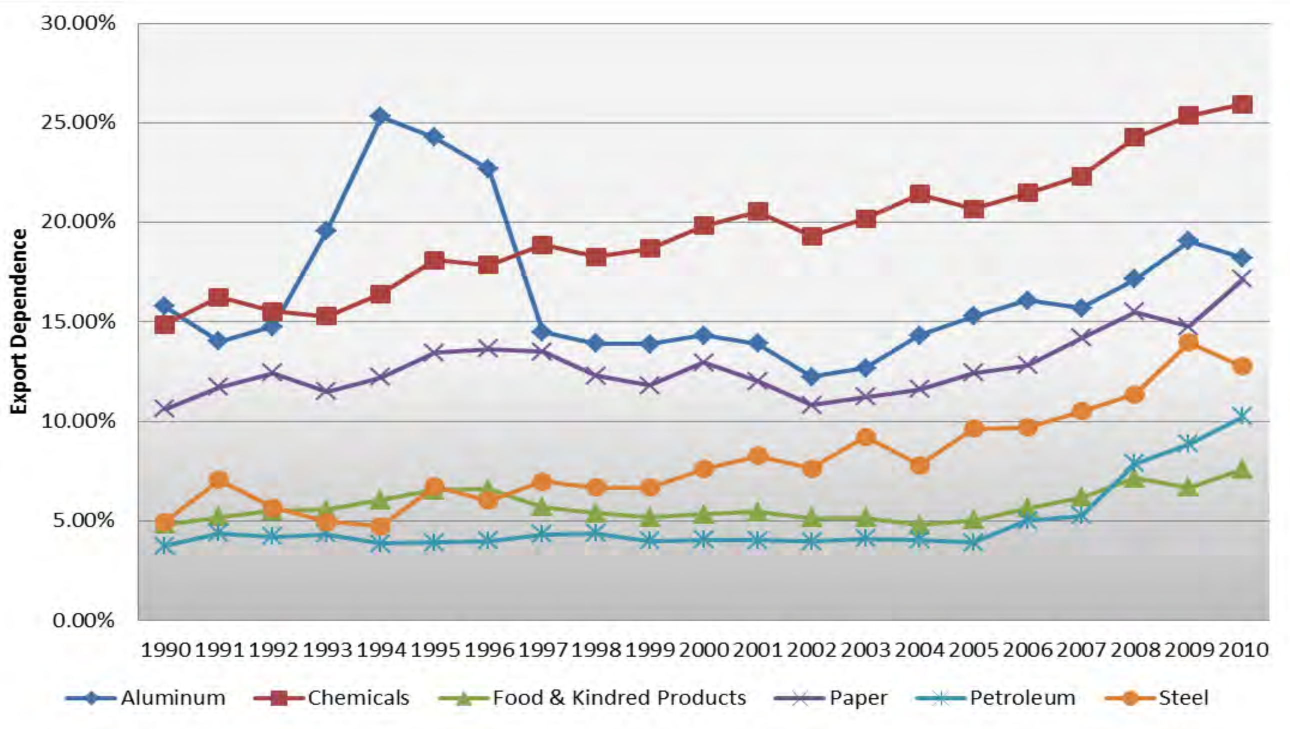
While imports rose over the past two decades, each of the industries became increasingly dependent on exports. ***Export dependence***, calculated as exports divided by value of shipments, measures the share of a segment"s sales that EPA presumes to be subject to foreign competition in export markets. Firms in industries that rely, to a greater extent, on export sales would have less latitude in increasing prices to recover compliance-related increases in production costs because foreign firms would not be subject to those increased costs. The estimated export dependence ratio for all U.S. manufacturing industries for 2010 is 22 percent. EPA assesses that industries with export ratios close to or above 22 percent, are at a relatively greater disadvantage in their potential ability for cost pass-through. *Figure 2B-6* reports export dependence for the Primary Manufacturing Industries from 1990 to 2010.

- The *Aluminum Industry* saw an overall increase in export dependence of about 2 percentage points between 1990 and 2010. In 2010, export dependence was 18 percent, below the average export dependence for manufacturers.
- The *Chemicals and Allied Products Industry* had the highest export dependence of the Primary Manufacturing Industries for the majority of the past two decades. The industry also saw an increase in its dependence on exports, of about 11 percentage points. In 2010, export dependence in the industry was above the average export dependence for manufacturers of 22 percent.
- The *Food and Kindred Products Industry* experienced little change in export dependence, which increased by 3 percentage points between 1990 and 2010. In 2010, export penetration increased more substantially, ending the period at 17 percent, but still 5 percentage points below the average export penetration for manufacturers.

- The *Paper and Allied Products Industry's* export dependence rose by approximately 7 percentage points between 1990 and 2010. However, in 2010, the Paper and Allied Products industry‟s export dependence of 17 percent was below the average for manufacturers.
- The *Petroleum Refining Industry's* export dependence remained relatively low for the majority of the past two decades, remaining constant at 4 percent until 2005. Overall, export dependence nearly tripled between 1990 and 2010. In 2010, export dependence for the Petroleum Refining industry was 10 percent, well below the average export dependence for manufacturers.
- The *Steel Industry's* export dependence more than doubled during the period of analysis, rising from 5 percent in 1990 to 13 percent in 2010. In 2010, export dependence remained well below the average export dependence for manufacturers.

From this assessment, EPA concluded that five of the Primary Manufacturing Industries – Aluminum, Food and Kindred Products, Paper and Allied Products, Petroleum Refining, and Steel Industries – would see improved cost pass-through potential based on the Export Dependence factor.

Figure 2B-6: Exhibit: Export Dependence for the Primary Manufacturing Industries from 1990 to 2010



Source: U.S. ITC, 1990-2010.

2B.3.5 Long-Term Industry Growth

Table 2B-4, below, shows the average annual growth rate,[42] from 1990 to 2010, for each of the Primary Manufacturing Industries and the U.S. economy. Most studies have found that recent growth in revenue correlates positively with profitability (Waldman & Jensen, 1997), which suggests a greater ability to recover costs fully. To assess whether an industry has experienced relatively high growth, EPA compared the industry‟s ***long-term growth*** to that of the entire U.S. economy. As shown, only the Chemicals and Allied Products and Petroleum

42 In this chapter, average annual growth rate refers to a year-to-year, constant percentage growth mean, which is calculated as the compound annual growth rate between the first and last values. This is the same concept as the geometric mean, if all of the individual year-to-year.

Refining Industries experienced long-term growth greater than the economy as a whole. The other four industries experienced lower long-term growth than the general U.S. economy, with the Aluminum and Paper and Allied Products Industries experiencing negative growth.

EPA concluded that two of the Primary Manufacturing Industries – Chemicals and Allied Products and Petroleum Refining – would see improved cost pass-through potential based on the Long-Term Growth factor.

Table 2B-4: Long-Term Industry Growth

Industry	Average Annual Growth Rate, 1990 to 2010
Aluminum	-1.59%
Chemicals and Allied Products	2.48%
Food and Kindred Products	1.84%
Paper and Allied Products	-1.18%
Petroleum Refining	4.48%
Steel	0.99%
U.S. Economy[a]	**2.46%**

a. Long-term growth for the U.S. economy is based on GDP growth.
Source: U.S. DOC, 1990 and 2010 ASM; U.S. BEA, 2013.

2B.4 Financial Performance and Outlook Assessment

The extent to which regulated facilities can absorb compliance costs is an important factor in assessing the economic/financial impact of the final. EPA reviewed four factors that, together, indicate the likely ability of facilities in each of the Primary Manufacturing Industries to absorb costs. These include:

- ***Capacity utilization*** measures the extent to which an industry‟s asset base – plant and equipment – is employed in producing output, and is generally higher for industries that are experiencing strong financial performance. All else equal, capacity utilization correlates directly with financial return on capital, which is a key measure of the financial performance and health of an industry (see *item 3*, below).
- ***Net profit margin*** in an industry must be sufficiently positive if the industry is to remain economically viable and attract capital. Industries with sufficiently positive net profit margins, indicating strong financial conditions, are more likely to be able to costs.
- ***Return on total capital*** in an industry must be sufficient if the industry is to remain economically viable and attract capital. Again, industries with sufficient returns on total capital are more likely to be able to withstand costs.
- ***Near-term industry outlook***[43], which indicates the near-term trend (one to two years) in financial performance. Industries whose financial performance is expected to improve, near-term, are in a better financial position to be able to absorb costs.

Table 2B-5 displays the results of EPA‟s assessment of financial performance, with "+" indicating strong performance and "-" indicating weak performance. Only the Petroleum Refining Industry has consistently positive indicators for financial performance. However, all of the Primary Manufacturing Industries experienced increasingly stronger financial performance in 2012 after weakness during the 2008 to 2009 recession. In addition, all the industries have either positive or neutral near-term outlooks. EPA assesses that facilities in each of the Primary Manufacturing Industries exhibited sufficiently strong financial performance and near-term outlook to absorb the compliance costs associated with this rule.

43 Based on assessments by Standard and Poor (S&P), a major business analysis and financial assessment firm.

Table 2B-5: Factors Relevant to Financial Performance and Outlook Assessment

Industry	Capacity Utilization[a]	Net Profit Margin[b]	Return on Capital[c]	Short-Term Outlook[d]
Aluminum	-	+	+	+
Chemicals and Allied Products	-	+	+	+
Food and Kindred Products	-	+	+	+/-
Paper and Allied Products	+	+	+	+/-
Petroleum Refining	+	+	+	+
Steel	-	+	+	+/-

a. This column indicates whether capacity utilization in each industry, in 2010, is above or below the threshold value of 78.8 percent, with industries above the threshold demarcated with "+" and those below with "-."
b. This column indicates whether the net profit margin for each industry, in 2012, shows recovery from the recent recession (+) or shows continued weak financial condition (-).
c. This column indicates whether the return on capital for each industry, in 2010, shows recovery from the recent recession (+) or shows continued weak financial condition (-).
d. This column indicates whether the near-term S&P outlook is positive (+), negative (-), or neutral (+/-).
Source: U.S. EPA Analysis, 2013

2B.4.1 Capacity Utilization

Capacity utilization measures actual output as a percentage of total potential output given available capacity. Capacity utilization indicates excess or insufficient capacity in an industry, and indicates the likelihood of new investment is. Industries and facilities that achieve higher capacity utilization will generally achieve higher financial returns and will have better prospects for strong financial performance, and, as such, will be better able to withstand the costs of compliance. This is especially true for industries with substantial fixed costs, such as the Aluminum Industry, where capacity utilization is linked closely to financial performance. The current long-term capacity utilization for manufacturing, as a whole, is 78.8 percent (Federal Reserve Board of Governors, 2012d). In 2010, capacity utilization in all but the Paper and Allied Products and Petroleum Refining Industry was below this figure, due largely to declines during the recent economic downturn. *Figure 2B-7* displays capacity utilization for the six Primary Manufacturing Industries from 1990 to 2010.[44]

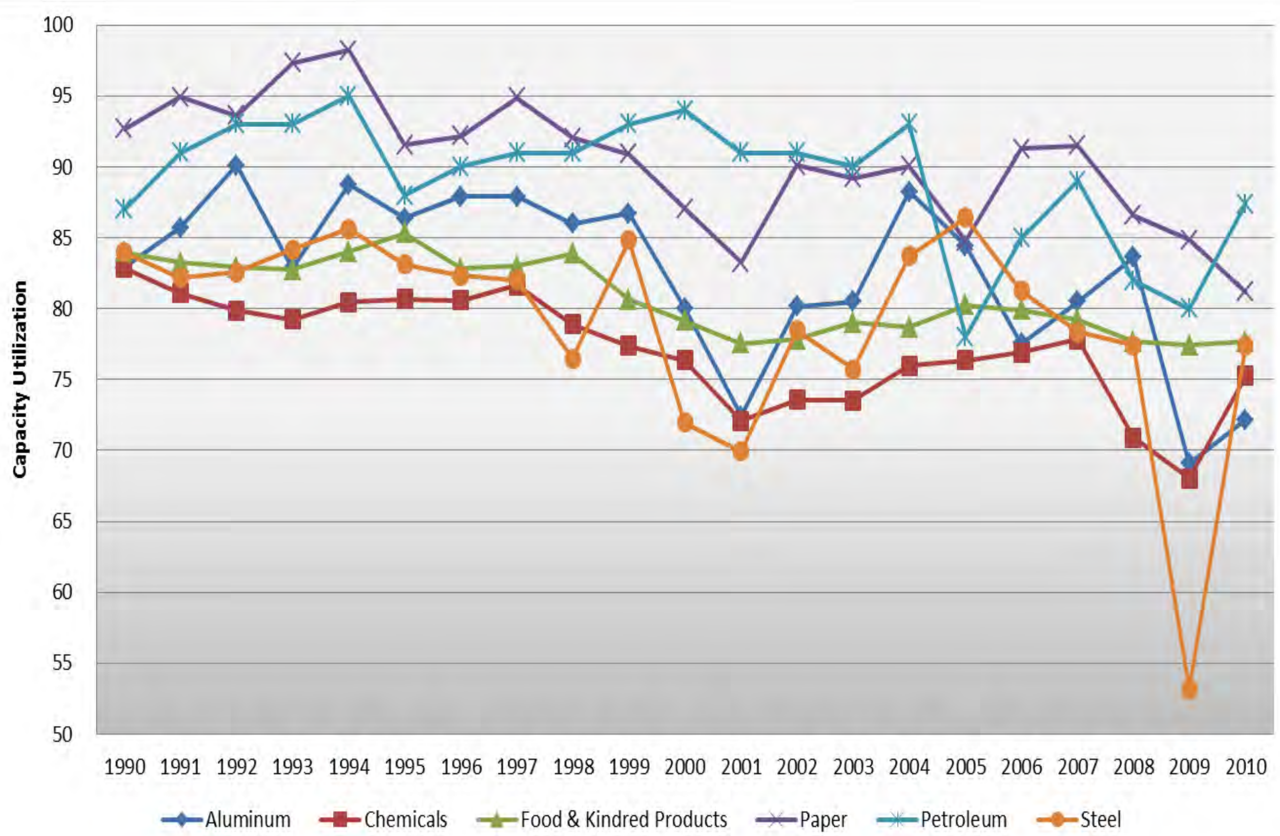
- The *Aluminum Industry* saw declining capacity utilization between 1990 and 1999, of 11 percentage points. In 2010, capacity utilization was 72 percent, 7 percentage points below the long-term manufacturing industry value of about 79 percent.
- The *Chemicals and Allied Products Industry* experienced an overall decline of 8 percentage points, ending the period with a capacity utilization of 75 percent in 2010. In 2010, capacity utilization in this industry was about 4 percentage points below that of the long-term capacity utilization for manufacturers as a whole.
- The *Food and Kindred Products Industry* experienced the smallest fluctuation in this 21-year period, with capacity utilization ranging between 77 percent and 85 percent. In 2010, capacity utilization was 78 percent for an overall decline of 8 percent for the period of analysis. Capacity utilization in the industry in 2010 was just 1 percentage point below that of the overall manufacturing industry.
- The *Paper and Allied Products Industry* tended to have the highest capacity utilization of the six Primary Manufacturing Industries, fluctuating between 81 percent and 98 percent. In 2010, the industry‟s capacity utilization was 81 percent, about 3 percentage points above the long-term manufacturing industry utilization.

44 For the Aluminum, Food and Kindred Products, Paper and Allied Products, and Steel Industries, the reported values are the annual value of shipments-weighted average of capacity utilization for the NAICS sectors reported in the individual profiles (see Appendices A through F).

- The *Petroleum Refining Industry's* capacity utilization saw little change, relative to the other Primary Manufacturing Industries, between 1990 and 2010. Capacity utilization for the industry was 87 percent in 2010, 8 percentage points above the long-term manufacturing industry capacity utilization.
- The *Steel Industry* experienced considerable volatility in capacity utilization between 1990 and 2010, with an overall decline of 7 percentage points. In 2010, the industry saw a large increase in capacity utilization, reaching 77 percent, just 2 percentage points below that of the entire manufacturing industry.

EPA concluded that two of the Primary Manufacturing Industries – Paper and Allied Products and Petroleum Refining – stood in relatively stronger financial condition based on the Capacity Utilization factor, with a high likelihood of being able to absorb compliance costs. Another two of the industries – Steel and Food and Kindred Products – had capacity utilization levels close to that of the entire manufacturing industry, indicating a likely ability to absorb costs. Only capacity utilization for the Aluminum and Chemicals and Allied products indicated a potentially weaker financial condition relative to the overall manufacturing industry.

Figure 2B-7: Capacity Utilization for the Primary Manufacturing Industries from 1990 to 2010



Source: Federal Reserve Board of Governors, 2012a; U.S. DOC, 1990-2010 SPC; U.S. DOC, 1988-1991, 1993-1996, 1998-2001, 2003-2006, and 2008-2010 ASM; U.S. DOC, 1992, 1997, 2002, and 2007 EC.

2B.4.2 Current Financial Data and Industry Outlook

The financial performance and condition of the Primary Manufacturing Industries are important determinants of their ability to absorb the costs of regulatory compliance without material, adverse economic/financial impact. They are particularly important factors in the ability of the regulated facilities and their owners to finance the capital outlays needed for regulatory compliance. To provide insight into the industries" financial performance and condition, EPA reviewed two key measures of financial performance over the 21-year period, 1988 to 2010: ***net profit margin*** and ***return on total capital***. EPA calculated these measures using data from the Quarterly

Financial Report for Manufacturing, Mining, and Trade Corporations (QFR) published by the U.S. Census Bureau. Financial performance in the most recent financial reporting period (2010) obviously is not a perfect indicator of conditions at the time of regulatory compliance. However, examining the trend and deviation from the trend through the most recent reporting period gives insight into where the industries *may be* in terms of financial performance and condition, at the time of compliance. In addition, the volatility of performance against the trend, in itself, provides a measure of the potential risk faced by the industries in a future period in which compliance requirements are faced. All else equal, the more volatile the historical performance, the more likely the industries *may be* in a period of relatively weak financial conditions at the time of compliance.

Net profit margin is calculated as after-tax income before nonrecurring gains and losses as a percentage of sales or revenues, and measures profitability, as reflected in the conventional accounting concept of net income. Over time, the firms in an industry and the industry collectively, must generate a sufficiently positive profit margin if the industry is to remain economically viable and attract capital. Year-to-year fluctuations in profit margin stem from several factors, including: variations in aggregate economic conditions (including international and U.S. conditions), variations in industry-specific market conditions (e.g., short-term capacity expansion resulting in overcapacity), or changes in the pricing and availability of inputs to the industry"s production processes (e.g., the cost of energy to the aluminum production process). The extent to which these fluctuations affect an industry"s profitability, in turn, depends heavily on the fixed vs. variable cost structure of the industry"s operations.

Return on total capital is calculated as annual pre-tax income divided by total financial capital, calculated as the sum of (1) long-term debt, (2) all other noncurrent liabilities, and (3) total stockholders" equity.[45] This concept measures the total productivity of the capital deployed by a firm or industry, regardless of the financial source of the capital (i.e., equity, debt, or liability element). As such, the return on total capital provides insight into the profitability of a business" assets independent of financial structure and is thus a "purer" indicator of asset profitability than return on equity. In the same way as described for net profit margin, the firms in an industry and the industry collectively, must generate a sufficient return on capital over time, if the industry is to remain economically viable and attract capital for replacement and growth of its productive asset base. The factors causing short-term variation in net profit margin will also be the primary sources of short-term variation in return on total capital.

Figure 2B-8 displays ***net profit margin*** while *Figure 2B-9* displays ***return on total capital*** for the Primary Manufacturing Industries from 1990 to 2012.[46] The financial performance of the six industries over the past two decades differs greatly, with some industries showing great volatility while others have remained relatively stable. EPA assessed whether these measures indicate ability to absorb compliance requirements by comparing the values for each of the Primary Manufacturing Industries in 2012 to the long-term trends for each industry. EPA also assessed the financial outlook for each industry based on the ***near-term industry outlook***.

- The *Aluminum Industry* shows cyclical financial performance, with declines in the early 1990s, early 2000s, and in the late 2000s, during the recent recession. After a major drop in financial performance in 2008, both net profit margin and return on total capital rose quickly as the industry recovered. In 2012, both indicators declined, but to values closer to the industry"s long-term average. The industry is expected to continue to improve, with industry experts projecting a positive outlook for the industry in 2013 (S&P, 2013b).
- The *Chemicals and Allied Products Industry* experienced fluctuations in financial performance over the period of analysis, but was not affected greatly by the recent economic recession. In 2012, net profit

45 A comparable value could be derived from the asset side of industries" balance sheet, in which case the analysis would focus on all assets but current assets. The data for the calculation, as described here, is readily available in QFR.

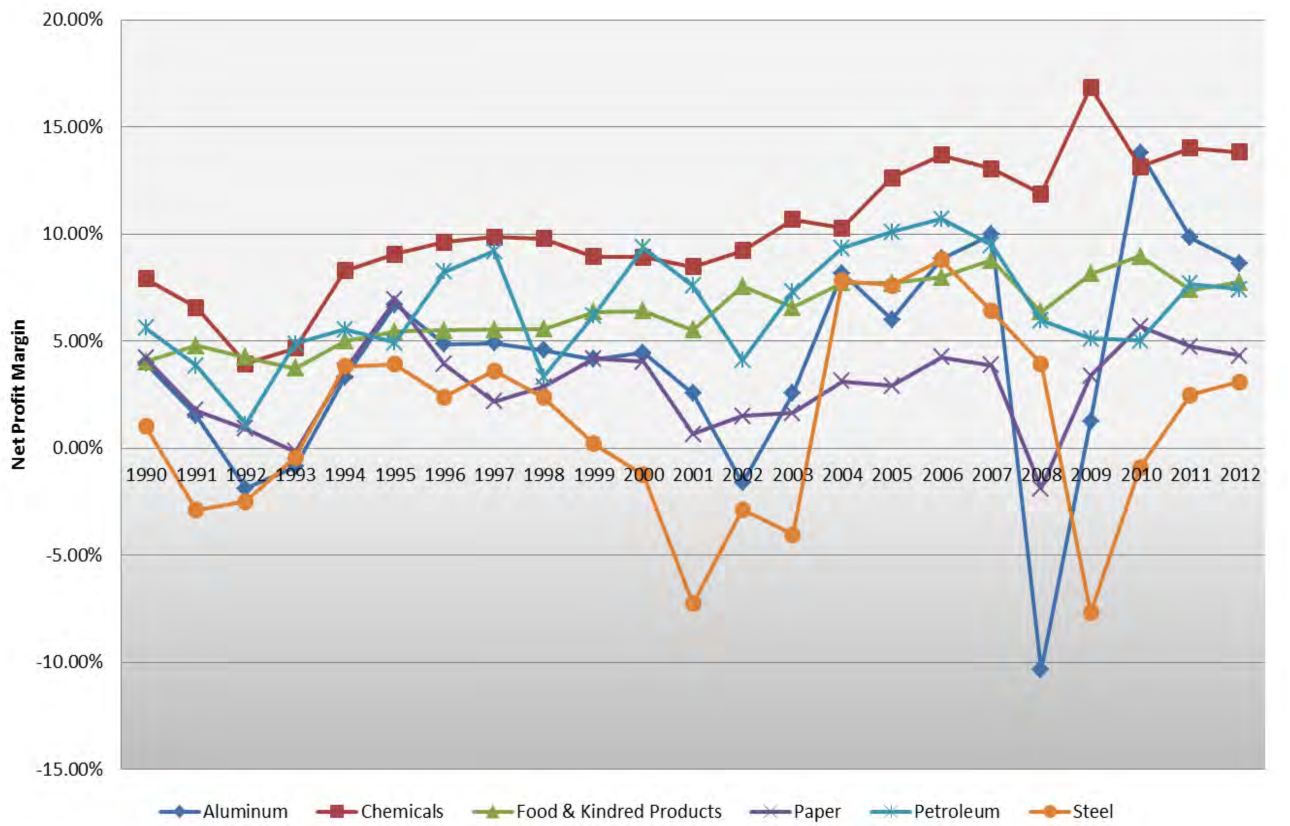
46 For additional detail on the financial performance of the Primary Manufacturing Industries over the full period analyzed by EPA, refer to Appendices A through F.

margin was slightly above the industry"s average net profit margin for 1990 to 2012, while return on total capital was slightly below the industry"s long-term average. According to industry experts, the outlook for the industry in 2013 is positive (S&P, 2013e).

- The *Food and Kindred Products Industry's* net profit margin and return on total capital remained relatively stable between 1990 and 2012, with slight declines in financial performance during the recent recession. In 2012, net profit margin was slightly above the long-term average for the industry, while return on total capital was below the industry"s long-term average. The outlook for this industry in 2013 varies by sub-industry sector, with a positive outlook for the distillers and vintners sector and neutral outlooks for the soft drinks and packaged foods and meats sectors (S&P, 2013a; S&P, 2013c; S&P, 2013d).
- The *Paper and Allied Products Industry* experienced substantial a decline in financial performance during the recent economic downturn. However, the industry has since begun recovery, with 2012 net profit margin and return on total capital near the industry"s long-term averages. The overall outlook for financial performance in 2013 is neutral. While experts believe pricing levels will remain high, the long-term trend in demand remains negative (S&P, 2013f). This projection is consistent with the observation earlier in this chapter that the Paper and Allied Products Industry is among U.S. industries with a longer-term declining importance in the overall economy.
- The *Petroleum Refining Industry* saw considerable volatility in financial condition over the period of analysis, with significant declines during the recent recession. Financial condition has since improved, with 2012 net profit margin and return on total capital both slightly above long-term averages. Experts report a positive near-term outlook for the industry, as North American refiners are expected to benefit from global demand for U.S. refined products (S&P, 2013g). This projection is consistent with the observation of increased export dependence for this industry.
- The *Steel Industry* is a highly cyclical industry, and showed varying financial performance over the period of analysis, with the greatest declines in performance occurring during the recent recession. Beginning in 2010, the industry has achieved significant improvement in performance with 2012 net profit margin and return on total capital slightly above long-term averages. Looking forward, analysts report a neutral outlook for the Steel Industry in 2013, as remaining excess steel capacity offsets expected increases in volume of steel shipments (S&P, 2013h).

EPA concluded that all the Primary Manufacturing Industries would be in sufficiently strong financial condition to absorb the costs of regulatory compliance without material, adverse economic/financial impact. Although the industries experienced substantial decreases in financial performance during the recent recession, they have all begun recovery from the downturn, with all nearing or, in some cases, already reaching their long-term average of performance for the assessed financial metrics.

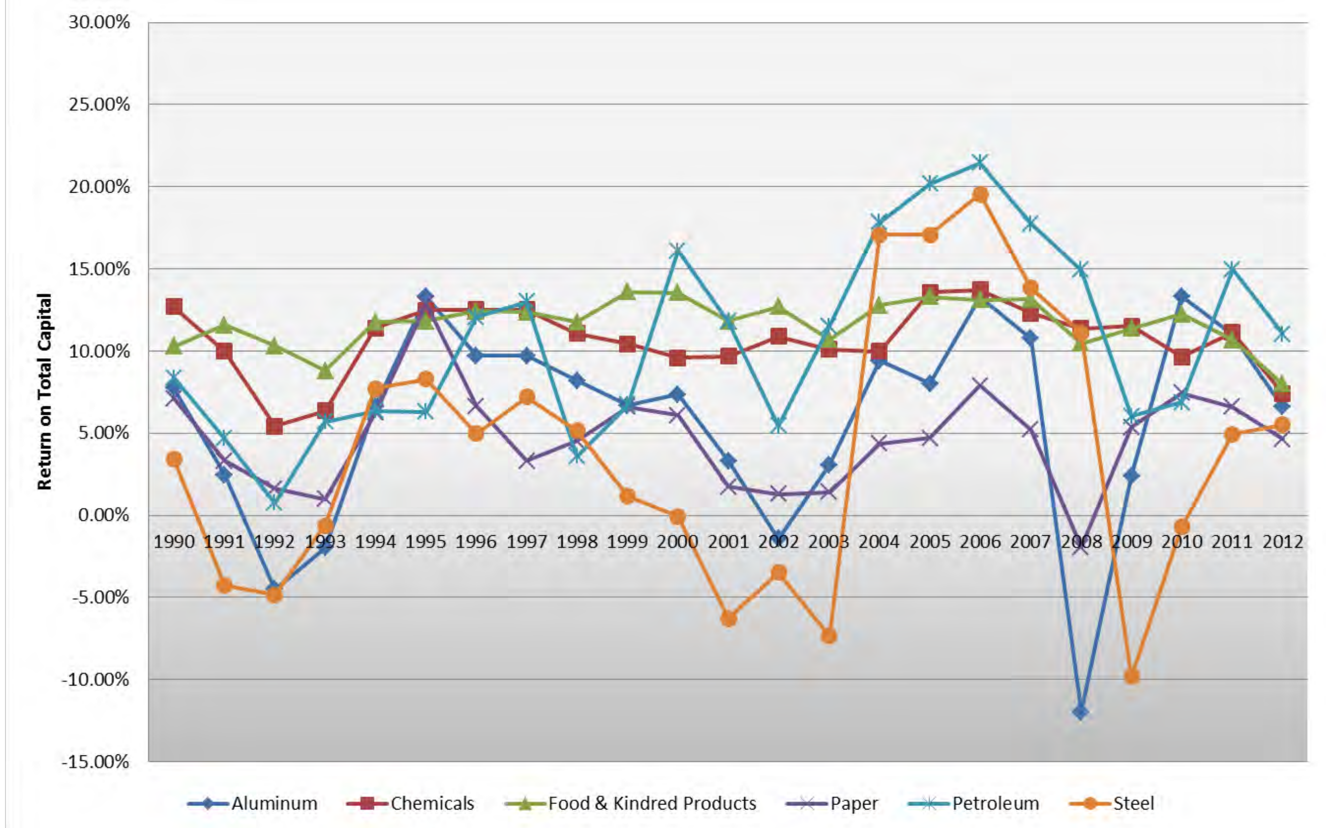
Figure 2B-8: Net Profit Margin for the Primary Manufacturing Industries from 1990 to 2012[a]



a. Data for 2012 reflects the most recent data available, which is for Q1 through Q3.

Source: U.S. DOC, 1990-2010 QFR

Figure 2B-9: Return on Total Capital for the Primary Manufacturing Industries from 1990 to 2012[a]



a. Data for 2012 reflects the most recent data available, which is for Q1 through Q3.

Source: U.S. DOC, 1990-2010 QFR

3 Compliance Costs

EPA assessed the costs and economic impacts of the final rule and other options EPA considered for existing and new units as described in *Chapter 1: Introduction*. Key inputs for these analyses include the estimated costs to facilities subject to the final rule (regulated facilities or Electric Generators and Manufacturers) to comply with and to the State and federal governments to administer the final rule and other options considered. This chapter describes the methodology and data that EPA used to calculate industry-level, annualized compliance costs, and how EPA uses these costs to assess the rule‟s economic impacts.

The *Technical Development Document (TDD)* provides a detailed description of compliance technologies as well as discusses development of technology and administrative costs to existing facilities to comply with and costs to permitting authorities to administer the final rule and other options considered (U.S. EPA, 2013x).

The following sections of this chapter describe:

- The development of costs to facilities for complying with the existing units provision of the final rule and other options considered, including the compliance-related outlays for certain administrative activities incurred by regulated facilities (*Section 3.1*)
- The development of costs for complying with the new units provision of the final rule and other new units options EPA considered for installing entrainment control technology (*Section 3.2*)
- Compliance costs for both the existing units and new units provisions of the final rule (*Section 3.3*)
- The development of costs to States and federal government for administering the final rule-existing units and other options considered (*Section 3.4*)

In developing compliance costs for the analysis, generally, EPA followed closely the analysis approaches and impact evaluation concepts used in the analysis for the previous CWA §316(b) regulatory analyses, including the proposed rule. To the extent possible, EPA also relied on the same data sources.[47]

3.1 Compliance Costs for Existing Units

EPA estimated costs to facilities for complying with the existing units provision of the final rule and other options considered. In the remainder of this section, the term *final rule* refers to the existing units provision of the final rule. Development of compliance costs involves four principal steps, the last two of which are the focus of the discussion below:

1. Determining the set of facilities potentially installing compliance technologies. See the *TDD* report and *Appendix H: Sample Weights* of this document for details.
2. Developing costs to regulated facilities, which are broken into four main cost components:
   - Installing and operating compliance technology
   - Energy penalty
   - Installation downtime
   - Administrative activities

   See the *TDD* for details.

[47] For more information on these analyses, see *Chapter B1: Summary of Compliance Costs* in the suspended 2004 *Economic and Benefits Analysis for the Final Section 316(b) Phase II Existing Facilities Rule* report (U.S. EPA, 2004a) and *Chapter C1: Summary of Cost Categories and Key Analysis Elements for Existing Facilities* in the 2006 *Economic and Benefits Analysis for the Final Section 316(b) Phase III Existing Facilities Rule* report (U.S. EPA, 2006).

3. Developing a technology installation schedule based on the years during which facilities will meet regulatory requirements. This schedule supports analysis of the timing of compliance costs, benefits, and the potential impact on electricity supply resulting from shutdown of generating units during compliance technology installation.
4. Estimating *total* industry costs for all regulated facilities under the final rule and other options considered.

EPA used an analysis period that begins in 2013, the final rule‟s promulgation year, with all options analyzed as of that date. All costs are in 2011 dollars, based on the data available at the time EPA developed the analysis framework.

3.1.1 Analysis Approach and Data Inputs

Facilities Potentially Incurring Compliance Costs

The final rule will apply to existing facilities with a design intake flow (DIF) for cooling water exceeding 2 million gallons per day (MGD) (for more details on application of this rule, see *Chapter 1: Introduction*). The other options considered would also apply to the same overall set of facilities; however, the uniform national standards and associated technology requirements for Proposal Option 4 would apply only those facilities with DIF exceeding 50 MGD.

As detailed in the *TDD*, EPA developed costs for technology to reduce impingement mortality (IM) and entrainment (E). The cost estimates reflect the incremental costs attributed only to the final rule and other options considered, accounting for the water intake systems that are already present in the baseline. The specific technologies, which vary in their application by option considered, reduce IM and E through one of two methods:

- Exclusion of organisms through implementation of design and construction technologies to reduce IM
- Flow reduction through conversion of cooling systems from once-through to recirculating operation to reduce the design intake flow and IM and E.

As discussed in detail in *Appendix H*, the final rule analysis focused on 544 Electric Generators and 521 Manufacturers.[48] Using the information collected through the 316(b) survey, EPA determined that certain regulated facilities would already meet the performance requirements of a given option and did not assign additional technology requirements or associated costs. Specifically, these facilities either (1) have a recirculating cooling water system in place, (2) already meet IM reduction requirements in the baseline, or (3) are subject to State requirements that are at least as stringent as those of the final rule or one of the other options considered (as relevant) (*Table 3-1*). However, these facilities are still subject to the rule, and would therefore incur costs for certain non-technology related activities (e.g., permitting, and compliance monitoring and reporting). Consequently, EPA estimated compliance technology costs for 342 Electric Generators and 320 Manufacturers under the final rule, 321 Electric Generators and 102 Manufacturers under Proposal Option 4, and 380 Electric Generators and 330 Manufacturers under Proposal Option 2. *Table 3-1* and *Table 3-2* present weighted counts of Electric Generators and Manufacturers, respectively.

[48] EPA estimated the number of Electric Generators using *facility-count based weights* and the number of Manufacturers using *technical weights*; these facility counts exclude baseline closures. For details, see *Appendix H.*

Table 3-1: Final Rule-Existing Units – Number of Electric Generators with and without Additional Technology Requirements for the Final Rule and Other Options Considered[a]

Facility Categories	Regulatory Option		
	Proposal Option 4	Final Rule-Existing Units	Proposal Option 2
Total number of Electric Generators	544	544	544
Facilities meeting performance requirements in their baseline	223	202	163
- Facilities with baseline re-circulating systems	109	109	109
- New York facilities with DIF≥20MGD[b]	28	28	28
- California facilities that use coastal and estuarine waters for power plant cooling[b]	16	16	16
- Facilities with intake velocity equal to or less than 0.5 feet per second	39	39	9
- Other facilities meeting performance requirements in the baseline	32	11	2
Number of Electric Generators with additional technology requirements	321	342	380

a. These are weighted facility counts estimated using facility count-based weights (see *Appendix H*).
b. These facilities are subject to State regulations that are at least as stringent as the final rule and the other options considered.
Source: U.S. EPA analysis, 2013

Table 3-2: Final Rule-Existing Units – Number of Manufacturers with and without Additional Technology Requirements for the Final Rule and Other Options Considered[a]

Facility Categories	Regulatory Option		
	Proposal Option 4	Final Rule-Existing Units	Proposal Option 2
Total number of Manufacturers	521	521	521
Facilities meeting performance requirements in their baseline	418	201	191
- Facilities with baseline re-circulating systems	79	79	79
- New York facilities with DIF≥20MGD[b]	20	20	20
- Facilities with intake velocity equal to or less than 0.5 feet per second	79	79	79
- Other facilities meeting performance requirements in the baseline	241	24	14
Number of Manufacturers with additional technology requirements	102	320	330

a. These are weighted facility counts estimated using technical weights (see *Appendix H*).
b. These facilities are subject to State regulations that are at least as stringent as the final rule and the other options considered.
Source: U.S. EPA analysis, 2013

Costs of Installing and Operating Compliance Technology

As detailed in the *TDD*, the major components of costs to install and operate compliance technology costs are:

- *Capital costs*: These costs include the cost of designing and installing the assigned compliance technology. EPA estimates that facilities will require four years to install cooling towers and thus spread each facility‟s capital costs for cooling tower installation over four years. The Agency estimates that installation of non-cooling tower technologies will take less than one year and expects that facilities will incur all the associated capital costs in one year.
- *Pilot study*: These costs are associated with wedgewire screens and include testing temporary smaller scale screens suspended from a floating structure in the waterbody near where screens would be located. EPA expects that only Manufacturers will have to perform this study and that facilities will incur these costs in the year of technology installation.
- *Annual operation and maintenance (O&M) costs*: These costs include outlays for operation, maintenance, and upgrading activities that occur annually, and include fixed and variable components.

In addition to these cost components, which EPA estimated for each facility, EPA accounted for two other technology-related effects that lead to costs:

- *Energy penalty.* This arises from two factors: (1) an increase in auxiliary power required to operate compliance technology and (2) a reduction in the energy-conversion efficiency of the power generating system, which occurs with operation of retrofitted, recirculating system compliance technologies.

Depending on facility type (i.e., Electric Generator or Manufacturer) and baseline operating circumstances, EPA assessed the combination of these effects as (1) a reduction in the generated electricity that is available for sale or use or (2) an increase in the production cost of sold or used electricity.

- *Installation downtime.* Installation of certain compliance technologies will require a one-time, temporary downtime period for the facility.

Appendix I provides details of the methods EPA used to estimate energy penalty and downtime costs and their effects on facility operations.

The *TDD* describes the methodology EPA used to estimate costs for the final rule and other options EPA considered.

Administrative Activities and Associated Costs

Under the final rule, regulated facilities will undertake a range of administrative activities to determine applicable compliance requirements, obtain needed permits, and perform periodic monitoring and reporting subsequent to initial compliance efforts. In analyzing the costs of the final rule and other options considered, EPA estimated costs for the following three categories of administrative activities:

- Start-up activities: EPA assumed that start-up activities will begin during the first year after promulgation of the final rule, 2014, and recur every five years.
- *Initial permitting activities*: These activities include review of permit applications and other information compiled by regulated facilities during the initial permitting process. The Agency assumed that facilities with post-promulgation permits expiring after December 31, 2016, will begin these activities three years before expiration of their first post-promulgation permit and all other regulated facilities will begin these activities three years prior to expiration of their second post-promulgation permit.
- *Annual activities*: These include collection and review of monitoring data, and other information produced by regulated facilities on an annual basis. The Agency assumed that facilities will begin these activities during the technology-installation year.
- *Non-annually recurring activities*: These activities include a subset of initial permitting activities that repeat periodically in the future. All of these activities begin ten years after the initial permitting activities begin and recur every five years. EPA expects that only 10 percent of regulated facilities would undertake these non-annually recurring activities.[49]

For details on these activities as well as time and labor requirements associated with these activities, see the Information Collection Requirements of the Section 316(b) Existing Facility Final Rule (*Final Rule ICR*).

EPA estimated costs for these activities by first developing 2011 hourly labor rates by labor category as follows:

- EPA obtained raw wage rates for all facility and contractor employees, and for State and federal government employees, from the Bureau of Labor Statistics Occupational Employment Statistics for May 2011 (http://www.bls.gov/oes/). EPA restated these hourly wages forward from the second quarter of 2011 to the annual average for 2011 using the Bureau of Labor Statistics‟ Employment Cost Index (http://www.bls.gov/ncs/ect/home.htm).
- To account for additional labor-related costs associated with benefits, indirect costs (e.g., overhead), and fee, EPA developed the following add-ons:

[49] Because EPA cannot determine which regulated facilities will undertake these activities, the Agency assigned 10 percent of the costs for each recurring activity to each regulated facility.

- A benefits multiplier applicable to unloaded wages, ranging from 1.42 to 1.65 by occupation category, based on the BLS Employer Costs for Employee Compensation as of the second quarter of 2012 (http://www.bls.gov/news.release/archives/ecec_12072011.htm).
- An indirect cost multiplier of 15 percent for facilities and States and 50 percent for contract services; applicable to wages plus benefits.
- Contractor fee multiplier, 8 percent for contract services; applicable to the sum of wages, benefits, and indirect costs.

➢ These calculations yield fully loaded labor costs, by labor category, in 2011 dollars.

Table 3-3: Average Hourly Labor Rates for Facility Employees and Contract Workers by Labor Category ($2011)

Labor Categories	Hourly Rate
Facility Employees	
Facility Management	$95.90
Economist	$71.10
Junior Technical	$44.70
CAD Operator	$37.10
Clerical	$21.70
Contractor-Provided Employees	
Manager	$126.90
Biologist	$63.50
Statistician	$81.70
Biological Technician	$43.60

a. Fully loaded hourly rates include base labor costs with add-ons for employee benefits, overhead, and fee (for contracted employees).
Source: U.S. EPA analysis, 2013

In addition to labor costs, administrative costs also include non-labor components, which EPA estimated as a per-hour add-on to labor cost. EPA also stated these in 2011 dollars using the BEA GDP Deflator.

EPA multiplied these unit costs– labor rates and non-labor costs – by the number of hours, by labor category, and activities that would be required for each administrative activity, and summed these costs across the administrative activities.

Development of Technology-Installation Years

The years in which individual regulated facilities will install compliance technologies are an important input to the time profile of costs that regulated facilities and society will incur due to the final rule. This profile is necessary for two reasons:

➢ *To estimate the net present value of compliance costs to the regulated industry and society*. The longer facilities wait to install compliance technologies, the lower is the present value of future cost outlays.

➢ *To assess effects of technology-installation downtime in electric power markets*. If a large quantity of generating capacity is out of service for compliance technology installation at the same time in a given North American Electric Reliability Council (NERC) region, this could lead to reduced reserve margins and jeopardize the reliability of power operations in that NERC region. Electricity production costs could also increase in the short term in an affected region if a substantial fraction of lower production cost capacity were out of service at the same time.

EPA expects that each regulated facility will study compliant technologies and operational measures, and subsequently install, incorporate and optimize the technology most appropriate for each site following rule promulgation. In evaluating compliance technologies, EPA considered the magnitude and complexity of process changes and new equipment installations that would be required at facilities to meet the requirements of the final rule. The standards and limitations represent Best Technology Available (BTA) to minimize the adverse environmental impact associated with the use of cooling water intake structures. The final rule schedule anticipates that facilities will have three years before the first post-promulgation expiration of their National Pollutant Discharge Elimination System (NPDES) permit, to conduct studies, including but not limited to the benefits valuation and entrainment and characterization studies, and to collect data (for details on specific studies and data to be collected, see *Final Rule ICR*). Facilities with NPDES permits expiring after December 31, 2016 must submit this information to State and federal government permitting authorities for review no later than 180 days before permit expiration. EPA expects the review of the submitted materials to take approximately a year, at which point the permitting authorities determine the requirements and conditions to include in the new permit. Facilities with permits expiring after promulgation of the final rule but before December 31, 2016 (i.e., before these facilities can be reasonably expected to complete the required studies and collect the necessary data) may request that permitting authorities temporarily waive the 316(b) requirements. In such cases, the permitting authorities must determine the schedule for submission of the waived permit application requirements. Regardless of when NPDES permits come up for renewal after promulgation of the final rule, the schedule of requirements established by the permitting authorities will ensure compliance with those requirements as soon as possible. In developing compliance schedules for Electric Generators, EPA expects permitting authorities to take measures to ensure adequate energy reliability and necessary grid reserve capacity during any expected facility outage associated with installation of compliance technology.[50]

For Electric Generators and Manufacturers with NPDES permits expiring after December 31, 2016, EPA assumed that the permitting authorities will review submitted materials during the first year and facilities will install IM technologies during the second year of their first post-promulgation permit cycle. For all other facilities, EPA assumed that the permitting authorities will review submitted materials during the first year and facilities will install IM technologies during the second year of their second post-promulgation permit cycle. This schedule results in compliance technology being installed during the five-year period of 2018 through 2022.

Because design and installation of entrainment control technology (i.e., cooling towers) would require more time than IM technology, EPA assumed a longer period to install entrainment control technology. Specifically, under Proposal Option 2, non-nuclear Electric Generators and Manufacturers required to meet the IM&E standards would have until 2025 to do so, while nuclear Electric Generators would have to meet these standards no later than 2030. EPA assumed that regulated facilities would install cooling towers during the 5-year windows of 2021 through 2025 and 2026 through 2030, respectively. As discussed in *Appendix I*, the Agency assumed that nuclear Electric Generators would install cooling towers in the year of their third or fourth post-promulgation In-Service Inspection (ISI) and all other facilities would install cooling towers in the year of their second or third post-promulgation NPDES permit renewal.

To summarize, EPA made the following assumptions regarding the timing of technology installation:

- Facilities will install IM technology during the 5-year window of 2018 through 2022.
- Non-nuclear Electric Generators and Manufacturers will complete installation of entrainment technology during the 5-year window of 2020 through 2024 (following a 5-year permit cycle), in the year of their second or third post-promulgation NPDES permit renewal. Each of these years represents the last of the four years required to install a cooling tower.

[50] These measures may include establishing a staggered schedule for multiple facilities serving the same localities. The permitting authorities may consult with independent system operators and state public utility regulatory agencies when establishing a schedule for Electric Generators. The permitting authorities may determine that extenuating circumstances warrant establishing a difference compliance date for manufacturing facilities.

- Nuclear Electric Generators required to install entrainment control technologies will complete installation during the 5-year window of 2026 through 2030, in the year of their third or fourth post-promulgation ISI. Again, each of these years represents the last of the four years required to install a cooling tower.
- EPA estimates that a small number of Manufacturers could be required to install both IM&E technology. EPA assumed that these facilities would install both technologies at the same time, during the 5-year window of 2021 through 2025. Again, each of these years represents the last of the four years required for entrainment control-technology installation.

EPA assumed that regulated facilities meeting the compliance requirements of the final rule and other options considered in the baseline, would install no additional technology nor incur additional related costs. However, these facilities would still have to undertake certain permit-related activities and incur costs associated with these activities. To account for these activities, the Agency developed facility-specific cost-incurrence schedules relative to these facilities" post-promulgation NPDES expiration years using the same approach as that used for facilities installing compliance technologies.

EPA notes that the assumed technology-installation years may not be the actual years when installation occurs. However, these assumptions reflect the *approximate* years, and thus provide a practical basis for the cost and economic impact analysis. For the final rule and Proposal Option 4, these assumptions result in an overall technology-installation window of nine years, 2014 through 2022. For Proposal Option 2, these assumptions result in a 17-year technology-installation window of 2014 through 2030 (including years during which facilities would undertake some administrative activities prior to installation (see *Administrative Activities and Associated Costs*, page 3-4).[51]

Development of Total Compliance Costs

EPA developed *total* compliance costs for Electric Generators and Manufacturers by aggregating various components of compliance costs discussed in the preceding sections as follows:

- First, EPA calculated total compliance costs for the 519 regulated facilities (313 Electric Generators and 206 Manufacturers), for which EPA explicitly developed and analyzed compliance costs.[52]
- The Agency calculated compliance costs on a "year-explicit" basis relative to the year it assumed that facilities would incur compliance costs (i.e., compliance year for technology costs and promulgation year for administrative costs). To do this, EPA restated compliance costs from the preceding step to specific cost-incurrence years, in 2011 dollars, using:
    - Construction Cost Index (CCI) from McGraw Hill Construction
    - Employment Cost Index (ECI) published by the Bureau of Labor Statistics (BLS)
    - Electricity price projections from the 2012 Energy Outlook (2012AEO)
    - Gross Domestic Product (GDP) deflator index published by the U.S. Bureau of Economic Analysis (BEA).[53]

[51] EPA conducted the cost and economic impact analyses on a calendar-year basis; for the economic impact analyses, EPA treated calendar year 2014 as the first post-promulgation analysis year.

[52] Facility counts exclude baseline closures.

[53] Specifically, EPA restated all compliance technology costs to an estimated technology installation year using the Construction Cost Index (CCI) from McGraw Hill Construction, and all administrative costs to an estimated cost incurrence year using the Employment Cost Index (ECI) from the Bureau of Labor Statistics. The Agency used the average of the year-to-year changes in the CCI and ECI, respectively, over the most recent 10-year reporting period. Because CCI and ECI are nominal cost-adjustment indices, the resulting costs are as of the compliance year or cost incurrence year, and in the dollars of that year. To restate compliance costs in 2011 dollars, the Agency deflated the nominal dollar values to 2011 using the average of the year-to-year changes in the Gross Domestic Product (GDP) deflator index published by the U.S. Bureau of Economic Analysis (BEA) over the most recent 10-year reporting period. As a result, all dollar values reported in this analysis are in constant 2011 dollars. Energy penalty and downtime costs were adjusted based

EPA developed and applied the CCI, ECI, and GDP adjustment factors through 2020, and applied the AEO adjustment factors through 2035, the year through which EIA reports these projections. Because long-term price projections for the individual categories of costs adjusted using these factors are uncertain after these years, EPA assumed only zero real growth (i.e., no change beyond general inflation) after 2020 and 2035, respectively.[54]

- EPA discounted all costs to the assumed year of rule promulgation, 2013, at a rate of 7 percent.[55]
- EPA annualized one-time costs and other costs that recur on other than an annual basis, over a specific useful life, implementation, and/or event recurrence period, using the 7 percent discount rate:
  - Capital costs of non-cooling tower technologies: 20, 25, or 30 years
  - Capital costs of cooling towers: 30 years
  - Pilot study costs: 30 years[56]
  - Downtime, and initial permitting costs: 30 years
  - Non-annually recurring permit-related costs: five and six years.
- EPA added annualized capital, pilot-study, downtime, and initial and non-annually recurring permitting costs to annual O&M, energy penalty, and administrative costs to derive total annualized compliance costs, where costs are expressed on an equivalent annual cost basis.
- EPA applied sample weights to these costs to estimate costs for 544 Electric Generators and 521 Manufacturers. For details on development and application of sample weights, see *Appendix H*.

EPA considered costs on both a pre-tax and after-tax basis. Pre-tax costs provide insight on the total expenditures as initially incurred by the facilities. After-tax costs are a more meaningful measure of compliance impact on privately owned, for-profit facilities, and incorporate approximate capital depreciation and other relevant tax treatments in the analysis. EPA calculated the after-tax value of compliance costs by applying combined federal and State tax rates to the pre-tax costs for privately owned, for-profit facilities.[57]EPA used State corporate rates from the Federation of Tax Administrators (http://www.taxadmin.org/) combined with federal corporate tax rate schedules from the Department of the Treasury, Internal Revenue Service. EPA uses either pre- or after-tax compliance costs in different analyses, depending on the concept appropriate to each analysis.

3.1.2 Key Findings

Electric Generators

As reported in *Table 3-4*, EPA estimates, on a *pre-tax* basis, that 544 Electric Generators will incur $270.8 million in costs under the final rule and $269.9 million and $4,175.6 million under Proposal Options 4 and 2, respectively. On an *after-tax* basis, these costs are $177.2 million for the final rule, $176.4 million for Proposal Option 4, and $2,824.5 million for Proposal Option 2.

on 2012 Energy Outlook (2012AEO) electricity price projections. Because the AEO2012 electricity price projections are in constant dollars, these adjustments yielded values in 2011 dollars.

54 The Agency judges that because 2020 is in the middle of a 5-year technology-installation window for IM technology installation (2018-2022) and only one year before the cooling tower-installation window, this year should closely reflect the operating conditions of these regulated facilities at the time of technology installation.

55 The rate of 7 percent is an estimate of the opportunity cost of capital to society.

56 Thirty years is the longest useful life assumed for any IM reduction and entrainment control technologies considered for this rule.

57 Government-owned entities and cooperatives are not subject to income taxes. For details on the approach EPA used to distinguish among the government-owned, privately owned, and cooperative ownership categories for Electric Generators, see *Chapter 4: Economic Impact Analysis – Electric Generators*. All Manufacturers are privately owned.

Table 3-4 also presents costs by North American Electric Reliability Corporation (NERC) regions. Each NERC region is responsible for managing electricity reliability issues in its region, based on available capacity and transmission constraints. Service areas of the member plants determine the boundaries of the NERC regions.

Because of differences in operating characteristics of Electric Generators across NERC regions, as well as differences in the baseline economic and electric power system regulatory circumstances of the NERC regions themselves, the final rule and other options considered may affect costs, profitability, electricity prices, and other impact measures differently across NERC regions. Under the final rule, EPA estimates that after-tax compliance costs will be the highest in the SERC region and the lowest in the WECC region. These findings are also true under the two other options considered in development of this rule.

Table 3-4: Final Rule-Existing Units – Annualized Compliance Costs to Electric Generators by NERC Region, for the Final Rule and Other Options Considered (Millions; $2011; at 2013)[a]

	One-Time Costs					Recurring Costs				
NERC Region[b]	Capital Technology	Pilot Study	Installation Downtime	Initial Permit Application	Initial and Follow-Up Start-Up	O&M	Monitoring, Record Keeping, and Reporting	Energy Penalty	Permit-Related Non-Annually Recurring	Total
Proposal Option 4										
Pre-Tax Compliance Costs										
ASCC	$0.0	$0.0	$0.0	$0.0	$0.0	$0.0	$0.0	$0.0	$0.0	$0.0
FRCC	$10.9	$0.0	$4.5	$0.9	$0.0	$3.8	$0.3	$0.0	$0.1	$20.6
HICC	$1.3	$0.0	$0.0	$0.1	$0.0	$1.1	$0.0	$0.0	$0.0	$2.5
MRO	$8.3	$0.0	$1.4	$2.5	$0.0	$3.8	$0.8	$0.0	$0.4	$17.2
NPCC	$7.6	$0.0	$0.0	$1.4	$0.0	$3.8	$0.5	$0.0	$0.2	$13.7
RFC	$38.0	$0.0	$1.3	$5.4	$0.1	$22.6	$1.6	$0.0	$0.8	$69.8
SERC	$48.0	$0.0	$19.5	$6.1	$0.1	$17.4	$1.7	$0.0	$1.0	$93.8
SPP	$4.8	$0.0	$12.9	$1.3	$0.0	$3.8	$0.4	$0.0	$0.2	$23.6
TRE	$13.4	$0.0	$5.2	$2.5	$0.0	$6.0	$0.6	$0.0	$0.4	$28.1
WECC	$0.1	$0.0	$0.0	$0.1	$0.0	$0.0	$0.2	$0.0	$0.0	$0.5
Total	**$132.3**	**$0.0**	**$44.9**	**$20.4**	**$0.3**	**$62.4**	**$6.4**	**$0.0**	**$3.2**	**$269.9**
After-Tax Compliance Costs										
ASCC	$0.0	$0.0	$0.0	$0.0	$0.0	$0.0	$0.0	$0.0	$0.0	$0.0
FRCC	$6.7	$0.0	$2.8	$0.6	$0.0	$2.4	$0.2	$0.0	$0.1	$12.8
HICC	$0.8	$0.0	$0.0	$0.1	$0.0	$0.6	$0.0	$0.0	$0.0	$1.5
MRO	$6.5	$0.0	$1.3	$1.8	$0.0	$3.1	$0.6	$0.0	$0.3	$13.5
NPCC	$4.5	$0.0	$0.0	$0.9	$0.0	$2.3	$0.3	$0.0	$0.1	$8.2
RFC	$22.9	$0.0	$0.8	$3.4	$0.0	$13.7	$1.0	$0.0	$0.5	$42.4
SERC	$32.5	$0.0	$11.9	$4.2	$0.1	$13.1	$1.2	$0.0	$0.7	$63.7
SPP	$3.0	$0.0	$7.9	$0.8	$0.0	$2.4	$0.3	$0.0	$0.1	$14.6
TRE	$9.2	$0.0	$3.4	$1.8	$0.0	$4.2	$0.4	$0.0	$0.3	$19.3
WECC	$0.1	$0.0	$0.0	$0.1	$0.0	$0.0	$0.2	$0.0	$0.0	$0.4
Total	**$86.2**	**$0.0**	**$28.1**	**$13.7**	**$0.2**	**$41.8**	**$4.3**	**$0.0**	**$2.2**	**$176.4**
Final Rule-Existing Units										
Pre-Tax Compliance Costs										
ASCC	$0.0	$0.0	$0.0	$0.0	$0.0	$0.0	$0.0	$0.0	$0.0	$0.0
FRCC	$10.9	$0.0	$4.5	$0.9	$0.0	$3.8	$0.3	$0.0	$0.1	$20.6
HICC	$1.3	$0.0	$0.0	$0.1	$0.0	$1.1	$0.0	$0.0	$0.0	$2.5
MRO	$8.5	$0.0	$1.4	$2.5	$0.0	$3.9	$0.8	$0.0	$0.4	$17.6
NPCC	$7.7	$0.0	$0.0	$1.4	$0.0	$3.9	$0.5	$0.0	$0.2	$13.9
RFC	$38.1	$0.0	$1.3	$5.4	$0.1	$22.7	$1.6	$0.0	$0.8	$70.0
SERC	$48.2	$0.0	$19.5	$6.1	$0.1	$17.4	$1.7	$0.0	$1.0	$94.0
SPP	$4.8	$0.0	$12.9	$1.3	$0.0	$3.8	$0.4	$0.0	$0.2	$23.6
TRE	$13.4	$0.0	$5.2	$2.5	$0.0	$6.0	$0.6	$0.0	$0.4	$28.1
WECC	$0.1	$0.0	$0.0	$0.1	$0.0	$0.0	$0.2	$0.0	$0.0	$0.5
Total	**$132.9**	**$0.0**	**$44.9**	**$20.4**	**$0.3**	**$62.6**	**$6.4**	**$0.0**	**$3.2**	**$270.8**
After-Tax Compliance Costs										
ASCC	$0.0	$0.0	$0.0	$0.0	$0.0	$0.0	$0.0	$0.0	$0.0	$0.0
FRCC	$6.7	$0.0	$2.8	$0.6	$0.0	$2.4	$0.2	$0.0	$0.1	$12.8
HICC	$0.8	$0.0	$0.0	$0.1	$0.0	$0.6	$0.0	$0.0	$0.0	$1.5
MRO	$6.7	$0.0	$1.3	$1.8	$0.0	$3.1	$0.6	$0.0	$0.3	$13.8
NPCC	$4.6	$0.0	$0.0	$0.9	$0.0	$2.3	$0.3	$0.0	$0.1	$8.4
RFC	$23.0	$0.0	$0.8	$3.4	$0.0	$13.8	$1.0	$0.0	$0.5	$42.6
SERC	$32.6	$0.0	$11.9	$4.2	$0.1	$13.1	$1.2	$0.0	$0.7	$63.8
SPP	$3.0	$0.0	$7.9	$0.8	$0.0	$2.4	$0.3	$0.0	$0.1	$14.6
TRE	$9.2	$0.0	$3.4	$1.8	$0.0	$4.2	$0.4	$0.0	$0.3	$19.3
WECC	$0.1	$0.0	$0.0	$0.1	$0.0	$0.0	$0.2	$0.0	$0.0	$0.4
Total	**$86.8**	**$0.0**	**$28.1**	**$13.7**	**$0.2**	**$42.0**	**$4.3**	**$0.0**	**$2.2**	**$177.2**

Table 3-4: Final Rule-Existing Units – Annualized Compliance Costs to Electric Generators by NERC Region, for the Final Rule and Other Options Considered (Millions; $2011; at 2013)[a]

NERC Region[b]	One-Time Costs					Recurring Costs				Total
	Capital Technology	Pilot Study	Installation Downtime	Initial Permit Application	Initial and Follow-Up Start-Up	O&M	Monitoring, Record Keeping, and Reporting	Energy Penalty	Permit-Related Non-Annually Recurring	
Proposal Option 2										
Pre-Tax Compliance Costs										
ASCC	$0.0	$0.0	$0.0	$0.0	$0.0	$0.0	$0.0	$0.0	$0.0	$0.0
FRCC	$143.5	$0.0	$16.7	$0.1	$0.0	$16.3	$1.3	$72.0	$0.0	$249.9
HICC	$15.2	$0.0	$1.5	$0.0	$0.0	$1.7	$0.2	$3.0	$0.0	$21.6
MRO	$151.9	$0.0	$8.1	$0.6	$0.0	$17.5	$2.5	$76.9	$0.1	$257.6
NPCC	$114.3	$0.0	$11.3	$0.3	$0.0	$13.2	$1.3	$71.3	$0.0	$211.6
RFC	$698.9	$0.0	$44.9	$0.6	$0.1	$79.7	$5.7	$306.3	$0.1	$1,136.2
SERC	$805.0	$0.0	$109.6	$0.4	$0.1	$91.4	$6.8	$469.6	$0.1	$1,483.0
SPP	$169.0	$0.0	$8.7	$0.1	$0.0	$19.5	$1.7	$60.1	$0.0	$259.2
TRE	$295.2	$0.0	$19.4	$0.1	$0.0	$33.4	$2.7	$205.2	$0.0	$556.1
WECC	$0.1	$0.0	$0.0	$0.1	$0.0	$0.0	$0.1	$0.0	$0.0	$0.4
Total	**$2,393.2**	**$0.0**	**$220.1**	**$2.2**	**$0.3**	**$272.6**	**$22.3**	**$1,264.5**	**$0.3**	**$4,175.6**
After-Tax Compliance Costs										
ASCC	$0.0	$0.0	$0.0	$0.0	$0.0	$0.0	$0.0	$0.0	$0.0	$0.0
FRCC	$90.2	$0.0	$10.4	$0.0	$0.0	$10.2	$0.9	$44.7	$0.0	$156.5
HICC	$9.3	$0.0	$0.9	$0.0	$0.0	$1.0	$0.1	$1.8	$0.0	$13.2
MRO	$114.2	$0.0	$5.3	$0.4	$0.0	$13.1	$1.8	$53.8	$0.1	$188.7
NPCC	$68.3	$0.0	$6.7	$0.2	$0.0	$7.9	$0.8	$42.6	$0.0	$126.5
RFC	$426.7	$0.0	$27.6	$0.4	$0.0	$48.7	$3.5	$187.3	$0.1	$694.5
SERC	$590.9	$0.0	$85.9	$0.3	$0.1	$67.2	$4.7	$347.2	$0.1	$1,096.3
SPP	$106.6	$0.0	$5.4	$0.1	$0.0	$12.3	$1.1	$37.8	$0.0	$163.3
TRE	$205.7	$0.0	$13.6	$0.1	$0.0	$23.3	$2.0	$140.6	$0.0	$385.3
WECC	$0.1	$0.0	$0.0	$0.1	$0.0	$0.0	$0.1	$0.0	$0.0	$0.4
Total	**$1,612.1**	**$0.0**	**$155.8**	**$1.6**	**$0.2**	**$183.7**	**$15.0**	**$856.0**	**$0.3**	**$2,824.5**

a. ASCC – Alaska Systems Coordinating Council; FRCC – Florida Reliability Coordinating Council; HICC – Hawaii Coordinating Council; MRO – Midwest Reliability Organization; NPCC – Northeast Power Coordinating Council; RFC – ReliabilityFirst Corporation; SERC – Southeastern Electric Reliability Council; SPP – Southwest Power Pool; TRE - Texas Reliability Entity, and WECC – Western Energy Coordinating Council.
b. No explicitly analyzed facilities are located in the ASCC NERC region; an implicitly analyzed facility in ASCC facility was grouped with facilities in the WECC region (for discussion on explicitly and analyzed facilities see *Appendix H*).
Source: U.S. EPA analysis, 2013

Manufacturers

As reported in *Table 3-5*, EPA estimates, on a *pre-tax* basis, that Manufacturers would incur $83.8 million in costs under the final rule and $59.3 million, and $259.0 million under Proposal Options 4 and 2, respectively. On an *after-tax* basis, these costs are $50.6 million (final rule), $35.9 million (Proposal Option 4), and $156.4 million (Proposal Option 2).

Table 3-5: Final Rule-Existing Units – Annualized Compliance Costs to Manufacturers by Industry Sector, for the Final Rule and Other Options Considered (Millions; $2011; at 2013)

Sector	One-Time Costs				Initial and Follow-Up Start-Up	Recurring Costs				Total
	Capital Technology	Pilot Study[a]	Connection Outage	Initial Permit Application		O&M	Monitoring, Record Keeping, & Reporting	Energy Penalty	Permit Renewal	
Proposal Option 4										
Pre-Tax National Costs										
Aluminum	$0.5	$0.0	$0.0	$0.5	$0.0	$0.0	$0.5	$0.0	$0.1	$1.7
Chemicals	$8.5	$0.0	$0.3	$3.2	$0.1	$2.3	$3.4	$0.0	$0.5	$18.3
Food	$1.1	$0.0	$0.0	$0.5	$0.0	$0.7	$0.6	$0.0	$0.1	$3.0
Paper	$6.2	$0.0	$0.0	$4.0	$0.1	$1.0	$4.3	$0.0	$0.6	$16.3
Petroleum	$4.0	$0.0	$0.0	$0.6	$0.0	$0.9	$0.5	$0.0	$0.1	$6.1
Steel	$8.7	$0.0	$0.0	$1.4	$0.0	$1.1	$1.2	$0.0	$0.2	$12.5
Other	$0.6	$0.0	$0.0	$0.3	$0.0	$0.3	$0.3	$0.0	$0.0	$1.5
Total	**$29.7**	**$0.0**	**$0.3**	**$10.4**	**$0.3**	**$6.4**	**$10.7**	**$0.0**	**$1.7**	**$59.3**
After-Tax National Costs										
Aluminum	$0.3	$0.0	$0.0	$0.3	$0.0	$0.3	$0.0	$0.0	$0.1	$1.0
Chemicals	$5.3	$0.0	$0.2	$1.9	$1.5	$2.1	$0.0	$0.1	$0.3	$11.2
Food	$0.6	$0.0	$0.0	$0.3	$0.4	$0.3	$0.0	$0.0	$0.1	$1.7
Paper	$3.7	$0.0	$0.0	$2.4	$0.6	$2.6	$0.0	$0.1	$0.4	$9.8
Petroleum	$2.4	$0.0	$0.0	$0.3	$0.6	$0.3	$0.0	$0.0	$0.1	$3.6
Steel	$5.2	$0.0	$0.0	$0.8	$0.6	$0.7	$0.0	$0.0	$0.1	$7.5
Other	$0.4	$0.0	$0.0	$0.2	$0.2	$0.2	$0.0	$0.0	$0.0	$0.9
Total	**$17.9**	**$0.0**	**$0.2**	**$6.3**	**$3.9**	**$6.5**	**$0.0**	**$0.2**	**$1.0**	**$35.9**
Final Rule-Existing Units										
Pre-Tax National Costs										
Aluminum	$0.6	$0.0	$0.0	$0.5	$0.1	$0.5	$0.0	$0.0	$0.1	$1.8
Chemicals	$15.3	$0.0	$0.3	$3.2	$3.3	$3.4	$0.0	$0.1	$0.5	$26.1
Food	$1.5	$0.0	$0.1	$0.5	$0.9	$0.6	$0.0	$0.0	$0.1	$3.7
Paper	$18.2	$0.0	$0.1	$4.0	$3.0	$4.3	$0.0	$0.1	$0.6	$30.4
Petroleum	$4.6	$0.0	$0.0	$0.5	$1.0	$0.5	$0.0	$0.0	$0.1	$6.7
Steel	$9.2	$0.0	$0.0	$1.3	$1.4	$1.1	$0.0	$0.0	$0.2	$13.3
Other	$0.8	$0.0	$0.0	$0.3	$0.3	$0.3	$0.0	$0.0	$0.0	$1.7
Total	**$50.3**	**$0.0**	**$0.5**	**$10.4**	**$10.0**	**$10.7**	**$0.0**	**$0.3**	**$1.7**	**$83.8**
After-Tax National Costs										
Aluminum	$0.4	$0.0	$0.0	$0.3	$0.0	$0.3	$0.0	$0.0	$0.1	$1.1
Chemicals	$9.4	$0.0	$0.2	$1.9	$2.1	$2.1	$0.0	$0.1	$0.3	$15.9
Food	$0.9	$0.0	$0.0	$0.3	$0.5	$0.3	$0.0	$0.0	$0.1	$2.2
Paper	$11.0	$0.0	$0.1	$2.4	$1.8	$2.6	$0.0	$0.1	$0.4	$18.3
Petroleum	$2.7	$0.0	$0.0	$0.3	$0.6	$0.3	$0.0	$0.0	$0.1	$4.0
Steel	$5.5	$0.0	$0.0	$0.8	$0.8	$0.7	$0.0	$0.0	$0.1	$8.0
Other	$0.5	$0.0	$0.0	$0.2	$0.2	$0.2	$0.0	$0.0	$0.0	$1.0
Total	**$30.4**	**$0.0**	**$0.3**	**$6.3**	**$6.0**	**$6.5**	**$0.0**	**$0.2**	**$1.0**	**$50.6**
Proposal Option 2										
Pre-Tax National Costs										
Aluminum	$1.9	$0.0	$0.4	$0.4	$0.3	$0.6	$1.8	$0.0	$0.1	$5.4
Chemicals	$60.7	$0.0	$1.2	$3.0	$6.6	$4.7	$29.4	$0.1	$0.5	$106.0
Food	$13.3	$0.0	$0.1	$0.5	$1.6	$1.1	$6.5	$0.0	$0.1	$23.2
Paper	$21.2	$0.0	$0.3	$3.9	$3.2	$4.6	$1.3	$0.1	$0.6	$35.3
Petroleum	$15.9	$0.0	$0.1	$0.3	$1.3	$0.8	$3.1	$0.0	$0.0	$21.6
Steel	$48.8	$0.0	$0.5	$0.9	$4.0	$2.2	$6.7	$0.0	$0.1	$63.4
Other	$2.4	$0.0	$0.1	$0.2	$0.4	$0.4	$0.6	$0.0	$0.0	$4.1
Total	**$164.1**	**$0.0**	**$2.6**	**$9.3**	**$17.5**	**$14.3**	**$49.4**	**$0.3**	**$1.5**	**$259.0**
After-Tax National Costs										
Aluminum	$1.2	$0.0	$0.2	$0.3	$0.2	$0.4	$1.2	$0.0	$0.0	$3.5
Chemicals	$37.2	$0.0	$0.7	$1.8	$4.1	$2.9	$18.1	$0.1	$0.3	$65.1
Food	$7.7	$0.0	$0.1	$0.3	$1.0	$0.6	$3.8	$0.0	$0.0	$13.5
Paper	$12.8	$0.0	$0.2	$2.4	$1.9	$2.8	$0.8	$0.1	$0.4	$21.3
Petroleum	$9.4	$0.0	$0.1	$0.2	$0.8	$0.5	$1.9	$0.0	$0.0	$12.8

Table 3-5: Final Rule-Existing Units – Annualized Compliance Costs to Manufacturers by Industry Sector, for the Final Rule and Other Options Considered (Millions; $2011; at 2013)

Sector	One-Time Costs				Initial and Follow-Up Start-Up	Recurring Costs				Total
	Capital Technology	Pilot Study[a]	Connection Outage	Initial Permit Application		O&M	Monitoring, Record Keeping, & Reporting	Energy Penalty	Permit Renewal	
Steel	$29.0	$0.0	$0.3	$0.5	$2.4	$1.3	$4.0	$0.0	$0.1	$37.7
Other	$1.4	$0.0	$0.0	$0.1	$0.3	$0.2	$0.3	$0.0	$0.0	$2.4
Total	**$98.8**	**$0.0**	**$1.6**	**$5.6**	**$10.6**	**$8.7**	**$30.1**	**$0.2**	**$0.9**	**$156.4**

a. Annualized pilot study costs under the final rule and Proposal Option 4 are less than $12,000 on a pre-tax basis and less than $10,000 on an after-tax basis.
Source: U.S. EPA Analysis, 2013

Electric Generators and Manufacturers

Table 3-6 presents total compliance costs for Electric Generators and Manufacturers.

Table 3-6: Final Rule-Existing Units – Annualized Compliance Costs to Electric Generators and Manufacturers, for the Final Rule and Other Options Considered (Millions; $2011; at 2013)[a]

Facility Group	One-Time Costs				Initial and Follow-Up Start-Up	Recurring Costs				Total
	Capital Technology	Pilot Study[b]	Installation Downtime	Initial Permit Application		O&M	Monitoring, Record Keeping, and Reporting	Energy Penalty	Repermitting	
Proposal Option 4										
Pre-Tax Compliance Costs										
Generators	$132.3	$0.0	$44.9	$20.4	$0.3	$62.4	$6.4	$0.0	$3.2	$269.9
Manufacturers	$29.7	$0.0	$0.3	$10.4	$0.3	$6.4	$10.7	$0.0	$1.7	$59.3
Total	**$162.0**	**$0.0**	**$45.2**	**$30.8**	**$0.6**	**$68.7**	**$17.0**	**$0.0**	**$4.9**	**$329.2**
After-Tax Compliance Costs										
Generators	$86.2	$0.0	$28.1	$13.7	$0.2	$41.8	$4.3	$0.0	$2.2	$176.4
Manufacturers	$17.9	$0.0	$0.2	$6.3	$0.2	$3.9	$6.5	$0.0	$1.0	$35.9
Total	**$104.2**	**$0.0**	**$28.3**	**$19.9**	**$0.4**	**$45.6**	**$10.8**	**$0.0**	**$3.2**	**$212.3**
Final Rule-Existing Units										
Pre-Tax Compliance Costs										
Generators	$132.9	$0.0	$44.9	$20.4	$0.3	$62.6	$6.4	$0.0	$3.2	$270.8
Manufacturers	$50.3	$0.0	$0.5	$10.4	$0.3	$10.0	$10.7	$0.0	$1.7	$83.8
Total	**$183.3**	**$0.0**	**$45.4**	**$30.8**	**$0.6**	**$72.6**	**$17.0**	**$0.0**	**$4.9**	**$354.5**
After-Tax Compliance Costs										
Generators	$86.8	$0.0	$28.1	$13.7	$0.2	$42.0	$4.3	$0.0	$2.2	$177.2
Manufacturers	$30.4	$0.0	$0.3	$6.3	$0.2	$6.0	$6.5	$0.0	$1.0	$50.6
Total	**$117.1**	**$0.0**	**$28.4**	**$19.9**	**$0.4**	**$48.0**	**$10.8**	**$0.0**	**$3.2**	**$227.8**
Proposal Option 2										
Pre-Tax Compliance Costs										
Generators	$2,393.2	$0.0	$220.1	$2.2	$0.3	$272.6	$22.3	$1,264.5	$0.3	$4,175.6
Manufacturers	$164.1	$0.0	$2.6	$9.3	$0.3	$17.5	$14.3	$49.4	$1.5	$259.0
Total	**$2,557.3**	**$0.0**	**$222.7**	**$11.4**	**$0.6**	**$290.1**	**$36.6**	**$1,313.9**	**$1.8**	**$4,434.5**
After-Tax Compliance Costs										
Generators	$1,612.1	$0.0	$155.8	$1.6	$0.2	$183.7	$15.0	$856.0	$0.3	$2,824.5
Manufacturers	$98.8	$0.0	$1.6	$5.6	$0.2	$10.6	$8.7	$30.1	$0.9	$156.4
Total	**$1,710.9**	**$0.0**	**$157.4**	**$7.2**	**$0.4**	**$194.2**	**$23.7**	**$886.0**	**$1.1**	**$2,980.9**

a. Values may not add up due to rounding.
b. Annualized pilot study costs under the final rule and Proposal Option 4 are less than $12,000 on a pre-tax basis and less than $10,000 on an after-tax basis.
Source: U.S. EPA analysis, 2013

3.1.3 Uncertainties and Limitations

This analysis is subject to the following uncertainties and limitations:

- Data on cooling water systems at regulated facilities may not reflect the current circumstances of some facilities, given the passage of time since completion of the 316(b) survey. In addition, the set of facilities in the earlier survey may differ from the set of facilities that will be complying with the final rule, because either a facility has been retired or generating and manufacturing units have been added since that time.
- To the extent that EPA used the same set of facilities for the analysis of this regulation as the one used for the previous 316(b) analyses, the same set of uncertainties regarding the facility sample and cost estimates apply.
- Given the passage of time since completion of the 316(b) survey, the survey data may no longer accurately reflect the business conditions or cooling water usage of the sampled facilities, and the facilities in the broader population that these sample facilities represent. EPA may have over- or under-estimated compliance technology costs presented here to the extent that survey data underlying the costs is out-dated.
- Given the large number of implicitly analyzed Electric Generators, it is impossible for EPA to develop sample weights that accurately account for all economic and operating differences of these facilities (see *Appendix H*). Consequently, compliance costs EPA developed for the electric power industry may be over- or under-estimated due to statistical error in the facility sample weights.
- Additional uncertainties are associated with the downtime cost estimates discussed in *Appendix I*. EPA relied on IPM-projected estimates of electricity generation and variable production costs and historical EIA electricity generation and prices, which may not be representative of actual electricity market conditions when regulated facilities suspend their operations to install compliance technology. Further, to the extent that technology installation occurs during the shoulder months of spring and fall, when electricity demand is typically below the annual average, the downtime costs, which EPA estimated using average annual generation, cost and revenue, are likely to be over-stated.
- For uncertainties associated with administrative activities as well as their timing and labor requirements, see the *TDD*. To the extent that the average hourly labor rates used in this analysis differ from the actual rates that State and federal governments will pay to their employees, EPA may have may have over- or under-estimated administrative costs.

3.2 Compliance Costs for New Units

Electric power generating units at Electric Generators that meet the definition of a *new unit* will be required to achieve intake flow commensurate with closed-cycle cooling under the final rule. This section summarizes the data and methodology used to estimate compliance costs that Electric Generators will incur for these new units (for a more detailed description of the methodology, see the *TDD*). The Agency expects that new unit-related compliance costs to Manufacturers will be negligible in total. Therefore, this discussion focuses on Electric Generators only. The term *final rule* refers to the provision of the final rule that applies to new units.

3.2.1 Analysis Approach and Data Inputs

EPA expects Electric Generators with new generating units to incur capital costs, additional fixed and variable O&M costs, and additional costs from auxiliary energy requirements from installation and operation of entrainment technology. In addition, EPA expects these facilities to incur costs associated with initial start-up, initial permitting, annual monitoring, and reporting and recordkeeping activities to implement the final rule. Facilities will not have to undertake follow-up start-up activities associated with the new units. EPA used the same methodology to calculate total industry compliance costs associated with new units, as it used for existing facilities (see *Section 3.2*).

EPA was unable to determine which Electric Generators will construct new units or repower existing units, or the precise timing of new unit construction and repowering. Therefore, the Agency estimated compliance costs for new units only at the national level and not at the NERC-region level. Further, the Agency assumed that the same number of new unit construction events, in terms of electric power generating capacity, would occur in every year during the 30-year analysis period.

3.2.2 Key Findings

Table 3-7 presents total annualized pre- and after-tax cost of compliance estimated for Electric Generators under the new units provision of the final rule and other new units options considered. As reported in *Table 3-7*, EPA estimates, on a pre-tax basis, that the new units provision of the final rule will result in $11.3 million in compliance costs to facilities. Under other new units options considered – Options A, B, and D – this cost would be $103.4 million, $40.9 million, and $4.0 million, respectively. On an after-tax basis, the new units provision of the final rule will result in $6.9 million in compliance costs to facilities. Under other new units options considered – Options A, B, and D – this cost would be $63.0 million, $24.9 million, and $2.4 million, respectively.

Table 3-7: Final Rule-New Units – Annualized Compliance Costs to Electric Generators, for the Final Rule and Other New Units Options Considered (Millions; $2011; at 2013)

	One-Time Costs					Recurring Costs				
Option	Capital Technology	Pilot Study	Installation Downtime	Initial Permit Application	Initial Start-Up[a]	O&M	Monitoring, Record Keeping, and Reporting	Energy Penalty	Non-Annually Recurring Permitting	Total
Pre-Tax Compliance Costs										
Option A	$70.3	$0.0	$0.0	$5.5	$0.0	$4.5	$0.7	$22.3	$0.0	$103.4
Option B	$28.3	$0.0	$0.0	$2.3	$0.0	$1.1	$0.3	$8.9	$0.0	$40.9
Final Rule-New Units	$6.4	$0.0	$0.0	$2.3	$0.0	$0.2	$0.3	$2.1	$0.0	$11.3
Option D	$0.9	$0.0	$0.0	$2.3	$0.0	$0.1	$0.3	$0.4	$0.0	$4.0
After-Tax Compliance Costs										
Option A	$42.8	$0.0	$0.0	$3.4	$0.0	$2.8	$0.4	$13.6	$0.0	$63.0
Option B	$17.2	$0.0	$0.0	$1.4	$0.0	$0.7	$0.2	$5.4	$0.0	$24.9
Final Rule-New Units	$3.9	$0.0	$0.0	$1.4	$0.0	$0.1	$0.2	$1.3	$0.0	$6.9
Option D	$0.6	$0.0	$0.0	$1.4	$0.0	$0.0	$0.2	$0.2	$0.0	$2.4

a. Initial start-up costs are less than $50,000.

Source: U.S. EPA analysis, 2013

3.3 Total Compliance Costs of the Final Rule

As reported in *Table 3-8*, EPA estimates that under the final rule, Electric Generators and Manufacturers will incur $365.8 million in costs on a pre-tax basis and $234.6 million on an after-tax basis, accounting for both the new units and the existing units provision. The new units provision accounts for approximately 3 percent of total costs.

Table 3-8: Total Annualized Compliance Costs of the Final Rule for Electric Generators and Manufacturers (Millions; $2011; at 2013)[a]

Option	One-Time Costs					Recurring Costs				Total
	Capital Technology	Pilot Study	Installation Downtime	Initial Permit Application	Initial and Follow-Up Start-Up	O&M	Monitoring, Record Keeping, and Reporting	Energy Penalty	Non-Annually Recurring Permitting	
Pre-Tax Compliance Costs										
Existing Units	$183.3	$0.0	$45.4	$30.8	$0.6	$72.6	$17.0	$0.0	$4.9	$354.5
New Units	$6.4	$0.0	$0.0	$2.3	$0.0	$0.2	$0.3	$2.1	$0.0	$11.3
Total	**$189.6**	**$0.0**	**$45.4**	**$33.1**	**$0.6**	**$72.8**	**$17.4**	**$2.1**	**$4.9**	**$365.8**
After-Tax Compliance Costs										
Existing Units	$117.1	$0.0	$28.4	$19.9	$0.4	$48.0	$10.8	$0.0	$3.2	$227.8
New Units	$3.9	$0.0	$0.0	$1.4	$0.0	$0.1	$0.2	$1.3	$0.0	$6.9
Total	**$121.0**	**$0.0**	**$28.4**	**$21.4**	**$0.4**	**$48.1**	**$11.0**	**$1.3**	**$3.2**	**$234.6**

a. Numbers may not add up due to rounding.
Source: U.S. EPA analysis, 2013

3.4 Administrative Costs to States and Federal Government

EPA also estimated costs to States and federal government for administering the final rule and other options EPA considered in development of this rule. These costs closely link to the administrative costs to regulated facilities and mainly reflect labor costs to review information produced by regulated facilities and to write the necessary permits. EPA assessed that these costs would vary across regulatory options, based primarily on differences in administrative requirements for facilities installing IM technology compared to those installing entrainment control technologies, i.e., cooling towers. This section presents administrative costs for the final rule and other options considered for existing and new units at Electric Generators and Manufacturers.

3.4.1 Analysis Approach and Data Inputs

Existing Units

EPA assessed administrative costs for 46 States and one territory with designated NPDES permitting authority under section 402(c) of the Clean Water Act (CWA). EPA is responsible for permitting and incurs the administrative costs associated with facilities located in four States and eight territories without designated NPDES permitting authority. EPA estimated costs for the following three categories of administrative activities for the final rule and other options considered:

- *Initial permitting activities*: These include initial start-up activities and review of permit applications and other information compiled by regulated facilities during the permitting process. Unlike regulated facilities, States and federal government will not have to undertake follow-up start-up activities.
- *Annual activities*: These include review of annual monitoring data and other information produced by regulated facilities on an annual basis.
- *Non-annually recurring activities*: These activities include a subset of initial permitting activities that repeat periodically in the future. All activities in this subset begin 10 years after the initial permitting activities begin and recur every five years.

Each NPDES permitting authority incurs costs only one time for start-up activities and for any activities that apply to the total set of facilities located in that permitting authority‟s jurisdiction. Activities that apply to individual facilities occur as many times as the number of regulated facilities in the jurisdiction.

For details on these activities as well as time and labor requirements associated with these activities, see the *TDD*. To estimate administrative costs associated with these activities, EPA first developed hourly labor rates by labor category using the same data sources and method described above on page *3-4*. *Table 3-9* presents the resulting labor rates EPA used to estimate administrative costs for States and federal government.

Table 3-9: Average Hourly Labor Rates for State and Federal Government Employees by Labor Category ($2011)

Labor Categories	Average Hourly Labor Rate for	
	State Governments	Federal Government
Senior Technical	$60.10	$87.50
Junior Technical	$45.30	$77.80
Clerical	$28.70	$33.50

a. Fully loaded hourly rates include base labor costs with add-ons for employee benefits and overhead.
Source: U.S. EPA analysis, 2013

EPA calculated total administrative costs by multiplying these average hourly rates by the number of hours, by labor category, and activity events that would be required for each administrative activity, and summing these costs across the administrative activities.

New Units

The Agency expects that government costs for administering the new units requirements for Manufacturers will be negligible. Therefore, EPA assessed these costs only for Electric Generators. The Agency assumed that NPDES authorities would incur initial permitting and annual monitoring, reporting, and recordkeeping costs to administer the new units provision. For details on these activities, see the *TDD*. EPA followed the same steps to calculate total administrative costs for new units as it followed for existing. EPA assumed that all new units activity will occur in States with NPDES permitting authority.

3.4.2 Key Findings

As shown in *Table 3-10*, EPA estimates that States and federal government will incur $1.1 million to administer the final rule for existing units. EPA estimates this cost would be $1.1 million and $0.7 million to administer Proposal Options 4 and 2, respectively.

Table 3-10: Annualized Administrative Costs to States and Federal Government for Electric Generators and Manufacturers - Existing Units (Millions; $2011; at 2013)

Option	Initial Permit Application[a]	Monitoring, Recordkeeping and Reporting	Non-Annually Recurring Total	Total
Proposal Option 4	$0.5	$0.5	$0.1	$1.1
Final Rule-Existing Units	$0.5	$0.5	$0.1	$1.1
Proposal Option 2	$0.2	$0.5	$0.0	$0.7

a. These costs include initial start-up costs that are less than $20,000, which are the same regardless of regulatory option.
Source: U.S. EPA analysis, 2013

As shown in *Table 3-11*, in addition to the existing units requirements, States will incur less than $50,000 to administer the new units provision of the final rule. States would incur $0.1 million to administer the new units requirements under Option A and less than $50,000 to administer the new units requirements under Options B and D . As shown in *Table 3-12*, EPA estimates that the total cost to States and federal government to administer existing and new units requirements of the final rule will be $1.2 million.

Table 3-11: Annualized Administrative Costs to States and Federal Government for Electric Generators and Manufacturers - New Units (Millions; $2011; at 2013)

Option	Initial Permit Application[a,b]	Monitoring, Recordkeeping and Reporting	Non-Annually Recurring Total	Total
Option A	$0.0	$0.1	$0.0	$0.1

Option B	$0.0	$0.0	$0.0	$0.0
Final Rule – New Units	$0.0	$0.0	$0.0	$0.0
Option D	$0.0	$0.0	$0.0	$0.0

a. Under Option A, initial permit application costs are less than $40,000.
b. Under the new units provision of the final rule and Options B and D, initial permit application costs are less than $15,000; monitoring, recordkeeping, and reporting costs under these options are less than $40,000 and total costs are less than $50,000.
Source: U.S. EPA analysis, 2013

Table 3-12: Total Annualized Administrative Costs to States and Federal Government of the Final Rule for Electric Generators and Manufacturers (Millions; $2011; at 2013)

Option	Initial Permit Application[a,b]	Monitoring, Recordkeeping and Reporting	Non-Annually Recurring Total	Total
Existing Units	$0.5	$0.5	$0.1	$1.1
New Units	$0.0	$0.0	$0.0	$0.0
Total	$0.5	$0.6	$0.1	$1.2

a. Under Option A, initial permit application costs to administer the new units provision are less than $40,000.
b. Under the new units provision of the final rule, initial permit application costs are less than $15,000; monitoring, recordkeeping, and reporting costs under these options are less than $40,000 and total costs are less than $50,000.
Source: U.S. EPA analysis, 2013

3.4.3 Uncertainties and Limitations

For uncertainties associated with administrative activities as well as their timing and labor requirements, see the *TDD*. To the extent that the average hourly labor rates that EPA estimated for this analysis differ from the rates that State and federal governments pay to their employees, EPA may have over- or under-estimated total administrative costs.

4 Economic Impact Analysis – Electric Generators

4.1 Analysis Overview

This chapter and *Chapter 7: Electricity Market Analysis* assess the economic impact of the existing units provision of the final rule and other options EPA considered on Electric Generators.[58] This economic assessment focuses on existing units at existing facilities. *Chapter 6: Barrier to Entry Analysis of the New Units Provision* contains the barrier-to-entry analysis conducted for new units.

EPA performed this analysis in two parts, key elements of which are parallel in concept to the impact analyses undertaken for Manufacturers, and described in *Chapter 5: Economic Impact Analyses – Manufacturers*. In particular, the impact analyses for both Electric Generators and Manufacturers begin with a cost-to-revenue screening analysis to assess the potential significance of compliance costs to regulated facilities. This screening analysis is followed by a more rigorous analysis of economic/financial impact using cash flow models to assess the impact of compliance costs on the financial performance of regulated facilities. The two parts of the analysis for Electric Generators are as follows:

1. A cost and economic impact assessment reflecting baseline operating characteristics of regulated facilities. This is a static analysis and assumes no changes in those baseline operating characteristics – e.g., level of electricity generation and revenue – as a result of the requirements of the final rule and other options considered. This assessment includes five analyses:
   - A cost-to-revenue screening analysis to assess the impact of compliance outlays on individual regulated facilities (*Section 4.2*).
   - A cost-to-revenue screening analysis to assess the impact of compliance outlays on domestic parent entities that own regulated facilities (*Section 4.3*).[59]
   - A screening-level assessment of the potential impact of compliance costs on electricity prices, across consumer groups (*Section 4.4*).
   - An assessment of the potential impact of compliance costs on electricity prices to residential households (*Section 4.5*).
   - An assessment of the reduction in the availability of generating capacity due to downtime during installation of compliance technology, and the impact of that capacity reduction on the North American bulk power system (*Section 4.6*).
2. A broader electricity market-level analysis based on the Integrated Planning Model (IPM) is discussed in *Chapter 7*. Unlike the preceding analysis, this market-level analysis accounts for the effect of compliance costs using detailed information on the baseline and projected profiles of the operating finances of individual facilities and generating units.[60] Very importantly, this analysis reflects the interdependence of electric power generating units in supplying power to the electric transmission grid. This analysis accounts for expected

[58] See *Chapter 1: Introduction* for option descriptions.

[59] The purpose of the cost-to-revenue assessments is to provide an indication of the relative magnitude of the compliance costs, controlling for the size or market share of the facility or entity. The assessments are not designed to predict closures and/or other types of economic impact on regulated facilities or entities that own these facilities.

[60] The IPM analysis involves cash flow and present value concepts that are similar to the after-tax cash flow/business value analysis that EPA conducted for Manufacturers.

changes in the operating characteristics and generation profile of regulated facilities and other electric power facilities over time from both:

- Estimated changes in electricity markets, operating characteristics, and generation profile of facilities *independent of the final rule and other options considered* and
- Estimated changes in electricity markets, operating characteristics, and generation profile of facilities *as a result of the final rule or other options considered*.

EPA closely followed the methodologies used to conduct analyses in support of the previous 316(b) regulatory analyses, including the proposed rule, and, to the extent possible, relied on the same data sources.

4.2 Cost-to-Revenue Analysis: Facility-Level Screening Analysis

The cost-to-revenue measure compares the cost of installing and operating compliance technologies with the facility‟s operating revenue, and provides a screening-level assessment of the impact of the final rule and other options considered. As discussed in *Chapter 2: Industry Profiles*, the majority of regulated facilities (59 percent) operate in States with rate-regulated electricity markets. EPA estimates that facilities located in these States may be able to recover compliance cost-based increases in their production costs through increased electricity prices. This depends on the business operation model of the facility owner(s), the ownership and operating structure of the facility itself, and the role of market mechanisms used to sell electricity. In contrast, in States in which electric power generation has been deregulated, cost recovery is less certain. While facilities operating within deregulated electricity markets *may be* able to recover some of their additional production costs through increased revenue, EPA cannot determine the extent of cost recovery ability for each facility.[61]

In assessing the cost impact of the final rule and other options considered on regulated facilities, the Agency assumed that regulated facilities will not be able to pass any of the increase in their production costs to consumers (zero cost pass-through). EPA makes this assumption for analytic convenience; it provides a *worst-case* scenario of impacts on regulated facilities. Even though the majority of regulated facilities may be able to pass nearly all increases in production costs to consumers through increased electricity prices, determining exactly which facilities will be able to, and the extent of cost pass-through that these facilities may achieve, is difficult. Consequently, assuming zero cost pass-through is appropriate for a screening-level, upper bound estimate of the potential cost impact on regulated facilities and their parent entities. To the extent that some regulated facilities are able to recover some of the increased costs through increased prices, this analysis will overstate facility-level impacts. While helpful to understand potential cost impacts, this analysis generally does not indicate whether profitability is jeopardized, cash flow is affected, or risk of financial distress is increased.

4.2.1 Analysis Approach and Data Inputs

As described in *Chapter 3: Compliance Costs*, EPA conducted economic impact analyses assuming 5-year technology-installation windows of 2018 through 2022 for IM technology installation, 2021 through 2025 for installation of cooling towers by non-nuclear Electric Generators, and 2026 through 2030 for installation of cooling towers by nuclear Electric Generators.

[61] As discussed in *Chapter 2*, while regulatory status in a given State affects the ability of electric power plants and their parent entities to recover electricity generation costs, it is not the only factor and should not be used solely as the basis for cost-pass-through determination.

EPA used a single year, 2011, as the basis for comparing facility-level compliance costs to facility-level revenue. Specifically, EPA compared annualized after-tax compliance costs (see *Chapter 3*) with estimated 2011 facility revenue.[62,63]

EPA developed facility-level revenues for all regulated facilities using data from the Energy Information Administration (EIA) of the U.S. Department of Energy (DOE)on electricity generation by prime mover, and utility/operator-level electricity prices and disposition. Specifically, EPA multiplied the 5-year average of electricity generation values over the period 2007 to 2011 from the EIA-906/920/923 database by 5-year average electricity prices over the period 2007 to 2011 from the EIA-861 database.[64]

To provide cost and revenue comparisons on consistent analysis- and dollar-year bases, EPA converted all costs and revenues to the cost-to-revenue analysis year of 2011, and expressed them in 2011 dollars as follows:

- The EIA electricity price data are reported in nominal dollars of each year. EPA‟s first step in calculating facility revenue was to restate these values in 2011 dollars using the Gross Domestic Product (GDP) deflator index published by the U.S. Bureau of Economic Analysis (BEA). The Agency then averaged these individual yearly values.[65]
- EPA originally estimated all compliance-technology costs, except for installation downtime and energy penalty, as of February 2009. EPA used the Construction Cost Index (CCI) from McGraw Hill Construction to adjust all compliance technology costs to 2011. Because the CCI is a nominal cost adjustment index, the resulting technology costs are for the assumed year of compliance, 2011, and in 2011 dollars.
- As detailed in *Appendix I: Energy Requirements*, EPA estimated costs associated with the energy penalty and downtime using variable cost estimates from the Integrated Planning Model (IPM) and EIA-based revenue values. The IPM-based variable production cost values are 3-year averages of values projected for 2015, 2020, and 2030. EPA did not adjust these values to account for possible real changes in variable production costs between these years and 2011, because the Agency had no reliable basis for making these adjustments. If cost changes follow the historically observed trend – costs increase at a greater rate than general inflation – then these variable production costs will be overstated in the cost-to-revenue

62 For private, tax-paying entities, *after-tax costs* are a more relevant measure of potential cost burden than *pre-tax costs*. For non-tax-paying entities (e.g., State government and municipality owners of regulated facilities), the estimated costs used in this calculation include no adjustment for taxes.

63 Although regulated facilities are expected to install compliance technologies in years after 2011, EPA sought to ensure that the cost and revenue estimates used in the cost-to-revenue analysis would be consistent in terms of cost-year. Although, elsewhere in this analysis, EPA estimated compliance costs for future years based on potential real change in costs over time, EPA was less confident in projecting future revenue for facilities (and parent entities, later in the analysis) given the potential for plant-level changes (e.g., adding or retiring generating capacity) that could materially change the plant‟s (or parent entity‟s) revenue. Therefore, to avoid introducing additional uncertainty into the analysis, EPA used 2011 as the basis for the revenue and compliance cost estimates for facilities, regardless of when they are expected to incur compliance costs. Because this analysis relies on a ratio of cost to revenue as opposed to absolute values, the ratio for a given facility will be the same in years beyond the selected analysis year as long as the cost and revenue values are as of the same year and the basis for projecting those values is the same, going forward from the selected analysis year. That is, beyond the selected analysis year, cost and revenue values are assumed to change at the same rate and thus, the ratio of these values will be constant over time.

64 EPA used 5-year averages instead of single-year values to avoid possibly anomalous years in terms of electricity generation and prices. In using the year-by-year revenue values to develop an average over the data years, EPA eliminated generation values that are anomalously low from the average calculation. Such low generating output likely results from temporary disruption in operation, such as a generating unit being out of service for maintenance.

65 Because the *AEO2012* electricity price projections are in constant dollars, these adjustments yield 2020 revenue values in 2011 dollars.

analysis. The EIA-based facility revenue values used in these calculations are the same as those used to calculate cost-to-revenue ratios and discussed above.

- Because administrative costs were originally estimated for 2011 and in 2011 dollars, EPA made no additional adjustments in these values.

In the cost-to-revenue comparisons, EPA used cost-to-revenue thresholds of 1 and 3 percent as markers of potentially significant impacts. EPA assesses that facilities incurring costs below 1 percent of revenue will not face significant economic impacts, while facilities with costs of at least 1 percent but less than 3 percent of revenue have a chance of facing significant economic impacts, with facilities incurring costs of at least 3 percent of revenue have a higher probability of significant economic impacts. EPA compared facility-level costs and revenue *on a non-weighted basis* and determined the number of instances in which facilities incurred costs in the cost-to-revenue impact ranges. EPA applied facility-level sample weights (see *Appendix H: Sample Weights* for a discussion of how EPA developed and applied the weights) to the individual facility counts within each impact category to estimate the number of facilities at the population-level incurring these cost burdens.

4.2.2 Key Findings

Table 4-1 reports facility-level cost-to-revenue results by North American Reliability Corporation (NERC) region for the final rule and other options considered.[66] EPA estimates that overall, under the final rule, majority of regulated facilities (84 percent) will incur compliance costs less than 1 percent of revenue; this is true for all NERC regions. Under Proposal Option 4, majority of regulated facilities would also incur costs less than 1 percent of revenue, at 85 percent; again, this finding is true for all NERC regions. EPA estimates that Proposal Option 2 would have a greater impact on regulated facilities, with 62 percent of facilities incurring costs exceeding 1 percent of revenue, and 48 percent incurring costs exceeding 3 percent of revenue.[67] Under this option, findings vary across NERC regions.

As reported in *Table 4-1*, under the final rule and Proposal Option 4, for nearly half of regulated facilities compliance costs are slight in relation to the overall scale of business activity at the facility measured by facility revenue (i.e., less than 0.1 percent of revenue). Proposal Option 2 would impose higher costs on regulated facilities, with 70 percent incurring costs exceeding 0.1 percent of revenue.

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66 NERC is responsible for the overall reliability, planning, and coordination of the power grids. It is organized into regional councils that are responsible for the overall coordination of bulk power policies that affect their regions" reliability and quality of service (see *Chapter 2*).

67 In these calculations, facilities with cost-to-revenue ratios of at least 3 percent were included in the number of facilities with cost-to-revenue such ratios of at least 1 percent.

Table 4-1: Facility-Level Cost-to-Revenue Analysis Results by NERC Region, Final Rule-Existing Units and Other Options Considered[a,b,c]

NERC Region	Total Number of Facilities[d]	No Revenue[e]	Number of Facilities with a Ratio of		
			<1%	≥1 and <3%	≥3%
Proposal Option 4					
ASCC	0	0	0	0	0
FRCC	24	0	22	2	0
HICC	3	0	2	2	0
MRO	63	0	52	8	3
NPCC	58	0	51	4	3
RFC	136	0	118	4	14
SERC	141	2	123	7	9
SPP	37	0	28	8	1
TRE	46	0	31	7	7
WECC	36	0	34	2	0
Total	**544**	**2**	**461**	**44**	**37**
Final Rule					
ASCC	0	0	0	0	0
FRCC	24	0	22	2	0
HICC	3	0	2	2	0
MRO	63	0	49	11	3
NPCC	58	0	49	6	3
RFC	136	0	118	4	14
SERC	141	2	123	7	9
SPP	37	0	28	8	1
TRE	46	0	31	7	7
WECC	36	0	34	2	0
Total	**544**	**2**	**456**	**48**	**37**
Proposal Option 2					
ASCC	0	0	0	0	0
FRCC	24	0	9	8	8
HICC	3	0	0	0	3
MRO	63	0	20	16	26
NPCC	58	0	34	8	15
RFC	136	0	50	11	75
SERC	141	2	37	25	76
SPP	37	0	17	0	20
TRE	46	0	3	7	36
WECC	36	0	34	2	0
Total	**544**	**2**	**205**	**77**	**260**

a. ASCC – Alaska Systems Coordinating Council; FRCC – Florida Reliability Coordinating Council; HICC – Hawaii Coordinating Council; MRO – Midwest Reliability Organization; NPCC – Northeast Power Coordinating Council; RFC – ReliabilityFirst Corporation; SERC – Southeastern Electric Reliability Council; SPP – Southwest Power Pool; TRE - Texas Reliability Entity, and WECC – Western Energy Coordinating Council.
b. No explicitly analyzed facilities are located in the ASCC region. For more information on explicitly and implicitly analyzed facilities, see *Appendix H*.
c. Facility counts may not add up due to rounding.
d. Facility counts exclude baseline closures.
e. EIA reports no revenue for 1 facility (2 on a weighted basis); consequently, the facility-level cost-to-revenue analysis is conducted for 542 facilities.
Source: U.S. EPA Analysis, 2013

Table 4-2: Facilities with Costs Below 0.1 Percent of Revenue by NERC Region, Final Rule-Existing Units and Other Options Considered[a,b,c]

NERC Region	Total Number of Facilities[d]	No Revenue[e]	Number of Facilities with a Ratio of <0.1%	Number of Facilities with a Ratio of ≥0.1%
Proposal Option 4				
ASCC	0	0	0	0
FRCC	24	0	17	8
HICC	3	0	0	3
MRO	63	0	16	47
NPCC	58	0	37	21
RFC	136	0	53	83
SERC	141	2	72	67
SPP	37	0	13	24
TRE	46	0	19	27
WECC	36	0	34	2
Total	**544**	**2**	**261**	**281**
Final Rule				
ASCC	0	0	0	0
FRCC	24	0	17	8
HICC	3	0	0	3
MRO	63	0	16	47
NPCC	58	0	37	21
RFC	136	0	53	83
SERC	141	2	72	67
SPP	37	0	13	24
TRE	46	0	19	27
WECC	36	0	34	2
Total	**544**	**2**	**261**	**281**
Proposal Option 2				
ASCC	0	0	0	0
FRCC	24	0	7	17
HICC	3	0	0	3
MRO	63	0	8	55
NPCC	58	0	29	29
RFC	136	0	35	101
SERC	141	2	35	104
SPP	37	0	9	28
TRE	46	0	3	43
WECC	36	0	34	2
Total	**544**	**2**	**160**	**382**

a. ASCC – Alaska Systems Coordinating Council; FRCC – Florida Reliability Coordinating Council; HICC – Hawaii Coordinating Council; MRO – Midwest Reliability Organization; NPCC – Northeast Power Coordinating Council; RFC – ReliabilityFirst Corporation; SERC – Southeastern Electric Reliability Council; SPP – Southwest Power Pool; TRE - Texas Reliability Entity, and WECC – Western Energy Coordinating Council.
b. No explicitly analyzed facilities are located in the ASCC region. For more information on explicitly and implicitly analyzed facilities, see *Appendix H*.
c. Facility counts may not add up due to rounding.
d. Facility counts exclude baseline closures.
e. EIA reports no revenue for 1 facility (2 on a weighted basis); consequently, the facility-level cost-to-revenue analysis is conducted for 542 facilities.
Source: U.S. EPA Analysis, 2013

4.2.3 Uncertainties and Limitations

The analysis of facility-level impacts is subject to several uncertainties and limitations, including:

- Given the large number of implicitly analyzed facilities, it is impossible to develop sample weights that accurately account for all economic and operating differences among these facilities. Specifically, the facility count-based weights EPA used, account only for the number of facilities within each NERC region (see *Appendix H*). The actual compliance costs assigned to each of the explicitly analyzed facilities may differ from the costs that would be assigned to the implicitly analyzed facilities they represent. Consequently, the facility counts in each impact magnitude group may be over- or under-estimated.
- To the extent that the IPM-projected variable production costs used to estimate the cost of energy penalty and technology-installation downtime differ from actual 2011 variable production costs, the impact of the final rule and other options considered may be over- or under-stated.
- To the extent that cost and revenue values do not change at the same rate beyond 2011, individual facility cost-to-revenue ratios calculated using 2011 cost and revenue values and the total impact of the final rule and other options considered may be over- or under-stated.
- As noted above, for analytic convenience, EPA assumed that regulated facilities will not be able to pass on any increase in their production costs due to compliance with the rule to consumers through higher electricity prices. To the extent that this is not the case, this analysis overstates the potential impact of the final rule and other options considered on regulated facilities.

4.3 Cost-to-Revenue Screening Analysis: Entity-Level Analysis

EPA also assessed the economic impact of the final rule and other options considered at the level of parent entity, referred to as the "entity level" in the remainder of this section. The cost-to-revenue screening analysis at the entity level provides insight on the impact of compliance requirements on those entities that own more than one regulated facility; the analysis attempts to answer the question of whether owning multiple facilities that need to comply with today‟s rule leads to a significant financial hardship. EPA conducted this analysis at the *highest* level of *domestic* ownership, referred to as the "domestic parent entity." The Agency performed this analysis for only the entity with the largest share of ownership (the "majority owner") in a regulated facility.[68,69] As with the facility-level cost-to-revenue analysis (*Section 4.2*), the entity-level analysis presented in this chapter assumes no pass-through of compliance costs to electricity consumers.

4.3.1 Analysis Approach and Data Inputs

To assess the entity-level economic/financial impact of compliance requirements, EPA aggregated facility-level compliance costs, calculated on an annualized after-tax basis (see *Section 4.2*), to the entity level and compared these costs to entity revenue. Similar to the facility-level analysis, EPA used cost-to-revenue thresholds of 1 and 3 percent as markers of potentially significant impact. Also similar to the facility-level analysis, EPA used cost-to-revenue ratios of 1 and 3 percent to assess whether these entity-level costs could constitute a *significant impact*. The Agency assumed that entities incurring costs below 1 percent of revenue will not face significant economic impacts, while entities with costs of at least 1 percent but less than 3 percent of revenue have a chance of facing

68 Throughout these analyses, EPA refers to the owner with the largest ownership share as the "majority owner" even when the ownership share is less than 51 percent.

69 When two entities have equal ownership shares in a facility (e.g., 50 percent each), EPA analyzed both entities and assigned 100 percent of facility-level compliance costs to each entity.

significant economic impacts, with entities incurring costs of at least 3 percent of revenue have a higher probability of significant economic impacts.

This analysis involved the following steps:

- Identifying the parent entity.
- Determining the parent-entity revenue.
- Estimating compliance costs at the level of the parent entity.

Identifying the Parent Entity

EPA identified the highest-level domestic parent entity for the explicitly and implicitly analyzed Electric Generators (see *Appendix H*). As discussed below, EPA needs this information to support an estimate of entity-level impact that reflects the numbers of parent entities for both the explicitly and implicitly analyzed Electric Generators and associated parent entities.

EPA relied on the information from the 2010 Questionnaire for the Steam Electric Power Generating Effluent Guidelines (SE industry survey) (EPAXXXXX), 2009 EIA-861 and EIA-860 databases, and corporate/financial websites to determine ownership for Electric Generators that participated in the SE industry survey. For all other facilities, the Agency used the 2011 EIA-861 and 2011 EIA-860 databases and corporate/financial websites.[70] EPA used the same data sources to determine each entity‟s ownership share in each regulated facility it owned. As stated above, EPA conducted the entity-level cost-to-revenue analysis only for entities with the largest share of ownership in regulated facilities.

Estimating Parent-Entity Revenue

For each parent entity identified in the preceding step, EPA estimated revenue as follows:

- EPA used entity-level revenue from the SE industry survey, where reported. For entities with revenue reported for more than one survey year (i.e., 2007, 2008, and/or 2009), EPA used the average. For entities with revenue reported for only one survey year, EPA used the reported revenue.
- For entities with no revenue reported in the SE industry survey, EPA used revenue from corporate/financial websites, if available. To be consistent with the SE industry survey data, EPA tried to obtain revenue for at least one of the three survey years (i.e., 2007, 2008, and/or 2009) and used the average..[71]
- For publicly owned entities with no revenue reported in either the SE industry survey or on the corporate/financial websites, the Agency used the 2007-2011 average revenue from the EIA-861 database.

EPA restated entity revenue in 2011 dollars using the GDP Deflator. The Agency assumed that these revenues will be the same, in constant 2011 dollars, in the 2011 analysis year.[72]

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70 For facilities included in the analysis conducted in support of the revisions of the existing Effluent Limitations Guidelines and Standards for the Steam Electric Power Generating Point Source Category (SE ELG), EPA used ownership information from that analysis. At the time SE ELG ownership analysis was conducted, 2009 EIA data were the most current data available.

71 For two entities EPA used revenue reported for 2010.

72 Although regulated facilities are expected to install required technologies during a window of time that is farther into the future, EPA was not confident in projecting revenue of entities that own these facilities beyond 2011. As is the case with the facility-level cost-to-revenue analysis (*Section 4.2*), To be consistent with the revenue estimates, EPA used 2011 as the basis for the revenue and compliance cost estimates, regardless of when facilities owned by these entities are expected to incur compliance costs. Because this analysis relies on a ratio of cost to revenue as opposed to absolute values, the ratio for a given entity will be the same in years beyond the selected analysis year as long as cost and revenue values are as of the same year and the basis for projecting those values is the

Estimating Compliance Costs at the Parent-Entity Level

Because EPA developed compliance costs only for explicitly analyzed facilities, the Agency was able to assign facility-level costs directly to only the entities that own explicitly analyzed facilities, and for only the explicitly analyzed facilities that they own. However, such a limited analysis would have omitted consideration of the costs incurred by implicitly analyzed facilities at the parent-entity level. To address this limitation, EPA developed weighting approaches to estimate and assign costs at the entity level that would account for the costs incurred by both explicitly *and* implicitly analyzed facilities.

Because the facility-level weights do not apply at the parent-entity level, and further, because EPA cannot develop joint facility-/entity-level weights, EPA conducted this analysis using two weighting approaches. These approaches provide a range of estimates for the number of entities incurring compliance costs and the costs incurred by any entity that owns a regulated facility:

- *Using facility-level weights*: EPA applied *facility-level weights* to annualized, after-tax compliance costs it estimated for the explicitly analyzed facilities and aggregated those costs to the level of the parent entity that owns them. In effect, this analysis assumes that a parent entity that owns one or more explicitly analyzed facilities is assumed to own and incur the compliance costs for those facilities *and* the implicitly analyzed facilities represented by the sample weights applied to the costs for the explicitly analyzed facilities. EPA then compared the resulting entity-level costs to entity revenue. *To the extent that parent entities of explicitly analyzed facilities do not own implicitly analyzed facilities and consequently, would not incur their costs, this analysis will overstate impacts on individual parent entities. Because this analysis does not account for entities that own only implicitly analyzed facilities, it underestimates the number of parent entities that own regulated facilities*.
- *Using entity-level weights*: EPA aggregated annualized, after-tax compliance costs developed for the explicitly analyzed facilities to the level of the parent entity without applying facility-level weights and compared the resulting entity-level costs to entity revenue. To account for parent entities that own *only* implicitly analyzed facilities – and thus are not directly captured in the analysis that uses facility-level weights – EPA applied *entity-level weights* to entity counts in each cost-to-revenue impact category to extrapolate the findings to the *total* population of parent entities, including those that own only implicitly analyzed facilities .For details on development of entity-level weights, see *Appendix H*. *To the extent that parent entities of explicitly analyzed facilities also own implicitly analyzed facilities and consequently, would incur their costs, this analysis will understate impacts on individual parent entities. However, unlike the analysis conducted using facility-level weights, this analysis provides a more accurate estimate of the number of entities that own regulated facilities*.

4.3.2 Key Findings

Using *facility-level weights*, EPA estimates that 116 parent entities own 544 regulated facilities (*Table 4-3*). EPA estimates that the majority of parent entities (91 percent) will incur compliance costs less than 1 percent of revenue under the final rule. For the other options considered, EPA estimated that 91 percent and 65 percent of parent entities would incur compliance costs less than 1 percent of revenue under Proposal Option 4 and Proposal Option 2, respectively. As discussed above, *the analysis using only facility-level weights is likely to overstate the costs to individual parent entities but may underestimate the number of parent entities in a given impact range*.

Using *entity weights*, EPA estimates that 159 parent entities own 544 regulated facilities (*Table 4-3*). Similar to the analysis conducted using facility-level weights, EPA estimates that the majority of parent entities (94 percent) will incur compliance costs less than 1 percent of revenue under the final rule. For the other options considered,

same, going forward from the selected analysis year. That is, beyond the selected analysis year, cost and revenue values are assumed to change at the same rate and thus, the ratio of these values will be constant over time.

EPA estimates that 94 percent and 75 percent of parent entities would incur compliance costs less than 1 percent of revenue under Proposal Options 4 and 2, respectively. As described above, *the analysis using only entity-level weights is likely to understate the costs to individual parent entities but provides a more comprehensive estimate of the number of parent entities incurring costs*.

Overall, this analysis shows that the entity-level compliance costs are low in comparison to the entity-level revenues; consequently, parent entities that own more than one regulated facility will not be “penalized” additionally by the rule as a result of their ownership of multiple facilities.

Table 4-3: Entity-Level Cost-to-Revenue Analysis Results, Using Facility-Level Weights, Final Rule-Existing Units and Other Options Considered

	Using Facility-Level Weights					Using Entity-Level Weights				
		Number of Entities with a Cost-to-Revenue Ratio of					Number of Entities with a Cost-to-Revenue Ratio of			
Entity Type	**Total Number of Entities**	**<1%**	**≥1% and <3%**	**≥3%**	**Unknown[b]**	**Total Number of Entities**	**<1%**	**≥1% and <3%**	**≥3%**	**Unknown[b]**
Proposal Option 4										
Cooperative	13	12	0	1	0	22	20	2	0	0
Federal	1	1	0	0	0	1	1	0	0	0
Investor-owned	57	56	0	0	1	63	62	0	0	1
Municipality	15	12	3	0	0	37	37	0	0	0
Nonutility	23	18	0	0	5	27	21	0	0	6
Other Political Subdivision	4	3	0	0	1	6	5	0	0	2
State	3	3	0	0	0	3	3	0	0	0
Total	**116**	**105**	**3**	**1**	**7**	**159**	**149**	**2**	**0**	**8**
Final Rule										
Cooperative	13	12	0	1	0	22	20	2	0	0
Federal	1	1	0	0	0	1	1	0	0	0
Investor-owned	57	56	0	0	1	63	62	0	0	1
Municipality	15	12	3	0	0	37	37	0	0	0
Nonutility	23	18	0	0	5	27	21	0	0	6
Other Political Subdivision	4	3	0	0	1	6	5	0	0	2
State	3	3	0	0	0	3	3	0	0	0
Total	**116**	**105**	**3**	**1**	**7**	**159**	**149**	**2**	**0**	**8**
Proposal Option 2										
Cooperative	13	8	2	3	0	22	15	5	2	0
Federal	1	0	0	1	0	1	0	0	1	0
Investor-owned	57	39	11	6	1	63	53	9	0	1
Municipality	15	8	5	2	0	37	27	7	2	0
Nonutility	23	16	0	2	5	27	19	1	1	6
Other Political Subdivision	4	1	0	2	1	6	2	0	3	2
State	3	3	0	0	0	3	3	0	0	0
Total	**116**	**75**	**18**	**16**	**7**	**159**	**119**	**22**	**9**	**8**

a. Facility counts exclude baseline closures.
b. EPA was unable to determine revenues for 7 parent entities (8 weighted).
Source: U.S. EPA Analysis, 2013

4.3.3 Uncertainties and Limitations

The analysis of entity-level impacts is subject to several uncertainties and limitations, including:

- As described above, EPA applied the facility-level and entity-level weights in developing the estimates of entity-level impacts and the numbers of entities incurring costs in given cost-to-revenue impact ranges.

The use of these sample weights creates the potential to over- or under-state the impact of regulatory requirements.

- Use of the facility-level weights alone likely overstates the cost-to-revenue impact on identified parent entities while potentially understating the number of parent entities in a given cost-to-revenue impact category.
- Use of entity-level weights alone may underestimate the number of facilities owned by a parent entity and the associated compliance costs incurred by the parent entity.

- As discussed in *Section 0*, the facility count-based sample weights EPA used account only for the number of facilities within each NERC region (see *Appendix H*). The actual compliance costs assigned to each of the explicitly analyzed facilities may differ from the costs that would be assigned to the implicitly analyzed facilities that they represent. Consequently, the cost estimates generated through application of facility-level weights may be over- or under-stated at the level of a given parent entity. This may also be the case with the entity counts in each of the impact magnitude groups, even if the facility-weights account properly for facility ownership.
- The entity-level revenues obtained from the SE industry survey, corporate, and financial websites are for 2007, 2008, and/or 2009 and those estimated based on EIA data for 2007 through 2011. To the extent that actual 2011 entity revenues are different, on a constant dollar basis, from estimated values, the impact of the final rule and other options considered on parent entities of regulated facilities may be over- or under-estimated.
- To the extent that cost and revenue values change at different rates after 2011, individual entity cost-to-revenue ratios calculated using 2011 cost and revenue values, and the total impact of the final rule and other options considered may be over- or under-stated.
- As is the case with the facility-level analysis discussed in *Section 4.3*, the zero cost pass-through assumption is relatively simple and used for analytic convenience. To the extent that some entities are able to pass at least some compliance costs to consumers through higher electricity prices, this analysis overstates the potential entity-level impact of the final rule and other options considered.

4.4 Assessment of Impact of Compliance Costs on Electricity Prices

As part of its assessment of the cost and economic impact of the final rule and other options considered, in this section EPA assessed the potential increase in electricity prices to electricity consumer groups, including residential, commercial, industrial, and transportation, and to households (discussed in *Section 4.5*). The facility-level and entity-level cost-to-revenue screening analyses, discussed in *Sections 4.2* and *4.3*, reflect an assumption that regulated facilities and their parent entities will absorb 100 percent of the compliance burden (zero cost pass-through). In contrast, this electricity price impact analysis and the household electricity cost analysis, assume 100 percent pass-through of compliance costs in electricity prices (full cost pass-through). *If this full cost pass-through condition were to occur, the screening analyses assessed in Sections 4.2 and 4.3 would not be relevant because the two conditions (no cost pass-through and full cost pass-through) could not occur for the same regulated facility.*

As discussed earlier in *Section 4.2*, facilities located in States where electricity prices remain regulated under the traditional cost-of-service rate regulation framework, may be able to recover compliance cost-based increases in their production costs through increased electricity prices, depending on the business operation model of the facility owner(s), the ownership and operating structure of the facility itself, and the role of market mechanisms used to sell electricity. Cost recovery is less certain for facilities located in States where electric power generation has been deregulated. Moreover, even though individual facilities subject to the final rule may not be able to recover all of their compliance costs through increased revenues, the market-level effect may still be that consumers will see higher overall electricity prices because of changes in the cost structure of electricity supply and resulting changes in market-clearing prices in deregulated electricity markets.

For the electricity price impact and the household electricity cost analyses, the Agency assumed that 100 percent of compliance costs would be passed through to consumers. This assumption is appropriate for two reasons: (1) the majority of facilities subject to the final rule are likely to be able to recover increases in their production costs through increased electricity prices because these facilities operate in the cost-of-service framework and (2) for facilities operating in States where electric power generation has been deregulated, EPA cannot estimate this consumer price effect at the State level. Thus, this full cost pass-through assumption represents a "worst-case" impact scenario from the perspective of the electricity consumers. It will avoid understating the potential cost impact to consumers from the final rule and other options considered. To the extent that all compliance-related costs are *not* passed through to consumers, this analysis will overstate consumer impacts.

4.4.1 Analysis Approach and Data Inputs

EPA assumed that compliance costs would be fully passed through as increased electricity prices and allocated among customer classes in proportion to the baseline quantity of electricity consumption by consumer group. EPA performed this analysis at the NERC-region level, as follows:

- EPA summed weighted pre-tax facility-level annualized compliance costs by NERC region.[73]
- EPA estimated the approximate average price impact per unit of electricity consumption by dividing total compliance costs by the projected total MWh of sales in 2020 by NERC region, from *AEO2012*. EPA followed this approach for all NERC regions except Alaska Systems Coordinating Council (ASCC) and Hawaiian Islands Coordinating Council (HICC), for which the Agency used the historical quantity of electricity sales – total and by consumer group – from the 2011 EIA-861 database.
- EPA compared the estimated average price effect to the projected electricity price by customer class and NERC region for 2020 from *AEO2012* for all NERC regions except, again, for ASCC and HICC. To estimate average electricity price by consumer group for ASCC and HICC, EPA divided electricity revenue by electricity sales (MWh) for each consumer class, as reported in the 2011 EIA-861 database.

4.4.2 Key Findings

As reported in *Table 4-4*, under the final rule, annualized compliance costs (in cents per kWh sales) range from nearly zero ¢ in the WECC region to 0.041 ¢ in the HICC region. EPA reached the same finding for Proposal Option 4. Under Proposal Option 2, costs range from nearly zero ¢ in the WECC region to 0.349 ¢ in the HICC region. On average, across the United States, the final rule and Proposal Option 4 result in a cost of 0.011¢ per kWh, while Proposal Option 2 results in a higher cost of 0.172¢ per kWh.

73 These compliance costs are in 2011 dollars as of a given compliance year (2020 through 2030, depending on a regulatory option) and discounted to 2020 at 7 percent.

Table 4-4: Compliance Cost per kWh of Sales by NERC Region in 2020, Final Rule-Existing Units and Other Options Considered[a,b,c]

NERC Region	Annualized Pre-Tax Compliance Costs (at 2020; $2011; million)	Total Electricity Sales (at 2020; kWh)	Costs per Unit of Sales (2011¢/kWh Sales)
Proposal Option 4			
ASCC	$0	6,317,798,000	0.000
FRCC	$33,129,049	227,725,769,000	0.015
HICC	$4,041,504	9,961,653,000	0.041
MRO	$27,660,921	212,722,061,000	0.013
NPCC	$21,940,825	269,363,615,000	0.008
RFC	$112,163,246	875,942,368,000	0.013
SERC	$150,622,400	1,056,641,854,000	0.014
SPP	$37,890,448	206,449,802,000	0.018
TRE	$45,096,897	332,132,690,000	0.014
WECC	$797,583	705,550,339,000	0.000
U.S.	**$433,342,873**	**3,906,950,928,000**	**0.011**
Final Rule			
ASCC	$0	6,317,798,000	0.000
FRCC	$33,129,049	227,725,769,000	0.015
HICC	$4,041,504	9,961,653,000	0.041
MRO	$28,232,068	212,722,061,000	0.013
NPCC	$22,260,138	269,363,615,000	0.008
RFC	$112,417,194	875,942,368,000	0.013
SERC	$150,932,313	1,056,641,854,000	0.014
SPP	$37,890,448	206,449,802,000	0.018
TRE	$45,096,897	332,132,690,000	0.014
WECC	$797,583	705,550,339,000	0.000
U.S.	**$434,797,193**	**3,906,950,928,000**	**0.011**
Proposal Option 2			
ASCC	$0	6,317,798,000	0.000
FRCC	$401,221,859	227,725,769,000	0.176
HICC	$34,725,767	9,961,653,000	0.349
MRO	$413,629,193	212,722,061,000	0.194
NPCC	$339,846,361	269,363,615,000	0.126
RFC	$1,824,494,891	875,942,368,000	0.208
SERC	$2,381,341,769	1,056,641,854,000	0.225
SPP	$416,228,677	206,449,802,000	0.202
TRE	$892,913,408	332,132,690,000	0.269
WECC	$658,566	705,550,339,000	0.000
U.S.	**$6,705,060,491**	**3,906,950,928,000**	**0.172**

a. ASCC – Alaska Systems Coordinating Council; FRCC – Florida Reliability Coordinating Council; HICC – Hawaii Coordinating Council; MRO – Midwest Reliability Organization; NPCC – Northeast Power Coordinating Council; RFC – ReliabilityFirst Corporation; SERC – Southeastern Electric Reliability Council; SPP – Southwest Power Pool; TRE - Texas Reliability Entity, and WECC – Western Energy Coordinating Council.
b. The electricity price impact analysis assumes full pass-through of all compliance costs to electricity consumers.
c. No explicitly analyzed facilities are located in the ASCC region. For more information on explicitly and implicitly analyzed facilities see *Appendix H*.
Source: U.S. EPA Analysis, 2013

As discussed above, EPA compared the per kWh compliance cost to baseline electricity prices for each consumer group and for the average electricity price of all consumer groups, to determine the potential significance of these compliance costs on electricity prices. As reported in *Table 4-5*, EPA estimates that across the United States, the final rule will result in a 0.1 percent increase. The Agency estimates that Proposal Option 4 would result in approximately the same cost increase, while Proposal Option 2 would result in a higher increase of 1.8 percent. Looking across the four consumer groups, overall, industrial consumers are estimated to experience the highest price increases: 0.2 percent under the final rule and Proposal Option 4 and 2.6 percent under Proposal Option 2. Residential consumers are estimated to experience the lowest price increases: less than 0.1 percent under the final rule and Proposal Option 4 and 1.5 percent under Proposal Option 2.

Table 4-5: Projected 2020 Price (Cents per kWh of Sales) and Potential Price Increase Due to Compliance Costs by NERC Region (2011 cents), Final Rule-Existing Units and Other Options Considered[a,b,c]

NERC Region	Compliance Cost (¢/kWh)	Residential		Commercial		Industrial		Transportation		All Consumer Group Average	
		Baseline Price	% Change	Baseline Price	% Change	Baseline Price	% Change	Baseline Price	% Change	Baseline Price	% Change
Proposal Option 4											
ASCC	0.000	17.60	0.00%	15.08	0.00%	15.71	0.00%	NA	NA	16.06	0.00%
FRCC	0.015	11.81	0.12%	9.85	0.15%	9.14	0.16%	9.12	0.16%	10.80	0.13%
HICC	0.041	34.68	0.12%	32.37	0.13%	28.40	0.14%	NA	NA	31.59	0.13%
MRO	0.013	10.41	0.12%	8.26	0.16%	6.12	0.21%	8.83	0.15%	8.14	0.16%
NPCC	0.008	17.56	0.05%	14.01	0.06%	8.73	0.09%	13.42	0.06%	14.45	0.06%
RFC	0.013	12.84	0.10%	10.66	0.12%	7.27	0.18%	9.96	0.13%	10.40	0.12%
SERC	0.014	10.57	0.13%	9.19	0.16%	6.13	0.23%	8.60	0.17%	8.85	0.16%
SPP	0.018	9.60	0.19%	8.21	0.22%	5.97	0.31%	9.30	0.20%	8.10	0.23%
TRE	0.014	11.36	0.12%	7.60	0.18%	5.88	0.23%	9.62	0.14%	8.60	0.16%
WECC	0.000	11.92	0.00%	10.56	0.00%	6.67	0.00%	9.43	0.00%	10.14	0.00%
U.S.	**0.011**	**11.80**	**0.09%**	**10.00**	**0.11%**	**6.60**	**0.17%**	**10.36**	**0.11%**	**9.79**	**0.11%**
Final Rule											
ASCC	0.000	17.60	0.00%	15.08	0.00%	15.71	0.00%	NA	NA	16.06	0.00%
FRCC	0.015	11.81	0.12%	9.85	0.15%	9.14	0.16%	9.12	0.16%	10.80	0.13%
HICC	0.041	34.68	0.12%	32.37	0.13%	28.40	0.14%	NA	NA	31.59	0.13%
MRO	0.013	10.41	0.13%	8.26	0.16%	6.12	0.22%	8.83	0.15%	8.14	0.16%
NPCC	0.008	17.56	0.05%	14.01	0.06%	8.73	0.09%	13.42	0.06%	14.45	0.06%
RFC	0.013	12.84	0.10%	10.66	0.12%	7.27	0.18%	9.96	0.13%	10.40	0.12%
SERC	0.014	10.57	0.14%	9.19	0.16%	6.13	0.23%	8.60	0.17%	8.85	0.16%
SPP	0.018	9.60	0.19%	8.21	0.22%	5.97	0.31%	9.30	0.20%	8.10	0.23%
TRE	0.014	11.36	0.12%	7.60	0.18%	5.88	0.23%	9.62	0.14%	8.60	0.16%
WECC	0.000	11.92	0.00%	10.56	0.00%	6.67	0.00%	9.43	0.00%	10.14	0.00%
U.S.	**0.011**	**11.80**	**0.09%**	**10.00**	**0.11%**	**6.60**	**0.17%**	**10.36**	**0.11%**	**9.79**	**0.11%**
Proposal Option 2											
ASCC	0.000	17.60	0.00%	15.08	0.00%	15.71	0.00%	NA	NA	16.06	0.00%
FRCC	0.176	11.81	1.49%	9.85	1.79%	9.14	1.93%	9.12	1.93%	10.80	1.63%
HICC	0.349	34.68	1.01%	32.37	1.08%	28.40	1.23%	NA	NA	31.59	1.10%
MRO	0.194	10.41	1.87%	8.26	2.36%	6.12	3.18%	8.83	2.20%	8.14	2.39%
NPCC	0.126	17.56	0.72%	14.01	0.90%	8.73	1.45%	13.42	0.94%	14.45	0.87%
RFC	0.208	12.84	1.62%	10.66	1.95%	7.27	2.87%	9.96	2.09%	10.40	2.00%
SERC	0.225	10.57	2.13%	9.19	2.45%	6.13	3.67%	8.60	2.62%	8.85	2.55%
SPP	0.202	9.60	2.10%	8.21	2.46%	5.97	3.38%	9.30	2.17%	8.10	2.49%
TRE	0.269	11.36	2.37%	7.60	3.54%	5.88	4.57%	9.62	2.79%	8.60	3.13%
WECC	0.000	11.92	0.00%	10.56	0.00%	6.67	0.00%	9.43	0.00%	10.14	0.00%
U.S.	**0.172**	**11.80**	**1.45%**	**10.00**	**1.72%**	**6.60**	**2.60%**	**10.36**	**1.66%**	**9.79**	**1.75%**

a. ASCC – Alaska Systems Coordinating Council; FRCC – Florida Reliability Coordinating Council; HICC – Hawaii Coordinating Council; MRO – Midwest Reliability Organization; NPCC – Northeast Power Coordinating Council; RFC – ReliabilityFirst Corporation; SERC – Southeastern Electric Reliability Council; SPP – Southwest Power Pool; TRE - Texas Reliability Entity, and WECC – Western Energy Coordinating Council.
a. The electricity price impact analysis assumes full pass-through of all compliance costs to electricity consumers.
b. No explicitly analyzed facilities are located in the ASCC region. For more information on explicitly and implicitly analyzed facilities see *Appendix H*.
Source: U.S. EPA Analysis, 2013

4.4.3 Uncertainties and Limitations

This analysis is subject to several uncertainties and limitations, including:

- The assumptions regarding the full pass-through of compliance costs to electricity prices are relatively simple and are used for analytic convenience. To the extent that some facilities subject to the final rule would not fully pass compliance costs to consumers through higher electricity prices, this analysis overstates the potential impact of the final rule and other options considered on electricity consumers.

- Assuming that compliance costs would be recovered via rate regulation, the assumption that compliance costs would be allocated across consumer classes on a uniform cents per kilowatt-hour basis may not reflect the allocation that would occur in a regulated cost-of-service ratemaking framework. As a result, this analysis may over- or understate the impact in specific consumer groups.

4.5 Assessment of Impact of Compliance Costs on Household Electricity Costs

As described above, EPA assessed the potential impact of electricity prices increases on households, again assuming a simple 100 percent pass-through of compliance costs in electricity prices. As stated above, this assumption may overstate the eventual consumer cost impact.

4.5.1 Analysis Approach and Data Inputs

EPA assumed that compliance costs would be fully passed through as increased electricity prices and allocated among customer classes in proportion to the baseline quantity of electricity consumption by consumer group (*see Section 4.4*). EPA analyzed the potential impact on annual electricity costs at the level of the „model" household, using the estimated household electricity consumption quantity by NERC region. This is appropriate given the structure and functioning of sub-national electricity markets, around which NERC regions are defined, and regional variations in household electricity consumption profiles.[74] The steps in this calculation are as follows:

- EPA used the all consumer-group average cost per MWh of electricity sales estimated by NERC region in *Section 4.4*.
- To calculate average annual electricity sales per household, EPA divided the total quantity of *residential* sales (in MWh) for 2011 in each NERC region by the number of households in that region. The Agency obtained both the quantity of residential sales and the number of households for all NERC regions from the 2011 EIA-861 database. EPA assumed that the average quantity of electricity sales per household by NERC region would remain the same in 2020 as in 2011.
- To assess the potential annual cost impact per household, EPA multiplied the estimated average price impact by the average quantity of electricity sales per household in 2011 by NERC region.

4.5.2 Key Findings

Table 4-6 reports the results of this analysis by NERC region. As shown in *Table 4-6*, under the final rule, the average annual cost per residential household varies by NERC region, ranging from $0.01 in WECC to $2.85 in HICC. EPA reached the same finding for Proposal Option 4. Under Proposal Option 2, the average annual cost per residential household also varies across NERC regions, ranging from $0.01 in WECC to $39.97 in TRE. EPA estimated that on average, for a typical U.S. household, the final rule will results in a cost of $1.24 per household. EPA estimates that this cost would be $1.24 per household under Proposal Option 4 and $19.11 per household under Proposal Option 2.

[74] NERC is responsible for the overall reliability, planning, and coordination of the power grids; it is organized into regional councils that are responsible for the overall coordination of bulk power policies that affect their regions" reliability and quality of service (see *Chapter 2*).

Table 4-6: Average Annual Cost per Household in 2020 by NERC Region, Final Rule-Existing Units and Other Options Considered[a,b,c]

NERC Region	Total Annual Compliance Cost (at 2020; Million; $2011)	Total Electricity Sales (at 2020; MWh)	Compliance Cost per Unit of Sales ($2011/MWh)	Residential Electricity Sales (at 2020; MWh)	Number of Households (at 2020)	Residential Sales per Residential Consumer (MWh)	Compliance Cost per Household ($2011)
Proposal Option 4							
ASCC	$0	6,317,798	$0.00	2,133,693	273,567	7.80	$0.00
FRCC	$33,129,049	227,725,769	$0.15	109,212,622	8,068,660	13.54	$1.97
HICC	$4,041,504	9,961,653	$0.41	2,928,743	417,531	7.01	$2.85
MRO	$27,660,921	212,722,061	$0.13	58,858,262	5,649,545	10.42	$1.35
NPCC	$21,940,825	269,363,615	$0.08	101,786,945	13,476,777	7.55	$0.62
RFC	$112,163,246	875,942,368	$0.13	341,721,033	33,099,990	10.32	$1.32
SERC	$150,622,400	1,056,641,854	$0.14	364,114,367	24,888,714	14.63	$2.09
SPP	$37,890,448	206,449,802	$0.18	75,232,915	5,499,815	13.68	$2.51
TRE	$45,096,897	332,132,690	$0.14	73,030,256	4,912,196	14.87	$2.02
WECC	$797,583	705,550,339	$0.00	239,623,754	26,596,757	9.01	$0.01
U.S.	**$433,342,873**	**3,906,950,928**	**$0.11**	**1,368,642,590**	**122,883,552**	**11.14**	**$1.24**
Final Rule							
ASCC	$0	6,317,798	$0.00	2,133,693	273,567	7.80	$0.00
FRCC	$33,129,049	227,725,769	$0.15	109,212,622	8,068,660	13.54	$1.97
HICC	$4,041,504	9,961,653	$0.41	2,928,743	417,531	7.01	$2.85
MRO	$28,232,068	212,722,061	$0.13	58,858,262	5,649,545	10.42	$1.38
NPCC	$22,260,138	269,363,615	$0.08	101,786,945	13,476,777	7.55	$0.62
RFC	$112,417,194	875,942,368	$0.13	341,721,033	33,099,990	10.32	$1.32
SERC	$150,932,313	1,056,641,854	$0.14	364,114,367	24,888,714	14.63	$2.09
SPP	$37,890,448	206,449,802	$0.18	75,232,915	5,499,815	13.68	$2.51
TRE	$45,096,897	332,132,690	$0.14	73,030,256	4,912,196	14.87	$2.02
WECC	$797,583	705,550,339	$0.00	239,623,754	26,596,757	9.01	$0.01
U.S.	**$434,797,193**	**3,906,950,928**	**$0.11**	**1,368,642,590**	**122,883,552**	**11.14**	**$1.24**
Proposal Option 2							
ASCC	$0	6,317,798	$0.00	2,133,693	273,567	7.80	$0.00
FRCC	$401,221,859	227,725,769	$1.76	109,212,622	8,068,660	13.54	$23.85
HICC	$34,725,767	9,961,653	$3.49	2,928,743	417,531	7.01	$24.45
MRO	$413,629,193	212,722,061	$1.94	58,858,262	5,649,545	10.42	$20.26
NPCC	$339,846,361	269,363,615	$1.26	101,786,945	13,476,777	7.55	$9.53
RFC	$1,824,494,891	875,942,368	$2.08	341,721,033	33,099,990	10.32	$21.50
SERC	$2,381,341,769	1,056,641,854	$2.25	364,114,367	24,888,714	14.63	$32.97
SPP	$416,228,677	206,449,802	$2.02	75,232,915	5,499,815	13.68	$27.58
TRE	$892,913,408	332,132,690	$2.69	73,030,256	4,912,196	14.87	$39.97
WECC	$658,566	705,550,339	$0.00	239,623,754	26,596,757	9.01	$0.01
U.S.	**$6,705,060,491**	**3,906,950,928**	**$1.72**	**1,368,642,590**	**122,883,552**	**11.14**	**$19.11**

a. ASCC – Alaska Systems Coordinating Council; FRCC – Florida Reliability Coordinating Council; HICC – Hawaii Coordinating Council; MRO – Midwest Reliability Organization; NPCC – Northeast Power Coordinating Council; RFC – ReliabilityFirst Corporation; SERC – Southeastern Electric Reliability Council; SPP – Southwest Power Pool; TRE - Texas Reliability Entity, and WECC – Western Energy Coordinating Council.
b. The rate impact analysis assumes full pass-through of all compliance costs to electricity consumers.
c. No explicitly analyzed facilities are located in the ASCC region. For more information on explicitly and implicitly analyzed facilities see *Appendix H*.
Source: U.S. EPA Analysis, 2013

4.5.3 Uncertainties and Limitations

The assessment of household electricity cost impact is subject to several uncertainties and limitations, including:

- The assumption that costs would be passed on to consumers in the form of a flat-rate price increase per unit of power, to be distributed in proportion to the current electricity consumption profile. Within a rate regulation framework, fixed and variable costs would be allocated among customer classes based on the contribution of each class to consumption during specific electricity production periods. As a result, the allocation of costs to the residential class could be higher or lower than estimated by this approach. In addition, this analysis ignores heterogeneous impacts at the household level, which may be more important for utilities that use block-rate pricing or other price-discrimination rate structures, in which unit consumption prices vary by consumption level. The analysis also does not account for rate structures – e.g., lifeline rates – which could moderate the impact of otherwise increased rates on lower income households.
- As noted above, the assumptions regarding pass-through of compliance costs to electricity prices are relatively simple. To the extent that some facilities subject to the final rule are not able to fully pass compliance costs to consumers through higher electricity prices, this analysis overstates the potential impact of the final rule and other options considered on households.

4.6 Assessment of Short-Term Reduction in Capacity Availability Due to Installation Downtime

EPA assessed the reduction in availability of generating capacity due to installation downtime, as well as the impact of that capacity reduction on the North American bulk power system:

- For the final rule, 216 Electric Generators are estimated to incur net downtime, ranging from 0.3 to nine weeks
- For the Proposal Option 4, 212 Electric Generators are estimated to incur net downtime, ranging from 0.3 to nine weeks
- For the Proposal Option 2, 316 Electric Generators are estimated to incur net downtime of between 0.3 and nine weeks for IM technology installation and either four weeks (non-nuclear facilities) or 24 weeks (nuclear facilities) for installation of cooling towers.[75]

4.6.1 Analysis Approach and Data Inputs

EPA estimated the quantity of generating capacity that would be temporarily out of service by NERC region over the years in which facilities would be expected to install technology for complying with the final rule and other options considered. This assessment aims to provide insight into whether the quantity of capacity that might be out of service at a given time would be substantial in relation to total available generating capacity by NERC region, and, as a result, potentially pose a short-term issue in electricity supply reliability.

EPA distributed the occurrence of installation downtime by facility, and by NERC region, over the periods in which facilities are expected to install compliance technology under the final rule and other options considered. Specifically, EPA distributed downtime occurrence in such way that the total capacity out of service, *by NERC region*, would be as uniform as possible over the periods in which facilities would be expected to install compliance technology and incur downtime.

In implementing this procedure, EPA recognized that the amount of capacity *at a facility* that would need to be removed from service at a given time for completion of technology installation could not be "subdivided" – i.e., all of the generating capacity associated with a given intake structure would need to be taken out of service *at the same time* to complete compliance technology installation for that intake structure. However, the implementation of this procedure involved a key simplifying assumption that will tend to overstate the capacity availability impact

[75] These are counts of surveyed non-retired DQ and STQ facilities (see *Appendix H*).

during the several year period of technology installation. Compliance technologies and downtime duration for the installation of these technologies are assigned to individual intake structures. As a result, only generating capacity associated with a specific intake structure would be expected to be out of service as a result of technology installation at a given time. For this assessment, EPA was unable to identify the specific steam-generating units and quantity of generating capacity associated with the individual intake structures. Thus, this assessment assumes that *all steam-generating capacity* at a given facility will be out of service at the same time. Therefore, to the extent that some regulated facilities may operate several intake structures with different generating units assigned to the different intake structures, this analysis may overstate the impact of downtime on short-term capacity availability.

As discussed in *Chapter 3*, EPA assumed that facilities assigned non-cooling tower technologies will install compliance technology during a 5-year time period of 2018 through 2022. The Agency assumed that non-nuclear and nuclear facilities assigned cooling towers will install compliance technology during 5-year windows of 2021 through 2025, and 2026 through 2030, respectively. Further, EPA assumed that downtime will occur in the year when a facility would complete technology installation. The Agency also assumed that facilities will incur downtime during the spring or fall seasons so as not to coincide with either the winter or summer higher demand periods. Consequently, facilities incurring installation downtime would have 10 time periods in which the downtime might occur (i.e., two time periods – spring and fall – for each of the possible compliance years).

EPA distributed the occurrence of downtime capacity as evenly as possible over these potential technology- and facility type-specific downtime periods, recognizing the limitation described above that *all* of a facility‟s reported steam-generating capacity would need to be taken out of service *at once*.[76] The resulting assignments of facility capacity to individual downtime periods were then summed over the facilities, by NERC region, to yield a potential reduction in capacity availability by downtime period. EPA intentionally did not assign these capacity estimates to particular years and/or seasons; the Agency assumed that each NERC region would work with facility owners to coordinate the occurrence of downtime within a given technology installation/compliance window in such way as to minimize the potential for adverse reductions in supply reliability due to the occurrence of installation downtime.

This distribution of downtime occurrence illustrates how the incremental installation downtime and capacity availability effects *might* occur during the available technology installation/compliance window – based on this specific approach for distributing the occurrence of downtime. *Table 4-7* and *Table 4-8* present a summary of the resulting downtime capacity values by downtime period, for each NERC region, for the final rule and other options considered. For Proposal Option 2, downtime capacity for facilities assigned IM technologies and non-nuclear facilities installing cooling towers is presented separately from that for nuclear facilities assigned cooling towers, because the windows for installing compliance technology would be different. Specifically, the former set of facilities would incur downtime during a 8-year window of 2018 through 2025 (16 downtime periods), while the latter set of facilities would incur downtime during a 5-year window of 2026 through 2030 (10 downtime periods).

To evaluate the reliability impact of technology-installation downtime, EPA assessed whether the amount of generating capacity that would be unavailable could prevent a given NERC region from meeting Reliability Standards developed and enforced by NERC – i.e., whether a given NERC region will be able to meet its electricity demand and its reserve margin requirement.[77] EPA used information on projected generating capacity,

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76 This methodology of capacity assignment to individual downtime periods does not account for the National Pollutant Discharge Elimination System (NPDES) permit renewal. Consequently, for some facilities expected to incur technology installation downtime, it resulted in an implied compliance schedule slightly different from that assumed for the other cost and economic impact analyses discussed in this report.

77 For more information, see http://www.nerc.com/files/StandardsBackground.pdf and http://www.nerc.com/page.php?cid=2%7C97.

electricity demand, and reserve margins from NERC"s 2010 Long-Term Reliability Assessment (LTRA) report.[78] This report defines reserve margin as the amount of unused available capacity at peak load in an electric power system, as a percentage of total electricity demand (NERC, 2010). To make this reliability assessment, EPA compared, by NERC region, the *Reference Reserve Margin* set by NERC with projected *actual* reserve margin adjusted for capacity loss as the result of 316(b) technology installation, referred to herein as *Compliance Adjusted Potential Reserve Margin*.[79]

EPA calculated *Compliance Adjusted Potential Reserve Margin* as follows:

$$CAPRM = \left(APC - 316bNDC - NID\right) \big/ \left(NID\right) \qquad (4\text{-}1)$$

Where:

CAPRM = *Compliance Adjusted Potential Reserve Margin*, or baseline NERC region reserve margin (*Reference Reserve Margin*) adjusted for the reduction in available capacity due to installation downtime

APC = *Adjusted Potential Capacity* (MW), an available capacity value published by NERC and defined as the sum of net capacity resources, existing uncertain resources less all derates,[80] total proposed resources reduced by a confidence factor and net non-firm transactions. This capacity value includes future capacity additions and adjusts for the possibility that some of this future capacity may not be available when estimated to be constructed.

316bNDC = *316(b) Net Downtime Capacity* (MW), or estimated capacity reductions due to 316(b) installation downtime, by NERC region and year; calculated as described above.

NID = *Net Internal Demand* (MW), a NERC-published region-level electricity demand value, defined as total internal demand reduced by dispatchable controllable (capacity) demand response.

The result of this calculation is capacity that would be available at peak demand after adjusting available capacity for capacity reductions due to installation downtime as a percentage of projected electricity demand.

In performing this calculation, EPA used NERC-reported data for *Adjusted Potential Capacity* and *Net Internal Demand* for the winter season. The 2010 LTRA report contains analysis of winter and summer bulk power system reliability, but does not report information for the shoulder season demand periods – fall and spring – which are the periods when EPA expects that installation downtime would generally occur. EPA used information for the winter season because, for the United States, winter is generally a lower demand season than summer. Therefore, winter would provide a better basis for assessing the impact of downtime-based capacity reductions *that would actually be expected to occur during the lower demand shoulder season operating periods.* To the extent that technology installation occurs during the shoulder months of spring and fall, when electricity demand is on average below that during winter, the reliability impact estimated using winter demand is likely to be over-stated.

In addition, EPA used NERC-reported data for the 2019/2020 winter season, which is the last year covered by the 2010 LTRA report. EPA judges that values reported for 2019/2020, which lies just before the beginning of the

78 While the 2011 LTRA report was available at the time of this analysis, EPA used the 2010 LTRA report because the NERC regions covered in that report align better with NERC regions in the 2011 EIA database.

79 EPA obtained all baseline reserve margin and other information from NERC"s 2010 Long-Term Reliability Assessment (LTRA) report (NERC, 2010), available online at: http://www.nerc.com/files/2010%20LTRA.pdf.

80 Derated capacity accounts for the amount of capacity that is expected to be unavailable at seasonal peak due to expected operating limitations, or loss in production capability over time due to aging of the generating unit. For example, a generating unit may not be able to operate at regular full output during periods of peak summer demand due to thermal discharge limits. The forecast of capacity availability at peak demand periods would account these reductions.

technology installation period (2020-2030), provides a reasonable basis for assessing the reliability impact of downtime.

To assess whether the reduction in available capacity due to installation downtime could pose a bulk power reliability concern, EPA compared *Compliance Adjusted Potential Reserve Margin* with *Reference Reserve Margin*, as reported by NERC. *Reference Reserve Margin* (percent MW) represents either the target reserve margin provided by the region/subregion *or* the target reserve margin assigned by NERC based on capacity mix (i.e., thermal vs. hydro).

The results of these calculations are reported in *Table 4-7* reports for eight NERC regions (ERCOT, FRCC, MRO, NPCC, RFC, SERC, SPP, and WECC):

- NERC Reference Reserve Margin (percentage) level
- *Net Internal Demand* (MW) for the 2019/2020 winter season
- *Adjusted Potential Capacity* (MW) for the 2019/2020 winter season
- EPA"s estimate of *Downtime Capacity* (MW) for each of the analyzed downtime periods
- *Compliance Adjusted Potential Reserve Margin* (percentage), as calculated above, by downtime period, based on the 2019/2020 winter *Net Internal Demand* and *Adjusted Potential Capacity*.

In any downtime period, the higher the percentage of total capacity that potentially would be out of service due to regulatory compliance, the greater the potential for electricity supply reliability effects.

It is important to note that this assessment of downtime effects does not account for the duration of downtime. As noted above, the analysis assumes that all of the downtime across facilities in a region occurs at the same time within a given seasonal analysis period. This assumption may lead to significant overstatement of the potential impact of downtime on electricity supply reliability to the extent that individual facilities would require downtime that is shorter than the seasonal analysis period *and* individual facilities" downtime could be scheduled to avoid overlap during a given seasonal analysis period.

Because energy reliability in Alaska and Hawaii is not under NERC"s oversight, the 2010 LTRA report does not include information on these States. Therefore, to assess reliability impact for these regions, EPA performed an additional analysis to examine downtime capacity as a percentage of total regional capacity (*Table 4-8*).

For IM technologies, which is the minimum technology standard required nationally under the final rule and other options considered, the required duration of net downtime is between 0.3 and nine weeks. Under the final rule, only three analyzed facilities are estimated to incur nine weeks of downtime, while net downtime averages 0.3 weeks for the majority of facilities. Under other options considered – Proposal Option 4 and Proposal Option 2 – only two and one facilities installing IM technologies would incur nine weeks of downtime, respectively; similar to the final rule, for majority of facilities installing IM technologies under these options net downtime would average 0.3 weeks. For cooling towers required under Proposal Option 2, most non-nuclear facilities, which are the vast majority of Electric Generators, are assigned 4 weeks of downtime, while some non-nuclear facilities are assigned no net downtime. Only nine nuclear facilities are assigned 24 weeks of downtime, while the other nuclear facilities are assigned no net downtime. Thus, incremental downtime is quite low for nearly all facilities under the final rule and Proposal Option 4 and for facilities assigned IM technologies under Proposal Option 2.

4.6.2 Key Findings

For the eight NERC regions that EPA was able to analyze using the methodology outlined above (i.e., all NERC regions except for ASCC and HICC), capacity loss due to compliance-technology installation is not expected to prevent any of these regions from meeting either the expected electricity demand or required reserve capacity margin under either the final rule or other options considered in development of the final rule. *Table 4-7* reports, for each NERC region, the Reference Margin (second column from left), the baseline Demand and Capacity values derived from the LTRA report, and the estimated Downtime Capacity and Compliance Adjusted Potential Capacity Margin for each of the 10 periods in which downtime might occur under the final rule and Proposal Option 4 (5-year IM technology-installation window of 2018-2022) and for each of the 16 periods under Proposal Option 2 (8-year technology-installation window of 2018-2025 for IM technology (2018-2022) and cooling towers at non-nuclear facilities (2021-2025)). As presented in *Table 4-7*, Compliance Adjusted Potential Capacity Margin remains greater than the target Reference Margin for the final rule and other options considered across all eight NERC regions and potential downtime periods.

To assess reliability impact for ASCC and HICC, EPA performed an additional analysis where the Agency looked at downtime capacity as a percentage of total regional capacity in each of these two regions (*Table 4-8*). Only one Electric Generator is located in ASCC (a non-nuclear facility with relatively low capacity of 28 MW). This facility is expected to install IM technology under all three analyzed options; this installation will require 0.3 weeks of net downtime. Given the small facility size and relatively short net downtime duration that would be required to install IM technology, EPA does not expect large reliability effects in the ASCC region as a result of this rule.

The HICC region includes three Electric Generators, all of which are non-nuclear. These facilities are relatively large with 610 MW, 372 MW, and 104 MW of steam capacity. EPA estimates that under the final rule, only one facility (610 MW) will incur additional downtime (0.3 weeks); this facility represents approximately 22 percent of the region"s total electric generating capacity. These findings are also true for Proposal Option 4. EPA estimates that under Proposal Option 2, all three facilities would incur net downtime of 4 weeks for cooling tower installation; these facilities represent 22 percent, 13 percent, and 4 percent of the total regional capacity. Given the relatively large size of these facilities, it is quite likely for them to operate multiple intake structures, in which case they would not need to be completely out of service to complete technology installation.

In conclusion, EPA does not expect the short-term loss of capacity as the result of compliance with the final rule and other options considered to cause large reliability effects in any of the NERC regions.

Table 4-7: Summary of Downtime Impact Analysis by NERC Region and Downtime Period, Final Rule-Existing Units and Other Options Considered

NERC Region[a]	Ref Margin[b]	Demand[c]	Cap[d]	Measure[e,f,g]	Downtime Periods[h] 1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16
Proposal Option 4																				
IM Technology																				
FRCC	15.0%	49,082	66,175	Downtime Capacity (MW)	3,333	1,722	1,159	1,042	962	935	395	0	0	0						
				Compl Adj Potential Cap Margin	28%	31%	32%	33%	33%	33%	34%	35%	35%	35%						
MRO	15.0%	38,423	59,120	Downtime Capacity (MW)	1,532	1,506	1,474	1,502	1,504	1,507	1,523	1,521	1,473	395						
				Compl Adj Potential Cap Margin	50%	50%	50%	50%	50%	50%	50%	50%	50%	53%						
NPCC	15.0%	48,959	83,830	Downtime Capacity (MW)	1,037	821	768	690	589	592	476	447	0	0						
				Compl Adj Potential Cap Margin	69%	70%	70%	70%	70%	70%	70%	70%	71%	71%						
RFC	15.0%	157,200	243,589	Downtime Capacity (MW)	5,413	5,390	5,408	5,397	5,406	5,409	5,410	5,409	5,346	627						
				Compl Adj Potential Cap Margin	52%	52%	52%	52%	52%	52%	52%	52%	52%	55%						
SERC	15.0%	201,577	291,657	Downtime Capacity (MW)	7,228	7,231	7,199	7,222	7,159	7,226	7,218	7,124	7,227	903						
				Compl Adj Potential Cap Margin	41%	41%	41%	41%	41%	41%	41%	41%	41%	44%						
SPP	13.6%	37,294	69,820	Downtime Capacity (MW)	1,779	1,707	1,701	1,674	1,791	1,763	1,702	1,769	1,693	738						
				Compl Adj Potential Cap Margin	82%	83%	83%	83%	82%	82%	83%	82%	83%	85%						
TRE	12.5%	49,307	98,049	Downtime Capacity (MW)	3,992	2,380	2,243	2,247	2,219	2,069	2,172	2,079	1,182	0						
				Compl Adj Potential Cap Margin	91%	94%	94%	94%	94%	95%	94%	95%	96%	99%						
WECC	14.1%	117,072	185,346	Downtime Capacity (MW)	2,270	1,129	817	202	0	0	0	0	0	0						
				Compl Adj Potential Cap Margin	56%	57%	58%	58%	58%	58%	58%	58%	58%	58%						
Final Rule																				
IM Technology																				
FRCC	15.0%	49,082	66,175	Downtime Capacity (MW)	3,333	1,722	1,159	1,042	962	935	395	0	0	0						
				Compl Adj Potential Cap Margin	28%	31%	32%	33%	33%	33%	34%	35%	35%	35%						
MRO	15.0%	38,423	59,120	Downtime Capacity (MW)	1,535	1,518	1,537	1,527	1,504	1,507	1,523	1,521	1,473	332						
				Compl Adj Potential Cap Margin	50%	50%	50%	50%	50%	50%	50%	50%	50%	53%						
NPCC	15.0%	48,959	83,830	Downtime Capacity (MW)	1,037	821	768	690	589	626	629	637	0	0						
				Compl Adj Potential Cap Margin	69%	70%	70%	70%	70%	70%	70%	70%	71%	71%						
RFC	15.0%	157,200	243,589	Downtime Capacity (MW)	5,420	5,414	5,408	5,397	5,406	5,409	5,416	5,415	5,413	578						
				Compl Adj Potential Cap Margin	52%	52%	52%	52%	52%	52%	52%	52%	52%	55%						
SERC	15.0%	201,577	291,657	Downtime Capacity (MW)	7,228	7,231	7,199	7,222	7,159	7,226	7,218	7,124	7,227	903						
				Compl Adj Potential Cap Margin	41%	41%	41%	41%	41%	41%	41%	41%	41%	44%						
SPP	13.6%	37,294	69,820	Downtime Capacity (MW)	1,779	1,707	1,701	1,674	1,791	1,763	1,702	1,769	1,693	738						
				Compl Adj Potential Cap Margin	82%	83%	83%	83%	82%	82%	83%	82%	83%	85%						
TRE	12.5%	49,307	98,049	Downtime Capacity (MW)	3,992	2,380	2,243	2,247	2,219	2,069	2,172	2,079	1,182	0						
				Compl Adj Potential Cap Margin	91%	94%	94%	94%	94%	95%	94%	95%	96%	99%						
WECC	14.1%	117,072	185,346	Downtime Capacity (MW)	2,270	1,129	817	202	0	0	0	0	0	0						
				Compl Adj Potential Cap Margin	56%	57%	58%	58%	58%	58%	58%	58%	58%	58%						

Table 4-7: Summary of Downtime Impact Analysis by NERC Region and Downtime Period, Final Rule-Existing Units and Other Options Considered

NERC Region[a]	Ref Margin[b]	Demand[c]	Cap[d]	Measure[e,f,g]	Downtime Periods[h]															
					1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16
Proposal Option 2																				
IM Technology and Cooling Towers – Non-Nuclear Facilities																				
FRCC	15.0%	49,082	66,175	Downtime Capacity (MW)	0	0	0	0	0	0	4,318	3,333	2,534	2,432	2,345	2,412	2,412	2,400	127	0
				Compl Adj Potential Cap Margin	35%	35%	35%	35%	35%	35%	26%	28%	30%	30%	30%	30%	30%	30%	35%	35%
MRO	15.0%	38,423	59,120	Downtime Capacity (MW)	456	117	115	99	107	88	1,852	1,871	1,856	1,857	1,807	1,811	1,875	1,856	1,795	471
				Compl Adj Potential Cap Margin	53%	54%	54%	54%	54%	54%	49%	49%	49%	49%	49%	49%	49%	49%	49%	53%
NPCC	15.0%	48,959	83,830	Downtime Capacity (MW)	376	311	103	25	0	0	2,895	1,778	1,428	1,187	1,258	1,254	1,227	740	0	0
				Compl Adj Potential Cap Margin	70%	71%	71%	71%	71%	71%	65%	68%	68%	69%	69%	69%	69%	70%	71%	71%
RFC	15.0%	157,200	243,589	Downtime Capacity (MW)	1,786	1,217	304	0	0	0	7,201	7,174	7,190	7,206	7,176	7,173	7,195	7,195	7,122	910
				Compl Adj Potential Cap Margin	54%	54%	55%	55%	55%	55%	50%	50%	50%	50%	50%	50%	50%	50%	50%	54%
SERC	15.0%	201,577	291,657	Downtime Capacity (MW)	654	543	88	0	0	0	9,897	9,847	9,871	9,896	9,887	9,881	9,866	9,898	9,867	1,076
				Compl Adj Potential Cap Margin	44%	44%	45%	45%	45%	45%	40%	40%	40%	40%	40%	40%	40%	40%	40%	44%
SPP	13.6%	37,294	69,820	Downtime Capacity (MW)	185	0	0	0	0	0	2,017	2,014	1,994	1,913	2,013	1,854	2,020	1,769	1,843	1,025
				Compl Adj Potential Cap Margin	87%	87%	87%	87%	87%	87%	82%	82%	82%	82%	82%	82%	82%	82%	82%	84%
TRE	12.5%	49,307	98,049	Downtime Capacity (MW)	0	0	0	0	0	0	3,992	3,462	3,424	3,481	3,434	3,450	3,475	3,488	3,365	239
				Compl Adj Potential Cap Margin	99%	99%	99%	99%	99%	99%	91%	92%	92%	92%	92%	92%	92%	92%	92%	98%
WECC	14.1%	117,072	185,346	Downtime Capacity (MW)	2,270	0	0	0	0	0	1,129	817	202	0	0	0	0	0	0	0
				Compl Adj Potential Cap Margin	56%	58%	58%	58%	58%	58%	57%	58%	58%	58%	58%	58%	58%	58%	58%	58%
Cooling Towers –Nuclear Facilities																				
FRCC	15.0%	49,082	66,175	Downtime Capacity (MW)	0	0	0	0	0	0	0	0	0	0						
				Compl Adj Potential Cap Margin	35%	35%	35%	35%	35%	35%	35%	35%	35%	35%						
MRO	15.0%	38,423	59,120	Downtime Capacity (MW)	631	0	0	0	0	0	0	0	0	0						
				Compl Adj Potential Cap Margin	52%	54%	54%	54%	54%	54%	54%	54%	54%	54%						
NPCC	15.0%	48,959	83,830	Downtime Capacity (MW)	563	0	0	0	0	0	0	0	0	0						
				Compl Adj Potential Cap Margin	70%	71%	71%	71%	71%	71%	71%	71%	71%	71%						
RFC	15.0%	157,200	243,589	Downtime Capacity (MW)	2,019	2,019	0	0	0	0	0	0	0	0						
				Compl Adj Potential Cap Margin	54%	54%	55%	55%	55%	55%	55%	55%	55%	55%						
SERC	15.0%	201,577	291,657	Downtime Capacity (MW)	3,494	2,003	1,845	1,200	1,138	0	0	0	0	0						
				Compl Adj Potential Cap Margin	43%	44%	44%	44%	44%	45%	45%	45%	45%	45%						
SPP	13.6%	37,294	69,820	Downtime Capacity (MW)	0	0	0	0	0	0	0	0	0	0						
				Compl Adj Potential Cap Margin	87%	87%	87%	87%	87%	87%	87%	87%	87%	87%						
TRE	12.5%	49,307	98,049	Downtime Capacity (MW)	0	0	0	0	0	0	0	0	0	0						
				Compl Adj Potential Cap Margin	99%	99%	99%	99%	99%	99%	99%	99%	99%	99%						
WECC	14.1%	117,072	185,346	Downtime Capacity (MW)	0	0	0	0	0	0	0	0	0	0						
				Compl Adj Potential Cap Margin	58%	58%	58%	58%	58%	58%	58%	58%	58%	58%						

Table 4-7: Summary of Downtime Impact Analysis by NERC Region and Downtime Period, Final Rule-Existing Units and Other Options Considered

NERC Region[a]	Ref Margin[b]	Demand[c]	Cap[d]	Measure[e,f,g]	Downtime Periods[h]															
					1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16

a. ASCC – Alaska Systems Coordinating Council; FRCC – Florida Reliability Coordinating Council; HICC – Hawaii Coordinating Council; MRO – Midwest Reliability Organization; NPCC – Northeast Power Coordinating Council; RFC – ReliabilityFirst Corporation; SERC – Southeastern Electric Reliability Council; SPP – Southwest Power Pool; TRE - Texas Reliability Entity, and WECC – Western Energy Coordinating Council.
b. Reference reserve margin: either the target reserve margin provided by the region/subregion or NERC assigned based on capacity mix (i.e., 15 percent and 10 percent reserve margin for predominantly thermal and hydro systems, respectively).
c. The projected 2019/2020 winter net internal demand. Net internal demand is a total internal demand reduced by dispatchable controllable (capacity) demand response used to reduce peak load.
d. The projected 2019/2020 winter adjusted potential capacity. Adjusted potential capacity is the sum of existing-certain, existing-other, future-planned, adjusted future-other, adjusted conceptual resources, net firm, expected, and provisional transactions. For more information, see the 2010 LTRA report.
e. Compliance Adjusted Potential Capacity Margin is calculated as (Adjusted Potential Capacity – Downtime Capacity - Net Internal Demand) / Net Internal Demand
f. 316(b) Facility-Level Downtime Capacity values are from the 2011 EIA-860 database. Facility-level capacity used for the downtime assessment includes steam capacity only.
g. In most instances when downtime capacity in a given time period exceeds 2 percent of the total capacity in the region, this downtime capacity belongs to an individual facility and, therefore, could not be subdivided to ensure a more uniform downtime capacity distribution across time periods. To the extent that the entire steam generating capacity of these individual facilities would not need to be out of service at the same time to complete technology installation, the assessment of capacity availability impact is likely overstated in these instances.
h. Facilities are estimated to experience downtime due to installation of IM technologies during a 5-year period of 2018 through 2022. Non-nuclear and nuclear facilities are estimated to experience downtime during 5-year windows of 2021 through 2025 and 2026 through 2030, respectively. Consequently, under Proposal Option 2, during 2021 and 2022 some facilities will be installing cooling towers, while some will be installing IM technologies.
Source: U.S. EPA Analysis, 2013; NERC 2010

Table 4-8: Downtime Capacity for the ASCC and HICC NERC Regions, by Region and Compliance Year, Final Rule-Existing Units and Other Options Considered

NERC Region	Total Regional Capacity (MW)[a]	Measure[b,c]	1	2	3
Proposal Option 4					
IM Technology					
ASCC	2,261	Downtime Capacity (MW)	28	0	0
		% of Region Total	1.2%	0.0%	0.0%
HICC	2,810	Downtime Capacity (MW)	610	0	0
		% of Region Total	21.7%	0.0%	0.0%
Final Rule					
IM Technology					
ASCC	2,261	Downtime Capacity (MW)	28	0	0
		% of Region Total	1.2%	0.0%	0.0%
HICC	2,810	Downtime Capacity (MW)	610	0	0
		% of Region Total	21.7%	0.0%	0.0%
Proposal Option 2					
IM Technology and Cooling Towers – Non-Nuclear Facilities					
ASCC	2,261	Downtime Capacity (MW)	28	0	0
		% of Region Total	1.24%	0.0%	0.00%
HICC	2,810	Downtime Capacity (MW)	610	372	104
		% of Region Total	21.7%	13.2%	3.7%
Cooling Towers – Nuclear Facilities					
ASCC	2,261	Downtime Capacity (MW)	0	0	0
		% of Region Total	0.00%	0.00%	0.00%
HICC	2,810	Downtime Capacity (MW)	0	0	0
		% of Region Total	0.00%	0.00%	0.00%

a. Regional capacity values for HICC and ASCC are from the 2011 EIA-860 database. Regional capacity is a total of steam and non-steam capacity.
b. Facility-level downtime capacity values are from the 2011 EIA-860 database. Facility-level capacity used for the downtime assessment includes steam capacity only.
c. There is only one Electric Generator in the ASCC NERC region and three Electric Generators in the HICC NERC region; none of these facilities are nuclear.
d. When downtime capacity in a given time period exceeds 2 percent of the total capacity in the region, this downtime capacity belongs to an individual facility and, therefore, could not be subdivided to ensure a more uniform downtime capacity distribution across time periods. To the extent that the entire steam generating capacity of these individual facilities would not need to be out of service at the same time to complete technology installation, the assessment of capacity availability impact is likely overstated in these instances.
Source: U.S. EPA Analysis, 2013; U.S. DOE, 2011x

4.6.3 Uncertainties and Limitations

The analysis of reliability effects is subject to several uncertainties and limitations, including:

- To the extent that generating capacity and electricity demand projected for winter of 2019 are different from the actual capacity and demand during installation downtime periods, reliability effects may be over- or under-estimated.
- To the extent that winter electricity demand on average exceeds demand occurring during the shoulder seasons of spring and fall, reliability effects may be over-estimated.

5 Economic Impact Analyses – Manufacturers

5.1 Introduction

This chapter assesses the expected economic impact of the existing units provisions of the final rule and other options EPA considered on Manufacturers. As explained in *Chapter 1*, the cost of the new units provision for Manufacturers is negligible. Therefore, the cost and economic impact assessment discussion in this chapter focuses on existing units only and the terms *final rule* and *other options considered* refer to existing units. Analysis of the new units provision is presented in *Chapter 6*. *Chapter 5* includes a facility-level analysis, which assesses the impact of compliance requirements and costs on Manufacturers, and an entity-level analysis, which assesses the regulation‟s impact on the entities that own Manufacturers (parent entities or entities).

The remaining sections of this chapter are as follows:

- Overview of the Manufacturers impact analysis, including:
  - Summary of the impact concepts used in this analysis
  - EPA‟s estimates of the number of Manufacturers
  - Data sources for this analysis
- Facility-level impact analysis: severe impacts
- Facility-level impact analysis: moderate impacts
- Entity-level impact analysis
- Uncertainties and limitations.

5.2 Overview of the Manufacturers Impact Analysis

5.2.1 Facility Universe

EPA assessed the cost and economic impact of the final rule and other options EPA considered on regulated manufacturing facilities, and the entities that own these facilities. In the same way as undertaken for the previous 316(b) analyses, this analysis focused on 575 facilities in the six Primary Manufacturing Industries and 13 facilities in the Other Industries. As the first step in this analysis, EPA determined which of these facilities show materially inadequate financial performance in the baseline – that is, in the absence of the regulation. These ***baseline closure*** facilities are at substantial risk of financial failure regardless of the final 316(b) regulation. EPA excluded them from the analysis of cost and regulatory impacts.

EPA undertook the impact analysis for the Primary Manufacturing Industries and estimated industry-level cost and impact results by applying sample weights to results estimated for surveyed facilities. The impact analysis for Other Industries is restricted to a sample of 12 facilities for which EPA received surveys, but which are not part of the statistically valid sample (for details, see *Appendix H*). As a result, EPA‟s analysis for the Other Industries group is limited to these known facilities; EPA did not apply sample weights to extend the findings to a broader population.[81] Although EPA performed the impact analysis for the Other Industries group using only these facilities, in EPA‟s view, its analysis for the Other Industries group provides a sufficient basis for regulation development. EPA‟s review of the engineering characteristics of cooling water intake and use in the Other Industries group indicates that cooling water intake and use in these industries do not differ materially from that of Generators or Manufacturers in the Primary Manufacturing Industries.

[81] Said another way, EPA used weights of *one* for these facilities.

5.2.2 Analysis Concept

In the same way as described for Electric Generators in Chapter 4, EPA undertook the facility-level economic impact analysis of the final rule for Manufacturers in two parts: (1) a ***cost-to-revenue screening analysis*** (*Section 5.3*) to assess the potential significance of compliance costs to regulated facilities, and (2) a more rigorous ***facility-level impact analysis*** (*Section 5.3*) , which uses economic/financial impact using cash flow models to assess the impact of compliance costs on the financial performance of regulated facilities. The facility-level impact analysis focuses first on the potential for facility closures and the associated losses in jobs, if any, at facilities that would close, due to the regulation **(*severe impacts*)**. The analysis then considers the potential for financial stress short of closure based on adverse changes in a facility‟s financial position that are not threatening to its short-term viability (***moderate impacts***), but may present challenges in obtaining financing (*Section 5.5*). The ***entity-level impact analysis*** assesses whether entities that own multiple facilities are likely to incur a significant impact due to the entity‟s total compliance cost burden (*Section 5.6*). Impacts may be significant at the entity level whether or not they are significant at the facility level, if an entity owns a number of facilities that incur costs and the total of these costs is substantial at the entity level. In addition, an entity-level analysis supports assessment of impacts on small businesses, as required by the Regulatory Flexibility Act (RFA) (*Chapter 11*). Other chapters consider the impacts on small entities.[82]

5.2.3 Data Sources

This analysis relies on data provided in the financial section of the 2000 Section 316(b) Detailed Industry Questionnaire (DQ) (316(b) survey). The 316(b) survey financial data include facility and parent-entity income statements and balance sheets for the three years 1996, 1997, and 1998.

In addition to the survey data, EPA used the following secondary data sources to characterize economic and financial conditions in the analyzed industries:

- Department of Commerce economic census and survey data, including the *Economic Census (EC); Census of Manufactures, Annual Surveys of Manufactures* (ASM)*, Quarterly Financial Report* (QFR), and *Survey of Plant Capacity (SPC)*;
- *Interactive Tariff and Trade Dataweb*, published by the U.S. International Trade Commission;
- Federal Reserve Board of Governors industry data, including *Moody's Yield on Seasoned Corporate Baa and Aaa Bonds for all industries* and *Industrial Production and Capacity Utilization;*
- *Producer Price Index,* published by the Bureau of Labor Statistics;
- *Implicit Price Deflator for Gross Domestic Product,* published by the U.S. Bureau of Economic Analysis;
- *Annual Statement Studies,* published by Risk Management Association (RMA); and
- Statistics of U.S. Businesses (SUSB).

The following sections describe the calculations and results of the severe and moderate facility-level impact assessments and the entity-level impact assessment.

5.3 Facility-Level Impacts: Cost-to-Revenue Screening Analysis

EPA conducted a cost-to-revenue-based screening analysis to determine the potential impact of regulatory costs on Manufacturers. In the cost-to-revenue comparisons, EPA used cost-to-revenue thresholds of 1 and 3 percent as

82 This chapter also includes four appendixes, which address particular elements of the cost and economic impact analysis conducted for Manufacturers.

markers of potentially significant impacts. EPA assesses that facilities incurring costs below 1 percent of revenue will not face significant economic impacts, while facilities with costs of at least 1 percent but less than 3 percent of revenue have a chance of facing significant economic impacts, with facilities incurring costs of at least 3 percent of revenue have a higher probability of significant economic impacts. EPA compared after-tax annualized compliance costs and revenue *on a non-weighted basis* and determined the number of instances in which facilities incurred costs in these cost-to-revenue impact ranges. EPA applied facility-level sample weights (see *Appendix H: Sample Weights* for a discussion of how EPA developed and applied the weights) to the individual facility counts within each impact category to estimate the number of facilities at the population-level incurring these cost burdens.

Of the 579 facilities, 571 facilities incur costs less than 1 percent of revenue and eight facilities incur costs between 1 and 3 percent of revenue under the final rule (see *Table 5-1*). For Proposal Option 4, all 579 facilities incur costs less than 1 percent of revenue. Under the more expensive Proposal Option 2, 564 facilities incur costs less than 1 percent, 14 facilities incur costs between 1 and 3 percent, and one facility incurs costs of greater than 3 percent of revenue.

As part of this screening analysis, EPA also considered whether costs would be consequential at the level of the facility. Specifically, EPA examined whether costs would exceed 0.1 percent of facility revenue, indicating that costs could be consequential, or below 0.1 percent of revenue. In the latter case, EPA reached a presumptive finding that costs are so slight in relation to the overall scale of business activity, measured by facility revenue, as to be not consequential in terms of potential adverse impact. As shown in *Table 5-2*, for the final rule, a substantial majority of facilities – 452 out of 579 facilities – incur compliance costs that are less than 0.1 percent of revenue. Under Proposal Option 4, which imposes technology requirements on fewer facilities, 505 facilities incur compliance costs less than 0.1 percent of revenue. Proposal Option 2 would impose higher costs on regulated facilities, with only 564 facilities incurring costs below 0.1 percent of revenue.

Table 5-1: Facility-Level Cost to Revenue Analysis Results, Final Rule- Existing Units and Other Options Considered

Industry	Facilities Analyzed	Number of Facilities with a Ratio of		
		<1%	≥1 and <3%	≥3%
Proposal Option 4				
Aluminum	27	27	0	0
Chemicals	171	171	0	0
Food	37	37	0	0
Paper	230	230	0	0
Petroleum	36	36	0	0
Steel	68	68	0	0
Total in the Primary Manufacturing Industries	**569**	**569**	**0**	**0**
Additional known facilities in Other Industries	10	10	0	0
Total	**579**	**579**	**0**	**0**
Final Rule-Existing Units				
Aluminum	27	27	0	0
Chemicals	171	167	4	0
Food	37	37	0	0
Paper	230	227	3	0
Petroleum	36	36	0	0
Steel	68	68	0	0
Total in the Primary Manufacturing Industries	**569**	**562**	**7**	**0**
Additional known facilities in Other Industries	10	9	1	0
Total	**579**	**571**	**8**	**0**
Proposal Option 2				
Aluminum	27	26	1	0
Chemicals	171	167	4	0
Food	37	34	3	0
Paper	230	227	3	0
Petroleum	36	36	0	0
Steel	68	67	1	0
Total in the Primary Manufacturing Industries	**569**	**556**	**13**	**0**
Additional known facilities in Other Industries	10	8	1	1
Total	**579**	**564**	**14**	**1**

Source: U.S. EPA Analysis, 2013

Table 5-2: Facilities with Costs Below 0.1 Percent of Revenue, Final Rule-Existing Units and Other Options Considered

Industry	Facilities Analyzed	Number of Facilities with a Ratio of <0.1%	Number of Facilities with a Ratio of ≥0.1%
Proposal Option 4			
Aluminum	27	26	1
Chemicals	171	136	35
Food	37	37	0
Paper	230	211	19
Petroleum	36	35	1
Steel	68	54	14
Total in the Primary Manufacturing Industries	569	499	70
Additional known facilities in Other Industries	10	6	4
Total	579	505	74
Final Rule-Existing Units			
Aluminum	27	26	1
Chemicals	171	127	44
Food	37	37	0
Paper	230	171	58
Petroleum	36	35	1
Steel	68	49	19
Total in the Primary Manufacturing Industries	569	446	124
Additional known facilities in Other Industries	10	6	4
Total	579	452	128
Proposal Option 2			
Aluminum	27	26	1
Chemicals	171	114	58
Food	37	31	7
Paper	230	166	64
Petroleum	36	30	6
Steel	68	33	35
Total in the Primary Manufacturing Industries	569	399	170
Additional known facilities in Other Industries	10	5	5
Total	579	404	175

Source: U.S. EPA Analysis, 2013

5.4 Facility-Level Impacts: Severe Impact Analysis

5.4.1 Analysis Approach and Data Inputs

EPA based the assessment of severe impacts for Manufacturers on the change in a facility‟s estimated business value, which EPA estimated from a discounted present value analysis of baseline cash flow and the change in cash flow resulting from regulatory compliance.[83] If the estimated discounted cash flow value of the facility is positive before considering the effects of regulatory compliance, but becomes negative when accounting for compliance costs, then EPA considered the facility a candidate for regulatory closure. EPA also included findings from the cost-to-revenue analysis, presented in *Section 5.3*, in the closure analysis. Specifically, EPA assessed whether compliance costs would fall below the threshold of 0.1 percent of revenue, and thus be judged as inconsequential, as part of the post-compliance severe impact analysis. For facilities to be assessed as post-

83 This cash flow analysis is similar in concept to the IPM analysis conducted for Electric Generators.

compliance closures based on the discounted cash flow value test, annualized compliance costs also needed to exceed 0.1 percent of revenue.

For the discounted cash flow value test, EPA compared the estimated ongoing business value of the facility with a threshold value of zero for the closure decision. As long as the discounted cash flow value of the facility is greater than zero, the business is earning its cost of invested capital and continuation of the business is financially beneficial. However, in the contrary case, if the discounted cash flow value of the facility is less than zero in the baseline or becomes less than zero as a result of compliance outlays, then the business would not earn its cost of invested capital and the owners would be better off financially by terminating the business. EPA assessed facilities with a negative baseline value as baseline closures and did not test these facilities for additional adverse impacts from regulatory compliance.

In an alternative formulation of this concept, business owners would compare the discounted cash flow value of the facility with the value that the facility‟s assets would bring in liquidation. In this case, the estimated ongoing business value would be compared with a value that may be different from zero: *liquidation value* could be positive or negative. When liquidation value is positive, business owners might benefit financially by terminating a business and seeking its liquidation value even when the ongoing business value is positive but less than the estimated liquidation value. With negative liquidation value – which generally would result from business termination liabilities (e.g., site clean-up) – the opposite result could occur: business owners may find it financially advantageous to remain in business *even though the business earns less than its cost of invested capital*, if the liquidation value of the business is "more negative," and thus less in value, than the ongoing business based on the discounted cash flow analysis. EPA considered this alternative impact test formulation for the previous 316(b) analyses conducted for Manufacturers. However, the liquidation value estimates are substantially speculative and subject to considerable error because such an assessment requires detailed facility-specific financial and operational history, and projections of future asset values and liabilities that are considerably uncertain. For these reasons, EPA decided against using liquidation value for comparison with ongoing business value in the closure test.

The cash flow concept used in calculating ongoing business value for the closure analysis is *free cash flow* available to all capital. This is the cash available to the providers of capital – both equity owners and creditors – on an after-tax basis from business operations, and takes into account the cash required for ongoing replacement of the facility‟s capital equipment. EPA discounted free cash flow at an estimated after-tax total *cost of capital* to yield the estimated business value of the facility. The following sections summarize the baseline and post-compliance cash flow concepts. *Appendix O: Economic Impact Methodology – Manufacturers* provides additional details for these calculations.

Calculation of Baseline Free Cash Flow and Performance of Baseline Closure Test

EPA performed the following steps:

- Average income statement data from surveys over response years and restate these values in 2011 dollars using the BEA‟s GDP Deflator Index series.
- Adjust after-tax income to exclude the effects of financial structure.
- Calculate after-tax cash flow from operations, before interest, by adjusting income for non-cash charges such as depreciation and amortization.
- Remove the implied cash flow benefit of any negative taxes, as reported in the facility‟s income statement after adjustment for removal of interest. This assumption is consistent with a later step in the post-compliance analysis in which EPA limited the cash flow benefit of tax deductions on compliance outlays not to exceed the taxes reported in the baseline income statement (and adjusted for interest).

- Adjust after-tax cash flow to reflect estimated real change in business performance, as reflected in baseline cash flow, from the time of survey data collection to the present (see *Appendix L: Adjusting Baseline Facility Cash Flow*). This adjustment addresses two concerns: (1) that facility survey data are from a period that deviated cyclically from the longer-term trend of business performance for the 316(b) manufacturing industries, and (2) that some of the industries might be experiencing a longer-term trend of deteriorating economic performance. In both cases, using the survey-based data for the current analysis – *without accounting for these possible effects* – could lead to misleading estimates of the affected industries" ability to withstand the compliance cost burdens of the final rule and other options considered.
- Calculate free cash flow by adjusting after-tax cash flow from operations for estimated ongoing capital equipment outlays (see *Appendix M)*.[84]
- Calculate baseline facility value as the present value of free cash flow over a 30-year analysis horizon, using an estimated real (i.e., excluding the effects of inflation), after-tax cost of capital of 7 percent. The use of 30 years as the time horizon reflects the facility-level analysis period for the final rule and other options considered.

As explained above, EPA considered a facility to be a baseline closure if its estimated business value was negative before incurring regulatory compliance costs. EPA neither tested baseline closures for adverse impact in the post-compliance impact analysis nor included their compliance costs in the tally of total costs of 316(b) regulatory compliance.

Calculation of Post-Compliance Free Cash Flow and Performance of the Post-Compliance Closure Test

For the post-compliance closure analysis, EPA recalculated annual free cash flow, accounting for changes in revenue, annual expenses, and taxes that would result from compliance-related outlays. EPA combined the post-compliance free cash flow value and the estimated compliance capital outlay in the present value framework to calculate business value on a post-compliance basis. As described above, for the post-compliance severe impact test, EPA also considered whether compliance costs would exceed 0.1 percent of revenue. As part of this analysis, EPA considered whether Manufacturers would be able to pass on compliance costs to customers through increased prices. From the analyses presented in *Appendix K: Cost Pass-Through Analysis*, EPA concluded that an assumption of zero cost pass-through is appropriate for analyzing the impact of the final rule and other options considered on facilities in the six Primary Manufacturing Industries (same assumption used in the previous 316(b) Manufacturers analyses). This means that facilities must absorb all compliance-related costs and operating effects (e.g., income loss from facility shutdown during equipment installation) within their baseline cash flow and financial condition. To the extent that facilities would be able to pass some of the compliance costs to customers through price increases, the analysis may overstate the potential impact on regulated facilities.

Calculation of post-compliance, free cash flow for the post-compliance closure test involved the following steps:

- Adjust baseline, annual, free cash flow to reflect compliance outlay effects. Relevant compliance cost and other operating effects include (1) annual change in revenue, (2) annually recurring operating and

[84] In the primary analysis, the cash flow analysis did not consider potential costs from other environmental regulations that might be affecting these industries at approximately the same time that the 316(b) regulatory requirements would come into effect. Recognizing this potential impact, EPA also undertook an alternative case analysis to account for the additional impact of other federal environmental regulations. In this analysis, EPA adjusted baseline cash flow to reflect costs that facilities might incur from compliance with recently promulgated federal environmental regulations, and whose costs would not be fully reflected in the after-tax cash flow adjustment analysis. This analysis, which is documented in *Appendix N: Analysis of Other Regulations*, found no material effect on the facility impact analysis, as reported in this chapter. The alternative case analysis, which incorporated estimated compliance costs from the recent federal environmental regulations, found one additional baseline closure and no change in post-compliance closures.

maintenance costs, (3) the annual equivalent of initial permitting and non-annually recurring permitting costs, (4) annually recurring permitting costs, (4) the annual equivalent of the income loss from installation downtime, and (5) related changes in taxes.[85]

- Limit tax adjustment not to exceed taxes as reported in the facility‟s baseline financial statement.
- Calculate post-compliance facility value based on a comparison of the present value of post-compliance free cash flow with the compliance capital outlay. As in the baseline analysis, EPA accounted for the compliance capital outlay as an undiscounted cash outlay in the first analysis period and used a 7 percent discount rate for this present value calculation.

For the cost-to-revenue part of the post-compliance severe impact analysis, EPA divided facility-level revenue by the facility‟s after-tax annualized, total compliance cost. If this value exceeded 0.1 percent, EPA considered compliance costs to be potentially consequential in terms of possible adverse financial impact of the facility.

EPA considered a facility to be a post-compliance closure if:

1. Its estimated business value was positive in the baseline, but became negative after adjusting for compliance-related cost, revenue, and tax effects, *And*
2. Its cost-to-revenue value exceeded 0.1 percent.

EPA measured the significance of closures in terms of losses in employment and output. Employment losses equal the number of employees reported by closure facilities in survey responses; output losses equal total revenue reported for regulatory closure facilities. EPA estimated national results by multiplying facility results by facility sample weights.

5.4.2 Key Findings

Table 5-3 reports estimated severe impacts for Manufacturers facilities for the final rule and other options considered. As described in *Appendix H*, EPA estimated that 70 facilities would close in the baseline. EPA removed these facilities from the severe impact analysis, leaving 509 Manufacturers that EPA estimated to incur compliance costs. EPA estimates that none of these remaining facilities will incur severe impacts as a result of the final rule. EPA reached the same finding – no severe impacts – for Proposal Option 4. For Proposal Option 2, EPA found that one facility would be at risk of closure.

Table 5-3: Number of Facilities with Severe Impacts by Sector, Final Rule-Existing Units and Other Options Considered

Sector	Total Operating in Baseline	Number of Facilities with Severe Impacts			
		Number	Percentage	Revenue (million; $2011)	Employment
Proposal Option 4					
Aluminum	24	0	0%	$0	0
Chemicals and Allied Products	167	0	0%	$0	0
Food and Kindred Products	34	0	0%	$0	0
Paper and Allied Products	197	0	0%	$0	0

85 For the facility cash flow analysis, EPA treated the income loss from installation downtime on an annual equivalent basis even though this financial event occurs only once, and at the beginning of the assumed analysis period, for two reasons. First, the installation downtime is assumed to have a useful "financial life" of 30 years to reflect the total potential business life of the facility with the installed compliance technology (note that reinstallation of the basic capital equipment other than cooling towers, which is assumed to recur on a 20-, 25-, or 30-year interval depending on the specific technology, does not require a new round of downtime). Because compliance capital equipment is assumed to have a specific useful life and the discounted cash flow analysis is structured around this period, if EPA were to include the income loss from installation downtime (which EPA assumes to have a 30-year useful life) as a one-time up-front cost, its impact would be overstated in the discounted cash flow calculation. Second, calculation of the downtime cost on an annual basis allows the tax effect from the one-time income loss to be summed with other annual tax effects for applying the limit to tax offsets, as explained in the next step of the analysis.

Table 5-3: Number of Facilities with Severe Impacts by Sector, Final Rule-Existing Units and Other Options Considered

Sector	Total Operating in Baseline	Number of Facilities with Severe Impacts			
		Number	Percentage	Revenue (million; $2011)	Employment
Petroleum Refining	31	0	0%	$0	0
Steel	47	0	0%	$0	0
Total Facilities in Primary Manufacturing Industries[a]	**500**	**0**	**0%**	**$0**	**0**
Additional known facilities in Other Industries	9	0	0%	$0	0
Final Rule-Existing Units					
Aluminum	24	0	0%	$0	0
Chemicals and Allied Products	167	0	0%	$0	0
Food and Kindred Products	34	0	0%	$0	0
Paper and Allied Products	197	0	0%	$0	0
Petroleum Refining	31	0	0%	$0	0
Steel	47	0	0%	$0	0
Total Facilities in Primary Manufacturing Industries[a]	**500**	**0**	**0%**	**$0**	**0**
Additional known facilities in Other Industries	9	0	0%	$0	0
Proposal Option 2					
Aluminum	24	0	0%	$0	0
Chemicals and Allied Products	167	0	0%	$0	0
Food and Kindred Products	34	0	0%	$0	0
Paper and Allied Products	197	0	0%	$0	0
Petroleum Refining	31	0	0%	$0	0
Steel	47	1	3%	$2,262	6,638
Total Facilities in Primary Manufacturing Industries[a]	**500**	**1**	**0%**	**$2,262**	**6,638**
Additional known facilities in Other Industries	9	0	0%	$0	0

a. Values may not sum to reported totals due to independent rounding.
b. For Proposal Option 2, the percentage of severe impacts is 0.3 percent.
Source: U.S. EPA analysis, 2013

5.5 Facility-Level Impacts: Moderate Impact Analysis

5.5.1 Analysis Approach and Data Inputs

EPA also conducted an analysis of financial stress short of closure to assess the occurrence of moderate impacts on Manufacturers. EPA does not assess facilities incurring moderate impacts as being at risk of closure due to the final rule and other options considered. The regulation, however, might reduce their financial performance to the point where they incur greater difficulty and higher costs in obtaining financing for future investments. The following discussion outlines the calculations undertaken for this assessment; *Appendix O* provides a detailed discussion of this analysis.

The analysis of moderate impacts examined two financial measures:

Pre-Tax Return on Assets (PTRA): ratio of pre-tax operating income – earnings before interest and taxes (EBIT) – to assets. This ratio measures the operating performance and profitability of a business‟ assets independent of financial structure and tax circumstances. PTRA is a comprehensive measure of a facility‟s economic and financial performance. If a facility cannot sustain a competitive PTRA on a post-compliance basis, it will likely face difficulty financing its investments, including the outlay for compliance equipment.

Interest Coverage Ratio (ICR): ratio of pre-tax operating cash flow – earnings before interest, taxes, and depreciation (EBITDA) – to interest expense. This ratio measures the facility‟s ability to service its debt based on current, ongoing financial performance, and to borrow for capital investments. Investors and creditors will be concerned about a facility whose operating cash flow does not comfortably exceed its contractual obligations. As ICR increases, the facility‟s general ability to meet interest payments and carry credit also increases. ICR also provides a measure of the amount of cash flow available for equity after interest payments.

Creditors and equity investors review the above two measures as criteria to determine whether and under what terms they will finance a business. PTRA and ICR also provide insight into a facility‟s ability to generate funds for compliance investments from internally generated equity, i.e., from after-tax cash flow.

Calculation of Moderate Impact Metrics

EPA calculated facility-level PTRA and ICR measures using data collected from the 316(b) industry survey, adjusted for inflation to 2011. EPA calculated these measures on a baseline and post-compliance basis. In calculating the baseline values of the PTRA and ICR measures, EPA applied the same cash flow adjustments as described above for the facility closure analysis, to the numerators of the PTRA and ICR measures. In the same way as described for the closure analysis, EPA intends these adjustments to capture the change in the financial performance of facilities in the Primary Manufacturing Industries between the time of the 316(b) survey and the present (see *Appendix L*).

Developing Threshold Values for PTRA and ICR

For evaluating manufacturing facilities according to the moderate impact measures, EPA compared baseline and post-compliance PTRA and ICR to 316(b) industry-specific thresholds that were developed from RMA data. RMA compiles and reports financial statement information by industry as provided by member commercial lending institutions. The threshold values represent the lowest 25th percentile values of PTRA and ICR for statements received by RMA for the 13 years from 1998 to 2010 within relevant industries (RMA, 2011). EPA developed 316(b) industry-level values by weighting and summing the RMA industry values according to the definition of 316(b) industries. Thresholds by sector ranged from 0.5 percent to 2.7 percent for PTRA and from 1.2 to 2.7 for ICR. Because the financial statements received by RMA are for businesses applying for credit from member institutions, the data do not represent a random sample. In particular, the RMA data likely exclude representation from the financially weakest businesses, which are unlikely to seek financing from RMA member lending institutions. As a result, EPA views the threshold values as somewhat likely to overestimate the occurrence of moderate impacts on regulated facilities. Both measures are important to financial success and ability to attract capital.

EPA consolidated the 6-digit North American Industry Classification System (NAICS) code data into industry-level weighted averages, weighted by 2010 value of shipments from ASM (U.S. DOC, 2010). For each industry and impact measure, a separate threshold was calculated. *Appendix O* describes the use of the RMA data for calculating the threshold values for pre-tax return on assets and interest coverage ratio.

Summary of Threshold Values

Table 5-4 reports the resulting threshold values for PTRA and ICR by industry. The PTRA values range from 0.3 percent for the Aluminum Industry to 2.7 percent for Petroleum Refining. The ICR values range from 1.2 for the Aluminum Industry to 2.7 for Petroleum Refining.

Table 5-4: Summary of Moderate Impact Thresholds by Manufacturers Industry, *based on 25th percentile value of entities reporting data to RMA*

Industry	PTRA	ICR
Aluminum	0.3	1.2
Chemicals and Allied Products	1.7	2.1
Food and Kindred Products	1.5	2.4
Paper and Allied Products	0.9	1.8
Petroleum Refining	2.7	2.7
Steel	0.4	1.4
Other	0.5	1.6
Source: U.S. EPA Analysis, 2013		

Calculation of Moderate Impacts

In estimating the occurrence of moderate impacts, EPA first set aside from the analysis facilities assessed as baseline or post-compliance closures, which varies across the final rule and other options considered. EPA then assessed whether the remaining facilities (1) meet the moderate impact thresholds in the baseline, and (2) are thus candidates for testing the occurrence of moderate impacts on a post-compliance basis. Specifically, EPA assessed facilities falling below one or both of the moderate impact thresholds in the baseline as baseline failures, and removed them from the post-compliance moderate impact analysis. EPA assessed facilities failing one or both thresholds in the post-compliance analysis as post-compliance failures for the moderate impact test.

5.5.2 Key Findings

EPA began the moderate impact analysis by testing whether facilities that passed the post-compliance closure (severe impact) analysis would fail the moderate impact test in the baseline. Because the number of post-compliance closures varies by regulatory option (see *Table 5-5*), the number of facilities brought forward to the moderate impact analysis also varies by option: 509 facilities passed the post-compliance closure analysis for the final rule and Proposal Option 4 (no post-compliance closures), while 508 facilities passed the post-compliance closure analysis for Proposal Option 2 (one post-compliance closure).[86] EPA conducted the baseline moderate impact analysis for those facilities that were brought forward for a given option. EPA found that the one facility that failed the post-compliance closure analysis for Proposal Option 2, while passing the closure analysis for the final rule and Proposal Option 4, failed the moderate impact test in the baseline. As a result, even though the number of facilities brought forward to the *baseline* moderate impact analysis varied by regulatory option, the number of facilities remaining in the *post-compliance* analysis did not vary by regulatory option. Of the 509 facilities, EPA found that 49 facilities failed the moderate impact test in the baseline for the final rule and Proposal Option 4, while 47 facilities failed the moderate impact test in the baseline for Proposal Option 2. EPA removed these facilities from the *post-compliance* moderate impact analysis, leaving 454 facilities in Primary Manufacturing Industries and seven facilities in the Other Industries, regardless of regulatory option (see *Table 5-5*).

86 For Proposal Option 2, EPA assesses five facilities, of the 509 facilities analyzed, as post-compliance closures (see *Table 5-3*); however, because of rounding there are actually slightly less than five post-compliance closures and therefore, 505 facilities pass the post-compliance severe impact test.

Table 5-5: Number of Facilities in Moderate Impact Analysis, by Sector			
Analysis Step and Industry	**Proposal Option 4**	**Final Rule**	**Proposal Option 2**
Facilities Passing Post-Compliance Closure (Severe Impact) Analysis			
Aluminum	24	24	24
Chemicals and Allied Products	167	167	167
Food and Kindred Products	34	34	34
Paper and Allied Products	197	197	197
Petroleum Refining	31	31	31
Steel[b]	47	47	46
Total Facilities in Primary Manufacturing Industries[a]	500	500	499
Additional known facilities in Other Industries	9	9	9
Total Facilities Passing Post-Compliance Closure Analysis[a]	**509**	**509**	**508**
Baseline Moderate Impact Failures			
Aluminum	5	5	5
Chemicals and Allied Products	19	19	19
Food and Kindred Products	3	3	3
Paper and Allied Products	9	9	9
Petroleum Refining	1	1	1
Steel[b]	9	9	8
Total Facilities in Primary Manufacturing Industries[a]	47	47	45
Additional known facilities in Other Industries	2	2	2
Total Facilities Failing Baseline Moderate Impact Analysis[a]	**49**	**49**	**47**
Facilities Carried Forward to Post-Compliance Moderate Impact Analysis			
Aluminum	20	20	20
Chemicals and Allied Products	147	147	147
Food and Kindred Products	31	31	31
Paper and Allied Products	187	187	187
Petroleum Refining	30	30	30
Steel	38	38	38
Total Facilities in Primary Manufacturing Industries[a]	454	454	454
Additional known facilities in Other Industries	7	7	7
Total Facilities in Post-Compliance Moderate Impact Analysis[a]	**461**	**461**	**461**

a. Values may not sum to reported totals due to independent rounding.
b. Industries with differences in findings by regulatory option in post-compliance closure analysis and baseline moderate impact analysis are highlighted with gray shading.
Source: U.S. EPA Analysis, 2013

Table 5-6 reports the estimated moderate impacts for the final rule and other options considered. Of the 461 Manufacturers assessed as remaining in the analysis after excluding post-compliance closures and baseline moderate impact failures, EPA estimated that 12 facilities, or 3 percent of facilities analyzed, will incur moderate impacts under the final rule. EPA estimated that two facilities would incur moderate impacts under Proposal Option 4, and that 12 facilities would incur moderate impacts under Proposal Option 2.

Table 5-6: Facilities with Moderate Impacts by Sector, Final Rule-Existing Units and Other Options Considered							
		Number of Facilities with Moderate Impacts					
	Number of Facilities	**Proposal Option 4**		**Final Rule-Existing Units**		**Proposal Option 2**	
Industry	**Analyzed**	**Number**	**Percentage**	**Number**	**Percentage**	**Number**	**Percentage**
Primary Manufacturing Industries							
Aluminum	20	0	0%	0	0%	0	0%
Chemicals and Allied Products	147	0	0%	4	3%	4	3%
Food and Kindred Products	31	0	0%	0	0%	0	0%
Paper and Allied Products	187	0	0%	6	3%	6	3%
Petroleum Refining	30	1	3%	1	3%	1	3%
Steel	38	1	3%	1	3%	1	3%
Total Facilities in Primary Manufacturing Industries[a]	454	2	1%	12	3%	12	3%
Known facilities in Other Industries	7	0	0%	0	0%	0	0%

Table 5-6: Facilities with Moderate Impacts by Sector, Final Rule-Existing Units and Other Options Considered
a. Values may not sum to reported totals due to independent rounding.
Source: U.S. EPA analysis, 2013

5.6 Entity-Level Impacts

The analysis of impact on entities that own Manufacturers goes beyond the facility impact analysis to assess whether entities that own regulated facilities may incur impacts at the level of the entity in a way that is not revealed by the facility impact analysis. For example, depending on the magnitude of total compliance costs, an entity may incur an adverse impact at the *entity level* at the same time that one or more individual facilities incur facility-level impacts, severe or moderate, *or* even if none of the *facilities* owned by the entity incur adverse impacts. Entities incurring adverse impacts *at the level of the entity* may be at greater risk of weaker business performance in their respective industries due to the overall burden of compliance requirements. Alternatively, an entity may *not* incur an adverse impact at the entity level (based on the analysis described below) even as one or more of the individual facilities that the entity owns incur facility-level impacts. In this case, the opposite outcome would apply: the entity would be less likely to experience an overall weakening of business performance even though one or more of its facilities would be adversely affected by the regulation. Thus, the entity-level analysis provides another level of assessment beyond that provided by the facility-level impact analysis.

5.6.1 Analysis Approach and Data Inputs

For the assessment of entity-level impacts, EPA performed a screening analysis, by comparing annualized after-tax compliance costs to entity revenue and identifying the numbers of entities incurring costs in three cost-to-revenue ranges: less than 1 percent; at least 1 percent but less than 3 percent; and 3 percent or greater. EPA assesses entities incurring costs less than 1 percent of revenue as not likely to incur an adverse impact at the entity level. EPA assesses entities incurring costs at least 1 percent but less than 3 percent of revenue as having a higher chance of facing an adverse impact, while entities incurring costs that are 3 percent of revenue or greater have an even higher probability of an adverse impact. EPA compared total annualized after-tax compliance costs to entity-level revenue by:

1. Identifying the parent entity,
2. Determining the parent entity revenue,
3. Estimating compliance costs at the level of the parent entity.

Identifying the Parent Entity

EPA used information reported in the 316(b) survey, supplemented by research on corporate websites, to identify parent entities.

Estimating Parent Entity Revenue

EPA obtained entity-level revenue from several sources including Dunn & Bradstreet data (D&B, 2009), corporate websites and recent annual reports, and the 316(b) survey. Where entity-level revenue was not available from any of these sources, EPA summed the revenue of owned facilities to the level of the entity. The Agency restated these revenue values in 2011 dollars using BEA‟s GDP Deflator Index.

Estimating compliance costs at the level of the parent entity

EPA‟s sample-based facility analysis supports specific estimates of (1) the number of regulated facilities and (2) the total compliance costs that these facilities would incur. However, the sample-based analysis does not support specific estimates of the number of entities that own these facilities, or of regulated facilities that a single entity may own, or the total of compliance costs across those facilities.

Thus, EPA estimated the number of parent entities, compliance costs at the level of the parent entity, and associated entity-level impacts as a range based on two weighting cases. These cases provide approximate upper and lower bound estimates of: (1) the number of entities incurring compliance costs and (2) the costs incurred by any entity that owns a regulated facility. These cases are as follows:

- *Case 1*: This case assumes that all facilities represented by sample weights are owned by the same entity that owns the sample facility; it represents a lower bound estimate of number of entities and an upper bound estimate of total compliance costs that an entity may incur. For this case, EPA grouped together all facilities with a common parent entity and sample-weighted the facility compliance costs using *technical weights* (see *Appendix H*). The Agency then calculated these costs as a percentage of entity revenue.
- *Case 2*: This case assumes that the facilities represented by sample weights are owned by different entities than those that own the known sample facilities; it represents an upper bound estimate of the number of entities that own regulated facilities, and a lower bound estimate of the total compliance costs that an entity may incur. For this case, EPA aggregated compliance costs developed for sample facilities to the level of their parent entity without application of facility *technical weights* and calculated the resulting entity-level costs as a percentage of entity revenue. EPA then used an *entity-level* weighting scheme, which is derived from facility-level sample weights, to account for parent entities that may own *only* facilities that are represented by sample facilities – and thus are not directly captured under Case 1 (for details on this entity-level weighting scheme, see *Appendix H*).

As discussed in *Chapter 4* for Generators, EPA used 2011 as the basis for the revenue and compliance cost estimates for facilities, regardless of when they are expected to incur compliance costs to ensure that the cost and revenue estimates used in the cost-to-revenue analysis would be consistent in terms of cost-year.

5.6.2 Key Findings

Table 5-7 summarizes the results from the entity-level impact analysis under Case 1 and Case 2. The table reports the number of entities that EPA estimated to incur costs in three ranges: less than 1 percent of revenue, at least 1 percent but less than 3 percent of revenue, and 3 percent of revenue or greater.

Under Case 1, for the final rule, of the 120 entities that own regulated facilities, 108 incur costs less than 1 percent of revenue, six incur costs between 1 and 3 percent of revenue, and one incurs costs greater than 3 percent of revenue. For Proposal Option 4, 113 entities incur costs less than 1 percent of revenue, two incur costs between 1 and 3 percent of revenue, and no facility incurs costs greater than 3 percent revenue. The impact findings for Proposal Option 2 are the same as those reported for the final rule.

Under Case 2, for the final rule, of the 337 entities that own regulated facilities, 319 incur costs less than 1 percent revenue, six incur costs between 1 and 3 percent revenue, and no facility incurs costs greater than 3 percent revenue. Under Proposal Option 4, 324 entities incur costs less than 1 percent revenue, one incurs costs between 1 and 3 percent revenue, and no facility incurs costs greater than 3 percent of revenue. The impact findings for Proposal Option 2 are the same as those reported for the final rule.

Table 5-7: Entity-Level Cost-to-Revenue Analysis Results, Final Rule- Existing Units and Other Options Considered

	Case 1: Lower bound estimate of number of entities that own regulated facilities					Case 2: Upper bound estimate of number of entities that own regulated facilities				
	Total Number of Entities	Number of Entities with a Ratio of				Total Number of Entities	Number of Entities with a Ratio of			
Industry		<1%	≥1% and <3%	≥3%	Unknown[a]		<1%	≥1% and <3%	≥3%	Unknown[a]
Proposal Option 4										
Aluminum	4	4	0	0	0	11	11	0	0	0
Chemicals and Allied Products	30	29	0	0	1	121	117	0	0	4
Food and Kindred Products	6	6	0	0	0	20	20	0	0	0
Paper and Allied Products	37	36	0	0	1	104	101	0	0	3
Petroleum Refining	16	15	0	0	1	25	24	0	0	1
Steel	13	11	1	0	1	32	29	0	0	3
Multiple[b]	4	4	0	0	0	14	14	0	0	0
Other Industries	10	8	1	0	1	10	8	1	0	1
Total[c]	**120**	**113**	**2**	**0**	**5**	**337**	**324**	**1**	**0**	**12**
Final Rule-Existing Units										
Aluminum	4	4	0	0	0	11	11	0	0	0
Chemicals and Allied Products	30	27	1	1	1	121	113	4	0	4
Food and Kindred Products	6	6	0	0	0	20	20	0	0	0
Paper and Allied Products	37	34	2	0	1	104	101	0	0	3
Petroleum Refining	16	15	0	0	1	25	24	0	0	1
Steel	13	11	1	0	1	32	29	0	0	3
Multiple[b]	4	4	0	0	0	14	14	0	0	0
Other Industries	10	7	2	0	1	10	7	2	0	1
Total[c]	**120**	**108**	**6**	**1**	**5**	**337**	**319**	**6**	**0**	**12**
Proposal Option 2										
Aluminum	4	4	0	0	0	11	11	0	0	0
Chemicals and Allied Products	30	27	1	1	1	121	113	4	0	4
Food and Kindred Products	6	6	0	0	0	20	20	0	0	0
Paper and Allied Products	37	34	2	0	1	104	101	0	0	3
Petroleum Refining	16	15	0	0	1	25	24	0	0	1
Steel	13	11	1	0	1	32	29	0	0	3
Multiple[b]	4	4	0	0	0	14	14	0	0	0
Other Industries	10	7	2	0	1	10	7	2	0	1
Total[c]	**120**	**108**	**6**	**1**	**5**	**337**	**319**	**6**	**0**	**12**

a. EPA was unable to determine revenues for 5 parent entities under Case 1 and for 12 parent entities under Case 2.
b. Entities designated as "multiple" own more than one facility, and those facilities belong to different manufacturing sectors. Facilities designated as "multiple" belong either to one of the Primary Manufacturing Industries or to the Other Industries; however, they are owned by entities that own facilities in multiple manufacturing industries.
c. Values may not sum to reported totals due to independent rounding.
Source: U.S. EPA Analysis, 2013

5.7 Uncertainties and Limitations

The analyses of facility-level and entity-level impacts for the Manufacturers segment are subject to a range of uncertainties and limitations, including:

- The facility-level data for these analyses are from 316(b) survey conducted by EPA in 1999 and reflect reporting years of 1996, 1997, 1998. Recognizing the length of time since collection of these data, EPA adjusted facility financial data to account for changes in overall economic conditions and industry performance from the time of the original survey to 2011 (see *Appendix L*). This adjustment improves the validity of using these data for the current analyses, but introduces uncertainty, and inevitably cannot account for all facility-level financial and overall economic/ financial changes since the time of the 316(b) survey.
- The analyses of facility-level and entity-level costs and impacts rely on data collected through the 316(b) survey, as outlined above. The use of data from surveyed facilities to support the cost and economic

impact analysis is an appropriate and valid approach for assessing the impact of the final rule and other options considered: the sampled facilities serve as models for assessing cost and impact across the expected universe of regulated facilities. Inevitably, however, use of sampled facilities as the basis for the analysis introduces uncertainty in the estimates of the number of regulated facilities and the estimates of total costs and impacts across the regulated facility universe.

- The assessment of entity-level impacts relies on approximate *upper* and *lower* bound concepts of the number of affected parent entities and the numbers of regulated facilities that these entities may own. In EPA‟s view, the *range* of results from these analyses provides appropriate insight into the overall extent of entity-level effects.
- The use of RMA data as the basis for the moderate impact thresholds provides an approximate basis for the assessment of moderate financial impacts. As described, the RMA data are not based on a statistically valid sample. In addition, these data may introduce bias in the quartile values, given the characteristics of businesses that the RMA data represent. Finally, the 25th percentile value is not a perfect indicator of the occurrence of adverse financial condition, and therefore, occurrence of adverse impact from the final rule and other options considered. The value is indicative of weak financial condition and performance *relative to other businesses present in the RMA data*, but is not an absolute indicator of financial weakness.

6 Barrier to Entry Analysis of the New Units Provision

Note to reviewers: This chapter will be substantially revised throughout to reflect recent changes in the definition of the new units provision of the final rule.

6.1 Introduction

The Final 316(b) Existing Facilities Rule requires that new units meet a performance standard for cooling water intake systems that is equivalent to the performance of a closed-cycle recirculating system (CCRS). This requirement applies to newly built capacity at an existing facility or to repowering of existing generating units where the turbine and condenser are replaced, and could affect decisions to repower or replace existing generating units. Of particular interest is whether the requirement would affect decisions to repower or replace existing coal-fired generating units with natural gas-fired combined cycle (NGCC) operation. Such conversions and/or retirements of existing coal-fired capacity and replacement with NGCC capacity are underway in the electric power industry for a number of reasons, as described below in *Section 6.2*.[87] These conversions/replacements are generally beneficial to the environment because NGCC units typically achieve higher energy conversion efficiency and lower air pollution than the coal-fired units that are repowered or replaced. In this Chapter, EPA assesses the impact of the CCRS requirement for new units on decisions to convert existing coal-fired capacity to NGCC operation.

EPA assessed the impact of the CCRS requirement in the context of four business cases in which plant owners might consider repowering or replacing an existing coal-fired unit with NGCC capacity. The cases vary by the plant owner‟s objectives in considering conversion; the analyses for these cases differ based on the resulting financial effect factors that the plant owner would take into account. To test the impact of the CCRS requirement, the analysis uses the 1,078 coal-fired units in the Integrated Planning Model[88] (IPM) database (v. 4.10) as the basis for this analysis. These units reflect *real* baseline circumstances in terms of unit capacity, heat rate, fuel consumption, fuel and other costs, dispatch level/capacity utilization, wholesale electricity price, and unit age/remaining life. Testing the impact of the CCRS requirement in the context of these units provides meaningful insight into the potential effect of the CCRS requirement on the economics of unit conversion. The analysis examines the frequency and characteristics of instances in which the CCRS requirement would potentially alter an otherwise favorable decision to convert an existing coal-fired unit to combined cycle operation – based on a dataset of actual units, which could be candidates for combined cycle conversion now or in the future.

From this analysis, EPA found that the CCRS requirement would alter an otherwise favorable conversion assessment for only a small percentage of coal-fired generating units and capacity in the IPM v.4.10 baseline: 1.0 percent of the generating units and 0.9 percent of the capacity that EPA estimates would otherwise be viable candidates for conversion in the most realistic of the business cases considered in this analysis. Based on this finding, EPA concludes that the CCRS requirement will not materially affect decisions to repower or replace existing coal-fired capacity with NGCC operation.

The remainder of the chapter is organized as follows:

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87 See, for example, http://www.marketwatch.com/story/natural-gas-commodity-markets-sleeping-giant-2013-03-15?pagenumber=2. The second part of this article describes the trend of increasing reliance on natural gas instead of coal for electric power generation, and cites a range of factors underlying this trend.

88 See *Chapter 7: Electricity Market Analysis*, for information

- *Section 6.2* describes key concepts and considerations in the analysis, and which underlie the analytic structure and specification of alternative business cases;
- *Section 6.3* defines four business cases that analyzed and describes our approach for assessing the economic/financial viability of each business case;
- *Section 6.4* summarizes key data required for the analysis;
- *Section 6.5* describes our data sources and methodology for estimating the pre-tax cash flow of operations associated with the existing coal unit configurations present in the business cases;
- *Section 6.6* describes our data sources and methodology for estimating the pre-tax cash flow of operations associated with the natural gas combined-cycle unit configurations present in the business cases; and,
- *Section 6.7* presents the analysis results.

6.2 Considerations in Assessing Effects of CCRS Requirements on NGCC Conversion Opportunities

This analysis assesses the degree to which a CCRS requirement reduces the economic/financial benefit of conversion from existing coal-fired capacity to NGCC, and whether that reduction is sufficient to alter an otherwise favorable assessment of a conversion opportunity. Although analytic configurations vary across the four business cases (see *Section 6.3.1*), each case reflects many of the same underlying considerations.

Considerations applying to the decision to repower/replace existing coal-fired capacity to NGCC capacity include:

1. <u>Increase in unit generating capacity.</u> NGCC conversion will generally increase the capacity of the converted unit. The increase in capacity results from the addition of gas turbine capability, as well as a possible increase in steam-generating capacity, which would accompany redesign of the generating unit and conversion of the unit from coal to natural gas. These increases may be substantial, ranging as high as a multiple of 2.5-3.0.[89] If increased generating capacity is a material objective in evaluating a potential combined cycle conversion opportunity, this factor will be of key importance.
2. <u>Differences in cost of additional generating capacity.</u> Based on DOE EIA data, NGCC capacity – whether building new combined cycle capacity, or converting existing capacity to combined cycle – is the least expensive option for adding generating capacity, and combined cycle‟s cost advantage is substantial compared to other technologies. To illustrate, DOE EIA 2012 data indicate a capital cost of approximately $0.9 million/MW ($2010) for *new* combined cycle capacity, compared to $2.5-$3.0 million/MW for new coal-fired capacity.[90] Where additional generating capacity is an objective in a conversion decision, this difference is important in evaluating a natural gas/combined cycle
3. <u>Differences in generating efficiency.</u> NGCC capacity provides a substantial improvement in a unit‟s thermal conversion efficiency compared to baseline coal-steam capacity, particularly if the comparison is with an older coal-fired unit with reduced generating performance. Based on DOE EIA data, NGCC capacity may achieve a heat rate as low of 6,400-7,100 Btu of energy input per kWh[91] compared to heat

89 EPA estimates. As noted in Table 6-8, EPA assumes a value of 1.0 for this parameter in the analysis.

90 From *U.S. Energy Information Administration – Assumptions to the Annual Energy Outlook 2012. National Energy Modeling System, Electricity Market Module*. U.S. Department of Energy, Energy Information Administration. See Table 8.2.
The cost of combined cycle conversion for an existing unit would be less than the EIA-reported values because of the ability to re-use some parts of the existing generating unit in the conversion, and thus avoid some of the cost for a newly constructed unit. EPA estimates a savings of 10-15 percent. Differences for other cost components are important as well, which are discussed below.

91 *U.S. Energy Information Administration – Assumptions to the Annual Energy Outlook 2012. National Energy Modeling System, Electricity Market Module*. U.S. Department of Energy, Energy Information Administration. See Table 8.2.

rates in older coal-fired units of 10,000-11,000 Btu per kWh.[92] NGCC capacity also has an efficiency advantage over new coal-fired capacity: according to DOE EIA data, new coal-fired capacity would achieve a heat rate of approximately 8,800 Btu/kWh, compared to the 6,400-7,100 Btu/kWh for combined cycle capacity.[93]

4. Fuel and electricity generation cost differential. The substantial decline in natural gas prices over the past several years has currently brought natural gas-based generating costs close to parity with coal-based electric generating costs (accounting for the difference in heat rates for NGCC and coal-fired operation, see item 3, above). However, looking into the future, natural gas prices are projected to rise more rapidly than coal prices.[94] As a result looking over the longer term, the *energy cost* of coal-based generation is likely to be less than for NGCC-based generation. The differential is more favorable for NGCC when accounting for differences in unit heat rate when converting an older, less efficient coal-fired unit to NGCC operation (see item 3, above). Nevertheless, given the expectation that electricity generating costs will be lower for coal-fired capacity than for NGCC capacity, the generating cost differential is not likely to be sufficient, by itself, to induce plant owners to repower/replace existing coal-fired capacity with NGCC capacity.
5. Change in unit dispatch/capacity utilization. Newer NGCC units run at higher capacity utilization than older coal-fired units and would very likely generate more revenue than the existing coal-fired unit. Based on IPM data, the median capacity utilization rate (CUR) for newer combined cycle units is approximately 85 percent, while older coal-fired units show CUR of approximately 75 percent. The higher capacity utilization provides a larger generation base over which the capital cost of unit conversion would be spread, and reduces the burden of the capital outlay per unit of electricity generated. This higher CUR is a favorable factor in evaluating conversion of existing coal-fired units to NGCC.[95]
6. Extension of unit life. Converting an older, existing coal-fired unit to NGCC operation will generally extend the operating life of the existing coal unit. The addition to unit life would be part of the economic/financial evaluation of the conversion opportunity.
7. Differences in other operating costs. Conversion of a coal-fired unit to NGCC operation will generally reduce other operating costs – e.g., avoided need to maintain a coal inventory, which ties up land and working capital; and reduced unit operating and maintenance expenses.
8. Reduced capital outlays and other expenses to meet environmental requirements. Some recently promulgated Clean Air Act (CAA) regulations – Mercury and Air Toxics Standards (MATS), Cross-State Air Pollution Rule (CSAPR) – primarily affect coal-fired capacity. Depending on coal characteristics and treatment systems in place, compliance with these regulations may involve substantial capital outlays and operating expenses for existing coal-fired capacity; these costs would not be incurred or incurred to a smaller degree for NGCC capacity. For example, converting an existing coal-fired unit to NGCC may allow a plant owner to avoid the cost of installing and operating a flue gas desulfurization system. The

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92 From EPA analysis of generating unit data in the Integrated Planning Model (IPM) baseline.

93 *U.S. Energy Information Administration – Assumptions to the Annual Energy Outlook 2012. National Energy Modeling System, Electricity Market Module*. U.S. Department of Energy, Energy Information Administration. See Table 8.2.

94 At current fuel prices, coal-based generation and natural gas/combined cycle generation are essentially at parity. Based on 2012 reported prices for coal and natural gas deliveries to the electric power sector (from EIA), the energy cost of electricity generation is approximately $23.50-$28.00/MWh (based on range of heat rate) for coal-based generation and $21.80-$24.20 for natural gas/combined cycle generation (again, based on range of heat rate). However, EIA projects that natural gas prices will rise by approximately 3.1 percent annually (inflation-adjusted prices) over the next 15 years, while coal prices increase annually by about 1.2 percent. The „essential parity‟ erodes quickly at this difference in price growth rates. These price comparisons are based on *national* average prices and thus don‟t account for regional differences in delivered fuel price, which could be important in this comparison.

95 In assessing NGCC compared to a new coal-fired unit, however, the *new* CURs are essentially the same: both would likely operate as a base-load unit with high CUR.

cost of these regulations will tend to favor conversion of existing coal-fired capacity to NGCC operation.[96]

In addition to these already promulgated regulations, other rules remain in development that would also affect coal-fired capacity. These include the Coal Combustion Residuals Rule (CCRR) and Effluent Guidelines for the Steam Electric source category (ELG/STE). These rules could also impose a greater level of costs on existing coal-fired capacity than on NGCC capacity. These compliance costs will factor into a decision of whether to retire and/or convert existing coal-fired capacity to natural gas/combined cycle operation.

Beyond these considerations, which apply specifically to assessing the economic/financial benefit from NGCC conversion, additional considerations matter in assessing the effect of a CCRS requirement:

- Additional capital cost from CCRS installation, which range from approximately $31,000/MW for a NGCC unit to approximately $61,000/MW for a coal-fired unit.[97] This value may be substantial on a total value basis for a given generating unit – e.g., for a 500 MW combined cycle unit, the additional total capital outlay would come to approximately $15.5 million. However, as described below, this value is small in relation to the total capital outlay required for combined cycle conversion.
- Additional fixed and variable O&M costs, which range from approximately $265/MW per year for a combined cycle unit to approximately $515/MW per year for a coal-fired unit.[98]
- Additional energy costs. CCRS operation will result in additional auxiliary energy requirements, which range from approximately 0.4 percent of baseline capacity for a combined cycle unit to approximately 0.8 percent for a coal-fired unit. [99]

The overall effect of these additional CCRS costs and operating effects is to increase the cost of NGCC conversion and operation. These additional costs reduce the financial gain from NGCC conversion, and on the margin, could theoretically dissuade a unit owner from converting a coal-fired unit to NGCC operation. However, whether this effect is material depends on the scale of the overall cost and operational effect of CCRS *in relation* to the costs and expected financial benefit for converting and operating an existing coal-fired unit to NGCC operation.

6.3 Analysis Overview

6.3.1 Case Definitions

The analysis examines four business cases in which plant owners might consider unit conversion. For each case, the analysis involves two steps:

1. A pre-CCRS requirement analysis, in which neither the existing coal-fired capacity nor the NGCC conversion are subject to the CCRS requirement. This case identifies the coal-fired units and their capacity for which NGCC conversion is financially attractive *before the CCRS requirement*.
2. A post-CCRS requirement analysis, in which the NGCC conversion, and where applicable, the coal-fired unit, are subject to the CCRS requirement. This case identifies the units and their capacity for which NGCC conversion remain financially attractive with the CCRS requirement. The difference in this finding

96 Several companies have cited the differential cost impact of environmental regulations (greater for coal-fired capacity than for NGCC) as a key factor in deciding to convert and/or retire existing coal-fired capacity and to replace this capacity with NGCC capacity.

97 EPA estimates.

98 EPA estimates.

99 EPA estimates.

from the first analysis identifies the units and capacity that are no longer financially attractive *because of the CCRS requirement*. This difference is the primary measure of potential adverse impact from the CCRS requirement.

The analysis uses all 1,078 coal-fired units in the IPM database (v. 4.10) as the basis for testing the impact of the CCRS requirement.[100] These units reflect *real* baseline circumstances in terms of unit capacity, heat rate, fuel consumption, fuel and other costs, dispatch level/capacity utilization, wholesale electricity price, and unit age/remaining life. Testing the impact of the CCRS requirement in the context of these units provides meaningful insight into the potential effect of the CCRS requirement on the economics of unit conversion. The analysis is not meant to predict NGCC conversion – with and without the CCRS requirement. Rather, it is intended to examine the frequency and characteristics of instances in which the CCRS requirement would potentially alter an otherwise favorable decision to convert an existing coal-fired unit to NGCC operation – based on a dataset of actual units, which could be candidates for combined cycle conversion now or in the future.

The coal and NGCC unit configurations vary across the cases by the plant owner‟s objectives for the conversion and the resulting considerations in the plant owner‟s analysis (described below and summarized in *Table 6-1*):

Table 6-1: Summary of Economic/Financial Considerations Associated with NGCC Conversion, by Case

Economic/Financial Factor	Case 1	Case 2	Case 3	Case 4
Reduced generating costs from lower gas prices and lower heat rate in combined cycle	✓	✓	✓	✓
Higher unit dispatch and revenue in NGCC operation	✓	✓	✓	✓
Extension of capacity life that would occur from the unit upgrade	✓	✓	✓	✓
Avoided costs for complying with environmental regulations (MATS, CSAPR)		✓	✓	✓
Additional capacity and generation that may be achieved in a NGCC conversion			✓	✓
Cost-differential associated with building an equivalent quantity of new coal capacity (versus additional capacity achieved in a NGCC conversion)				✓

Case 1: Plant owner seeks *and accounts for* reduced generating costs from lower natural gas prices and lower heat rate in NGCC units *and* higher unit dispatch (higher revenue), both compared to existing coal-fired units. The plant owner also accounts for the extension of capacity life that would occur from the unit upgrade.

Case 2: Same as Case 1, except that the plant owner seeks *and accounts for* reduced or avoided costs for complying with environmental regulations – in particular, avoidance of costs from complying with CAA regulations that largely affect coal-fired capacity: the Cross-State Air Pollution Rule (CSAPR) and the Mercury Air Toxics Rule (MATS).

Case 3: Same as Case 2, except that the plant owner *accounts for* the benefit of additional electric generating capacity (and generation) that would typically be achieved in a NGCC conversion. Although this capacity addition involves increased capital outlay, the additional capacity comes at much lower cost than the cost of new coal-fired capacity construction; *however, Case 3 does not account for this cost differential.* Because Cases 1 and 2 did not account for any potential change in generating capacity (or additional cost to achieve the additional capacity), Cases 1 and 2 look at the pure effect of reduced generating costs, higher dispatch, and avoided environment regulation costs. As such, Cases 1 and 2 are somewhat artificial in that the plant owner would recognize and account for the capacity expansion benefit that NGCC conversion would typically achieve.

Case 4: Same as Case 3, except that the plant owner now seeks additional electric generating capacity and *accounts for* the difference in the cost of acquiring additional electric generating capacity via NGCC conversion compared to new coal-fired capacity construction. For this case, the additional environmental compliance costs for CAA regulations only to the existing capacity component of the coal-fired unit. EPA assumes that the cost for new coal capacity already includes costs for compliance with applicable CAA regulations. This case differs from the preceding three cases in that the coal-fired unit is now assumed to become subject to the CCRS requirement

[100] These units are described in Table 6-2.

because of the addition of capacity and potentially other unit modifications *to the coal-fired unit* that would be undertaken in this case. For applying the CCRS requirement to the coal unit, EPA assumes that the existing capacity component will incur all capital and operating costs and operational effects from the CCRS. However, EPA assigned only operating costs and other operational effects to the new capacity component of the coal-fired unit. EPA did not assign additional capital costs to the new capacity component of the coal-fired unit, under the assumption that the capital cost of CCRS installation for the new coal-fired capacity is offset by the avoided cost of additional cooling water intake system capacity that would be otherwise required for a once-through cooling water system.

These four business cases define a range of economic gain from unit conversion, with Case 1 providing the least benefit from conversion and Case 4 being providing the most benefit. Each case could "make sense" from a business objective/decision perspective. From EPA‟s review of articles and company statements describing these conversions, the factors reflected in Cases 3 and 4 are the most frequently cited: improved economics due to low natural gas prices, increased generating efficiency, avoided/reduced cost of complying with CAA regulations, and, for Case 4, need/benefit of additional capacity.

6.3.2 Assessing the Economic/Financial Viability of NGCC Conversion

EPA assessed the financial viability of the NGCC conversion by comparing the net present value (NPV) of pre-tax cash flow (PTCF) of (1) the coal-fired capacity option with (2) the combined cycle conversion option.[101] EPA performed these calculations for each of the four business cases outlined above, and for each of the 1,078 coal-fired units in the IPM v. 4.10 database. For each business case, EPA identified the units in which conversion would be financially advantageous. For those units, EPA then assessed whether the CCRS requirement would alter that finding. As described above, the CCRS requirement involves a number of effects, including capital outlay, fixed and variable O&M expense, and loss of some electricity sales due to the energy required to operate the CCRS; these effects reduce the financial gain that would otherwise be achieved by NGCC conversion.

Before making the NPV calculation for a given unit, EPA calculated the unit‟s PTCF annually for the applicable life of the unit. Each annual value is comprised of applicable revenue, operating expenses, and capital outlays. For the existing coal unit, the analysis extends until the unit is 60 years old. The analyses for NGCC capacity assume a capital life of 30 years. For Case 4, which involves new coal-fired capacity, the analysis assumes a capital life of 40 years for the coal unit.

For each business cases-generating unit combination, EPA calculated annual PTCF as follows:

$$PTCF_t = OI_t - CAPOUT_t \tag{6-1}$$

and

$$OI_t = SALES_t - FOM_t - VOM_t - FUEL_t - EP_t \tag{6-2}$$

where,

$PTCF_t$	=	pre-tax cash flow in year *t*
OI_t	=	the unit‟s operating income in year *t*
$CAPOUT_t$	=	capital outlays in year *t* (for NGCC, CCRS, environmental compliance technology, or additional coal capacity)

[101] EPA undertook this analysis on a pre-tax basis to avoid issues of tax effects, which, for example, would vary by company, and introduce considerable complexity. While an after-tax cash flow analysis would reflect more accurately the analysis that a plant owner would undertake in considering NGCC conversion, in EPA‟s view, consideration of tax effects would not materially alter the basic finding of financial viability.

$SALES_t$	=	electricity sales in year *t* (based on electricity sales quantity and price)
FOM_t	=	fixed operating costs in year *t*
VOM_t	=	variable operating costs in year *t*
$FUEL_t$	=	fuel costs in year *t*
EP_t	=	lost electricity sales due to energy penalty or other operational effects in year *t*.

Depending on the business case, each of these components of PTFC reflects the specific considerations encompassed in the case: for example, Case 1 does not account for avoided/reduced cost of environmental compliance for the NGCC capacity compared to coal-fired capacity, while Cases 2-4 account for this factor. Energy penalty effects are present for units in cases that account for the costs of retrofit air pollution controls or a CCRS. Both of these technologies/systems use some of the generating unit‟s electricity output, which the analysis accounts for as a reduction in the electricity that would otherwise be available for sale. Similarly, these technologies, as well as any capacity additions to either the coal unit or the gas unit, require FOM and VOM costs that are incorporated along with the existing unit operating costs, as applicable in each case.

A unit may incur capital outlays in cases where the analysis accounts for the addition of new capacity, retrofit air pollution controls, and/or CCRS. Capital costs for new capacity include outlays for NGCC conversion or for new coal capacity. For calculating annual PTCF, EPA assumed that any capital outlays are uniformly distributed across a specified construction duration (in years), as detailed in *Sections 6.5* and *6.6*. EPA assumed that associated operating costs begin in the year following completion of construction.

In addition, the analysis assumes – for both coal and NGCC units – that the unit owner would retire the unit if PTCF from operations (i.e., not accounting for capital outlays) during the unit‟s potential operating period.

EPA calculated the NPV of the unit‟s annual stream of PTCF as follows, assuming a 7 percent discount rate:

$$\sum_{t=1}^{T} \frac{PTCF_t}{(1+DR)^t)} \qquad (6\text{-}3)$$

Where:

T	=	total number of years in the unit-level analysis
DR	=	discount rate.

For each business case, EPA identified the generating units for which conversion is financially viable, as indicated by the NPV of the NGCC-converted unit being positive and higher than the NPV of coal-fired operation. In each business case, for generating units in which NGCC conversion is financially viable, EPA then tested whether the CCRS requirement would alter that finding, by adding the associated CCRS costs to the NGCC conversion unit and recalculating the NPV:

- If the NPV of the NGCC unit remains positive and greater than the NPV of coal-fired operation, EPA judges that a CCRS requirement would not prevent a conversion.
- Alternatively, if the additional CCRS requirement causes the initially viable conversion NPV to turn negative and/or be less than the NPV for the coal-fired option, this indicates a unit for which the CCRS requirement would adversely affect the assessment of NGCC conversion.

Section 6.7 presents the results of these comparisons by presenting, for each business case, the number of economically viable conversions and their associated capacity, and the number of those that become unviable due to the CCRS requirement.

6.4 Summary of Key Data Inputs

As described above, the analysis is based on the 1,078 coal-fired generating units, and their baseline characteristics, that are contained in the IPM v. 4.10 database. Key data items for each generating unit include:

- Unit capacity
- Heat rate
- Fuel consumption and cost
- Other fixed and variable costs
- Dispatch level/capacity utilization
- Wholesale electricity price and revenue
- Unit age/remaining life.

The analysis also requires various information and assumptions to specify the alternative business cases and to project unit operations and financial performance over the analysis period. Key additional case- and unit-specific information and assumptions include:

- Baseline prices for electricity and coal
- Baseline natural gas prices
- Unit dispatch/capacity utilization after combined cycle conversion
- Technology requirements and associated capital, O&M and operational effects for compliance with CAA regulations, accounting for each regulation‟s applicability criteria, the baseline technologies in place for each unit, and retrofit requirements for air pollution controls
- Capital and operating costs, and heat rate for combined cycle conversion *and* for additional coal-fired capacity
- Capacity addition associated with a combined cycle conversion
- Remaining life of existing capacity, and benefit of extended capacity life from combined cycle conversion or new coal capacity
- Capital and other costs, and operational effects from CCRS installation
- Adjustments to convert any cost values to a common dollar-year (2011).

Specific values and data sources for these unit-specific parameters, for coal and NGCC units, are detailed in *Section 6.5* and *6.6*, respectively. The following section describes the fuel price change forecast data requirements for the analysis, which are not unit-specific.

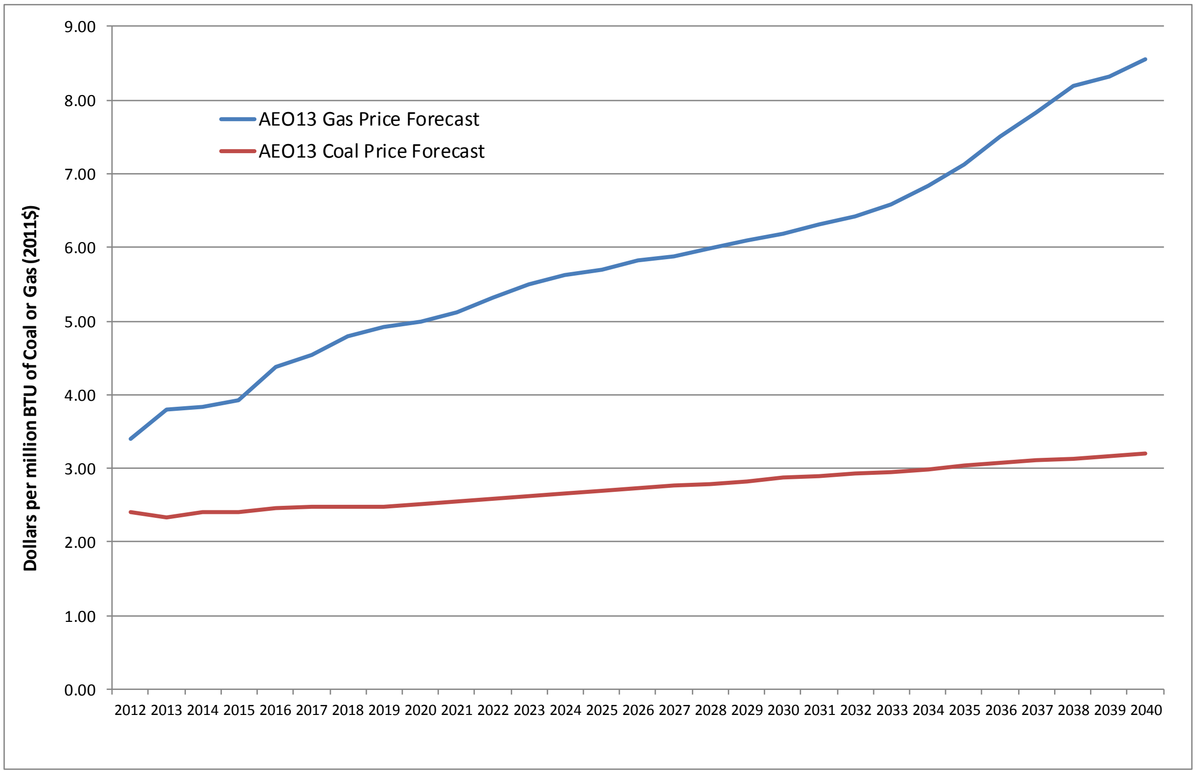
6.4.1 Forecasted Changes in Coal, Natural Gas, and Wholesale Electricity Prices

The analysis requires forecasts of changes in the prices for coal, natural gas, and wholesale electricity sales in order to estimate fuel and sales revenue values over time. For each generating unit, the analysis begins with the baseline price value for coal, gas, and electricity – as noted above and detailed in Section *6.5* and *6.6* – and then applies the forecast of annual percentages changes to create unit-specific price forecasts (e.g., each unit gets the same *annual change forecast* for coal, gas, and electricity assigned to their baseline prices).

Figure 6-1 and *Figure 6-2*, following page, present the price forecasts for coal, gas, and electricity that were used to estimate the annual percentage change values for this analysis. These data are based on the EIA‟s Annual

Energy Outlook 2013 forecast through 2040, and show prices in 2011 dollars.[102] To support a longer period of analysis, EPA extended the AEO forecasts from 2040 to 2060 using the annual growth rate projected by EIA for the last five years of each forecast.

Figure 6-1: Coal and Natural Gas Price Forecasts



Source:

Energy Information Administration, Annual Energy Outlook (2013, Early Release)

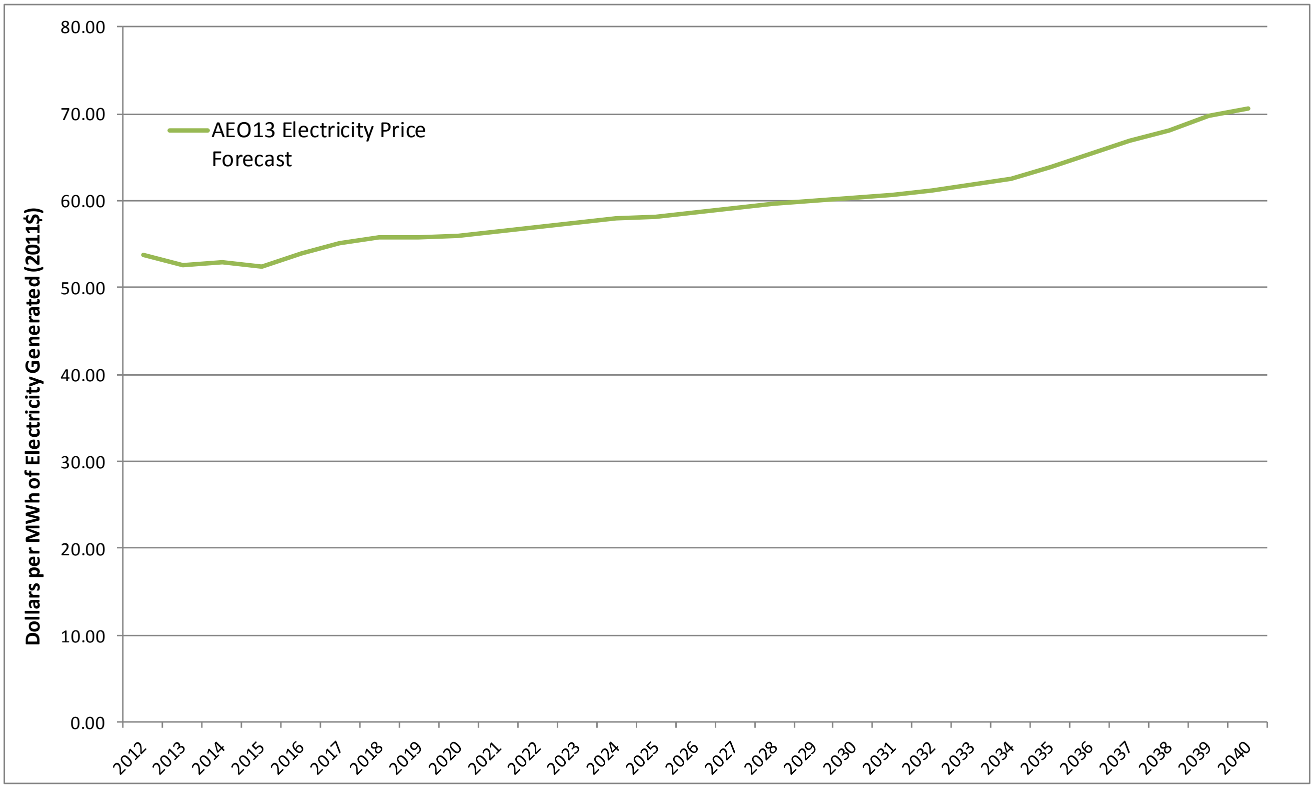
Notes:

Actual 2012 fuel prices used in the analysis vary by unit (as previously described). The analysis applies the annual percentage change in price from the AEO forecast to each unit's fuel prices to develop unit-specific forecasts.

The AEO 2013 forecast ends at 2040. The analysis assumes the long-term annual average growth rate for each fuel for the period 2041 - 2060 (gas=2.0%, coal=1.0%).

[102] AEO 2013 tables include: for coal see "Coal Supply, Disposition, and Prices (Reference Case)"; For gas see "Natural Gas Supply, Disposition, and Prices (Reference Case)"; and for electricity see "Electricity Supply, Disposition, Prices, and Emissions (Reference Case)".

Figure 6-2: Wholesale Electricity Price Forecasts



Source:

Energy Information Administration, Annual Energy Outlook (2013, Early Release)

Notes:

Actual 2012 electricity prices used in the analysis vary by NERC region (as previously described). The analysis applies the annual percentage change in price from the AEO forecast to develop NERC-specific forecasts.

The AEO 2013 forecast ends at 2040. The analysis assumes the long-term annual average growth rate for the period 2041 - 2060, 0.7%.

6.5 Calculating PTCF for Coal Unit Configurations

The four business cases require estimates of annual PTCF for the alternative configurations of the coal-fired option. Referring back to *Table 6-1*:

- PTCF from the existing coal unit as currently configured in IPM is required in all four cases in order to assess the benefit of higher dispatch and reduced generating costs relative to the NGCC option.
- PTCF from the installation of retrofit air pollution controls is required for cases 2, 3, and 4 to assess the avoided/reduced costs of air pollution controls associated with NGCC conversion.
- PTCF from the installation of new coal capacity and the installation of a CCRS (which would accompany the additional capacity installation in the CCRS case) are required for Case 4 to assess the relative cost of additional NGCC conversion capacity compared to an equivalent quantity of new coal capacity. In the same way that the NGCC unit is assumed not to require CCRS in the *pre-CCRS requirement* comparison, the coal-fired unit is also assumed not to require CCRS in the pre-CCRS requirement comparison. In the *post-CCRS requirement comparison*, the entire coal-fired unit becomes subject to the CCRS requirement. However, as described in *Section 6.3.1*, EPA applied the CCRS costs to the coal-fired capacity differently, with the *existing* coal capacity receiving all CCRS cost and operational effects, but with the *capacity addition* assumed not to incur capital costs for CCRS installation. The *capacity addition* does incur CCRS operating costs.

The subscript, *t*, denotes a year in the analysis, where t = 1…T, and T is the total number of years in the potential life of the unit. All calculations of dollar values are in units of $1,000 and are denoted in 2011 dollars.

The sections below describe the four coal unit components underlined above, including input parameter specifications, data sources, and assumptions, as well as the associated calculations that require those inputs.

6.5.1 Existing Coal Unit, as Currently Configured in IPM

Table 6-2 describes the observation set of 1,078 existing coal units from the IPM v4.10 database, that are included in the analysis, including parameter values taken directly from the IPM database, data sources for additional parameters values not present in IPM, and all related key assumptions.

Table 6-2: Summary of Existing Coal Units Included in the Analysis

Variable	Units	Value	Data Source / Notes
Total Number of Coal Units	n of units	1,078	Generating-unit observations taken directly from IPM (2011 simulation). An initial set of 1,264 coal steam units was reduced to 1,078 after removing units with zero reported FOM and VOM costs.
Average Age	years	37.1	Calculated from IPM baseline, weighted by the capacity of the 1,078 units. Unit age increases by one per year of the analysis.
Existing Coal Unit Life	years	60	Assumed coal unit lifetime if no coal capacity is added (which is presumed to include a life-extension upgrade).
Capacity			Based on IPM 2015 (2013 - 2017) simulation. Capacity may vary over time for a unit based on changes in future IPM simulation years: 2020 (2018 - 2022) and 2030 (2028 - 2032). Analysis assumes 2020 values for the period 2023 - 2027, and 2030 values for all years after 2032.
Total	MW	299,852	
Average per unit	MW	278.2	
Range	MW	0.9 - 1,310	
Generation			Based on IPM 2015 (2013 - 2017) simulation. Average generation per unit is weighted by unit capacity. Generation may vary over time for a unit based on changes in future IPM simulation years: 2020 (2018 - 2022) and 2030 (2028 - 2032). Analysis assumes 2020 values for the period 2023 - 2027, and 2030 values for all years after 2032.
Total	MW	1,955,208	
Average per unit	GWh	3,459.0	
Range	GWh	6.7 - 9484.8	
Heat Rate			Based on IPM 2015 (2013 - 2017) simulation. Average heat rate per unit is weighted by unit capacity. Heat rate may vary over time for a unit based on changes in future IPM simulation years: 2020 (2018 - 2022) and 2030 (2028 - 2032). Analysis assumes 2020 values for the period 2023 - 2027, and 2030 values for all years after 2032.
Average per unit	Btu/kWh	10,193	
Range	Btu/kWh	14,500 - 7,448	
Fixed O&M Cost			Based on IPM 2015 (2013 - 2017) simulation. Average costs per unit are weighted by unit capacity. O&M unit costs may vary over time based on changes in future IPM simulation years: 2020 (2018 - 2022) and 2030 (2028 - 2032). Analysis assumes 2020 values for the period 2023 - 2027, and 2030 values for all years after 2032. O&M costs were a) converted from IPM units of millions of dollars per year to $/KW and $/MWh for FOM and VOM, respectively, and b) adjusted from 2009 to 2011 dollars using the BLS Producer Price Index (PPI) for the Industrial Electric Power.
Average per unit	$/kW	67.8	
Range	$/kW	188.2 - 1.4	
Variable O&M Cost			
Average per unit	$/MWh	3.97	
Range	$/MWh	10.64 - 0.96	
Units with Retrofit Air Pollution Controls			Based on IPM 2015 (2013 - 2017) simulation, which provides a text field indicating the presence of air pollution controls. These data form part of the criteria for requiring additional controls under cases that account for CSAPR and MATS requirements (see Table 6-4).
Scrubber	n of units	240	
SCR	n of units	69	
SNCR	n of units	4	
DSI	n of units	196	
Mercury Control	n of units	308	
Coal Price (to the plant)			Coal prices are based on data from the EIA-923 Monthly Time Series File (Fuel Receipts and Cost, Schedules 2), November 2012. Units for which plant-specific coal prices were available were assigned those prices (229 units). The remaining units were assigned a state-level coal price (693 units) or a national-level price (156) for states where no coal price data were reported in EIA-923. State-level average prices were estimated based on EIA-923 plant-level data, weighted by the quantity of coal delivered to each plant. Coal prices were not reported for nine states that contain a total of 156 generating units included in the analysis (CA, CT, DE, MA, MD, MT, NJ, NY, PA). Average coal price values reported here are the average values assigned to each
Based on plant-specific price			
Number of units	$/MMBtu	229	
Average coal price	$/MMBtu	2.57	
Range	$/MMBtu	0.81 - 4.75	
Based on state-average price			
Number of units	$/MMBtu	693	
Average coal price	$/MMBtu	2.15	
Range	$/MMBtu	1.43 - 4.45	
Based on national-average price			

Table 6-2: Summary of Existing Coal Units Included in the Analysis			
Variable	**Units**	**Value**	**Data Source / Notes**
Number of units *National coal price*	$/MMBtu $/MMBtu	156 2.50	group of units (plant-level, state-level, national-level), weighted by their capacity. Current coal prices assigned to each unit change annually based on the EIA's AEO 2013 forecast of fuel prices (see *Figure 6-1*).

Table 6-3 summarizes the distribution of coal units by NERC region, along with the average wholesale electricity prices estimated for each NERC region from the 2015 IPM database (applies 2013 – 2017). Each unit is assigned a baseline electricity price from this table based on its NERC region.

Table 6-3: Existing Coal Units, Capacity, and Electricity Prices by NERC Region, 2015 IPM Baseline

NERC	Number of Units	Total Capacity (MW)	Electricity Price ($/MWh)	Data Sources / Notes
FRCC	23	9,158	$64.35	Average NERC-level price calculated based on IPM 2015 (2013 - 2017) simulation. All units are assigned an initial electricity sales price based on their NERC region. This value changes annually based on EIA's AEO 2013 electricity price forecast (see Figure 2). Electricity prices in IPM were adjusted from 2007 to 2011 dollars using the BLS Producer Price Index (PPI) for the Industrial Electric Power sector.
MRO	154	28,570	$50.48	
NPCC	41	5,151	$62.26	
RFC	327	93,886	$54.55	
SERC	332	95,326	$53.20	
SPP	56	19,841	$50.82	
ERCOT	33	18,590	$54.63	
WECC	112	29,331	$50.21	
Total	**1,078**	**299,852**		

The analysis of pre-tax cash flow (PTCF) for the existing coal unit requires estimating the following values annually: *electricity sales revenue, fixed and variable O&M costs, and fuel costs from current operations*.

Since the current operations of the unit do not include any capital investments, the sales and expense values are calculated beginning in 2013 for each existing unit. The analysis extends until each unit reaches 60 years of age, except in Case 4, where the existing unit runs for 40 years beyond 2013 due to the life extension benefit of capacity expansion.

Wholesale Electricity Sales Revenue

$$SALES_t = GEN_{\boldsymbol{t}} * P\_ELEC_t \qquad (6\text{-}4)$$

Where:

$SALES_t$ = is the value of wholesale electricity sales revenue in year t ($1,000)

GEN_t = is the quantity of generation in year t (GWh)

P_ELEC_t = is the NERC-level wholesale electricity price in year t ($/MWh).

Fixed and Variable O&M Expenses

$$FOM_t = CAP_{\boldsymbol{t}} * P\_FOM_t \qquad (6\text{-}5)$$

and

$$VOM_t = GEN_{\boldsymbol{t}} * P\_VOM_t \qquad (6\text{-}6)$$

Where:

FOMt = is the value of fixed operations and maintenance cost in year t ($1,000)

VOM_t = is the value of variable operations and maintenance cost in year t ($1,000)

CAP_t = is the existing coal unit capacity (MW)

GEN_t = is the quantity of generation in year t (GWh)

P_FOM_t	=	is the unit cost of fixed operations and maintenance in year t ($/KW).
P_VOM_t	=	is the unit cost of variable operations and maintenance in year t ($/MWh).

Fuel Expenses

$$FUEL_t = [(P\_COAL_t * HR_t)/1000] * GEN_t \quad (6\text{-}7)$$

Where:

$FUEL_t$	=	is the value of fuel cost in year t ($1,000)
HR_t	=	is the heat rate in year t (Btu/kWh)
GEN_t	=	is the quantity of generation in year t (GWh)
P_COAL_t	=	is the unit cost of coal delivered to the plant in year t ($/MMBtu).

6.5.2 Retrofit Air Pollution Controls

Technology costs and operational effects for air pollution controls are based on documentation for the IPM v.4.10 database, as described in *Table 6-4*.[103] In the analysis, each coal unit may be required to install up to three air pollution control technologies – for controlling SO_2, NO_x, and/or Mercury emissions – based on unit- and case-specific criteria, which are also described in *Table 6-4*.

Table 6-4: Specifications for Retrofit Air Pollution Controls

Variable	Units	Value	Data Source / Notes
Requires SO_2 Control			A unit is assumed to require SO_2 controls if it a) has capacity greater than 25MW, b) is located in an SO_2 state under CSAPR (see Table 6-5), and c) does not currently have a scrubber (per Table 6-2).
Number of units	n of units	645	
Total capacity	MW	163,165	
Requires NO_x Control			A unit is assumed to require NOx controls if it a) has capacity greater than 25MW, b) is located in a NOx state under CSAPR (see Table 6-5), and c) does not currently have either SCR or SNCR technology (per Table 6-2).
Number of units	n of units	851	
Total capacity	MW	231,028	
Requires Mercury Control			A unit is assumed to require mercury controls if it a) has capacity greater than 25MW and b) does not currently have either mercury control technology or DSI (per Table 6-2).
Number of units	n of units	646	
Total capacity	MW	180,971	
SO_2 Control Technology			Technology variable specifications are based on input data from the Documentation for IPM Base Case v.4.10 (August 2010). Cost and capacity penalty values are provided for combinations of heat rate and capacity ranges. Unit-specific values are estimated based on the closest heat rate option and a linear interpolation within the corresponding capacity range. Technology options include a limestone forced oxidation (LSFO) or lime spray dryer (LSD) scrubber. The analysis assumes LSFO, which is approximately 15% more expensive for all heat rate and capacity ranges. Dollar values were adjusted from 2007 to 2011 dollars using the ENR Construction Cost Index (CCI) for capital costs, and the BLS Producer Price Index (PPI) for the Industrial Electric Power sector for O&M costs.
Technology type		Scrubber, LSFO	
Capital Cost	$/KW	930.2 - 441.8	
Capacity Penalty	%	(1.50%) - (1.84%)	
Fixed O&M Cost	$/KW	26.2 - 6.7	
Variable O&M Cost	mill $/kWh	2.29 - 1.87	
NO_x Control Technology			As above.
Technology type		SCR	
Capital Cost	$/KW	293.8 - 167.4	
Capacity Penalty	%	(0.54%) - (0.58%)	
Fixed O&M Cost	$/kW	2.82 - 0.45	
Variable O&M Cost	mill $/kWh	1.50 - 1.30	
Mercury Control Technology			As above.
Technology type		SPAC ESP	
Capital Cost	$/kW	30.7 - 19.4	

[103] U.S. EPA. 2010. Documentation for EPA Base Case v.4.10 Using the Integrated Planning Model. August 2010. Available online at http://www.epa.gov/airmarkets/progsregs/epa-ipm/BaseCasev410.html#documentation

Table 6-4: Specifications for Retrofit Air Pollution Controls

Variable	Units	Value	Data Source / Notes
Capacity Penalty	%	(0.43)%	
Fixed O&M Cost	$/kW	0.56 - 0.34	
Variable O&M Cost	mill $/kWh	2.78 - 2.58	
AP Control Construction Duration	years	1	Assumed duration over which capital costs for air pollution control are incurred.

Table 6-5, referenced above in *Table 6-4*, indicates the states for which SO_2 and/or NO_x controls would be required under the Cross-State Air Pollution Rule (CSAPR).

Table 6-5: Cross-State Air Pollution Rule (CSAPR) State Applicability

State	Reduce SO_2 and NO_x	Reduce Ozone Season NO_x
Alabama	1	1
Arkansas	0	1
Florida	0	1
Georgia	1	1
Iowa	1	1
Illinois	1	1
Indiana	1	1
Kansas	1	1
Kentucky	1	1
Louisianna	0	1
Maryland	1	1
Michigan	1	1
Minnesota	1	0
Mississippi	0	1
Missouri	1	1
North Carolina	1	1
Nebraska	1	0
New Jersey	1	1
New York	1	1
Ohio	1	1
Oklahoma	0	1
Pennsylvania	1	1
South Carolina	1	1
Tennessee	1	1
Texas	1	1
Virginia	1	1
Wisconsin	1	1
West Virginia	1	1
TOTALS	**23**	**26**

Source:
U.S. EPA. 2010. Documentation for EPA Base Case v.4.10 Using the Integrated Planning Model. August 2010. Available online at http://www.epa.gov/airmarkets/progsregs/epa-ipm/BaseCasev410.html#documentation

The PTCF effect for the retrofit air pollution controls includes the following values for each technology: *capital costs for technology installation, annual lost electricity sales revenue due to energy penalty, and annual fixed and variable O&M costs*.

Since these technologies require construction/installation, the annual time series of values includes a construction period and an operations period. The analysis assumes a one-year construction period, occurring in 2013, for all three air pollution control technologies; O&M costs and energy penalty effects begin in 2014.

The equations below are the same for all three technology options, except that the input values for costs and energy penalty differ based on *Table 6-4*.

Capital Cost (applies in 2013)

$$CAPOUT_t = (CAP\_COST * CAP)/LEAD \quad (6\text{-}8)$$

Where:

CAPOUTt	=	capital outlays in each year, t, of the construction period ($1,000)
CAP_COST	=	unit capital cost of the air pollution control technology ($/KW)
CAP	=	existing coal unit capacity (MW)
LEAD	=	number of years over which installation occurs

Loss in Wholesale Electricity Sales Revenue

$$EP_t = SALES_t * P\_EP \quad (6\text{-}9)$$

Where:

EP_t	=	lost electricity sales revenue in year t ($1,000)
$SALES_t$	=	electricity sales revenue in year t for the existing coal unit ($1,000)
P_EP	=	percentage of capacity required to operate the air pollution control technology (%)

Fixed and Variable O&M Expenses

$$FOM_t = CAP * P\_FOM \quad (6\text{-}10)$$

and

$$VOM_t = GEN_t * P\_VOM \quad (6\text{-}11)$$

Where:

FOM_t	=	fixed operations and maintenance cost in year t ($1,000)
VOM_t	=	variable operations and maintenance cost in year t ($1,000)
CAP	=	coal unit capacity (MW)
GEN_t	=	generation in year t for the existing coal unit (GWh)
P_FOM	=	unit cost of fixed operations and maintenance ($/KW)
P_VOM	=	unit cost of variable operations and maintenance ($/MWh)

6.5.3 Coal Capacity Expansion

Table 6-6 describes parameter specifications for new coal capacity, based on documentation for IPM Base Case v.4.10. These costs and other operational effects occur only in Case 4.

Table 6-6: Specifications for New Coal Capacity

Variable	Units	Value	Data Source / Notes
Capacity Added to Existing Unit	MW	-	This is a case- and plant-specific value estimated from the original unit capacity and the NGCC capacity multiplier (i.e., the analysis compares the effect of additional NGCC capacity to an equivalent quantity of new coal capacity).
New Coal Capacity Life	years	40	Lifespan of the unit once additional coal capacity is added. Value is based on the life extension expenditure data in documentation for IPM Base Case v.4.10 (Table 4-10, August 2010).
Capital Cost*	$/KW	3,373.6	The capital cost per kW of capacity for new coal generation (e.g., the total installed cost of developing and building a new plant) is based on documentation

			for IPM Base Case v.4.10 (Table 4-13, August 2010). The total capital cost of the conversion is spread uniformly over the period, 2013 - 2016, based on the construction duration, below. Dollar values were adjusted from 2007 to 2011 dollars using the ENR Construction Cost Index (CCI).
Fixed O&M Cost* Variable O&M Cost*	$/KW $/MWh	32.4 3.2	Fixed and variable O&M costs for new coal capacity are based on documentation for IPM Base Case v.4.10 (Table 4-13, August 2010). FOM and VOM costs begin for each converted unit in 2017, following the completion of construction. Dollar values were adjusted from 2007 to 2011 dollars using the BLS Producer Price Index (PPI) for the Industrial Electric Power sector for O&M costs.
Construction Duration[2]	years	4	Based on the lead-time specified for new coal capacity in documentation for IPM Base Case v.4.10 (Table 4-13, August 2010).
Utilization Heat Rate	% Btu/kWh	77.3% 8,906	National average capacity utilization and heat rate values for new coal units estimated by from IPM Base Case v.4.10 database.

The analysis of pre-tax cash flow (PTCF) for new coal capacity includes estimating the following values annually: *electricity sales revenue from generation associated with the additional capacity, capital costs for technology installation, fixed and variable O&M costs, and fuel costs.*

Since this component requires construction/installation, the annual time series of PTCF values includes a construction period and an operations period. The analysis assumes that new coal capacity will be constructed over a four-year period, 2013 - 2016, with O&M and other recurring costs/operational effects beginning in 2017.

Capital Cost (applied for years 2013 – 2016)

$$CAPOUT_t = (CAP\_COST * N\_CAP)/LEAD \quad (6\text{-}12)$$

Where:

CAPOUTt = capital outlays in each year, t, of the construction period ($1,000)

CAP_COST = unit capital cost of new coal capacity ($/KW)

N_CAP = quantity of new coal capacity installed (MW)

And

CAP = new coal capacity (MW)

CAP_MULT = percentage expansion of original coal capacity expected to be achieved from a NGCC conversion (see *Table 6-8*, below)

LEAD = number of years over which installation occurs.

Wholesale Electricity Sales Revenue

$$SALES_t = GEN_t * P\_ELEC \quad (6\text{-}13)$$

Where:

$SALES_t$ = electricity sales revenue in year t from the additional capacity ($1,000)

GEN_t = generation per year from the additional capacity (GWh)

And

$$GEN_t = N\_CAP * CUR * 8.76 \quad (6\text{-}14)$$

Where:

N_CAP	=	new coal capacity (MW)
CUR	=	capacity utilization of new coal capacity (%)
P_ELEC_t	=	NERC-level wholesale electricity price in year t ($/MWh).

Fixed and Variable O&M Expenses

$$FOM_t = N\_CAP * P\_FOM \quad (6\text{-}15)$$

And

$$VOM_t = GEN_t * P\_VOM \quad (6\text{-}16)$$

Where:

FOM_t	=	fixed operations and maintenance cost in year t ($1,000)
VOM_t	=	variable operations and maintenance cost in year t ($1,000)
N_CAP	=	new coal capacity (MW)
GEN_t	=	generation in year t for the new coal capacity (GWh)
P_FOM	=	unit cost of fixed operations and maintenance ($/KW)
P_VOM	=	unit cost of variable operations and maintenance ($/MWh)

Fuel Expenses

$$FUEL_t = [(P\_COAL_t * HR)/1000] * GEN_t \quad (6\text{-}17)$$

Where:

$FUEL_t$	=	fuel cost in year t ($1,000)
HR_t	=	heat rate for new coal capacity (Btu/kWh)
GEN_t	=	generation in year t from new coal capacity (GWh)
P_COAL_t	=	unit cost of coal delivered to the plant in year t ($/MMBtu).

6.5.4 Closed-Cycle Recirculating System (CCRS)

Table 6-7 describes parameter specifications for CCRS for the coal-fired option. These costs and other operational effects occur only in Case 4.

Table 6-7: Specifications for Coal Closed-Cycle Cooling Systems (CCCS)

Variable	Units	Value	Data Source / Notes
Existing Coal Unit			CCCS costs are based on EPA estimates. When applicable in an analysis case (Case 4), all of these costs apply to the *existing capacity* component of the coal-fired unit, while the *capacity addition* does not incur CCRS capital costs. The total capital cost of the system is spread uniformly over the construction duration, which is assumed to occur simultaneously with the new capacity construction, over 4 years, 2013 - 2016. FOM and VOM costs begin in the year following completion of construction, 2017. The energy penalty accounts for (1) the power required to operate the cooling water system, and (2) the loss in thermal conversion efficiency for the existing capacity component of the coal-fired unit. Energy penalty is applied as a percentage reduction in effective capacity, and ultimately electricity sales.
Capital Cost	$/KW	60.1	
Construction Duration	years	4	
Energy Penalty – auxiliary requirement	%	-0.77%	
Energy Penalty – thermal conversion loss	%	-1.50%	
Fixed O&M	$/KW	0.366	
Variable O&M - Chemicals	$/KW	0.151	

The analysis of PTCF for CCRS includes the following values for each technology: *capital costs for technology installation, lost electricity sales revenue due to energy penalty, and fixed and variable O&M costs*.

Since the CCRS addition requires construction/installation, the annual time series of values includes a construction period and an operations period. The analysis assumes a 4-year construction period for coal CCRS (i.e., the installation will occur simultaneously with coal capacity expansion), 2013 - 2016, with O&M costs and energy penalty beginning in 2017. As described above, in *Section 6.3.1*, EPA applied these costs only in the *post-CCRS requirement* analysis, and applied them differently to the existing and additional capacity components of the coal-fired units: the existing capacity component incurs *all* costs and operational effects from CCRS installation and operation; the additional capacity component does *not* incur capital costs for CCRS installation.

Capital Cost (apply in 2013 - 2016)

$$CAPOUT_t = \frac{(CAPCOST * N\_CAP)}{LEAD}/1000 \quad (6\text{-}18)$$

Where:

$CAPOUT_t$	=	capital outlays in each year, t, of the construction period ($1,000)
CAP_COST	=	unit capital cost of CCRS ($/MW)
N_CAP	=	new coal unit capacity (MW)
LEAD	=	number of years over which installation occurs.

Loss in Wholesale Electricity Sales Revenue

$$EP_t = SALES_t * P\_EP \quad (6\text{-}19)$$

Where:

EP_t	=	lost electricity sales revenue in year t ($1,000)
$SALES_t$	=	electricity sales revenue in year t for the new coal capacity ($1,000)
P_EP	=	energy penalty percentage, applied as percentage loss in capacity (%).

Fixed and Variable O&M Expenses

$$FOM_t = N\_CAP * P_{FOM}/1000 \quad (6\text{-}20)$$

and (6-21)

$$VOM_t = N\_CAP * P\_VOM/1000$$

Where:

FOMt	=	fixed operations and maintenance cost in year t ($1,000)
VOMt	=	variable operations and maintenance cost in year t ($1,000)
N_CAP	=	new coal capacity (MW)
P_FOM	=	unit cost of fixed operations and maintenance ($/MW)
P_VOM	=	unit cost of variable operations and maintenance ($/MW)

6.6 Estimating PTCF for NGCC Conversion Unit Configurations

The four business cases require estimates of PTCF for the different configurations of the NGCC conversion option. Referring back to*Table 6-1*:

- PTCF from operation of an NGCC unit with equivalent capacity as the exiting coal unit is required in all four cases in order to assess the benefit of higher dispatch and reduced generating costs relative to the coal-fired option.
- PTCF from the installation of additional NGCC capacity is required for Case 3 to assess the benefit of additional NGCC capacity and generation relative to the coal-option, and in Case 4 to assess this benefit relative to the effects of building an equivalent quantity of new coal capacity.
- PTCF from the installation of a CCRS is required for all four cases to assess the impact of adding CCRS to the NGCC unit.

The subscript, *t*, denotes a year in the analysis, where t = 1…T, and T is the total number of years in the life of the unit. All calculations of dollar values are in units of $1,000 and are in 2011 dollars. *Section 6.6.1* describes the inputs, data sources, and methodology for calculations related to NGCC capacity. *Section 6.6.2* describes the analysis of a CCRS requirement for the NGCC unit.

6.6.1 NGCC Conversion Unit Capacity

Table 6-8 describes parameter specifications for estimating annual PTCF associated with NGCC conversion unit capacity; these specifications are based on documentation for IPM Base Case v.4.10.

Table 6-8: Specifications for the Natural Gas Combined-Cycle Conversion Unit

Variable	Units	Value	Data Source / Notes
NGCC Conversion Unit Life	years	30	Lifespan of the unit once converted to NGCC. Value is based on the life extension expenditure data in documentation for IPM Base Case v.4.10 (Table 4-10, August 2010).
Conversion Capacity Multiplier	% capacity	100%	An assumed multiplier applied to the NGCC conversion capacity (i.e., original capacity * [1+multiplier]) on a case-specific basis to account for the potential of a plant owner to increase a unit's overall capacity as part of the NGCC conversion process. The analysis assumes a 100 percent capacity addition – i.e., baseline steam capacity is augmented by an equal quantity of gas turbine capacity. Public records indicate that the capacity increase varies widely, depending on the character of the capacity modification and the plant owner‟s objective in undertaking the capacity modification.
Capital Cost Conversion discount factor Adjusted capital cost	$/kW % $/kW	1,111.3 15% 944.6	The capital cost per kW of capacity for new NGCC generation (e.g., the total installed cost of developing and building a new plant) is based on documentation for IPM Base Case v.4.10 (Table 4-13, August 2010). The total capital cost of the conversion is spread uniformly over the period, 2013 - 2015, based on estimated construction duration. Dollar values were adjusted from 2007 to 2011 dollars using the ENR Construction Cost Index (CCI). The conversion discount factor accounts for cost savings associated with retrofitting the existing plant versus a new-build scenario.
Fixed O&M Cost **Variable O&M Cost**	$/kW $/MWh	16.24 2.90	Fixed and variable O&M costs for new NGCC generation are based on the Documentation for IPM Base Case v.4.10 (Table 4-13, August 2010). FOM and VOM costs begin for each converted unit in 2016, following the completion of construction. Dollar values were adjusted from 2007 to 2011 dollars using the BLS Producer Price Index (PPI) for the Industrial Electric Power sector for O&M costs.
Construction Duration	years	3	Based on the lead time specified for new NGCC generation in the documentation for IPM Base Case v.4.10 (Table 4-13, August 2010).
Utilization	%	84.6	National average capacity utilization and heat rate values for new

Table 6-8: Specifications for the Natural Gas Combined-Cycle Conversion Unit

Variable	Units	Value	Data Source / Notes
Heat Rate	Btu/kWh	6,810	NGCC units estimated from IPM v.4.10 database.
Gas Price (to the plant) Based on state-average price *Number of units* *Average gas price* *Range* Based on national-average price *Number of units* *National gas price*	 $/MMBtu $/MMBtu $/MMBtu $/MMBtu $/MMBtu	 963 3.38 6.14 - 2.77 115 3.58	Gas prices are based on data from the EIA-923 Monthly Time Series File (Fuel Receipts and Cost, Schedules 2), November 2012. State-level average prices were estimated based on EIA-923 plant-level data, weighted by the quantity of gas delivered to each plant. Gas prices were not reported for six states that contain a total of 115 generating units in the analysis (DE, MD, MT, ND, NJ, PA). EPA assigned these units a national-average price. Average gas price values reported here are the average values assigned to each group of units (plant-level, state-level, national-level), weighted by their capacity. Current gas prices assigned to each unit change annually based on the EIA's AEO 2013 forecast of fuel prices (see *Figure 6-1*).

The analysis of NGCC capacity includes estimating the following values by year: *electricity sales revenue from generation associated with the capacity, capital costs for technology installation, fixed and variable O&M costs, and fuel costs.*

As described previously, for Case 1 and Case 2, EPA assumed that the NGCC conversion unit keeps the same capacity as the existing coal unit; therefore, calculation of the above italicized items would be associated with that fixed quantity of capacity. However, for Case 3 and Case 4, EPA assumed that the overall unit capacity would increase relative to the baseline as part of the NGCC conversion. The additional capacity added to the unit is a function of an assumed multiplier applied to the NGCC conversion capacity (i.e., baseline capacity * [1+multiplier]) to account for the potential of a plant owner to increase a unit's overall capacity as part of the NGCC conversion process. For this analysis, EPA assumed a 100 percent capacity addition – i.e., baseline steam capacity is augmented by an equal quantity of gas turbine capacity. Public records indicate that the capacity increase varies widely, depending on the character of the capacity modification and the plant owner‟s objective in undertaking the capacity modification.

Analytically, EPA used the same procedure (described below) for calculating annual PTCF from the baseline capacity quantity and the additional capacity expansion value. In Cases 1 and 2, the calculations are performed once – for the baseline quantity of capacity. In Cases 3 and 4, the calculations are performed twice for each NGCC unit: once, for the baseline quantity of capacity, and a second time, for the capacity expansion value.

Because converting a unit to NGCC requires construction/installation, the annual time series of PTCF values includes a construction period and an operations period. New gas capacity is assumes a 3-year construction period, 2013 - 2015, with O&M costs beginning in 2016.

Capital Cost (apply 2013 – 2015)

$$CAPOUT_t = (CAP\_COST * CAP)/LEAD \qquad (6\text{-}22)$$

Where:

$CAPOUT_t$	=	capital outlays in each year, t, of the construction period ($1,000)
CAP_COST	=	unit capital cost of NGCC capacity, adjusted per *Table 6-8* to account for cost savings associated with retrofit construction versus new build ($/KW)
CAP	=	NGCC capacity installed (MW), and
LEAD	=	number of years over which installation occurs.

Wholesale Electricity Sales Revenue

$$SALES_t = GEN_t * P\_ELEC \quad (6\text{-}23)$$

Where:

$SALES_t$ = electricity sales revenue in year t from the additional capacity ($1,000)

GEN_t = generation per year from the NGCC capacity (GWh),

and

$$GEN_t = CAP * CUR * 8.76 \quad (6\text{-}24)$$

CAP = NGCC capacity (MW)

CUR = capacity utilization of NGCC capacity (%)

P_ELEC_t = NERC-level wholesale electricity price in year t ($/MWh)

Fixed and Variable O&M Expenses

$$FOM_t = CAP * P\_FOM \quad (6\text{-}25)$$

and

$$VOM_t = GEN_t * P\_VOM \quad (6\text{-}26)$$

Where:

FOM_t = fixed operations and maintenance cost in year t ($1,000)

VOM_t = variable operations and maintenance cost in year t ($1,000)

N_CAP = NGCC capacity (MW)

GEN_t = generation in year t for the NGCC capacity (GWh)

P_FOM = unit cost of fixed operations and maintenance ($/KW)

P_VOM = unit cost of variable operations and maintenance ($/MWh)

Fuel Expenses

$$FUEL_t = [(P\_GAS_t * HR)/1000] * GEN_t \quad (6\text{-}27)$$

Where:

$FUEL_t$ = fuel cost in year t ($1,000)

HR_t = heat rate for NGCC capacity (Btu/kWh)

GEN_t = generation in year t from NGCC capacity (GWh)

P_GAS_t = unit cost of gas delivered to the plant in year t ($/MMBtu)

6.6.2 Closed-Cycle Recirculating System (CCRS)

Table 6-9 describes parameter specifications for CCRS for the coal-fired option.

Table 6-9: Specifications for NGCC Closed-Cycle Cooling Systems (CCCS)

Variable	Units	Value	Data Source / Notes
NGCC Conversion Unit			CCCS costs for the new NGCC unit are based on EPA estimates. When applicable in an analysis case, these costs apply only to the existing steam capacity present at the unit. The total capital cost of the system is spread uniformly over the construction duration, which is assumed to occur simultaneously with the new NGCC capacity construction, over 3 years, 2013 - 2015. FOM and VOM costs begin in the year following construction completion, in 2016. The energy penalty accounts for the power required to operate the cooling water system, and applies as a percentage reduction in effective capacity, and ultimately electricity sales associated with the original unit capacity.
Capital Cost	$/KW	30.8	
Construction Duration	years	3	
Energy Penalty	%	-0.40%	
Fixed O&M	$/KW	0.188	
Variable O&M - Chemicals	$/KW	0.077	

The analysis of PTCF for the NGCC CCRS includes estimating the following values by year for each technology: *capital costs for technology installation, lost electricity sales revenue due to energy penalty, and fixed and variable O&M costs*.

Because CCRS requires construction/installation, the annual time series of values includes a construction period and an operations period. The analysis assumes a simultaneous three-year construction period for NGCC and CCRS, 2013 - 2015, with O&M costs and energy penalty beginning in 2016. The costs of CCRS apply only to the baseline coal capacity of the unit.

Capital Cost (applies in 2013 - 2015)

$$CAPOUT_t = \frac{(CAPCOST * CAP)}{LEAD}/1000 \quad (6\text{-}28)$$

Where:

CAPOUT$_t$ = capital outlays in each year, t, of the construction period ($1,000)

CAP_COST = unit capital cost of NGCC CCRS ($/MW)

CAP = baseline quantity of unit capacity (MW)

LEAD = number of years over which installation occurs

Loss in Wholesale Electricity Sales Revenue

$$EP_t = SALES_t * P\_EP \quad (6\text{-}29)$$

Where:

EP$_t$ = lost electricity sales revenue in year t ($1,000)

SALES$_t$ = electricity sales revenue in year t for the NGCC capacity ($1,000)

P_EP = percentage of capacity required to operate the CCRS (%)

Fixed and Variable O&M Expenses

$$FOM_t = CAP * P\_FOM/1000 \quad (6\text{-}30)$$

and

$$VOM_t = CAP * P\_VOM/1000 \quad (6\text{-}31)$$

Where:

FOM$_t$ = fixed operations and maintenance cost in year t ($1,000)

VOM$_t$ = variable operations and maintenance cost in year t ($1,000)

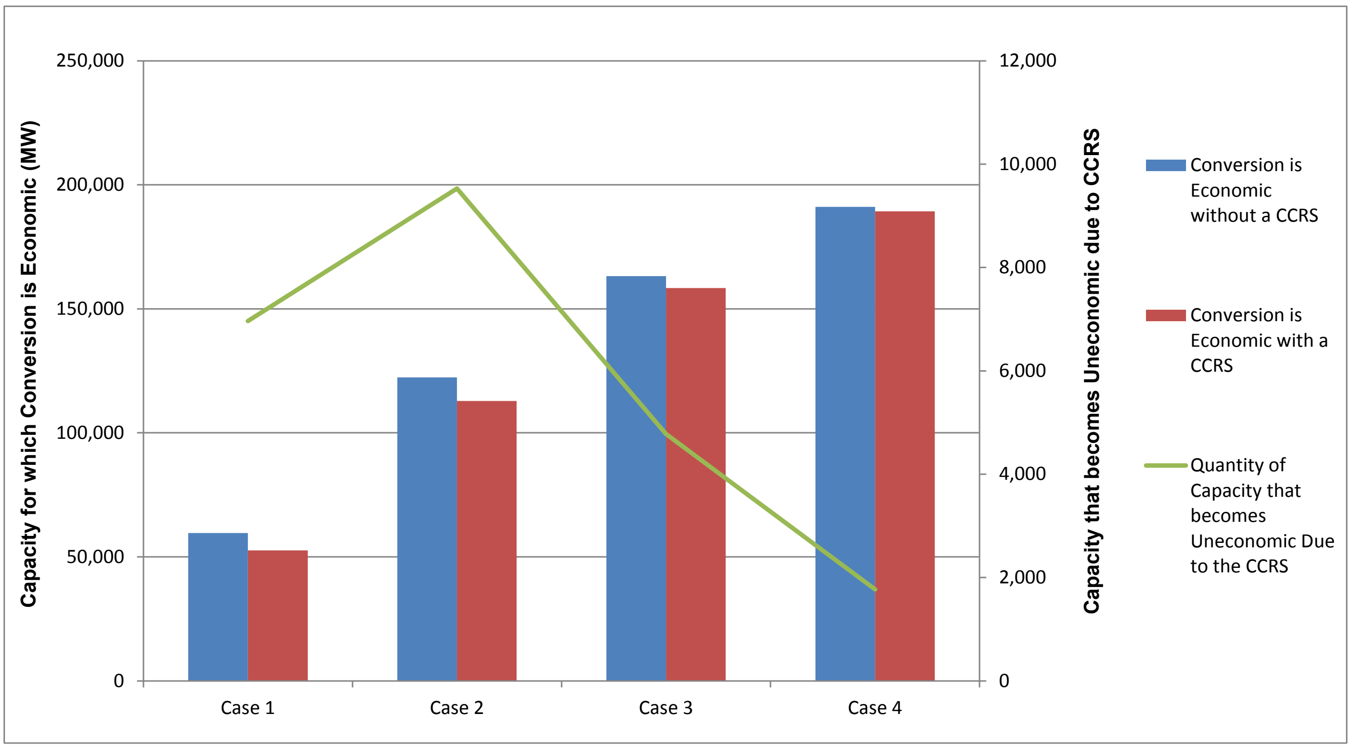
N_CAP	=	baseline quantity of unit capacity (MW)
P_FOM	=	unit cost of fixed operations and maintenance ($/MW)
P_VOM	=	unit cost of variable operations and maintenance ($/MW)

6.7 Results

Table 6-10 presents the results of the analysis. The quantity and fraction of financially viable conversion opportunities, *before consideration of the CCRS requirement*, increase across the four analysis cases: 59,600 MW (19.9 percent of total capacity) under Case 1 to 191,100 MW (63.7 percent of total capacity) under Case 4. This increase reflects the strengthening of the business case for conversion, as additional benefit factors are taken into account across the four analysis cases.

In all analysis cases, some units and capacity become *not* financially viable for conversion because of the CCRS requirement. The number of these units and quantity of capacity vary across the four cases. This variation reflects the changing density of conversion opportunities (within the overall distribution of conversion opportunity) that are *just financially viable* across the four analysis cases. In this analysis, the quantity of capacity for which combined cycle conversion becomes *not* viable, declines from Case 2 through Case 4, with approximately 9,500 MW of capacity becoming not viable for conversion under Case 2, and 1,800 MW becoming not viable under Case 4.

Figure 6-3: Quantity of Capacity for which NGCC Conversion is not Viable due to CCRS



The percentage of capacity that is otherwise viable for conversion but that becomes *not* viable because of the CCRS requirement is the largest, 11.7 percent, under Case 1, and declines substantially across the cases, reaching 0.9 percent under Case 4. The declining percentage reflects (1) the increasing quantity of capacity for which combined cycle conversion is financially viable across the four cases (which is the denominator in the percentage calculation), and (2) the declining quantity of capacity that becomes *not* viable for conversion (the numerator in the percentage calculation). While the percentage of otherwise viable capacity is higher, at 11.7 percent, under Case 1, EPA emphasizes that this case accounts only for the change in electric generating cost and increased unit dispatch resulting from lower natural gas prices and increased energy conversion efficiency from NGCC conversion. As described above, in *Section 6.2*, page 3, these factors alone are not likely to be sufficient to induce plant owners to repower/replace existing coal-fired capacity with NGCC capacity.

Looking at the cases in which additional factors are accounted for, EPA finds that few conversions that are otherwise viable would become *not* viable. Under Case 3, 2.9 percent of capacity that is otherwise viable for conversion would become not viable for conversion, and under Case 4, 0.9 percent of capacity otherwise viable becomes not viable for conversion. As stated above, company statements describing the rationale for ongoing conversions generally cite all of the factors accounted for in Case 4 as the basis for the conversion decision: namely, low natural gas prices, improved energy conversion efficiency, improved economics of electricity generation, avoided/reduced environmental compliance costs, and additional, lower cost generating capacity. From this analysis, the combination of these factors presents a strong business case for converting existing coal-fired capacity to NGCC operation – particularly when the existing coal-fired capacity is older and less efficient (high heat rate), and likely to require substantial investments to meet CAA rule requirements. From this analysis, EPA finds that the CCRS requirement applicable to repowering and replacement of existing coal-fired capacity will not have a material adverse impact on the conversion of these units to NGCC operation, when such conversion would otherwise be financially advantageous independent of the CCRS requirement.

Table 6-10: Analyzing the Impact of the CCRS Requirement on Conversion of Existing Coal-Fired capacity to Natural Gas/Combined Cycle Operation

Case Result	Case 1	Case 2	Case 3	Case 4
Baseline Generating Units (from IPM v.4. 10)				
Total Number of Coal Units	1,078	1,078	1,078	1,078
Capacity of Units (MW)	299,852	299,852	299,852	299,852
Operational and Economic/Financial Benefit Factors Accounted for in Analysis Case				
	➢ Natural gas price relative to coal price ➢ Heat rate (existing coal vs. natural gas/combined cycle) ➢ Unit dispatch (existing vs. natural gas/combined cycle) ➢ Additional revenue ➢ Capacity live extension	➢ Case 1 *plus* ➢ Avoided/reduced cost of complying with CAA rules affecting coal-fired capacity – CSAPR and MATS	➢ Case 2 *plus* ➢ Capacity addition (and increased generation and electricity sales revenue) from combined cycle conversion	➢ Case 3 *plus* ➢ Differential cost of new generating capacity: coal vs. NGCC conversion
Units for which Conversion to NGCC is Financially Viable before CCRS Requirement				
Number of Units	356	535	608	664
percent of Total Units	33.0%	49.6%	56.4%	61.6%
Capacity of Units (MW)	59,580	122,388	163,183	191,108
percent of Total Capacity	19.9%	40.8%	54.4%	63.7%
Units for which Conversion to NGCC Becomes Not Viable with CCRS Requirement				
Number of Units	44	41	9	7
percent of total units	4.1%	3.8%	0.8%	0.6%
percent of initially viable units	12.4%	7.7%	1.5%	1.0%
Capacity of Units (MW)	6,966	9,528	4,780	1,769
percent of total capacity	2.3%	3.2%	1.6%	0.6%
percent of initially viable capacity	11.7%	7.8%	2.9%	0.9%
Source: EPA analysis				

7 Impacts of the Final Rule in the Context of National and Regional Electricity Markets

In analyzing the impacts of the proposed rule, EPA used the Integrated Planning Model (IPM®), an electricity market optimization model, developed by ICF, Inc., to assess the impacts of analyzed regulatory options within the context of regional and national electricity markets. Among the options that EPA analyzed for the proposed rule, Proposal Option 1 (the preferred option) aligns closely with the final rule and Proposal Option 2, as specified at the time of proposed rule analysis, aligns closely with Proposal Option 2 as analyzed for the final rule. In the context of the IPM analysis for the proposed rule, EPA referred to these options as Market Model Analysis 1 and Market Model Analysis 2.[1] EPA did not conduct IPM analysis of Proposal Option 4 due to time and resource constraints.

Use of a comprehensive, market analysis system is important in assessing the potential impact of 316(b) regulatory options because of the interdependence of electricity generating units in supplying power to the electric transmission grid. Increases in electricity production costs and potential reductions in electricity output at affected facilities – whether due to the temporary shutdown of electric generating units during technology installation and/or the energy production penalties that can result from compliance system operation – can have a range of broader market impacts that extend beyond the effect on regulated facilities and their direct customers. In addition, the impact of compliance requirements on regulated facilities may be seen differently when the analysis considers the impact on those facilities in the context of the broader electricity market instead of looking at the impact on a standalone, single-facility basis.

For the proposed rule analysis, EPA used the IPM version 3.02 EISA platform (IPM V3.02_EISA). Since then, the EPA Office of Air and ICF updated the IPM platform in several ways; these include accounting for recently passed Clear Air Act regulations and changes in the universe of electricity power facilities and units. These updates are incorporated in the IPM version 4.10 MATS platform (IPM V4.10_MATS), which was the most current IPM platform available when EPA conducted supporting analyses for the final rule.[2] For the analysis in support of the final rule, EPA assessed whether (1) another IPM analysis, using the most current platform (i.e., IPM V4.10_MATS), was warranted to evaluate the impacts of the final rule in the context of regional and national electricity markets, or (2) results from the proposed rule analysis for Market Model Analysis Option 1 were sufficient to evaluate these impacts. The Agency conducted this assessment as follows:

- First, EPA reviewed IPM analysis results for Market Model Analysis Option 1. This analysis found that Market Model Analysis Option 1 would have very little effect on the overall electricity market, in general, and the group of regulated facilities, in particular, at the national level and the level of North American Electric Reliability Council (NERC).
- Second, given the finding of very limited impacts of Proposal Option 1 in the context of the IPM analysis, EPA then asked whether a new IPM analysis of the final rule using the most current IPM platform would show materially different – specifically, higher – impacts than those estimated for Proposal Option 1. EPA determined that impacts could differ for primarily two reasons – (1) differences in the requirements

[1] As detailed in *Chapter 7* of the *Economic and Benefits Analysis for Proposed Section 316(b) Existing Facilities Rule report* (*Proposed Rule EBA*) (EPA 821-R-11-003), the options analyzed in IPM were not identical to the proposed rule or other options, but aligned very closely with those discussed elsewhere in that report. For details see *Proposed Rule EBA*.

[2] The new IPM analysis of the final rule using the IPM V4.10_MATS platform was in progress at the time EPA was preparing supporting documents for the final rule.

and cost of the final rule compared to Proposal Option 1, and (2) differences in the IPM analytic platform – and focused its question on these considerations:

- EPA first compared total industry costs and operational requirements of the final rule with those of Proposal Option 1. This comparison found that the total cost and operational requirements of the final rule are likely to be lower than those estimated for Proposal Option 1.
- EPA then considered whether the changes in the IPM platform would materially affect the findings from the previous IPM analysis. In this assessment, EPA determined that any changes due to the IPM platform are not likely to be substantial and the direction of their effect is indeterminate.

From this review, EPA found that a new IPM analysis of the final rule using the IPM V4.10_MATS platform would very likely not show materially different impacts; indeed, a new analysis would most likely find smaller impacts than those estimated for the proposed rule. Given this finding, EPA concluded that a new IPM analysis of the final rule would yield no insights that would alter EPA's decisions on the option it chose as the final rule. As a result, given (1) the previous finding of very limited impact found for Proposal Option 1, and (2) the likelihood that IPM analysis of the final rule would show no greater impact than that estimated for Proposal Option 1, EPA decided not to undertake an additional IPM analysis for the final rule.

In this chapter, EPA *summarizes* findings from the IPM analysis undertaken for Proposal Option 1 (Market Model Analysis Option 1), with the qualification that those findings are likely to overstate the impact of the final rule – given, in particular, the expected lower cost of the final rule compared to that of Proposal Option 1. EPA also summarizes findings from the IPM analysis undertaken for Proposal Option 2 (Market Model Analysis Option 2). *Detailed* results of the IPM analysis conducted for both options and discussion of those results are presented in *Chapter 7* of the *Economic and Benefits Analysis for Proposed Section 316(b) Existing Facilities Rule* report (*Proposed Rule EBA*) (EPA 821-R-11-003). As stated above and described in the *Proposed Rule EBA*, EPA did not conduct an IPM analysis for Proposal Option 4 due to time and resource constraints. Because Proposal Option 4 applied the same requirements as Proposal Option 1, but only to a subset of regulated facilities, EPA concluded that IPM-based impact estimates for Proposal Option 4 would be lower than those estimated for Proposal Option 1 (Market Model Analysis Option 1). The *Proposed Rule EBA* also documents other cost and economic impact analyses conducted in support of the proposed rule. The *Technical Development Document for the Proposed Section 316(b) Existing Facilities Rule* report (*Proposed Rule TDD*) (EPA 821-R-11-001) describes development of compliance requirements for the proposed rule.

This chapter is organized as follows:

- *Section 7.1* documents EPA's assessment of whether another IPM analysis to evaluate the impacts of the final rule in the context of regional and national electricity markets was warranted or IPM analysis results for Market Model Analysis Option 1 were sufficient to evaluate such impacts. Specifically,
  - *Section 7.1.1* discusses the IPM analysis results generated for Market Model Analysis 1 using the IPM V3.02_EISA platform.
  - *Section 7.1.2* reviews the differences in estimated total industry costs and operational impacts between Proposal Option 1 and the final rule.
  - *Section 7.1.3* assesses the potential effects of changes from the IPM V3.02_EISA platform to the IPM V4.10_MATS platform.
  - *Section 7.1.4* summarizes EPA's conclusion not to undertake a new IPM analysis specifically for the final rule.
- *Section 7.2* summarizes the IPM analysis results for Market Model Analysis Option 2 (*Section 7.2.1*) and describes how these results relate to the currently analyzed Proposal Option 2 (*Section 7.2.2*).

In assessing the potential market impact of the final rule, EPA concluded that it could not rely solely on the findings from the analyses based on the IPM V3.02_EISA platform, largely due to the baseline not including more recent air regulations that will affect the electric power industry and markets. Since publication of the proposed rule, EPA conducted an IPM analysis using the IPM V4.10 platform (during summer of 2011), which considered a number of regulations affecting power markets, including a 316(b) regulatory option that is similar to the final rule. The IPM V4.10 platform is a more current platform than the IPM V3.02_EISA platform used in analyses for the proposed rule, but is not as current as the IPM V4.10_MATS platform. In particular, the IPM V4.10 platform includes the Proposed Transport Rule and the Proposed Toxics Rule, and accounts for costs that the electric power industry would have faced to comply with these regulations. However, the IPM V4.10 platform does not reflect the final Cross-State Air Pollution Rule (CSAPR) and the final Mercury and Air Toxics Standards (MATS), which are captured in the IPM V4.10_MATS platform. Although the costs of the Proposed Transport Rule and the Proposed Toxics Rule may differ from the costs of the final Cross-State Air Pollution Rule (CSAPR) and the final Mercury and Air Toxics Standards (MATS), which are captured in the IPM V4.10_MATS platform, the costs for these proposed rules serve as proxies for the costs of those final rules.

In addition, the 316(b) regulatory option considered in the IPM V4.10 platform analysis differs in several ways from the final 316(b) rule and the 316(b) rule option analyzed using the IPM V3.02_EISA platform. Of most importance, the 316(b) option in the IPM V4.10 platform required a considerably shorter compliance schedule (3 years) than specified for the final rule (5 years) or for the regulatory option analyzed using the IPM V3.02_EISA platform (also 5 years). This difference increases the likelihood that the IPM V4.10 platform analysis would find adverse impacts as electricity markets absorb installation downtime and other compliance effects in fewer years in responding to the rule's requirements. Nevertheless, despite these differences, EPA concluded that the analysis of the 316(b) option performed with the IPM V4.10 platform would also provide useful insight into the potential impact of the final rule.

Accordingly, given the Agency's desire not to rely for the final rule solely on the analyses from the proposal based on the IPM V3.02_EISA platform, EPA therefore also considered the findings from the analysis using the IPM V4.10 platform in its market impact assessment. In this regard, as discussed in Appendix P: Analysis Using the IPM V4.10 Platform, the IPM V4.10 platform analysis showed that the 316(b) option most closely approximating the final rule would have a very small effect on the overall electricity market. This observation further confirms EPA's conclusion that the final rule will not adversely affect electricity markets.

7.1 Assessing the Need for a New IPM Analysis

EPA analyzed whether a new IPM analysis, using the most current IPM platform (IPM V4.10_MATS), was warranted to evaluate the impacts of the final rule in the context of regional and national electricity markets or results found for Market Model Analysis Option 1 were sufficient to evaluate such impacts. As part of this assessment, EPA presents IPM analysis results for Market Model Analysis Option 1 and discusses how these results relate to the final rule.

7.1.1 IPM Analysis Findings for Market Model Analysis Option 1 (Proposal Option 1)

As the first step in this assessment, EPA reviewed the impact findings from the IPM analysis of Market Model Analysis Option 1 (Proposal Option 1) on national and regional electricity markets. Proposal Option 1 is very similar to the final rule, in that both set performance standards based on IM technology. As described in the *Proposed Rule EBA*, EPA assessed impacts as the difference between key economic and operational impact metrics reported for the baseline (i.e., pre-policy) and policy scenarios (see *Table 7-1* and *Table 7-2*).

The Agency conducted two analyses for Proposal Option 1:

- *The steady-state impact*: EPA looked at output from the analysis run-year 2028, which is the first year when all regulated facilities would have achieved compliance under any of the three regulatory options considered in development of the proposed rule, to assess the regulatory effect during the steady-state period of post-compliance operations. The Agency conducted this analysis for the group of regulated facilities and the electric power sector as a whole, including all electric power facilities.[3]
- *The downtime impact*: EPA also looked at the results reported for the 2015 IPM run-year to assess the impact of technology-installation downtime.[4] The Agency conducted this analysis for the electric power sector as a whole.

As described in the *Proposed Rule EBA*, both the steady-state and downtime impact analyses showed that Market Model Analysis Option 1 would have very small effects on the overall electricity market, in general and the group of regulated facilities, in particular, at the national level and at the level of North American Electric Reliability Corporation (NERC) region.

Steady-State Impact Analysis

As reported in *Table 7-1*, for the electric power market as a whole, the net change in total capacity, including reductions in capacity (which includes early retirements) and capacity additions in new facilities/units, as well as the change in generation, are essentially zero. Consequently, EPA concluded that Market Model Analysis Option 1 would not have a material ongoing effect on capacity availability and supply reliability at the national level. The impact on capacity and electricity generation is greater for regulated facilities; however, the changes remain very small, with total available capacity and electricity generation falling by only 0.2 percent and 0.1 percent, respectively.[5] Total electricity production costs increase by 0.3 percent of the baseline value for the electric power sector as a whole and for regulated facilities – again, a modest amount – with no cost components experiencing large changes. The changes in other impact metrics are also very small.

In addition to reporting IPM-based cost and operational effects (as done in the proposed rule analysis), *Table 7-1* reports estimated changes in air pollutant emissions – Mercury, Nitrogen Oxides (NO_x), and Sulfur Dioxide (SO_2) – and greenhouse gas emissions (as CO_2-equivalents). These changes are also very small, amounting, on a percentage basis, to no more than a 0.2 percent increase (SO_2 emissions).

Downtime-Impact Analysis

As reported in *Table 7-1*, with only a few facilities experiencing an increase in net downtime under Market Model Analysis Option 1, the estimated effects of downtime are also minor. Total electricity production costs increase by

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3 For the analysis conducted in support of the proposal rule, EPA assumed that the first year of full compliance would be 2018 for Proposal Option 1 and 2028 for Proposal Option 2. To facilitate comparison of market-level impacts across analyzed options, EPA focused on 2028 as the steady-state comparison year.

4 At the time of the analysis for the proposed rule, EPA estimated that regulated facilities would install IM technologies, and experience downtime, during a five-year window of 2013 through 2017. Results for the 2015 IPM run-year are indicative of annual effects during each of these years.

5 The 1 GW of capacity loss at regulated facilities reflects a combination of closures and avoided closures. Some closures were full facility closures (i.e., all steam generating units at the facility close), while others were partial closures (i.e., at least one steam generating unit, but not all, at the facility is assessed as closing in the post-compliance case). For avoided closures, the analysis found that at least one steam generating unit at a facility estimated to shut down all steam generating units in the baseline case, would not to shut down in the post-compliance case. Overall, the analysis for Proposal Option 1 found that 39 generating units would close (approximately 9.8 GW) and 30 generating units would avoid closure (approximately 8.8 GW), resulting in net closure of 9 generating units (approximately 1 GW). The 39 generating unit closures reflect closure of 20 units in 13 full closure facilities (5.6 MW) and 19 units in 16 partial closure facilities (4.2 GW). The net closures are the appropriate metric to consider; while a number of generating units close as a consequence of the rule, and that number is larger than the net, these closures would not happen without the avoided closures also happening. Thus, there is no scenario under which regulatory closures occur in isolation.

only 0.4 percent, with variable production costs per MWh increasing by 0.1 percent, while the change in total revenue is nearly zero. The changes in other impact metrics are also very small. EPA also found minimal regional impacts; as detailed in the *Proposed Rule EBA*, EPA estimated that none of the NERC regions would experience substantial changes in the impact metrics under Market Model Analysis 1.

As shown in *Table 7-2*, overall, Market Model Analysis Option 1 would have had only a slight impact on electricity prices. EPA estimated that electricity prices would increase by no more than 0.1 percent during either the steady-state impact period or the downtime impact period. These very small estimated changes in electricity prices are essentially within the analytic "noise" of the IPM system.[6]

As stated in the *Proposed Rule EBA*, based on these findings, EPA concluded that Market Model Analysis Option 1 (Proposal Option 1) would not have had material adverse effects on national and regional electricity markets.

As above, the estimated emission changes are also very small, with the largest percentage change being a 0.1 percent decrease for NOx emissions.

Table 7-1: Impact of Market Model Analysis 1 (Proposal Option 1) on National Electricity Market

Economic Measures (all dollar values in $2011)	Electric Power Sector: Value – Baseline	Electric Power Sector: Value – Policy	Electric Power Sector: Value – Difference	Electric Power Sector: % Change	Regulated Facilities: Baseline	Regulated Facilities: Policy	Regulated Facilities: Difference	Regulated Facilities: % Change
Impact During Steady-State Impact Period: 2028								
Total Capacity (MW)	1,147,571	1,147,556	-16	0.0%	479,054	478,003	-1,051	-0.2%
Existing			-597	-0.1%				
New Additions			581	0.1%				
Early Retirements – Full and Partial (MW)			601	0.1%	32,757	33,814	1,056	3.2%
Number of Fully-Retired Regulated Facilities			NA	NA	39	45	6	15.4%
Generation (GWh)	4,894,596	4,894,626	29	0.0%	2,750,442	2,746,772	-3,670	-0.1%
Revenue ($Millions)	$325,391	$325,573	$182	0.1%	$164,270	$164,103	-$167	-0.1%
Costs ($Millions)	$194,107	$194,622	$516	0.3%	$88,969	$89,251	$282	0.3%
Fuel Cost	$93,899	$93,854	-$45	0.0%	$47,242	$47,084	-$157	-0.3%
Variable O&M	$15,105	$15,139	$34	0.2%	$5,292	$5,323	$31	0.6%
Fixed O&M	$50,178	$50,636	$458	0.9%	$35,637	$36,056	$419	1.2%
Capital Cost	$34,925	$34,993	$69	0.2%	$798	$788	-$11	-1.3%
Pre-Tax Income ($Millions)	$131,284	$130,951	-$334	-0.3%	$75,301	$74,853	-$449	-0.6%
Variable Production Cost ($/MWh)	$22.27	$22.27	$0.00	0.0%	$19.10	$19.08	-$0.02	-0.1%
CO_2 Emissions (Million Metric Tons)	2,602	2,601	-1	0.0%				
Mercury Emissions (Tons)	41	41	0	0.1%				
NOx Emissions (Million Tons)	3	3	0	-0.1%				
SO_2 Emissions (Million Tons)	9	9	0	0.2%				
Impact During Downtime-Impact Period: 2015 (2013-2017)								
Generation (GWh)	4,319,717	4,319,585	-131	0.0%				
Revenue ($Millions)	$219,872	$219,899	$27	0.0%				
Costs ($Millions)	$148,964	$149,535	$571	0.4%				
Fuel Cost	$83,748	$83,753	$5	0.0%				
Variable O&M	$12,431	$12,479	$48	0.4%				
Fixed O&M	$45,137	$45,594	$457	1.0%				
Capital Cost	$7,649	$7,709	$61	0.8%				
Pre-Tax Income ($Millions)	$70,908	$70,364	-$544	-0.8%				
Variable Production Cost ($/MWh)	$22.26	$22.28	$0.01	0.1%				
CO_2 Emissions (Million Metric Tons)	2,972	2,971	-1	0.0%				
Mercury Emissions (Tons)	40	40	0	0.0%				
NO_x Emissions (Million Tons)	3	3	-0	-0.1%				
SO_2 Emissions (Million Tons)	8	8	0	0.0%				

Source: Proposed Rule EBA, 2011

6 IPM provided estimates of electricity prices effects for each NERC region.

Table 7-2: Impact of Market Model Analysis Option 1 (Proposal Option 1) on Electricity Prices[a,b]

NERC Region	Steady-State Impact: 2028 Value				Downtime Impact: 2015 Value			
	Baseline	Policy	Difference	% Change	Baseline	Policy	Difference	% Change
FRCC	$65.66	$65.65	-$0.01	0.0%	$68.95	$69.03	$0.08	0.1%
MRO	$53.88	$53.88	$0.00	0.0%	$38.92	$38.94	$0.03	0.1%
NPCC	$76.97	$77.06	$0.09	0.1%	$67.05	$67.04	-$0.01	0.0%
RFC	$54.99	$55.02	$0.03	0.1%	$40.51	$40.51	$0.00	0.0%
SERC	$56.63	$56.62	-$0.01	0.0%	$47.12	$47.16	$0.04	0.1%
SPP	$51.45	$51.45	-$0.01	0.0%	$47.66	$47.70	$0.03	0.1%
TRE	$61.62	$61.61	-$0.01	0.0%	$60.35	$60.31	-$0.05	-0.1%
WECC	$57.93	$57.91	-$0.02	0.0%	$54.34	$54.34	$0.00	0.0%

a. FRCC – Florida Reliability Coordinating Council; MRO – Midwest Reliability Organization; NPCC – Northeast Power Coordinating Council; RFC – ReliabilityFirst Corporation; SERC – Southeastern Electric Reliability Council; SPP – Southwest Power Pool; TRE - Texas Reliability Entity, and WECC – Western Energy Coordinating Council.
b. IPM does not model two NERC regions: Alaska Systems Coordinating Council (ASCC) and Hawaii Coordinating Council (HICC).
Source: Proposed Rule EBA, 2011

7.1.2 Costs and Operational Impacts - Proposal Option 1 and the Final Rule

Given that EPA estimated minimal impacts for Market Model Analysis Option 1 (Proposal Option 1), EPA next looked at whether a new analysis for the final rule using the IPM V4.10_MATS platform would be expected to show materially different – specifically, higher – impacts from those estimated for Proposal Option 1. The first part of this question focused on comparing total compliance costs and operational effects estimated for Proposal Option 1 with those estimated for the final rule. The costs and operational effects for the final rule differ in several ways from those that EPA previously assessed for Proposal Option 1:

- While both Proposal Option 1 and the final rule set performance standards based on installation of IM technologies, the expected compliance responses in terms of the technologies that some facilities will install and their associated costs differ between Proposal Option 1 and the final rule.
- The administrative requirements considered for the final rule are generally less than those analyzed for Proposal Option 1.[7]
- The universe of facilities estimated to be subject to the requirements of the final rule is slightly smaller than the universe of regulated facilities analyzed for the proposed rule.[8,9]

7 For details on technological and administrative requirements considered for the proposed rule, see the *Proposed Rule TDD* and the *Proposed Rule EBA*.

8 The proposed rule analysis focused on 548 facilities (559 on a weighted basis). As detailed in the *Proposed Rule EBA*, EPA found that of the 656 facilities that responded to the 316(b) survey, 37 facilities had retired their steam operations and 15 were expected to do so by 2013, according to the 2007 EIA database. In addition, the previous IPM analysis estimated that 39 facilities would close independently of 316(b) regulatory requirements. EPA removed these facilities from the analysis of the proposed rule. At that time, EPA also excluded from the analysis 19 California facilities that use coastal and estuarine waters for power plant cooling. California regulations require that these facilities achieve performance that equals or exceeds the technology requirements of the proposed rule and the alternative regulatory options considered at that time. As such, EPA determined that these facilities would incur no technology costs under the final rule.

9 As discussed, the final rule analysis focused on 532 facilities (544 on a weighted basis). EPA found that of the 656 facilities that responded to the 316(b) survey, 73 facilities have retired their steam operations and 51 are expected to do so by 2021, according to the 2010 EIA database. When conducting the IPM analysis for the proposed rule, the Agency found that some generating units projected to close in the baseline avoided closure as the result of 316(b) regulatory options. To avoid underestimating the number of regulated facilities and compliance costs for the analysis of the final rule, EPA chose not to exclude facilities projected to close by IPM from the analysis. Further, for the final rule, EPA chose to *include* California facilities that use coastal and estuarine waters for power plant cooling in the analysis, even though they would not be expected to incur technology costs due to the final rule. Similarly, the Agency did not exclude New York facilities with DIF of at least 20 MGD from the analysis. Although EPA expects that these California and New York facilities will not incur technology costs under the final rule, they will incur costs for permitting, monitoring and reporting.

- Compared to Proposal Option 1, the final rule provides facilities with more flexibility and a longer window to comply with the regulatory requirements.[10]

Because of these differences, total pre-tax compliance costs estimated for the final rule are approximately 42 percent lower, on an inflation-adjusted basis, than those that EPA estimated for Proposal Option 1 (*Table 7-3*).[11] As reported in *Table 7-3*, EPA also estimates that none of the NERC regions will incur higher compliance costs under the final rule than they would under Proposal Option 1.

In addition to comparing the cost of compliance with regulatory requirements, EPA looked at the length of time that regulated facilities would be out of service to install compliance technology under Proposal Option 1 and the final rule. For the national electricity market analysis, EPA used the estimated number of downtime weeks for each regulated facility as an input to IPM. Therefore, the Agency compared the total number of weeks that all regulated facilities would be out of service due to technology installation (facility-weeks) and the capacity effect during the technology installation period (downtime capacity-weeks[12]), under Proposal Option 1 and the final rule. *Total downtime capacity-weeks* provides a summary measure of potential impact in terms of capacity loss during installation downtime, while accounting for downtime duration.

As shown in *Table 7-4*, EPA estimates that the final rule will result in fewer downtime facility-weeks and downtime capacity-weeks compared to Proposal Option 1. A few NERC regions show greater downtime facility-weeks and/or downtime capacity-weeks. However, the longer compliance schedule under the final rule will reduce the potential for adverse effects from downtime.

[10] At the time of analysis conducted in support of the proposed rule, EPA expected facilities to install IM technologies by 2017. For the final rule, facilities have to install IM technologies by 2022.

[11] EPA looked at pre-tax as opposed to after-tax costs for comparison of the proposed rule and the final rule because pre-tax cost estimates are used as an input to IPM.

[12] *Downtime capacity-week* is the product of capacity loss at a given facility *and* the *net* weeks of installation downtime for the facility.

Table 7-3: Annualized Pre-Tax Compliance Costs by NERC Region (in millions, $2011, at 2013)[a]

NERC Region[b]	One-Time Costs					Recurring Costs				
	Capital Technology	Pilot Study	Installation Downtime	Initial Permit Application	Initial and Follow-Up Start-Up	O&M	Monitoring and Reporting	Energy Penalty	Permit Renewal	Total
Proposal Option 1[d]										
ASCC	$0.0	$0.0	$0.0	$0.0	$0.0	$0.00	$0.0	$0.0	$0.0	$0.0
FRCC	$18.1	$0.0	$7.1	$0.1	$0.0	$11.97	$1.3	$0.0	$0.1	$38.6
HICC	$1.6	$0.0	$0.0	$0.0	$0.0	$2.19	$0.2	$0.0	$0.0	$4.0
MRO	$7.1	$0.0	$6.7	$0.1	$0.0	$10.20	$2.5	$0.0	$0.1	$26.8
NPCC	$16.4	$0.0	$0.0	$0.2	$0.0	$28.49	$3.2	$0.0	$0.2	$48.5
RFC	$53.6	$0.0	$7.0	$0.5	$0.0	$64.41	$9.5	$0.0	$0.5	$135.5
SERC	$40.6	$0.0	$7.6	$0.5	$0.0	$54.53	$8.2	$0.0	$0.5	$111.8
SPP	$7.5	$0.0	$35.7	$0.1	$0.0	$14.45	$1.9	$0.0	$0.1	$59.7
TRE[c]	$13.8	$0.0	$4.1	$0.1	$0.0	$17.20	$2.2	$0.0	$0.1	$37.5
WECC	$1.2	$0.0	$0.5	$0.1	$0.0	$0.95	$1.0	$0.0	$0.1	$3.8
Total	**$160.0**	**$0.0**	**$68.7**	**$1.7**	**$0.0**	**$204.40**	**$29.9**	**$0.0**	**$1.6**	**$466.3**
Final Rule										
ASCC	$0.0	$0.0	$0.0	$0.0	$0.0	$0.0	$0.0	$0.0	$0.0	$0.0
FRCC	$10.9	$0.0	$4.5	$0.9	$0.0	$3.8	$0.3	$0.0	$0.1	$20.6
HICC	$1.3	$0.0	$0.0	$0.1	$0.0	$1.1	$0.0	$0.0	$0.0	$2.5
MRO	$8.5	$0.0	$1.4	$2.5	$0.0	$3.9	$0.8	$0.0	$0.4	$17.6
NPCC	$7.7	$0.0	$0.0	$1.4	$0.0	$3.9	$0.5	$0.0	$0.2	$13.9
RFC	$38.1	$0.0	$1.3	$5.4	$0.1	$22.7	$1.6	$0.0	$0.8	$70.0
SERC	$48.2	$0.0	$19.5	$6.1	$0.1	$17.4	$1.7	$0.0	$1.0	$94.0
SPP	$4.8	$0.0	$12.9	$1.3	$0.0	$3.8	$0.4	$0.0	$0.2	$23.6
TRE	$13.4	$0.0	$5.2	$2.5	$0.0	$6.0	$0.6	$0.0	$0.4	$28.1
WECC	$0.1	$0.0	$0.0	$0.1	$0.0	$0.0	$0.2	$0.0	$0.0	$0.5
Total	**$132.9**	**$0.0**	**$44.9**	**$20.4**	**$0.3**	**$62.6**	**$6.4**	**$0.0**	**$3.2**	**$270.8**

a. ASCC – Alaska Systems Coordinating Council; FRCC – Florida Reliability Coordinating Council; HICC – Hawaii Coordinating Council; MRO – Midwest Reliability Organization; NPCC – Northeast Power Coordinating Council; RFC – ReliabilityFirst Corporation; SERC – Southeastern Electric Reliability Council; SPP – Southwest Power Pool; TRE - Texas Reliability Entity, and WECC – Western Energy Coordinating Council.

b. No explicitly analyzed facilities are located in the ASCC NERC region; an implicitly analyzed facility in ASCC facility was grouped with facilities in the WECC region (for discussion on explicitly and analyzed facilities see *Appendix H*).

c. EPA referred to this region as Electric Reliability Council of Texas (ERCOT) in the analysis conducted in support of the proposed rule. Texas Reliability Entity, Inc., (TRE) replaced ERCOT as the reliability management authority for this region in 2006.

d. EPA generated these costs using the same assumptions about promulgation year, technology-installation schedule and facility universe as those used to conduct cost and economic impact analysis in support of the proposed rule, but discounted these costs to 2013, as opposed to 2012, and restated in 2011 dollars using GDP Deflator.

Source: Proposed Rule EBA, 2011; U.S. EPA analysis, 2013

Table 7-4: Number of Downtime Facility-Weeks and Capacity Weeks[a]

NERC Region	Downtime Facility-Weeks[b]			Downtime Capacity-Weeks[c]		
	Proposal Option 1	Final Rule	% Difference	Proposal Option 1	Final Rule	% Difference
ASCC	0	0	NA	0	0	NA
FRCC	13	6	-56.4%	20,167	13,213	-34.5%
HICC	0	0	NA	0	0	NA
MRO	30	35	16.2%	15,867	18,312	15.4%
NPCC	0	8	NA	0	382	NA
RFC	26	32	23.7%	21,011	9,317	-55.7%
SERC	46	40	-14.1%	27,879	65,015	133.2%
SPP	56	35	-38.0%	90,569	62,174	-31.4%
TRE[d]	13	10	-25.3%	18,016	19,744	9.6%
WECC	10	0	-100.0%	847	0	-100.0%
Total	**195**	**165**	**-15.5%**	**194,355**	**188,159**	**-3.2%**

a. ASCC – Alaska Systems Coordinating Council; FRCC – Florida Reliability Coordinating Council; HICC – Hawaii Coordinating Council; MRO – Midwest Reliability Organization; NPCC – Northeast Power Coordinating Council; RFC – ReliabilityFirst Corporation; SERC – Southeastern Electric Reliability Council; SPP – Southwest Power Pool; TRE - Texas Reliability Entity, and WECC – Western Energy Coordinating Council.
b. Facility counts are weighted estimates generated using facility-count based weights. For details on sample weights, see *Appendix H*.
c. Capacity-weeks are weighted estimates generated using capacity weights. For details on sample weights, see *Appendix H*.
d. EPA referred to this region as Electric Reliability Council of Texas (ERCOT) in the proposed rule analysis. Texas Reliability Entity, Inc., (TRE) replaced ERCOT as the reliability management authority for this region in 2006.
Source: Proposed Rule EBA, 2011; U.S. EPA Analysis, 2013

In summary, from this comparison, EPA found that the final rule overall will have lower cost and less adverse operational effects, based on installation downtime, than previously assessed for Proposal Option 1. In addition, the final rule provides additional flexibility in terms of a longer compliance schedule than Proposal Option 1. As a result, based on these considerations, EPA concluded that a new IPM analysis for the final rule is not likely to yield *higher impacts*, which could lead EPA to change its decision on the final rule. Indeed, a new IPM analysis would more likely find lower impacts, given the substantially lower costs and greater flexibility for the final rule compared to Proposal Option 1.

7.1.3 Potential Effects from Recent Changes in the IPM Platforms

The second factor that could cause the findings from a new IPM analysis to change from those estimated for Proposal Option 1 is changes in the IPM analysis platform. As described in the introduction, key changes from the previous platform (IPM V3.02_EISA) and the platform that EPA would have used for new IPM analyses (IPM V4.10_MATS) include (1) a more current universe of electric power facilities/units and (2) incorporation of recent EPA Office of Air regulatory actions affecting the electric power sector in the analytic baseline. *Table 7-5* summarizes the principal differences between the two platforms.

Table 7-5: Differences in IPM Platforms

Item	IPM V3.02_EISA Platform	IPM V4.10_MATS Platform
Basis for facility/unit universe	EIA-860 (2005) and EIA-767 (2005)	EIA-860 (2006) and EIA-767 (2005)
Total number of facilities (number of regulated facilities)	4,933 (533)	4,910 (520)
Total number of generating units (number of generating units at regulated facilities)	14,903 (2,100)	14,920 (2,020)
Total capacity (capacity at regulated facilities) (GW)	1,012 (475)	1,033 (486)
Unit-aggregation scheme	Custom Base Case developed for Abt: unbundled; each generating unit behaves like a stand-alone plant; allows for analysis of unit-level closures.	Model-plant aggregation/modeling; does not allow for analysis of unit-level closures.
Electricity demand	Annual Energy Outlook 2008	Annual Energy Outlook 2010
Generation costs	NA; reflect market conditions at that time	NA; reflect higher-cost market conditions
Information on new units/capacity	Global Energy Decisions New Entrants database (August 2007)[a]	Global Energy Decisions New Entrants database (November 2009)[a]
Emission rate and post-combustion control information	EPA's Emission Tracking System (2006)[b]	EPA's Emission Tracking System (2007)[b]
Emission control technologies	NA	The methodology used in developing the cost and performance assumptions for the various control technologies was significantly revised.
Power sector regulatory environment	Includes: Title IV of the Clean Air Act (the Acid Raid Program); the NOx SIP Call; various New Source Review (NSR) settlements;c and several State rules affecting emissions of SO2 and NOx that were finalized through February 3, 2009;d State rules that have been finalized and/or approved by a state's legislature or environmental agency, and in certain instances, facility-level compliance technology installations that have already been undertaken because of CAIR requirements. Does not include: CAMR, CAVR, and Proposed Transport Rule.	Includes: The final Mercury and Air Toxics Standards (MATS); the final Cross-State Air Pollution Rule (CSAPR); Title IV of the Clean Air Act Amendments; NOx SIP Call trading program; the Regional Greenhouse Gas Initiative; Renewable Portfolio Standards; New Source Review Settlements; and several State-level regulations affecting emissions of SO2, NOx, and Hg that were either in effect or expected to come into force in the years following promulgation of the final rule.
Fuel assumptions	NA	A comprehensive update of the coal market assumptions, which affected the delivered coal prices.
Modeled time frame	24-year period from 2012 to 2035	43-year period from 2012 to 2054
Run-year mapping	316(b)-specific: 2012 (2012); 2015 (2013-2017); 2020 (2018-2022); 2025 (2023-2027); 2028 (2028-2035); 2028 (2028), 2032 (2029-2035).	2012 (2012-2013); 2015 (2014-2016); 2020 (2017-2024); 2030 (2025-2034); 2040 (2035-2045); 2050 (2046-2054)
Model regions	Canada is not modeled.	Canada is modeled endogenously.

a. Global Energy's New Entrants database has information on new power plant builds, rerates, and retirements. Used for information on planned-committed units.
b. The Emission Tracking System (ETS) database is updated quarterly and certified annually. It contains boiler-level information such as primary fuel, heat input, SO_2 and NO_X controls, and SO_2, NO_X and CO_2 emissions. NEEDS V3.02_EISA used ETS data to develop emission rate and post-combustion control information.
c. Including agreements between EPA and Southern Indiana Gas and Electric Company (Vectren), Public Service Enterprise Group, Tampa Electric Company, We Energies (WEPCO), Virginia Electric & Power Company (Dominion), Santee Cooper, Minnkota Power Coop, American Electric Power (AEP), East Kentucky Power Cooperative (EKPC), Nevada Power Company, Illinois Power, Mirant, Ohio Edison, and Kentucky.
d. Include current and future state programs in Connecticut, Delaware, Georgia, Illinois, Maine, Maryland, Massachusetts, Minnesota, Missouri, New Hampshire, North Carolina, New Jersey, New York, Oregon, Texas, and Wisconsin.
Source: U.S. EPA, 2010x; U.S. EPA, 2010x

Although the IPM-analysis platforms differ in several ways, the changes largely involve the facility universe and relatively marginal factors in terms of electricity demand, fuel price assumptions, run-year mapping, model regions, among other factors. Because these changes all reflect changes in information and/or projections that have occurred in the space of two to three years, EPA expects that none of these changes would be so significant – by themselves – as to cause *substantial* changes in the analysis results between the two platforms.

Of potentially more consequence is the incorporation of recent EPA Office of Air regulations in the platform. These regulations increase the production costs of certain facilities, and might lead to early retirement of some units and early installation of new, more efficient capacity. Together, these effects could lead to changes in the baseline production costs and dispatch profile of generating units that will be within the scope of the final rule. However, given the very small estimated effect of Proposal Option 1 in *any* of the impact metrics summarized above (see *Section 7.1.1*), EPA assesses that the effects from changes in the IPM platform would not cause the overall findings from the proposed rule analysis to change materially, and the direction of any changes is indeterminate. Moreover, as described in *Section 7.1.2*, EPA estimates that the final rule will impose considerably lower costs and other operational impacts than estimated for Proposal Option 1. In this light, EPA further assesses it highly unlikely that use of the newer IPM platform would lead to substantial changes *increasing* the impacts of the final rule to such a degree that would alter the Agency's assessment favoring promulgation of the final rule.

7.1.4 Impact of the Final Rule on National and Regional Electricity Markets

From the assessments presented above, EPA concluded that performing new IPM analysis of the final rule would not yield insights to alter its determinations in favor of the final rule. Key factors underlying this conclusion include:

- EPA's finding in the previous IPM analyses of Market Model Analysis Option 1 (Proposal Option 1) is very limited impact on regional and national electricity markets,
- The considerably lower cost and operational impact of the final rule compared to Proposal Option 1, and
- The high likelihood that changes in the IPM analytic platform would not cause material change in analytic findings for Proposal Option 1, or the final rule, it EPA were to conduct a new IPM analysis.

In summary, EPA assesses that its previous findings of very limited market-level impact, both nationally and regionally, would not change with a new IPM analysis. Indeed, EPA expects that a new IPM analysis for the final rule would find (1) a lower impact on national and regional electricity markets compared to those found for the proposed rule, and (2) that the final rule would not result in material adverse effects on national and regional electricity markets.

As a result, EPA decided not to undertake additional IPM analyses for the final rule. From the foregoing assessment, EPA's view is that findings from IPM analysis of Market Model Analysis Option 1 (Proposal Option 1) presented in *Section 7.1.1* are likely to overstate the impact of the final rule – given, in particular, the expected lower cost and operational impacts of the final rule compared to Proposal Option 1. For detailed findings from the IPM analysis undertaken in support of the proposed rule see *Chapter 6* in *Proposed Rule EBA*.

7.2 IPM Analysis Results for Market Model Analysis Option 2 (Proposal Option 2)

In this section, EPA presents the findings from Market Model Analysis Option 2, which aligns closely with Proposal Option 2 (as defined for both the proposed and final rule analyses). These findings provide insight into the potential impacts of the currently analyzed Proposal Option 2 in the context of regional and national electricity markets. This section summarizes the IPM analysis results for Market Model Analysis Option 2, and discusses briefly how these results relate to the currently analyzed Proposal Option 2.

7.2.1 Findings from the Proposed Rule Analysis

As done for Proposal Option 1, EPA reviewed the impact findings from the IPM analysis of Proposal Option 2 conducted for the proposed rule. As described above, in the context of IPM analysis, EPA referred to this option as Market Model Analysis Option 2. This option is similar to Proposal Option 2 as analyzed for the final rule in that both options set performance standards based on entrainment-control technology for facilities with design intake flow (DIF) exceeding 125 MGD and on IM technology for all other facilities. As above, EPA analyzed impacts for this option based on the difference between key economic and operational impact metrics reported for the baseline (i.e., pre-policy) and policy scenarios, and conducted *steady-state impact* and *downtime impact* analyses. For the steady-state impact analysis, EPA again looked at output from the IPM run-year 2028. For the downtime impact analysis, EPA looked at results for three years: 2015 for installing IM technology (as done for Proposal Option 1, above), 2020 for installing entrainment-control technology at non-nuclear facilities, and 2025 for installing entrainment-control technology nuclear facilities.[13]

Steady-State Impact Analysis

As presented in *Table 7-6*, Market Model Analysis Option 2 results *overall* in greater impacts compared to those estimated for Market Model Analysis Option 1, as some facilities would be required to install cooling towers. Similar to Market Model Analysis Option 1, under Market Model Analysis Option 2, the net changes in total capacity and generation are essentially zero, indicating that this option would not have a material ongoing effect on capacity availability and supply reliability, at the national level.[14] The impact on capacity and electricity generation is greater for regulated facilities, with total available capacity and electricity generation falling by only 5.4 percent and 3.0 percent, respectively. Similar to Market Model Analysis Option 1, overall, Market Model Analysis Option 2 results in essentially no change in emissions.

Total electric power sector revenue increases as a whole by a very small amount (0.1 percent), reflecting very modest overall increases in prices to customers (*Table 7-7*). For regulated facilities, however, revenue declines by 3.7 percent, reflecting smaller amount of electricity generated at these facilities at the result of regulatory requirements. As expected for Market Model Analysis Option 2, which is more expensive than Market Model Analysis Option 1, the increase in total annual costs for the electric power sector as a whole is greater than that estimated for Market Model Analysis Option 1. At the national level, total annual costs increase by 5.4 percent. The larger parts of this increase occur in fixed O&M (12.1 percent) and annual recognition of capital costs (9.3 percent), reflecting the cost requirements of cooling tower installation. Fuel costs increase by a much smaller amount (0.8 percent) reflecting the improved energy efficiency and lower fuel cost of new capacity. For regulated facilities as a group, total generation costs increase by 4.8 percent, with fixed O&M cost increasing by 15.9 percent, and fuel, variable O&M, and capital costs declining by 2.9, 0.2, and 8.5 percent, respectively. Variable production costs per MWh, which is a measure of the short-run production cost of electricity – fuel and variable O&M – increase by comparatively small amounts for the electric power sector as a whole and a group of regulated facilities (1.0 percent and 0.5 percent, respectively).

As would be expected with higher compliance outlays and greater energy penalty, pre-tax income for the electric power market as a whole, and for regulated facilities both show a greater decline compared to Market Model Analysis Option 1 (7.6 percent and 13.6 percent, respectively).

As detailed in the *Proposed Rule EBA*, these impacts vary across NERC regions and are generally higher than those estimated for Market Model Analysis 1.As presented in *Table 7-7*, Market Model Analysis Option 2 has a

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[13] At the time of the analysis for the proposed rule, EPA assumed that regulated facilities required to install IM technologies would do so, and experience downtime, during a 5-year window of 2013 through 2017. Results for the 2015 IPM run-year are indicative of annual effects during each of these years. Further, at that time, EPA assumed that non-nuclear and nuclear facilities would install entrainment-control technologies, and experience downtime, during 5-year windows of 2018 through 2022 and 2023 through 2027, respectively. Results for the 2020 and 2025, respectively, are indicative of annual effects during each of these years.

[14] The change in existing capacity at the national level, a reduction of approximately 24 GW, represents approximately 2.1 percent of total baseline generating capacity. Of this reduction, approximately 14 GW occurs as early retirements, or approximately 1.3 percent of total baseline capacity; the residual results from energy penalty reductions in capacity. The offsetting increase in capacity at new plants/units of approximately 24 GW is approximately 2 percent of total baseline generating capacity.

slight impact on electricity prices across all NERC regions. In four out of eight NERC regions, electricity prices increase slightly by no more than 0.3 percent. The other four NERC regions record a slight drop in electricity prices of no more than 0.3 percent.

Downtime-Impact Analysis

As described above, to assess the technology installation-downtime impact of Market Model Analysis Option 2, EPA looked at IPM analysis results for three IPM-run years, each of which represents a five-year window.

- **2015 (2012-2017)***:* During the first five-year period, when facilities were expected to install IM technologies, downtime effects under Market Model Analysis Option 2, although larger than those under Market Model Analysis Option 1, remain small. Variable production costs decline by 0.2 percent, as the overall market begins to adjust in anticipation of the larger effects on capacity availability as the result of cooling-tower installation in later years. Total market-level revenue increases by only 0.6 percent, indicating small effects on consumer prices (*Table 7-7*).
- **2020 (2018-2022):** During the second five-year period, when non-nuclear regulated facilities were expected to install cooling towers, downtime effects are more pronounced. At the market level, variable production costs decline again, by 0.8 percent, but revenue increases by 3.4 percent, indicating a greater impact on consumer prices than during the preceding five years. Electricity prices increase in all but two NERC regions, with the largest increase (4.7 percent) occurring in RFC (*Table 7-7*). Variable production costs (per MWh) decline, reflecting replacement of generation from older, less efficient and higher fuel cost capacity, with generation from more energy efficient, lower production cost capacity.
- **2025 (2023-2027):** The greatest impact on variable production cost under this option occurs during the third five-year period (2023-2027), when nuclear facilities, which have longer downtime than non-nuclear facilities, complete technology installation.[15] During this period, variable production costs increase by 0.6 percent (while they declined during the previous five-year windows). Annual revenue also increases by 0.6 percent. As shown in *Table 7-7*, the impact on electricity prices during this five-year technology-installation window is lower compared to that estimated for the previous five-year window for technology installation at non-nuclear facilities. Three NERC regions record a slight reduction in electricity prices of no more than 0.8 percent, while the other five record a slight increase in electricity prices of no more than 1.6 percent.

As is the case for the steady-state impact analysis, downtime impacts vary across NERC regions. For details see *Proposed Rule EBA*.

[15] For some nuclear facilities, net downtime for cooling-tower installation was estimated to be 24 weeks compared to four weeks estimated for non-nuclear facilities.

Table 7-6: Impact of Market Model Analysis Option 2 (Proposal Option 2) on National Electricity Market

Economic Measures (all dollar values in $2011)	Electric Power Sector: Value Baseline	Electric Power Sector: Value Policy	Electric Power Sector: Value Difference	Electric Power Sector: % Change	Regulated Facilities: Value Baseline	Regulated Facilities: Value Policy	Regulated Facilities: Value Difference	Regulated Facilities: % Change
Impact During Steady-State Impact Period: 2028								
Total Capacity (MW)	1,147,571	1,147,528	-44	0.0%	479,054	453,149	-25,905	-5.4%
Existing			-23,657	-2.1%				
New Additions			23,614	2.1%				
Early Retirements – Full and Partial (MW)			14,418	1.3%	32,757	49,572	16,815	51.3%
Number of Fully-Retired Partial Facilities			NA	NA	39	54	15	38.7%
Generation (GWh)	4,894,596	4,893,873	-723	0.0%	2,750,442	2,666,703	-83,739	-3.0%
Revenue ($Millions)	$325,391	$325,832	$441	0.1%	$164,270	$158,266	-$6,004	-3.7%
Costs ($Millions)	$194,107	$204,495	$10,389	5.4%	$88,969	$93,218	$4,250	4.8%
Fuel Cost	$93,899	$94,606	$707	0.8%	$47,242	$45,890	-$1,352	-2.9%
Variable O&M	$15,105	$15,431	$327	2.2%	$5,292	$5,284	-$8	-0.2%
Fixed O&M	$50,178	$56,270	$6,091	12.1%	$35,637	$41,314	$5,677	15.9%
Capital Cost	$34,925	$38,189	$3,264	9.3%	$798	$730	-$68	-8.5%
Pre-Tax Income ($Millions)	$131,284	$121,337	-$9,947	-7.6%	$75,301	$65,048	-$10,254	-13.6%
Variable Production Cost ($/MWh)	$22.27	$22.48	$0.21	1.0%	$19.10	$19.19	$0.09	0.5%
CO_2 Emissions (Million Metric Tons)	2,972	3,010	37	0.0%				
Mercury Emissions (Tons)	40	40	0	0.6%				
NO_x Emissions (Million Tons)	3	3	0	0.0%				
SO_2 Emissions (Million Tons)	8	8	0	0.0%				
Impact During Downtime-Impact Period:								
2015 (2013-2017)								
Generation (GWh)	4,319,717	4,319,560	-157	0.0%				
Revenue ($Millions)	$219,872	$221,181	$1,309	0.6%				
Costs ($Millions)	$148,964	$149,005	$41	0.0%				
Fuel Cost	$83,748	$83,562	-$186	-0.2%				
Variable O&M	$12,431	$12,453	$23	0.2%				
Fixed O&M	$45,137	$45,123	-$14	0.0%				
Capital Cost	$7,649	$7,867	$218	2.8%				
Pre-Tax Income ($Millions)	$70,908	$72,176	$1,268	1.8%				
Variable Production Cost ($/MWh)	$22.26	$22.23	-$0.04	-0.2%				
CO_2 Emissions (Million Metric Tons)	2,602	2,599	-3	0.0%				
Mercury Emissions (Tons)	41	41	0	0.0%				
NO_x Emissions (Million Tons)	3	3	0	0.0%				
SO_2 Emissions (Million Tons)	9	9	0	0.0%				
2020 (2018-2022)								
Generation (GWh)	4,530,122	4,530,208	87	0.0%				
Revenue ($Millions)	$270,150	$279,421	$9,272	3.4%				
Costs ($Millions)	$165,624	$172,968	$7,345	4.4%				
Fuel Cost	$86,167	$85,008	-$1,159	-1.3%				
Variable O&M	$13,789	$14,112	$323	2.3%				
Fixed O&M	$47,681	$52,565	$4,884	10.2%				
Capital Cost	$17,987	$21,284	$3,297	18.3%				
Pre-Tax Income ($Millions)	$104,526	$106,453	$1,927	1.8%				
Variable Production Cost ($/MWh)	$22.06	$21.88	-$0.19	-0.8%				
CO_2 Emissions (Million Metric Tons)	2,754	2,785	31	0.0%				
Mercury Emissions (Tons)	41	40	-1	-2.3%				
NO_x Emissions (Million Tons)	3	3	0	0.0%				
SO_2 Emissions (Million Tons)	9	8	0	0.0%				

Table 7-6: Impact of Market Model Analysis Option 2 (Proposal Option 2) on National Electricity Market								
Economic Measures (all dollar values in $2011)	**Electric Power Sector**				**Regulated Facilities**			
	Value			**% Change**	**Value**			**% Change**
	Baseline	**Policy**	**Difference**		**Baseline**	**Policy**	**Difference**	
2025 (2023-2027)								
Generation (GWh)	4,746,195	4,746,202	7	0.0%				
Revenue ($Millions)	$289,861	$291,669	$1,808	0.6%				
Costs ($Millions)	$180,619	$190,994	$10,375	5.7%				
Fuel Cost	$89,488	$89,673	$185	0.2%				
Variable O&M	$14,365	$14,766	$401	2.8%				
Fixed O&M	$49,129	$55,263	$6,134	12.5%				
Capital Cost	$27,637	$31,292	$3,655	13.2%				
Pre-Tax Income ($Millions)	$109,242	$100,675	-$8,567	-7.8%				
Variable Production Cost ($/MWh)	$21.88	$22.00	$0.12	0.6%				
CO_2 Emissions (Million Metric Tons)	2,852	2,902	51	0.0%				
Mercury Emissions (Tons)	41	41	0	0.5%				
NO_x Emissions (Million Tons)	3	3	0	0.0%				
SO_2 Emissions (Million Tons)	8	8	0	0.0%				

Source: Proposed Rule EBA, 2011

Table 7-7: Impact of Market Model Analysis Option 2 (Proposal Option 2) on Electricity Prices[a,b]

NERC Region	Value			% Change
	Baseline	Policy	Difference	
Steady-State Impact: 2028				
FRCC	$65.66	$65.72	$0.06	0.1%
MRO	$53.88	$53.95	$0.07	0.1%
NPCC	$76.97	$75.71	-$1.26	-1.6%
RFC	$54.99	$55.18	$0.19	0.3%
SERC	$56.63	$56.59	-$0.04	-0.1%
SPP	$51.45	$51.41	-$0.05	-0.1%
TRE	$61.62	$61.72	$0.11	0.2%
WECC	$57.93	$57.76	-$0.17	-0.3%
Impact During Downtime-Impact Period:				
2015 (2013-2017)				
FRCC	$68.95	$69.14	$0.19	0.3%
MRO	$38.92	$38.72	-$0.20	-0.5%
NPCC	$67.05	$67.94	$0.89	1.3%
RFC	$40.51	$40.53	$0.03	0.1%
SERC	$47.12	$47.42	$0.30	0.6%
SPP	$47.66	$47.89	$0.23	0.5%
TRE	$60.35	$60.59	$0.24	0.4%
WECC	$54.34	$54.39	$0.05	0.1%
2020 (2018-2022)				
FRCC	$68.75	$67.39	-$1.36	-2.0%
MRO	$48.81	$50.24	$1.44	2.9%
NPCC	$72.87	$73.14	$0.27	0.4%
RFC	$51.64	$54.05	$2.40	4.7%
SERC	$52.51	$54.22	$1.72	3.3%
SPP	$48.69	$49.71	$1.01	2.1%
TRE	$61.00	$61.60	$0.60	1.0%
WECC	$57.42	$56.88	-$0.55	-0.9%
2025 (2023-2027)				
FRCC	$62.13	$62.18	$0.05	0.1%
MRO	$50.27	$51.06	$0.79	1.6%
NPCC	$70.41	$69.85	-$0.55	-0.8%
RFC	$51.46	$52.25	$0.80	1.5%
SERC	$53.66	$53.67	$0.01	0.0%
SPP	$48.21	$48.87	$0.66	1.4%
TRE	$58.56	$58.07	-$0.49	-0.8%
WECC	$54.71	$54.55	-$0.16	-0.3%

a. FRCC – Florida Reliability Coordinating Council; MRO – Midwest Reliability Organization; NPCC – Northeast Power Coordinating Council; RFC – ReliabilityFirst Corporation; SERC – Southeastern Electric Reliability Council; SPP – Southwest Power Pool; TRE - Texas Reliability Entity, and WECC – Western Energy Coordinating Council.
b. IPM does not model two NERC regions: Alaska Systems Coordinating Council (ASCC) and Hawaii Coordinating Council (HICC).
Source: Proposed Rule EBA, 2011

7.2.2 Interpreting IPM Analysis Findings for Market Model Analysis Option 2 in the Context of Final Rule Analyses

Similar to the final rule, the costs and operational effects for the currently analyzed Proposal Option 2 differ in several ways from those that EPA previously assessed for Proposal Option 2. While both options set performance standards based on installation of entrainment control technologies for facilities with DIF exceeding 125 MGD and IM technologies for all other facilities, the expected compliance responses in terms of IM technologies that some facilities would have to install and their associated costs differ between the two options. In addition, administrative requirements currently considered differ from those analyzed for proposed rule.[16] Further, under the currently analyzed Proposal Option 2, facilities would have more flexibility and a longer period to comply with the regulatory requirements compared to those EPA assumed for the proposed rule analysis.[17] Finally, as discussed above, the current universe of regulated facilities is slightly smaller than that analyzed for the proposed rule.

Because of these differences, EPA estimates total pre-tax compliance costs for the currently analyzed Proposal Option 2 are approximately 26 percent lower than those estimated for this option for the proposed rule ($4,175.2 compared to $5,663.0).[18] EPA also estimates that the currently analyzed Proposal Option 2 would result in fewer downtime facility-weeks (21 percent less) and downtime capacity-weeks (10 percent less) than those estimated for this option for the proposed rule.

Based on these differences between the two options, EPA expects that the currently analyzed Proposal Option 2, *overall*, would likely have less adverse effects on national and regional electricity markets than those estimated for Market Model Analysis Option 2. Because of the two-year overlap between the five-year windows assumed in the current analysis for IM-technology installation (2018-2022) and cooling-tower installation at non-nuclear facilities (2021-2025), the downtime impact of the currently analyzed Proposal Option 2 could be greater than that estimated separately for these two technology-installation windows under Market Model Analysis Option 2. However, EPA assesses that (1) the lower downtime weeks and downtime capacity weeks estimated for Proposal Option 2, as analyzed for the final rule, and (2) the longer compliance schedule assumed for Proposal Option 2, would likely mitigate the impacts of technology-installation downtime.

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16 For details on technological and administrative requirements considered for the proposed rule, see the *Proposed Rule TDD* and the *Proposed Rule EBA*.

17 At the time of analysis conducted in support of the proposed rule, EPA expected all facilities required to install IM technologies to do so by 2017 and non-nuclear and nuclear facilities required to install entrainment control technologies to do so by 2022 and 2027, respectively. For the final rule, EPA expects all facilities required to install IM technologies to do so by 2022 and non-nuclear and nuclear facilities required to install entrainment control technologies to do so by 2025 and 2030, respectively.

18 EPA generated costs for previously analyzed Proposal Option 2 using the same assumptions about promulgation year, technology-installation schedule and facility universe as those used to conduct cost and economic impact analysis in support of the proposed rule, but discounted these costs to 2013, as opposed to 2012, and restated in 2011 dollars using GDP Deflator.

8 Total Social Costs

This chapter develops EPA"s estimates of the costs to society resulting from the final rule and other options considered in development of this rule. As analyzed in this chapter, the social costs of regulatory actions include the *opportunity costs* to society of employing scarce resources to prevent the environmental damage otherwise occurring except for the design and operation of compliance technology. These compliance-related social costs include (1) costs to Electric Generators and Manufacturers to comply with the final rule, and (2) costs to State and federal governments to administer regulatory compliance. EPA conducted this analysis for existing units at Electric Generators and Manufacturers and new units at Electric Generators.

8.1 Analysis Approach and Data Inputs

Chapter 3: Compliance Costs provides details on compliance-related costs to Electric Generators and Manufacturers, and costs to the National Pollutant Discharge Elimination System (NPDES) permitting authorities and the federal government for administering the rule. These costs form the basis for the analysis of social costs with the following two exceptions:

- The compliance costs used to estimate total social costs differ in their consideration of taxes from those reported in *Chapter 3*, which were calculated for the purpose of estimating the private costs and impacts of the final rule and other options considered. In the analysis of costs to society, compliance costs are considered without accounting for any tax effects. The costs to society are the full value of the resources used, whether they are paid for by the regulated facilities or by all taxpayers in the form of lost tax revenues.[122]
- The social cost accounting for installation downtime and energy penalty also differs from that used in the economic impact analysis. In the facility impact analysis, EPA accounts for downtime as the loss in net income from temporary suspension of operations, in particular for electric power generation, both at Electric Generators and Manufacturers. However, the cost to society from this suspension of operations differs from the cost incurred by the regulated facilities. When generating units are out of service for installation of compliance technology, other generating units provide the electricity that would otherwise have been generated by the out-of-service units. The cost to society is the *increase* in electricity production costs from other generators needing to supply the electricity otherwise produced by the out-of-service units. For Manufacturers, a similar concept applies to the energy penalty that results from operation of compliance technology. In some instances, EPA accounts for the impact of energy penalty as loss in electricity sales revenue. However, again, the cost to society is different: if other generating units provide the electricity that cannot be delivered for consumption due to the energy penalty, then the cost to society is the production cost incurred by the other generating units in producing that electricity. For details on how EPA estimated the social cost of downtime and energy penalty, see *Appendix I: Energy Requirements*.

As described in *Chapter 3*, for existing units at existing facilities, EPA assumed that facilities, *in the aggregate*, would install compliance technology as follows. Under the final rule and Proposal Option 4, facilities are assumed to achieve compliance via installation of IM technology during the 5-year window of 2018 through 2022. In the lead-up to compliance, these facilities would incur various planning and other administrative-type costs; these

122 For the cost and economic impact analyses, compliance costs are measured as they affect the financial performance of the regulated facilities and their parent entities. Therefore, these impact analyses consider the tax deductibility of compliance expenditures, as appropriate depending on the tax status of the regulated facility and entity, respectively.

costs are expected to begin in 2014, the first year following promulgation. Because Proposal Option 2 involves installation of entrainment control technologies (closed-cycle recirculating systems) in addition to IM technology, EPA anticipated that compliance with this option would occur over a longer timeframe. The Agency assumed that non-nuclear Electric Generators and Manufacturers would install cooling towers during a 5-year window of 2021 through 2025, while nuclear Electric Generators would do so during a 5-year window of 2026 through 2030.[123] Facilities that are already in compliance with regulatory requirements will not incur technology installation costs but may incur administrative costs, again beginning in 2014.

These assumptions result in an overall compliance window of nine years, 2014 through 2022 for the final rule and Proposal Option 4, and a 17-year compliance window of 2014 through 2030 for Proposal Option 2, with the year 2030 being the last year of technology installation for any facility under any of the regulatory options considered for this rule. EPA assumed that facilities would continue to incur capital costs to install replacement IM technology, operation and maintenance (O&M) costs, energy penalty, and costs associated with annually and non-annually recurring administrative activities through at least one cycle of compliance technology life over the aggregate of regulated facilities.[124] However, under Proposal Option 2, EPA assumed that facilities would not re-install – i.e., completely rebuild – entrainment control technologies (required components such as piping and the concrete basin can be reused). EPA developed a year-explicit schedule of compliance outlays over the 46-year period of 2014 through 2059 according to cost-incurrence assumptions discussed in *Chapter 3*.[125] In those instances when the estimated useful life of a given compliance cost outlay extended beyond the remaining number of compliance years in the overall social cost analysis period, EPA prorated the initial cost value based on the remaining number of compliance years in the analysis.

For estimating the social cost of the new units provision of the final rule at Electric Generators, EPA assumed that the same number of new units, in terms of generating capacity, would come online each year during the 46-year social cost analysis period, beginning in 2014. EPA accounted for compliance costs for these units on an as-incurred basis, as it accounted for existing units at existing facilities.

EPA also included administrative costs to NPDES permitting authorities and the federal government discussed in *Chapter 3*. The Agency accounted for these costs in the same way as that described above for regulated facilities. Government administrative costs in the social cost analysis reflect the opportunity cost of expending taxpayer dollars to administer this regulation in lieu of other public projects.

After creating a cost-incurrence schedule for each cost component, EPA summed the costs it expected each regulated facility to incur each year. The Agency then adjusted these costs for estimated real (i.e., inflation-adjusted) change between their stated year and the year(s) of their incurrence as follows:

- All technology costs were first adjusted to their incurrence year(s) using the Construction Cost Index (CCI) from McGraw Hill Construction, and then restated to a constant dollar basis using the Gross Domestic Product (GDP) deflator index published by the U.S. Bureau of Economic Analysis (BEA);
- All administrative costs were adjusted to their incurrence year(s) using the Employment Cost Index (ECI) Bureau of Labor Statistics (BLS), and then restated to a constant dollar basis using the GDP deflator.

123 EPA assumed that it would take four years to install a cooling tower. Each of these technology-installation years represents the last year of installation, i.e., the year when a cooling tower would begin to operate.

124 The social cost-analysis approach differs from that described in *Chapter 3* and used in cost and economic impact analyses discussed in *Chapter 5: Economic Impact Analyses-Manufacturers*, *Chapter 4: Economic Impact Analyses-Electric Generators*, and *Chapter 11: Regulatory Flexibility Act (RFA) Analysis*. Those analyses do not explicitly account for continued recurrence of these costs.

125 The end of the analysis period, 2059, was determined based on the life of the longest-lived compliance technology (30 years), and the last year of technology installation for any facility under any of the regulation options considered for this rule (2030). For this analysis, EPA assumed that this last year of technology installation for all regulated facilities, in the aggregate, overlaps with the first year of steady-state compliance with the final rule and other options considered.

- Energy penalty and downtime costs were adjusted to their incurrence year(s) based on 2012 Energy Outlook (2012AEO) electricity price projections. Unlike the technology and administrative costs adjustments, the AEO electricity price projections are inflation-adjusted and thus require no further adjustment.

EPA developed the CCI and ECI adjustment factors only through the year 2020 and AEO adjustment factors were available through 2035; after these years, EPA assumed that the real change in prices is zero – that is, costs are expected to change in line with general inflation.[126] This assumption is reasonable, given the uncertainty of long-term future price projections.

After developing the year-explicit schedule of total social costs and adjusting them for predicted real change to the year of their incurrence, EPA calculated the present value of these cost outlays as of the promulgation year by discounting the cost in each year back to 2013, using both 3-percent and 7-percent discount rates. These discount rate values reflect guidance from the Office of Management and Budget (OMB) regulatory analysis guidance document, Circular A-4 (OMB, 2003; updated 2009). EPA calculated the constant annual equivalent value (annualized value), again using the two values of the discount rate, 3 percent and 7 percent, over a 51-year social cost analysis period. The 51-year period reflects the 46 years of potential cost incurrence, as described above, *plus* an additional five years during which benefits stemming from reduced impingement and entrainment of aquatic organisms are expected to accrue to society *even though, for the social cost and benefit analysis, compliance technology is assumed to have ceased functioning*. That is, EPA estimates that benefits will continue for five years after the end of the useful life of a compliance technology, and will decline to zero over this period.[127]

To estimate social costs of the final rule and other options considered, EPA assumed that the market prices for labor, equipment, material, and other compliance resources needed to comply with the rule represent the opportunity costs to society for use of those resources in regulatory compliance. The Agency also assumed that the final rule and other options considered will not affect the *aggregate* quantity of electricity or other affected goods and services sold to consumers. Thus, the social cost of regulatory requirements includes no loss in consumer and producer surplus from reduced sales of electricity or other goods and services produced by regulated facilities, given the small impact of the regulation on electricity production cost for the total industry (see *Chapter 7: Electricity Market Analysis*). EPA‟s estimates include direct compliance costs for facilities estimated to close because of regulatory requirements (i.e., policy closures). This approach may overstate the social costs of compliance, to the extent that the net economic loss to society in facility closures is less than the estimated cost to society of compliance.[128]

8.2 Key Findings for Regulatory Options

The following sections present EPA‟s estimates of social costs for the final rule and other options considered.

[126] EPA used the average of the year-to-year changes in the CCI and ECI over the most recent ten-year reporting period to bring these values to specific cost incurrence years. EPA was not confident in projecting real changes in cost values beyond 2020; consequently, in making this adjustment, the Agency assumed zero real growth starting in 2021.

[127] See *BA* for a summary of benefits methodology and the phase-down of benefits following termination of compliance activities.

[128] Including costs for regulatory closures yields an estimate of social costs assuming that all facilities, except those assessed as baseline closures, would incur the costs of regulatory compliance and continue to operate post-regulation. Calculating costs as if all facilities continue operating will overstate social costs if the social cost of compliance is greater than the net economic loss to society from facility closure. Whether this result will hold depends, in part, on the difference between social and private discount rates, and the marginal cost to society to replace the lost production of goods and services in closing facilities.

8.2.1 Costs of Regulatory Compliance

Table 8-1 presents annualized direct compliance costs for the existing units provision of the final rule and other options considered, for Electric Generators and Manufacturers. At the 3-percent discount rate, EPA estimates annualized costs of compliance of $282.3 million under the existing units provision of the final rule, $260.7 million under Proposal Option 4, and $3,999.0 million under Proposal Option 2; at the 7-percent discount rate, these costs are $295.9 million, $271.8 million, and $3,892.3 million, respectively. These costs include the direct costs of compliance, the cost of installation downtime as described above, and the administrative costs incurred by regulated facilities.

Table 8-1: Summary of Annualized Direct Compliance Costs – Existing Units (Millions; $2011; at 2013)

Discount Rate	Proposal Option 4	Final Rule-Existing Units	Proposal Option 2
3%	$260.7	$282.3	$3,999.0
7%	$271.8	$295.9	$3,892.3

Source: U.S. EPA Analysis, 2013

Table 8-2 presents annualized direct compliance costs for new units at Electric Generators under the new units provision of the final rule and other new units options considered. As reported in *Table 8-2*, using the 3-percent discount rate, EPA estimates that the new units provision of the final rule will result in $14.0 million in compliance costs to facilities. Under other new units options considered – Options A, B, and D – this cost would be $133.0 million, $52.1 million, and $4.7 million, respectively. Using the 7-percent discount rate, EPA estimates that the new units provision of the final rule will result in $11.9 million in compliance costs to facilities. Under the other new units options considered – Options A, B, and D – this cost would be $111.0 million, $43.8 million, and $4.2 million, respectively.

Table 8-2: Summary of Annualized Direct Compliance Costs – New Units (Millions; $2011; at 2013)

Discount Rate	Option A	Option B	Final Rule-New Units	Option D
3%	$133.0	$52.1	$14.0	$4.7
7%	$111.0	$43.8	$11.9	$4.2

Source: U.S. EPA Analysis, 2013

As reported in *Table 8-3*, EPA estimates that under the final rule, Electric Generators and Manufacturers will incur $296.3 million at the 3-percent discount rate and $307.8 million at the 7-percent discount rate, accounting for both the existing units provision (*Table 8-1*) and the new units provision (*Table 8-2*).

Table 8-3: Total Annualized Direct Compliance Costs of the Final Rule (Millions; $2011; at 2013)

Discount Rate	Existing Units	New Units	Total
3%	$282.3	$14.0	$296.3
7%	$295.9	$11.9	$307.8

Source: U.S. EPA Analysis, 2013

8.2.2 Costs of Government Administration of Regulatory Requirements

Table 8-4 summarizes government administrative costs under the final rule and other options considered, for existing units at Electric Generators and Manufacturers. EPA estimates that the existing units provision of the final rule will result in $1.0 million (at both the 3-percent and 7-percent discount rates) in government administrative costs. These findings are also true for Proposal Option 4. For Proposal Option 2, EPA estimates approximately $0.7 million (3-percent and 7-percent discount rates). Under all options, State and Territory governments bear almost all administrative costs of no more than $1.0 million, with federal government bearing no more than $0.04 million.

Table 8-4: Summary of Annualized Government Administrative Costs – Existing Units (Millions; $2011; at 2013)				
Discount Rate	**Government Level**	**Proposal Option 4**	**Final Rule – Existing Units**	**Proposal Option 2**
3%	State/Territory	$1.0	$1.0	$0.7
	Federal[b]	$0.0	$0.0	$0.0
	Total[a]	**$1.0**	**$1.0**	**$0.7**
7%	State/Territory	$1.0	$1.0	$0.7
	Federal[b]	$0.0	$0.0	$0.0
	Total[a]	**$1.0**	**$1.0**	**$0.7**

a. Values may not sum to totals due to independent rounding.
b. The value is less than $40,000.
Source: U.S. EPA Analysis, 2013

Table 8-5 presents annualized administrative costs to States and federal government for new units at Electric Generators under the new units provision of the final rule and other new units options considered. EPA assumed that all new units activity will occur in States with NPDES permitting authority. As reported in *Table 8-5*, using the 3-percent discount rate, EPA estimates that the new units provision of the final rule will result in $0.1 million in administrative costs to States. Under other new units options considered – Options A, B, and D – this cost would be $0.2 million, $0.1 million, and $0.1 million, respectively. Using the 7-percent discount rate, EPA estimates that the new units provision of the final rule will result in less than $50,000 in administrative costs to States. Under the other new units options considered these costs would be approximately the same as those estimated using the 3-percent discount rate.

Table 8-5: Summary of Annualized Government Administrative Costs – New Units (Millions; $2011; at 2013)					
Discount Rate	**Government Level**	**Option A**	**Option B[c]**	**Final Rule-New Units[c]**	**Option D[c]**
3%	State/Territory	$0.2	$0.1	$0.1	$0.1
	Federal[a]	$0.0	$0.0	$0.0	$0.0
	Total[b]	**$0.2**	**$0.1**	**$0.1**	**$0.1**
7%	State/Territory	$0.1	$0.0	$0.0	$0.0
	Federal[a]	$0.0	$0.0	$0.0	$0.0
	Total[b]	**$0.1**	**$0.0**	**$0.0**	**$0.0**

a. EPA assumed that all new units activity will occur in States with NPDES permitting authority.
b. Values may not sum to totals due to independent rounding.
c. Using the 7-percent discount rate, total costs to States are less than $50,000.
Source: U.S. EPA Analysis, 2013

As reported in *Table 8-8*, EPA estimates that States and federal government will incur approximately $1.1 million at both the 3-percent and 7-percent discount rates, to administer both the existing units provision (*Table 8-4*) and the new units provision (*Table 8-5*) of the final rule to Electric Generators and Manufacturers.

Table 8-6: Total Annualized Government Administrative Costs for the Final Rule (Millions; $2011; at 2013)

Discount Rate	Government Level	Existing Units	New Units[c]	Total[b]
3%	State/Territory	$1.0	$0.1	$1.1
	Federal[a]	$0.0	$0.0	$0.0
	Total[b]	**$1.0**	**$0.1**	**$1.1**
7%	State/Territory	$1.0	$0.0	$1.0
	Federal[a]	$0.0	$0.0	$0.0
	Total[b]	**$1.0**	**$0.0**	**$1.1**

a. EPA assumed that all new units activity will occur in States with NPDES permitting authority.
b. Values may not sum to totals due to independent rounding.
c. Using the 7-percent discount rate, total costs to States associated with the new units provision are less than $50,000.
Source: U.S. EPA Analysis, 2013

8.2.3 Total Social Cost

Table 8-7 combines reports the total annualized social costs, including direct compliance costs to regulated facilities and administrative costs to State and federal governments, discounted at both 3-percent and 7-percent rates, for existing units at Electric Generators and Manufacturers. At the 3-percent discount rate, total social costs are $283.3 million for the existing units provision of the final rule, $261.7 million for Proposal Option 4, and $3,999.7 million for Proposal Option 2. At the 7-percent discount rate, these costs are $296.9 million for the existing units provision of the final rule, $272.8 million for Proposal Option 4, and $3,893.0 million for Proposal Option 2. Compliance costs account for the larger share of total social costs across all three analyzed options, with government administrative costs accounting for less than 1 percent.

Table 8-7: Summary of Total Social Costs – Existing Units (Millions; $2011; at 2013)

Discount Rate	Cost Category	Proposal Option 4	Final Rule-Existing Units	Proposal Option 2
3%	Compliance Cost	$260.7	$282.3	$3,999.0
	Gov. Admin.	$1.0	$1.0	$0.7
	Total[a]	**$261.7**	**$283.3**	**$3,999.7**
7%	Compliance Cost	$271.8	$295.9	$3,892.3
	Gov. Admin.	$1.0	$1.0	$0.7
	Total[a]	**$272.8**	**$296.9**	**$3,893.0**

a. Values may not sum to totals due to independent rounding.
Source: U.S. EPA Analysis, 2013

Table 8-8 presents total annualized social costs for new units at Electric Generators and Manufacturers under the new units provision of the final rule and other new units options considered. As reported in *Table 8-8*, using the 3-percent discount rate, EPA estimates that the new units provision of the final rule will result in $14.1 million in total social costs. Under other new units options considered – Options A, B, and D – this cost would be $133.2 million, $52.2 million, and $4.8 million, respectively. Using the 7-percent discount rate, EPA estimates that the new units provision of the final rule will result in $12.0 million in compliance costs to facilities. Under the other new units options considered – Options A, B, and D – this cost would be $111.1 million, $43.8 million, and $4.2 million, respectively.

Table 8-8: Summary of Total Social Costs – New Units (Millions; $2011; at 2013)

Discount Rate	Cost Category	Option A	Option B[c]	Final Rule-New Units[c]	Option D[c]
3%	Compliance Cost	$133.0	$52.1	$14.0	$4.7
	Gov. Admin.[a]	$0.2	$0.1	$0.1	$0.1
	Total[b]	**$133.2**	**$52.2**	**$14.1**	**$4.8**
7%	Compliance Cost	$111.0	$43.8	$11.9	$4.2
	Gov. Admin.[a]	$0.1	$0.0	$0.0	$0.0
	Total[b]	**$111.1**	**$43.8**	**$12.0**	**$4.2**

a. EPA assumed that all new units activity will occur in States with NPDES permitting authority.
b. Values may not sum to totals due to independent rounding.
c. Using the 7-percent discount rate, government administrative costs are less than $50,000.
Source: U.S. EPA Analysis, 2013

Table 8-9 reports total annualized social costs for the final rule, including the existing units provision (*Table 8-7*) and the new units provision (*Table 8-8*). As reported in *Table 8-9*, EPA estimates that the final rule will result in $297.4 million at the 3-percent discount rate and $308.9 million at the 7-percent discount rate in total social costs. The new units provision accounts for less than 5 percent of total costs.

Table 8-9: Total Social Costs of the Final Rule (Millions; $2011; at 2013)

Discount Rate	Cost Category	Existing Units	New Units[c]	Total[b]
3%	Compliance Cost	$282.3	$14.0	$296.3
	Gov. Admin.[a]	$1.0	$0.1	$1.1
	Total[b]	**$283.3**	**$14.1**	**$297.4**
7%	Compliance Cost	$295.9	$11.9	$307.8
	Gov. Admin.[a]	$1.0	$0.0	$1.1
	Total[b]	**$296.9**	**$12.0**	**$308.9**

a. EPA assumed that all new units activity will occur in States with NPDES permitting authority.
b. Values may not sum to totals due to independent rounding.
c. Using the 7-percent discount rate, government administrative costs are less than $50,000.
Source: U.S. EPA Analysis, 2013

Table 8-10, *Table 8-11* and *Table 8-12* provide the time profiles of costs for the broad cost categories: direct compliance costs, administrative costs, and total social costs for the existing units provision of the final rule, Proposal Option 4, and Proposal Option 2, respectively. The largest compliance outlays occur over the years 2018 through 2022 (the existing units provision of the final rule and Proposal Option 4) and 2018 through 2030 (Proposal Option 2), when regulated facilities make capital outlays for compliance technology and incur technology-installation downtime.[129] As stated above, EPA does not expect regulated facilities to re-install cooling towers. Replacement of IM capital equipment and consequent additional capital outlays are required for all facilities under the final rule and Proposal Option 4, and for some facilities (i.e., facilities installation IM technologies) under Proposal Option 2, reflected in the higher costs in year 2038 through 2047.

[129] As discussed in *Chapter 3*, EPA assumed that it would take facilities four years to install cooling towers, considered under Proposal Option 2, with the fourth year being the year of technology-installation downtime. Therefore, while 2021 is the first year any facilities required to install a cooling tower experiences technology-installation downtime, 2018 is the first year any such facility begins to occur capital costs for installation of a cooling tower.

Table 8-13 presents time profiles of total social costs including compliance costs to facilities and administrative costs to States and federal government, for new units at Electric Generators under the final rule and other new units options considered. *Table 8-14* presents time profile of total social costs of the final rule, including the existing units provision (*Table 8-11*) and the new units provision (*Table 8-13*).

Table 8-10: Time Profile of Total Social Costs for Proposal Option 4 (Millions; $2011)

Year	Compliance Costs	Administrative Costs	Total
2013	$0.0	$0.0	**$0.0**
2014	$49.4	$0.3	**$49.7**
2015	$88.9	$0.0	**$88.9**
2016	$98.0	$0.0	**$98.0**
2017	$91.1	$2.0	**$93.0**
2018	$459.2	$2.0	**$461.2**
2019	$875.4	$2.1	**$877.5**
2020	$785.1	$2.0	**$787.1**
2021	$593.3	$3.0	**$596.3**
2022	$1,057.1	$0.8	**$1,057.9**
2023	$139.6	$0.8	**$140.5**
2024	$147.4	$0.8	**$148.2**
2025	$148.8	$0.8	**$149.7**
2026	$149.7	$0.8	**$150.5**
2027	$148.9	$1.1	**$150.0**
2028	$150.3	$1.0	**$151.3**
2029	$154.0	$1.0	**$155.1**
2030	$151.1	$1.0	**$152.1**
2031	$149.7	$1.1	**$150.8**
2032	$148.9	$1.1	**$150.0**
2033	$150.3	$1.0	**$151.3**
2034	$154.0	$1.0	**$155.1**
2035	$151.1	$1.0	**$152.1**
2036	$149.7	$1.1	**$150.8**
2037	$148.9	$1.1	**$150.0**
2038	$432.6	$1.0	**$433.6**
2039	$570.9	$1.0	**$571.9**
2040	$377.0	$1.0	**$378.0**
2041	$393.5	$1.1	**$394.6**
2042	$590.3	$1.1	**$591.3**
2043	$182.5	$1.0	**$183.6**
2044	$369.9	$1.0	**$370.9**
2045	$419.7	$1.0	**$420.7**
2046	$271.3	$1.1	**$272.4**
2047	$359.5	$1.1	**$360.5**
2048	$150.8	$1.0	**$151.8**
2049	$154.0	$1.0	**$155.1**
2050	$151.9	$1.0	**$152.9**
2051	$153.1	$1.1	**$154.2**
2052	$149.7	$1.1	**$150.8**
2053	$150.3	$1.0	**$151.3**
2054	$154.0	$1.0	**$155.1**
2055	$151.1	$1.0	**$152.1**
2056	$147.7	$1.0	**$148.7**
2057	$145.2	$1.0	**$146.2**
2058	$172.1	$0.9	**$173.0**
2059	$165.7	$0.9	**$166.5**
2060	$0.0	$0.0	**$0.0**
2061	$0.0	$0.0	**$0.0**
2062	$0.0	$0.0	**$0.0**
2063	$0.0	$0.0	**$0.0**
2064	$0.0	$0.0	**$0.0**
Present Value, 3%	**$6,956.9**	**$27.3**	**$6,984.2**
Annualized, 3%	**$260.3**	**$1.0**	**$261.3**
Present Value, 7%	**$4,016.5**	**$15.2**	**$4,031.6**
Annualized, 7%	**$271.4**	**$1.0**	**$272.4**

Source: U.S. EPA Analysis, 2013

Table 8-11: Time Profile of Total Social Costs for Final Rule-Existing Units (Millions; $2011)

Year	Compliance Costs	Administrative Costs	Total
2013	$0.0	$0.0	**$0.0**
2014	$49.4	$0.3	**$49.7**
2015	$88.9	$0.0	**$88.9**
2016	$98.0	$0.0	**$98.0**
2017	$91.1	$2.0	**$93.0**
2018	$525.3	$2.0	**$527.3**
2019	$931.3	$2.1	**$933.4**
2020	$1,004.9	$2.0	**$1,006.9**
2021	$610.5	$3.0	**$613.5**
2022	$1,143.8	$0.8	**$1,144.6**
2023	$145.9	$0.8	**$146.8**
2024	$153.6	$0.8	**$154.5**
2025	$155.1	$0.8	**$155.9**
2026	$156.0	$0.8	**$156.8**
2027	$155.2	$1.1	**$156.2**
2028	$156.6	$1.0	**$157.6**
2029	$160.3	$1.0	**$161.3**
2030	$157.3	$1.0	**$158.3**
2031	$156.0	$1.1	**$157.1**
2032	$155.2	$1.1	**$156.2**
2033	$156.6	$1.0	**$157.6**
2034	$160.3	$1.0	**$161.3**
2035	$157.3	$1.0	**$158.3**
2036	$156.0	$1.1	**$157.1**
2037	$155.2	$1.1	**$156.2**
2038	$457.3	$1.0	**$458.3**
2039	$586.5	$1.0	**$587.6**
2040	$392.5	$1.0	**$393.5**
2041	$409.1	$1.1	**$410.2**
2042	$609.3	$1.1	**$610.4**
2043	$215.4	$1.0	**$216.4**
2044	$396.1	$1.0	**$397.1**
2045	$545.0	$1.0	**$546.0**
2046	$277.6	$1.1	**$278.6**
2047	$398.6	$1.1	**$399.6**
2048	$160.1	$1.0	**$161.2**
2049	$164.2	$1.0	**$165.2**
2050	$160.6	$1.0	**$161.6**
2051	$160.0	$1.1	**$161.1**
2052	$156.8	$1.1	**$157.9**
2053	$156.6	$1.0	**$157.6**
2054	$160.3	$1.0	**$161.3**
2055	$157.3	$1.0	**$158.3**
2056	$154.0	$1.0	**$155.0**
2057	$151.5	$1.0	**$152.5**
2058	$180.2	$0.9	**$181.2**
2059	$172.4	$0.9	**$173.3**
2060	$0.0	$0.0	**$0.0**
2061	$0.0	$0.0	**$0.0**
2062	$0.0	$0.0	**$0.0**
2063	$0.0	$0.0	**$0.0**
2064	$0.0	$0.0	**$0.0**
Present Value, 3%	**$7,534.5**	**$27.3**	**$7,561.8**
Annualized, 3%	**$281.9**	**$1.0**	**$282.9**
Present Value, 7%	**$4,373.3**	**$15.2**	**$4,388.5**
Annualized, 7%	**$295.5**	**$1.0**	**$296.5**

Source: U.S. EPA Analysis, 2013

Table 8-12: Time Profile of Total Social Costs for Proposal Option 2 (Millions; $2011)

Year	Compliance Costs	Administrative Costs	Total
2013	$0.0	$0.0	**$0.0**
2014	$26.3	$0.4	**$26.8**
2015	$38.0	$0.2	**$38.2**
2016	$37.6	$0.2	**$37.8**
2017	$35.4	$1.1	**$36.5**
2018	$3,517.4	$1.0	**$3,518.5**
2019	$5,232.6	$1.3	**$5,233.8**
2020	$7,852.7	$1.2	**$7,853.9**
2021	$10,071.2	$1.4	**$10,072.6**
2022	$9,190.5	$0.8	**$9,191.2**
2023	$9,466.9	$0.7	**$9,467.6**
2024	$7,836.9	$0.6	**$7,837.6**
2025	$7,020.1	$0.6	**$7,020.8**
2026	$5,660.4	$0.6	**$5,661.0**
2027	$5,460.7	$0.7	**$5,461.4**
2028	$5,102.2	$0.7	**$5,102.9**
2029	$4,944.1	$0.7	**$4,944.8**
2030	$4,848.2	$0.7	**$4,848.9**
2031	$3,671.6	$0.7	**$3,672.3**
2032	$3,678.2	$0.7	**$3,678.9**
2033	$3,682.0	$0.7	**$3,682.7**
2034	$3,713.2	$0.7	**$3,713.9**
2035	$3,739.5	$0.7	**$3,740.2**
2036	$3,739.4	$0.7	**$3,740.1**
2037	$3,739.0	$0.7	**$3,739.7**
2038	$3,780.9	$0.7	**$3,781.6**
2039	$3,761.4	$0.7	**$3,762.1**
2040	$3,761.9	$0.7	**$3,762.6**
2041	$3,804.8	$0.7	**$3,805.5**
2042	$3,782.7	$0.7	**$3,783.4**
2043	$3,794.7	$0.7	**$3,795.4**
2044	$3,803.0	$0.7	**$3,803.8**
2045	$3,902.3	$0.7	**$3,903.0**
2046	$3,840.2	$0.7	**$3,840.9**
2047	$3,816.1	$0.7	**$3,816.8**
2048	$3,751.2	$0.7	**$3,751.9**
2049	$3,775.5	$0.7	**$3,776.2**
2050	$3,744.9	$0.7	**$3,745.6**
2051	$3,740.3	$0.7	**$3,741.1**
2052	$3,739.8	$0.7	**$3,740.6**
2053	$3,738.9	$0.7	**$3,739.6**
2054	$3,742.7	$0.7	**$3,743.4**
2055	$3,739.5	$0.7	**$3,740.2**
2056	$3,738.6	$0.7	**$3,739.3**
2057	$3,737.6	$0.7	**$3,738.3**
2058	$3,741.1	$0.7	**$3,741.7**
2059	$3,740.2	$0.6	**$3,740.8**
2060	$0.0	$0.0	**$0.0**
2061	$0.0	$0.0	**$0.0**
2062	$0.0	$0.0	**$0.0**
2063	$0.0	$0.0	**$0.0**
2064	$0.0	$0.0	**$0.0**
Present Value, 3%	**$106,881.6**	**$18.3**	**$106,899.9**
Annualized, 3%	**$3,998.6**	**$0.7**	**$3,999.3**
Present Value, 7%	**$57,603.4**	**$10.1**	**$57,613.5**
Annualized, 7%	**$3,891.9**	**$0.7**	**$3,892.6**

Source: U.S. EPA Analysis, 2013

Table 8-13: Time Profile of Total Social Costs – New Units (Millions; $2011)

Year	Option A	Option B	Final Rule-New Units	Option D
2013	$0.0	$0.0	$0.0	$0.0
2014	$25.5	$10.4	$4.2	$2.6
2015	$45.9	$18.6	$6.0	$2.9
2016	$66.8	$27.0	$8.0	$3.2
2017	$91.9	$36.9	$10.2	$3.6
2018	$96.6	$38.7	$10.7	$3.7
2019	$101.3	$40.5	$11.2	$3.9
2020	$106.1	$42.4	$11.6	$4.0
2021	$109.7	$43.7	$12.0	$4.1
2022	$113.3	$45.1	$12.3	$4.2
2023	$117.0	$46.5	$12.6	$4.3
2024	$120.8	$47.9	$13.0	$4.4
2025	$124.3	$49.2	$13.3	$4.6
2026	$127.9	$50.6	$13.7	$4.7
2027	$131.5	$51.9	$14.0	$4.8
2028	$135.1	$53.2	$14.4	$4.9
2029	$138.8	$54.6	$14.7	$5.0
2030	$142.5	$56.0	$15.1	$5.1
2031	$146.3	$57.5	$15.4	$5.2
2032	$150.1	$58.9	$15.8	$5.3
2033	$153.8	$60.3	$16.1	$5.4
2034	$158.0	$61.9	$16.5	$5.5
2035	$162.4	$63.5	$16.9	$5.6
2036	$166.1	$64.9	$17.3	$5.7
2037	$169.8	$66.3	$17.6	$5.8
2038	$173.5	$67.7	$18.0	$6.0
2039	$177.2	$69.1	$18.3	$6.1
2040	$180.9	$70.5	$18.7	$6.2
2041	$184.7	$71.9	$19.0	$6.3
2042	$188.4	$73.3	$19.4	$6.4
2043	$192.1	$74.7	$19.7	$6.5
2044	$195.8	$76.1	$20.1	$6.6
2045	$199.5	$77.4	$20.4	$6.7
2046	$203.2	$78.8	$20.8	$6.8
2047	$206.9	$80.2	$21.1	$6.9
2048	$210.6	$81.6	$21.5	$7.0
2049	$214.3	$83.0	$21.8	$7.1
2050	$218.1	$84.4	$22.2	$7.2
2051	$221.8	$85.8	$22.5	$7.3
2052	$225.5	$87.2	$22.9	$7.4
2053	$229.2	$88.6	$23.2	$7.6
2054	$232.9	$90.0	$23.6	$7.7
2055	$236.6	$91.4	$23.9	$7.8
2056	$240.3	$92.8	$24.3	$7.9
2057	$244.0	$94.2	$24.6	$8.0
2058	$247.8	$95.6	$25.0	$8.1
2059	$251.5	$97.0	$25.3	$8.2
2060	$0.0	$0.0	$0.0	$0.0
2061	$0.0	$0.0	$0.0	$0.0
2062	$0.0	$0.0	$0.0	$0.0
2063	$0.0	$0.0	$0.0	$0.0
2064	$0.0	$0.0	$0.0	$0.0
Present Value, 3%	**$3,559.6**	**$1,395.6**	**$375.9**	**$128.2**
Annualized, 3%	**$133.2**	**$52.2**	**$14.1**	**$4.8**
Present Value, 7%	**$1,643.9**	**$648.4**	**$177.2**	**$62.2**
Annualized, 7%	**$111.1**	**$43.8**	**$12.0**	**$4.2**

Source: U.S. EPA Analysis, 2013

Table 8-14: Time Profile of Total Social Costs (Millions; $2011)

Year	Existing Units	New Units	Total
2013	$0.0	$0.0	$0.0
2014	$49.7	$4.2	$53.9
2015	$88.9	$6.0	$94.9
2016	$98.0	$8.0	$106.0
2017	$93.0	$10.2	$103.3
2018	$527.3	$10.7	$538.0
2019	$933.4	$11.2	$944.5
2020	$1,006.9	$11.6	$1,018.5
2021	$613.5	$12.0	$625.5
2022	$1,144.6	$12.3	$1,156.9
2023	$146.8	$12.6	$159.4
2024	$154.5	$13.0	$167.5
2025	$155.9	$13.3	$169.3
2026	$156.8	$13.7	$170.5
2027	$156.2	$14.0	$170.3
2028	$157.6	$14.4	$172.0
2029	$161.3	$14.7	$176.1
2030	$158.3	$15.1	$173.4
2031	$157.1	$15.4	$172.5
2032	$156.2	$15.8	$172.0
2033	$157.6	$16.1	$173.7
2034	$161.3	$16.5	$177.9
2035	$158.3	$16.9	$175.3
2036	$157.1	$17.3	$174.3
2037	$156.2	$17.6	$173.9
2038	$458.3	$18.0	$476.3
2039	$587.6	$18.3	$605.9
2040	$393.5	$18.7	$412.2
2041	$410.2	$19.0	$429.2
2042	$610.4	$19.4	$629.8
2043	$216.4	$19.7	$236.1
2044	$397.1	$20.1	$417.2
2045	$546.0	$20.4	$566.4
2046	$278.6	$20.8	$299.4
2047	$399.6	$21.1	$420.8
2048	$161.2	$21.5	$182.6
2049	$165.2	$21.8	$187.1
2050	$161.6	$22.2	$183.8
2051	$161.1	$22.5	$183.6
2052	$157.9	$22.9	$180.7
2053	$157.6	$23.2	$180.8
2054	$161.3	$23.6	$184.9
2055	$158.3	$23.9	$182.3
2056	$155.0	$24.3	$179.3
2057	$152.5	$24.6	$177.1
2058	$181.2	$25.0	$206.1
2059	$173.3	$25.3	$198.6
2060	$0.0	$0.0	$0.0
2061	$0.0	$0.0	$0.0
2062	$0.0	$0.0	$0.0
2063	$0.0	$0.0	$0.0
2064	$0.0	$0.0	$0.0
Present Value, 3%	**$7,561.8**	**$375.9**	**$7,937.6**
Annualized, 3%	**$282.9**	**$14.1**	**$297.0**
Present Value, 7%	**$4,388.5**	**$177.2**	**$4,565.7**
Annualized, 7%	**$296.5**	**$12.0**	**$308.5**

Source: U.S. EPA Analysis, 2013

9 Social Costs and Benefits

This chapter compares national monetized benefits and social costs for the final rule and other options EPA considered. The social costs in this analysis include (1) costs to Electric Generators and Manufacturers to comply with the final rule, and (2) costs to State and federal governments to administer regulatory compliance. Some potentially significant benefit categories have not been fully monetized, and thus the national monetized benefits are likely to understate substantially the rule‟s expected benefits to society.[130] EPA conducted this analysis for the existing and new units provisions. For details on the analysis of social costs, see *Chapter 8: Total Social Costs* in this document. For details on the analysis of benefits, see the *Benefits Assessment (BA)* report. This chapter also satisfies the requirements of Executive Order 12866: Regulatory Planning and Review.

9.1 Summary of Benefits Estimation for the Final Rule

Benefits from the final rule occur due to the reduction in impingement mortality and entrainment (IM&E) at cooling water intake structures (CWISs) affected by the rule. IM&E kills or injures large numbers of aquatic organisms at all life stages. By reducing the levels of IM&E, the final rule and other options considered would increase the number of fish, shellfish, and other aquatic organisms in the affected waterbodies. This in turn would directly and indirectly improve use benefits such as those associated with recreational and commercial fisheries. Other types of benefits, including nonuse values of the affected resources, would also be enhanced. The *BA Chapter 4: Economic Benefit Categories Associated with IM&E Reduction* provides an overview of the types and sources of benefits anticipated and how these benefits are estimated (i.e., monetized, quantified but not monetized, or assessed qualitatively) (U.S. EPA 2010). *Chapter 5* through *Chapter 9 and Chapter 12* of the *BA* report provide detailed descriptions of the methodologies used to analyze the benefits of the final rule and other options considered.

The economic benefits of the final rule and other options considered can be broadly defined according to categories of goods and services provided by the species that are affected by IM&E from CWISs. The first category includes benefits that pertain to the use (direct or indirect) of the affected fishery resources. The “direct use” benefits of the options include both “market” commodities (e.g., commercial fisheries) and “nonmarket” goods (e.g., recreational angling). Indirect use benefits also can be linked to either market or nonmarket goods and services. An example of an indirect use benefit would be the manner in which reduced IM&E-related losses of forage species leads through the aquatic ecosystem food web to enhance the biomass of species targeted for commercial (market) and recreational (nonmarket) uses.

The second category includes benefits that are independent of any current or anticipated use of the resource; these are known as “nonuse” or “passive use” values. Nonuse benefits reflect human values associated with existence and bequest motives, or willingness to pay (WTP) for the knowledge that an ecosystem is functioning as if it were not affected by human activity, or to pass such ecosystem function on to future generations.

EPA estimated the economic benefits from the regulatory options using a range of valuation methods, depending on the benefit category, data availability, and other relevant factors. Commercial fishery benefits are valued using market data. Recreational angling benefits are valued using a benefit-transfer approach. Nonuse values were estimated for two of the seven benefits regions using a separate benefit transfer approach. Agency benefits estimates are based on projected numbers of age-one equivalent fish saved and changes in harvest under final

[130] See BA *Chapter 4: Economic Benefit Categories Associated with IM&E Reduction* of the *Benefits Analysis* for additional discussion of benefits categories monetized by EPA.

regulatory options. EPA also estimated benefits associated with changes in CO_2-equivalent emissions based on the social cost of carbon.

EPA derived national benefit estimates for the final rule and other options considered from a series of regional studies across the country representing a range of water body types and aquatic resources. National benefit estimates are obtained by summing regional benefits. EPA calculated the monetary value of benefits of the national regulatory options for existing facilities using two discount rate values: 3 percent and 7 percent. All dollar values presented are in 2011 dollars (annual average). Because avoided fish deaths occur mainly in fish that are younger than harvestable age (eggs, larvae, and juveniles), the estimated use benefits from avoided IM&E include a biological lag to account for the time required for fish to grow and mature to harvestable size. Appendix D of the *BA* report provides detail on the time profile of expected benefits.

9.2 Comparison of Benefits and Social Costs by Option

Chapter 8 in this document and *Chapter 13: National Benefits* in the *BA*, present estimates of social costs and benefits, respectively, for the final rule and other options considered.

As documented in the *BA*, the monetized benefit values developed by EPA for the regulatory options presented in this chapter include estimated use values for commercial and recreational fishing (including recreational use value of threatened and endangered species) for all benefits regions, estimated nonuse values for two of the seven benefit regions, and national benefits associated with changes in CO_2 equivalent emissions. EPA was unable, at this time, to estimate a monetized value of nonuse benefits from reduced IM&E in all of the seven benefits regions. As *Chapter 3* of the *BA* report, the harvested commercial and recreational fish species that have direct use values comprise between 1 and 10 percent of baseline IM&E in each region, with a national average of 3 percent. The remaining 97 percent of IM&E includes unharvested recreational and commercial fish and forage fish which do not have direct use values. EPA‟s nonuse analysis was limited to two of the seven benefit regions and values were not estimated for unharvested fish in the remaining five benefits regions. The total estimated benefits are likely to be significantly understated due to the regional limitations of EPA‟s nonuse analysis and the relatively large fraction of IM&E reductions that are not commercially or recreationally harvested. EPA did not assess use values other than commercial and recreational fishing, such as improved recreation opportunities for non-fishing activities (e.g., diving or wildlife viewing), in this analysis. EPA notes, however, that recreational users other than fishers (e.g., divers) are likely to have positive use values for all fish and shellfish species, including commercially and recreationally targeted species as well as for forage species. Although the analysis omits some categories of use benefits (i.e., benefits for recreational users other than fishers), EPA captured the largest use-value categories (i.e., commercial and recreational fishing).

As stated above, EPA was unable to use benefit transfer to generate national estimates of non-use benefits for the final rule and other options considered. EPA‟s nonuse analysis generated estimates of nonuse values for resource changes expected to result in the North Atlantic and Mid-Atlantic benefit regions from the final options, but EPA was unable to estimate reliable nonuse valuations for changes expected to result in other study regions. EPA developed and fielded an original stated preference survey to estimate total WTP for improvements to fishery resources affected by IM&E from regulated 316(b) facilities (75 FR 42,438, July 21, 2010). The survey attempted to assess how much survey respondents would be willing to pay for improvements to fishery resources affected by impingement mortality and entrainment from 316(b) facilities. EPA will obtain Science Advisory Board (SAB) review of the SP survey EPA conducted. The SAB review follows the external peer review EPA already conducted on the survey. SAB review will provide high caliber, independent professional judgment concerning the quality of the survey done to date, including possible improvements EPA could make. EPA considers the use of the SP survey results prior to completion of the SAB review to be premature. Therefore, EPA did not use those estimates in its quantitative comparison of costs and benefits for the final rule.[131]

Table 9-1 presents EPA‟s estimates of monetized benefits and total social costs for the existing units provision of the final rule and other options considered, at 3 percent and 7 percent discount rates, and annualized over 51 years. As stated above, the benefits values used in this analysis include benefits associated with changes in greenhouse gas emissions for bother existing and new units at existing facilities (for details see BA *Chapter 9*). At the 3 percent discount rate,[132] EPA estimates that social costs exceed mean monetized benefits by $245.1 million for the final rule, and $261.7 million and $5.0 billion for Proposal Options 4 and 2, respectively. At the 7 percent discount rate, social costs exceed mean monetized benefits by $255.0 million for the final rule, by $278.0 million for Proposal Option 4, and by $4.7 billion for Proposal Option 2.

Table 9-1: Final Rule-Existing Units - Total Annualized Benefits and Social Costs (Millions; $2011; at 2013)

Option	Discount Rate	
	3%	7%
Proposal Option 4		
Total Monetized Benefits[a]	$20.2	$17.8
Total Social Costs[b]	$261.7	$272.8
Final Rule-Existing Units		
Total Monetized Benefits[a]	$21.6	$18.9
Total Social Costs[b]	$283.3	$296.9
Proposal Option 2		
Total Monetized Benefits[a]	-$1,016.5	-$773.1
Total Social Costs[b]	$3,999.7	$3,893.0

a. *Total Monetized Benefits* are the estimated "mean" values. Additional "low" and "high" value estimates are presented in BA *Chapter 13*. These values also include benefits associated with changes in greenhouse gas emissions.
b. *Total Social Costs* include compliance costs to facilities and government administrative costs.
Source: U.S. EPA Analysis, 2013

Table 9-2 presents EPA‟s estimates of monetized benefits and social costs for the new units provision of the final rule and other new units options considered in development of the final rule.

131 However, EPA is posting the final results from the survey on its website for this rule. EPA intends this information to advance the conversation about the value of the final rule. Further, making the information readily available may lead to further clarity with respect to the value the public attached to the benefits associated with cooling water intake control and thus assist permitting authorities in their site-specific decisions on entrainment controls.

132 As used in EPA‟s analysis of social cost and benefits for the 316(b) rule.

Table 9-2: Total Benefits and Social Costs – New Units (Millions; $2011; at 2013)

Option	Discount Rate 3%	Discount Rate 7%
Option A		
Total Monetized Benefits[a]	$5.7	$5.4
Total Social Costs[b]	$133.2	$111.1
Option B		
Total Monetized Benefits[a]	$1.4	$1.6
Total Social Costs[b]	$52.2	$43.8
Final Rule-New Units		
Total Monetized Benefits[a]	-$0.4	-$0.1
Total Social Costs[b]	$14.1	$12.0
Option D		
Total Monetized Benefits[a]	-$0.2	-$0.1
Total Social Costs[b]	$4.8	$4.2

a. *Total Monetized Benefits* are the estimated "mean" values. Additional "low" and "high" value estimates are presented in BA *Chapter 13*. These values also include benefits associated with changes in greenhouse gas emissions.
b. *Total Social Costs* include compliance costs to facilities and government administrative costs.
Source: U.S. EPA Analysis, 2013

Table 9-3 presents total monetized benefits and total social costs of the final rule, including the existing and new units provisions, for Electric Generators and Manufacturers. As shown in *Table 9-3*, EPA estimates that under the final rule, social costs exceed mean monetized benefits by $276.2 million and $290.1 million at the 3-percent and 7-percent discount rates, respectively.

Table 9-3: Total Benefits and Social Costs of the Final Rule (Millions; $2011; at 2013)

Option	Discount Rate 3%	Discount Rate 7%
Existing Units		
Total Monetized Benefits[a]	$21.6	$18.9
Total Social Costs[b]	$283.3	$296.9
New Units		
Total Monetized Benefits[a]	-$0.4	-$0.1
Total Social Costs[b]	$14.1	$12.0
Total		
Total Monetized Benefits[a]	$21.2	$18.8
Total Social Costs[b]	$297.4	$308.9

a. *Total Monetized Benefits* are the estimated "mean" values. Additional "low" and "high" value estimates are presented in BA *Chapter 13*. These values also include benefits associated with changes in greenhouse gas emissions.
b. *Total Social Costs* include compliance costs to facilities and government administrative costs.
Source: U.S. EPA Analysis, 2013

The following tables provide additional detail on net benefits. *Table 9-4* presents time profiles of benefits and costs for the existing units provision of the final rule and other options considered. EPA estimated benefits assuming the same technology-installation schedule and analysis periods as social costs (see *Chapter 8* in this document). *Table 9-5* presents the time profiles of monetized benefits and total social costs for both the existing and new units provisions of the final rule.

Table 9-4: Time Profile of Benefits and Social Costs by Option (Millions; $2011)						
	Proposal Option 4		Final Rule – Existing Units		Proposal Option 2	
Year	Total Monetized Benefits	Total Social Costs	Total Monetized Benefits	Total Social Costs	Total Monetized Benefits	Total Social Costs
2013	$0.0	$0.0	$0.0	$0.0	$0.0	$0.0
2014	$0.0	$49.7	$0.0	$49.7	$0.0	$26.8
2015	$0.0	$88.9	$0.0	$88.9	$0.0	$38.2
2016	$0.0	$98.0	$0.0	$98.0	$0.0	$37.8
2017	$0.0	$93.0	$0.0	$93.0	$0.0	$36.5
2018	$24.6	$461.2	$24.8	$527.3	$96.1	$3,518.5
2019	$25.2	$877.5	$25.4	$933.4	$98.0	$5,233.8
2020	$26.4	$787.1	$27.0	$1,006.9	$101.2	$7,853.9
2021	$28.1	$596.3	$28.9	$613.5	-$875.7	$10,072.6
2022	$33.2	$1,057.9	$34.5	$1,144.6	-$870.2	$9,191.2
2023	-$6.1	$140.5	-$4.7	$146.8	-$1,002.6	$9,467.6
2024	-$0.2	$148.2	$1.5	$154.5	-$996.9	$7,837.6
2025	$1.7	$149.7	$3.6	$155.9	-$1,006.0	$7,020.8
2026	$2.3	$150.5	$4.2	$156.8	-$1,720.4	$5,661.0
2027	$2.4	$150.0	$4.3	$156.2	-$1,755.1	$5,461.4
2028	$55.1	$151.3	$57.0	$157.6	-$1,784.4	$5,102.9
2029	$55.7	$155.1	$57.6	$161.3	-$1,812.6	$4,944.8
2030	$56.5	$152.1	$58.4	$158.3	-$1,852.2	$4,848.9
2031	$57.1	$150.8	$59.0	$157.1	-$1,352.2	$3,672.3
2032	$57.9	$150.0	$59.8	$156.2	-$1,380.6	$3,678.9
2033	$57.6	$151.3	$59.5	$157.6	-$1,406.9	$3,682.7
2034	$20.7	$155.1	$22.6	$161.3	-$1,437.8	$3,713.9
2035	$20.7	$152.1	$22.6	$158.3	-$1,464.5	$3,740.2
2036	$20.7	$150.8	$22.6	$157.1	-$1,495.9	$3,740.1
2037	$20.7	$150.0	$22.6	$156.2	-$1,522.6	$3,739.7
2038	$20.7	$433.6	$22.6	$458.3	-$1,549.4	$3,781.6
2039	$20.7	$571.9	$22.6	$587.6	-$1,580.5	$3,762.1
2040	$20.7	$378.0	$22.6	$393.5	-$1,607.0	$3,762.6
2041	$20.7	$394.6	$22.6	$410.2	-$1,634.0	$3,805.5
2042	$20.7	$591.3	$22.6	$610.4	-$1,660.9	$3,783.4
2043	$20.7	$183.6	$22.6	$216.4	-$1,683.4	$3,795.4
2044	$20.7	$370.9	$22.6	$397.1	-$1,710.3	$3,803.8
2045	$20.7	$420.7	$22.6	$546.0	-$1,737.2	$3,903.0
2046	$20.7	$272.4	$22.6	$278.6	-$1,759.7	$3,840.9
2047	$20.7	$360.5	$22.6	$399.6	-$1,786.6	$3,816.8
2048	$20.7	$151.8	$22.6	$161.2	-$1,813.5	$3,751.9
2049	$20.7	$155.1	$22.6	$165.2	-$1,840.5	$3,776.2
2050	$20.7	$152.9	$22.6	$161.6	-$1,862.9	$3,745.6
2051	$20.7	$154.2	$22.6	$161.1	-$1,885.7	$3,741.1
2052	$20.7	$150.8	$22.6	$157.9	-$1,908.8	$3,740.6
2053	$20.7	$151.3	$22.6	$157.6	-$1,932.1	$3,739.6
2054	$20.7	$155.1	$22.6	$161.3	-$1,955.7	$3,743.4
2055	$20.7	$152.1	$22.6	$158.3	-$1,979.6	$3,740.2
2056	$20.7	$148.7	$22.6	$155.0	-$2,003.7	$3,739.3
2057	$20.7	$146.2	$22.6	$152.5	-$2,028.2	$3,738.3
2058	$20.7	$173.0	$22.6	$181.2	$100.1	$3,741.7
2059	$20.7	$166.5	$22.6	$173.3	$99.4	$3,740.8
2060	$18.6	$0.0	$20.3	$0.0	$131.8	$0.0
2061	$16.5	$0.0	$17.9	$0.0	$111.7	$0.0
2062	$4.3	$0.0	$4.9	$0.0	$54.6	$0.0
2063	$2.2	$0.0	$2.6	$0.0	$33.7	$0.0
2064	$1.1	$0.0	$1.3	$0.0	$17.3	$0.0
PV 3%	**$524.2**	**$6,984.2**	**$560.5**	**$7,561.8**	**-$26,379.4**	**$106,899.9**
Annualized at 3%	**$20.2**	**$261.3**	**$21.6**	**$282.9**	**-$1,016.5**	**$3,999.3**
PV 7%	**$246.2**	**$4,031.6**	**$261.4**	**$4,388.5**	**-$10,693.9**	**$57,613.5**
Annualized at 7%	**$17.8**	**$272.4**	**$18.9**	**$296.5**	**-$773.1**	**$3,892.6**

Source: U.S. EPA Analysis, 2013

Table 9-5: Time Profile of Benefits and Social Costs of the Final Rule (Millions; $2011)

	Existing Units		New Units		Total	
Year	Monetized Benefits	Total Social Costs	Monetized Benefits	Total Social Costs	Monetized Benefits	Total Social Costs
2013	$0.0	$0.0	$0.0	$0.0	$0.00	$0.0
2014	$0.0	$49.7	$0.0	$4.2	$0.00	$53.9
2015	$0.0	$88.9	$0.1	$6.0	$0.10	$94.9
2016	$0.0	$98.0	$0.1	$8.0	$0.10	$106.0
2017	$0.0	$93.0	$0.1	$10.2	$0.10	$103.3
2018	$24.8	$527.3	$0.1	$10.7	$24.90	$538.0
2019	$25.4	$933.4	$0.1	$11.2	$25.50	$944.5
2020	$27.0	$1,006.9	$0.1	$11.6	$27.10	$1,018.5
2021	$28.9	$613.5	$0.1	$12.0	$29.00	$625.5
2022	$34.5	$1,144.6	$0.1	$12.3	$34.60	$1,156.9
2023	-$4.7	$146.8	$0.1	$12.6	-$4.60	$159.4
2024	$1.5	$154.5	$0.1	$13.0	$1.60	$167.5
2025	$3.6	$155.9	$0.0	$13.3	$3.60	$169.3
2026	$4.2	$156.8	$0.0	$13.7	$4.20	$170.5
2027	$4.3	$156.2	$0.0	$14.0	$4.30	$170.3
2028	$57.0	$157.6	-$0.1	$14.4	$56.90	$172.0
2029	$57.6	$161.3	-$0.1	$14.7	$57.50	$176.1
2030	$58.4	$158.3	-$0.1	$15.1	$58.30	$173.4
2031	$59.0	$157.1	-$0.2	$15.4	$58.80	$172.5
2032	$59.8	$156.2	-$0.2	$15.8	$59.60	$172.0
2033	$59.5	$157.6	-$0.3	$16.1	$59.20	$173.7
2034	$22.6	$161.3	-$0.3	$16.5	$22.30	$177.9
2035	$22.6	$158.3	-$0.4	$16.9	$22.20	$175.3
2036	$22.6	$157.1	-$0.5	$17.3	$22.10	$174.3
2037	$22.6	$156.2	-$0.5	$17.6	$22.10	$173.9
2038	$22.6	$458.3	-$0.6	$18.0	$22.00	$476.3
2039	$22.6	$587.6	-$0.7	$18.3	$21.90	$605.9
2040	$22.6	$393.5	-$0.7	$18.7	$21.90	$412.2
2041	$22.6	$410.2	-$0.8	$19.0	$21.80	$429.2
2042	$22.6	$610.4	-$0.9	$19.4	$21.70	$629.8
2043	$22.6	$216.4	-$1.0	$19.7	$21.60	$236.1
2044	$22.6	$397.1	-$1.1	$20.1	$21.50	$417.2
2045	$22.6	$546.0	-$1.1	$20.4	$21.50	$566.4
2046	$22.6	$278.6	-$1.2	$20.8	$21.40	$299.4
2047	$22.6	$399.6	-$1.3	$21.1	$21.30	$420.8
2048	$22.6	$161.2	-$1.4	$21.5	$21.20	$182.6
2049	$22.6	$165.2	-$1.5	$21.8	$21.10	$187.1
2050	$22.6	$161.6	-$1.6	$22.2	$21.00	$183.8
2051	$22.6	$161.1	-$1.7	$22.5	$20.90	$183.6
2052	$22.6	$157.9	-$1.8	$22.9	$20.80	$180.7
2053	$22.6	$157.6	-$1.9	$23.2	$20.70	$180.8
2054	$22.6	$161.3	-$2.0	$23.6	$20.60	$184.9
2055	$22.6	$158.3	-$2.1	$23.9	$20.50	$182.3
2056	$22.6	$155.0	-$2.2	$24.3	$20.40	$179.3
2057	$22.6	$152.5	-$2.3	$24.6	$20.30	$177.1
2058	$22.6	$181.2	-$2.5	$25.0	$20.10	$206.1
2059	$22.6	$173.3	-$2.6	$25.3	$20.00	$198.6
2060	$20.3	$0.0	$2.5	$0.0	$22.80	$0.0
2061	$17.9	$0.0	$2.1	$0.0	$20.00	$0.0
2062	$4.9	$0.0	$1.1	$0.0	$6.00	$0.0
2063	$2.6	$0.0	$0.7	$0.0	$3.30	$0.0
2064	$1.3	$0.0	$0.4	$0.0	$1.70	$0.0

Table 9-5: Time Profile of Benefits and Social Costs of the Final Rule (Millions; $2011)

Year	Existing Units		New Units		Total	
	Monetized Benefits	Total Social Costs	Monetized Benefits	Total Social Costs	Monetized Benefits	Total Social Costs
PV 3%	$560.5	$7,561.8	-$10.4	$375.9	$550.2	$7,937.6
Annualized at 3%	$21.6	$282.9	-$0.4	$14.1	$21.2	$297.0
PV 7%	$261.4	$4,388.5	-$1.4	$177.2	$260.1	$4,565.7
Annualized at 7%	$18.9	$296.5	-$0.1	$12.0	18.8	$308.5

Source: U.S. EPA Analysis, 2013

10 Employment Effects

While estimates of employment impacts typically are not included in a standard benefit-cost analysis,[133] such an analysis is of particular concern in the current economic climate. Executive Order 13563, which supplements Executive Order 12866, states, "Our regulatory system must protect public health, welfare, safety, and our environment while promoting economic growth, innovation, competitiveness, and job creation" (emphasis added). For the final rule, EPA assessed the *potential* for employment impacts at the national level, focusing specifically on the final rule. For information purposes, EPA also analyzed and presents estimated employment effects for the other options EPA considered, defined in *Chapter 1: Introduction* and discussed elsewhere in this document.

EPA assessed the potential quantitative impact of the final rule and other options considered on jobs by estimating employment changes at the national level in the directly regulated Electric Power Industry, the six Primary Manufacturing Industries, and Other Industries. EPA based this employment-effects analysis on an econometric analysis of industry response to environmental regulations and focuses on the *on-going* employment effects of meeting compliance requirements.[134] EPA conducted this analysis for existing units at Electric Generators and Manufacturers and new units at Electric Generators. In addition, EPA conducted a qualitative analysis of potential employment effects, the results of which are also included in this chapter.

The results of this analysis address requirements of the Executive Order 12866: Regulatory Planning and Review and Executive Order 13563: Improving Regulation and Regulatory Review, discussed in *Chapter 13: Other Administrative Requirements*.

10.1 Assessing Employment Effects of Regulations

Estimating employment effects of an environmental regulation is not straightforward; it requires consideration of many factors, some of which are difficult to isolate and quantify. Some difficulties arise due to lack of data, while others exist because of ambiguity of certain impacts the analysis attempts to capture. This section discusses how an environmental regulation may potentially affect employment levels and assesses employment trends and the current employment levels in the directly affected Electric Power Industry and the six Primary Manufacturing Industries.

10.1.1 General Considerations

An environmental regulation can be understood as an increase in demand for a particular output: environmental quality. Meeting this new demand can lead to higher demand for various factors of production available to the economy (including labor) in the directly affected industry(ies) as well as in the environmental protection economic sector comprised of industries providing goods and services to the directly affected industry(ies). However, the directly affected industry(ies) generally have to rely on revenue generated by their other (market) outputs to cover the costs of satisfying society's demand for environmental quality. This can lead to reduced demand for labor and other factors of production in the directly regulated sector(s). The net effect of an environmental regulation on regulated sectors and the overall economy is therefore indeterminate. The costs imposed on directly regulated sectors may affect their competitive position and put some jobs at risk. At the same time, environmental regulations may create jobs in other sectors, e.g., in the environmental protection sector.

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[133] One exception is the extent to which labor costs are part of total costs in a benefit cost analysis.

[134] Note that this analysis accounts only for a subset of potential changes in employment; however, these are the employment impacts EPA can defensibly assess at this time. EPA is committed to using the best available science, utilizing the relevant theoretical and empirical literature in this assessment, and is pursuing efforts to support new research in this field.

Tracing out these opposing effects against the temporal dynamics of labor markets is complex and makes quite difficult the derivation of estimates of how regulations will impact economy-wide net employment.

Adding to this complexity, employment effects are also likely to change over time. Some employment effects occur soon after a regulation becomes effective, while other effects occur farther in the future, depending on the phasing of regulatory requirements and when the „steady state" compliance period is reached. Further, short-term production disruptions may arise in a directly regulated sector during the transition to compliance (e.g., due to production capacity being taken offline during installation of compliance technology), which may result in short-term price increases. These price increases, even if temporary, may lead to reduced sales and profits; depending on the magnitude of this effect, directly affected industries may contract their business operations and lay off employees or slow the pace of hiring. Longer term, changes in employment will depend on how directly affected industries adjust to the new regulatory requirements, and the indirect upstream and downstream effects of those adjustments. For instance, in the long run, regulated facilities may be able to change their production processes in terms of the mix of production inputs, potentially leading to changes in demand for employment in the directly affected industries, and changes in demand for pollution control equipment and services provided by the environmental protection sector industries. Also, in the long run, directly affected industries may be able to train their employees to perform certain services for which they initially hired specialists from the environmental protection sector industries, thereby leading to reduced demand for services provided by the environmental protection sector industries. In addition, due to technological changes over time in compliance equipment and processes, a wider range of pollution control alternatives may become available, potentially changing the profile of demand for equipment and services, including employment.

In addition to varying over time, these direct and indirect impacts on employment levels can vary in their magnitude across regions, depending on regional variations in the operating characteristics of affected industries. Regional differences in regulatory response are likely to result in offsetting direct and indirect effects, which vary across regions due to different regional presence of directly and indirectly affected industry sectors. In addition, the degree to which regulated entities will be able to increase prices to recover increased production costs may vary by region, depending on industry structure. Further, interconnectedness of industry sectors across regions is likely to result in spillover effects, which are generally difficult to capture. Focusing on localized employment effects or national effects that result from only one of the several factors that can lead to potentially conflicting employment effects, can paint an inaccurate picture of net employment impacts if not properly placed in a broader economic context. At the same time, differences in regulatory response, regional industry presence, industry structure, and potential spillover effects make estimating employment effects challenging not only at the regional but also at the national level.

It is important to account for the state of economy at the time of regulatory action. When the economy is at full employment, an environmental regulation is unlikely to have a considerable impact on net employment in the long run; instead, labor would primarily be reallocated from one productive use to another, e.g. from producing electricity or steel to producing pollution abatement equipment. Even in the full employment case, however, transitory employment effects are possible, as some workers may require time to either retrain or look for new jobs. Regardless, overall, theory and peer-reviewed published empirical evidence support the argument that, in the case of full employment, the net employment effects from environmental regulation are likely to be small, even in the regulated industries. In contrast, Schmalansee and Stavins point out that positive net employment effects are possible in the near term, during a period of sustained unemployment, due to the potential hiring of previously unemployed workers by the regulated industries to help meet new requirements (e.g., to install new equipment) or by the environmental protection sector to produce new abatement capital (Schmalensee and Stavins, 2011). However, it is also theoretically possible to have near-term negative net employment effects. For example, during periods of sustained high unemployment, workers displaced by regulations may require more time to find alternative employment. In the longer term, the net effect on employment is more difficult to predict and will depend on how the related industries respond to regulatory requirements and whether the labor market remains in sustained disequilibrium or returns to full employment. Assessing the net employment impacts when the economy is not at full employment also involves significant methodological challenges. For example, the opportunity cost of labor is more difficult to assess, labor demand caused by an environmental regulation may have positive external effects, and reductions in labor may give rise to negative external effects.

10.1.2 Employment in the Electric Power Industry

According to the U.S. Bureau of Labor Statistics (BLS), in 2011, the electric power generation, transmission and distribution sector (NAICS 2211) employed 398,000 workers (BLS, 2012a). In the overall Electric Power Industry, installation, maintenance, and repair occupations accounted for the largest share of workers (30 percent).[135] These occupation categories include jobs involved in inspection, testing, repairing and maintaining of electrical equipment and/or installation and repair of cables used in electrical power and distribution systems. Other major occupation categories include office and administrative support (17 percent), production occupations (15 percent), architecture and engineering (11 percent), business and financial operations (7 percent) and management (6 percent). The other occupation categories each account for less than 5 percent of employment in the industry (BLS, 2012b).

As shown in *Table 10-1*, employment in the Electric Power Industry as a whole has declined steadily since 1990, at an average annual rate of approximately 2 percent, resulting in an overall decrease of 28 percent. At the same time, electricity generation increased by 36 percent, indicating substantial improvements in labor productivity, which likely underlie, in part, the reduction in employment *despite the substantial growth in the industry's output*. Therefore, while employment in this industry has likely been affected by changes in general economic conditions, technological changes have also been an important contributor, leading to higher factor productivity overall and a reduced need for labor.

135 BLS does not provide specific occupational employment estimates for the electric power generation industry.

Table 10-1: Total Employment and Labor Intensity in the Electric Power Industry

Year	Number of Employees[a]		Electricity Generation[b]		Labor Intensity	
	Number	% Change	TWh	% Change	Employees per TWh	% Change
1990	550,200	NA	3,038	NA	181	NA
1991	544,300	-1.1%	3,074	1.2%	177	-2.2%
1992	536,700	-1.4%	3,084	0.3%	174	-1.7%
1993	523,100	-2.5%	3,197	3.7%	164	-6.0%
1994	504,400	-3.6%	3,248	1.6%	155	-5.1%
1995	486,000	-3.6%	3,353	3.3%	145	-6.7%
1996	464,200	-4.5%	3,444	2.7%	135	-7.0%
1997	449,200	-3.2%	3,492	1.4%	129	-4.6%
1998	443,800	-1.2%	3,620	3.7%	123	-4.7%
1999	438,400	-1.2%	3,695	2.1%	119	-3.2%
2000	434,400	-0.9%	3,802	2.9%	114	-3.7%
2001	433,800	-0.1%	3,737	-1.7%	116	1.6%
2002	433,800	0.0%	3,858	3.3%	112	-3.2%
2003	417,900	-3.7%	3,883	0.6%	108	-4.3%
2004	408,600	-2.2%	3,971	2.2%	103	-4.4%
2005	401,300	-1.8%	4,055	2.1%	99	-3.8%
2006	396,100	-1.3%	4,065	0.2%	97	-1.5%
2007	397,600	0.4%	4,157	2.3%	96	-1.8%
2008	403,700	1.5%	4,119	-0.9%	98	2.5%
2009	404,100	0.1%	3,950	-4.1%	102	4.4%
2010	398,000	-1.5%	4,125	4.4%	96	-5.7%
Total Percent Change (1990-2010)		**-27.7%**		**35.8%**		**-46.7%**
Total Percent Change (2000-2010)		**-8.4%**		**8.5%**		**-15.6%**
Average Annual Rate of Change (1990-2010)		**-1.6%**		**1.5%**		**-3.1%**

a. Total number of employees reported for NAICS 2211: Electric Power Generation, Transmission and Distribution. Includes full- and part-time, temporary and intermittent employees. Employee counts are not seasonally adjusted.
b. Net electricity generation reported in the 2010 Electric Power Annual report published by the Energy Information Administration.
Sources: U.S. DOE, 2001; U.S. DOE, 2011b; BLS, 2012a

10.1.3 Employment in the Primary Manufacturing Industries

Employment trends varied over the last two decades in the individual industries comprising the Primary Manufacturing Industries. Most industries experienced declines in employment, as did the Primary Manufacturing Industries group overall. Further, as the result of industry restructuring and technological advancements, all six industries became less reliant on labor for their production. While employment in the Primary Manufacturing Industries is likely to continue growth as these industries recover from the recent recession, none of these industries are likely to experience substantial employment growth in the near future.

Aluminum

In 2011, the Aluminum Industry (NAICS 3313) employed approximately 30,000 workers (U.S. Census, 2011x). As shown in *Table 10-2*, employment in this industry as a whole declined steadily since the early 1990s, at an average annual rate of 3 percent, resulting in an overall decrease in employment of 50 percent. During this time, value added also decreased (39 percent), although not as rapidly as employment. The more rapid reduction in employment compared to that in value added results in an overall decline in labor intensity (19 percent). As discussed in more detail in the Aluminum Industry profile (*Appendix A*), during the last two decades, Aluminum industry production fluctuated in response to changes in domestic and foreign demand. During the recent recession, production contracted substantially, with value added decreasing by 54 percent during 2007 through 2009. Employment fell by a smaller amount, 20 percent. However, as the economic recovery began in 2010, value added in the Aluminum Industry increased by 40 percent, but employment increased by less than 1 percent. While the Aluminum Industry is likely to continue to grow, substantial employment growth in this industry is not likely, as technological changes have achieved higher labor productivity. For a detailed discussion of the Aluminum Industry, see *Appendix A*.

Table 10-2: Total Employment and Labor Intensity in the Aluminum Industry

Year	Number of Employees[a]		Value Added[b]		Labor Intensity	
	Number	% Change	Millions; $2011	% Change	Employees per Million; $2011	% Change
1990	57,525	n/a	$9,453	n/a	6.1	n/a
1991	57,627	0.2%	$8,232	-12.9%	7.0	15.0%
1992	57,734	0.2%	$9,238	12.2%	6.2	-10.7%
1993	56,330	-2.4%	$7,724	-16.4%	7.3	16.7%
1994	53,821	-4.5%	$8,787	13.8%	6.1	-16.0%
1995	54,100	0.5%	$10,209	16.2%	5.3	-13.5%
1996	54,257	0.3%	$9,103	-10.8%	6.0	12.5%
1997	50,121	-7.6%	$9,518	4.6%	5.3	-11.7%
1998	49,655	-0.9%	$10,581	11.2%	4.7	-10.9%
1999	48,743	-1.8%	$11,004	4.0%	4.4	-5.6%
2000	46,929	-3.7%	$8,128	-26.1%	5.8	30.3%
2001	43,358	-7.6%	$7,545	-7.2%	5.7	-0.5%
2002	40,085	-7.5%	$7,948	5.3%	5.0	-12.2%
2003	37,301	-6.9%	$7,015	-11.7%	5.3	5.4%
2004	34,549	-7.4%	$7,848	11.9%	4.4	-17.2%
2005	34,835	0.8%	$8,190	4.4%	4.3	-3.4%
2006	34,316	-1.5%	$9,859	20.4%	3.5	-18.2%
2007	35,750	4.2%	$9,003	-8.7%	4.0	14.1%
2008	34,621	-3.2%	$8,086	-10.2%	4.3	7.8%
2009	28,532	-17.6%	$4,138	-48.8%	6.9	61.0%
2010	28,704	0.6%	$5,787	39.9%	5.0	-28.1%
Total Percent Change (1990-2010)		**-50.1%**		**-38.8%**		**-18.5%**
Total Percent Change (2000-2010)		**-38.8%**		**-28.8%**		**-14.1%**
Average Annual Rate of Change (1990-2010)		**-3.4%**		**-2.4%**		**-1.0%**

a. Total number of employees reported for primary (NAICS 331311 & 331312) and secondary (NAICS 331314 & 331315) stages of aluminum production. Includes full- and part-time, temporary and intermittent employees. Employee counts are not seasonally adjusted.
b. Value Added reported in the Economic Census (EC) and Annual Survey of Manufacturers (ASM) published by the U.S. Census Bureau.
Sources: U.S. Census 2010x, U.S Census 2008x, U.S Census 2007x, U.S Census 2002x, U.S Census 1997x, U.S Census 1992x,

Chemicals and Allied Products

In 2011, the Chemicals and Allied Products Industry (NAICS 3313) employed approximately 392,000 workers (U.S. Census, 2011x). As shown in *Table 10-3*, employment in this industry declined since 1990 at an average annual rate of approximately 1 percent, resulting in an overall decline of 24 percent. This decrease in employment can be attributed to cost-reduction measures such as restructuring and downsizing, which have been induced by competitive pressures (see *Appendix B*). Additionally, technology investments and automation increased factor productivity. At the same time, value added increased by 53 percent, leading to a large overall decline in labor intensity (51 percent). Though the industry is hiring additional science personnel as the complexity of work rises, the demand for highly skilled workers is not expected to reverse the loss in chemicals industry employment (C&EN, 2010). For a detailed discussion of the Chemicals and Allied Products Industry, see *Appendix B*.

Table 10-3: Total Employment and Labor Intensity in the Chemicals and Allied Products Industry

Year	Number of Employees[a]		Value Added[b]		Labor Intensity	
	Number	% Change	Millions; $2011	% Change	Employees per Million; $2011	% Change
1990	488,860	n/a	$149,676	n/a	3.3	n/a
1991	478,491	-2.1%	$144,281	-3.6%	3.3	1.5%
1992	470,126	-1.7%	$147,898	2.5%	3.2	-4.2%
1993	462,125	-1.7%	$146,186	-1.2%	3.2	-0.6%
1994	454,225	-1.7%	$155,738	6.5%	2.9	-7.7%
1995	462,111	1.7%	$164,397	5.6%	2.8	-3.6%
1996	452,142	-2.2%	$156,068	-5.1%	2.9	3.1%
1997	437,598	-3.2%	$175,378	12.4%	2.5	-13.9%
1998	444,442	1.6%	$182,834	4.3%	2.4	-2.6%
1999	452,547	1.8%	$176,701	-3.4%	2.6	5.4%
2000	455,163	0.6%	$173,456	-1.8%	2.6	2.5%
2001	448,030	-1.6%	$169,085	-2.5%	2.6	1.0%
2002	459,451	2.5%	$188,198	11.3%	2.4	-7.9%
2003	439,382	-4.4%	$203,568	8.2%	2.2	-11.6%
2004	417,519	-5.0%	$223,228	9.7%	1.9	-13.3%
2005	412,389	-1.2%	$239,864	7.5%	1.7	-8.1%
2006	398,181	-3.4%	$244,969	2.1%	1.6	-5.5%
2007	414,638	4.1%	$242,080	-1.2%	1.7	5.4%
2008	406,068	-2.1%	$231,946	-4.2%	1.8	2.2%
2009	378,691	-6.7%	$210,502	-9.2%	1.8	2.8%
2010	370,102	-2.3%	$229,291	8.9%	1.6	-10.3%
Total Percent Change (1990-2010)		**-24.3%**		**53.2%**		**-50.6%**
Total Percent Change (2000-2010)		**-18.7%**		**32.2%**		**-38.5%**
Average Annual Rate of Change (1990-2010)		**-1.4%**		**2.2%**		**-3.5%**

a. Total number of employees reported for Basic Chemicals (NAICS 3251), Resins and Synthetics (NAICS 3252), Pesticides and Fertilizers (NAICS 3253), and Pharmaceuticals (NAICS 3254). Includes full- and part-time, temporary and intermittent employees. Employee counts are not seasonally adjusted.
b. Value Added reported in the Economic Census (EC) and Annual Survey of Manufacturers (ASM) published by the U.S. Census Bureau.
Sources: U.S. Census 2010x, U.S Census 2008x, U.S Census 2007x, U.S Census 2002x, U.S Census 1997x, U.S Census 1992x,

Food and Kindred Products

The Food and Kindred Products Industry (NAICS 321, 3121) employed approximately 1,485,000 workers in 2011 (U.S. Census, 2011x). As shown in *Table 10-4*, between 1990 and 2010, employment in the Food and Kindred Products Industry increased at an average annual rate of 0.3 percent, resulting in an overall increase of 6 percent. Overall, employment in this industry increased nearly every year during the 1990s but declined during 2000s. This was likely due to heavy investments in technology and increased automation, trends which have allowed companies to rely on fewer employees. A very modest increase in employment during the last two decades coupled with a significant industry growth (51 percent increase in value added) show that the Food and Kindred Products Industry has become significantly less labor intensive (30 percent decline in labor intensity). This trend of increasing labor productivity suggests that the industry is not likely to see significant increases in employment going forward. For a detailed discussion of the Food and Kindred Products Industry, see *Appendix C*.

Table 10-4: Total Employment and Labor Intensity in the Food and Kindred Products Industry

Year	Number of Employees[a]		Value Added[b]		Labor Intensity	
	Number	% Change	Millions; $2011	% Change	Employees per Million; $2011	% Change
1990	1,351,500	n/a	$210,689	n/a	6.4	n/a
1991	1,341,200	-0.8%	$208,726	-0.9%	6.4	0.2%
1992	1,382,500	3.1%	$222,453	6.6%	6.2	-3.3%
1993	1,395,800	1.0%	$228,810	2.9%	6.1	-1.8%
1994	1,391,400	-0.3%	$232,043	1.4%	6.0	-1.7%
1995	1,400,300	0.6%	$239,887	3.4%	5.8	-2.7%
1996	1,386,800	-1.0%	$232,425	-3.1%	6.0	2.2%
1997	1,565,470	12.9%	$257,439	10.8%	6.1	1.9%
1998	1,565,407	0.0%	$267,945	4.1%	5.8	-3.9%
1999	1,573,693	0.5%	$268,570	0.2%	5.9	0.3%
2000	1,599,585	1.6%	$272,466	1.5%	5.9	0.2%
2001	1,595,160	-0.3%	$278,815	2.3%	5.7	-2.5%
2002	1,582,065	-0.8%	$286,526	2.8%	5.5	-3.5%
2003	1,538,062	-2.8%	$300,329	4.8%	5.1	-7.2%
2004	1,514,620	-1.5%	$308,113	2.6%	4.9	-4.0%
2005	1,508,006	-0.4%	$314,092	1.9%	4.8	-2.3%
2006	1,487,276	-1.4%	$301,188	-4.1%	4.9	2.9%
2007	1,541,750	3.7%	$303,741	0.8%	5.1	2.8%
2008	1,516,819	-1.6%	$301,812	-0.6%	5.0	-1.0%
2009	1,471,227	-3.0%	$311,893	3.3%	4.7	-6.1%
2010	1,433,907	-2.5%	$317,317	1.7%	4.5	-4.2%
Total Percent Change (1990-2010)		**6.1%**		**50.6%**		**-29.6%**
Total Percent Change (2000-2010)		**-10.4%**		**16.5%**		**-23.0%**
Average Annual Rate of Change (1990-2010)		**0.3%**		**2.1%**		**-1.7%**

a. Total number of employees reported for Food Manufacturing (321) and Beverage Manufacturing (3121). Includes full- and part-time, temporary and intermittent employees. Employee counts are not seasonally adjusted.
b. Value Added reported in the Economic Census (EC) and Annual Survey of Manufacturers (ASM) published by the U.S. Census Bureau.
Sources: U.S. Census 2010x, U.S Census 2008x, U.S Census 2007x, U.S Census 2002x, U.S Census 1997x, U.S Census 1992x,

Paper and Allied Products

The Paper and Allied Products Industry (NAICS 3221) employed approximately 108,000 workers in 2011 (U.S. Census, 2011x). As shown in *Table 10-5*, employment in this industry has declined steadily, by 51 percent overall, since 1990. At the same time, value added fluctuated cyclically with the economy, but declined overall by 18 percent; most of this decline took place during the last decade. As discussed in more detail in the Paper and Allied Products Industry profile, during the last decade, the industry faced increased foreign competition, overcapacity, and difficulty adapting to changing business conditions. Specifically, demand for paper products has weakened as electronic substitution, such as online bill paying, email, internet publications, and electronic readers, has gained popularity.

As shown in *Table 10-5*, the industry‟s labor intensity declined overall by 39 percent since 1990. Going forward, this trend, coupled with weakening demand for paper products, is likely to result in further employment reductions in the Paper and Allied Products Industry, even as this industry continues to recover from recession. For a detailed discussion of the Paper and Allied Products Industry, see *Appendix D*.

Table 10-5: Total Employment and Labor Intensity in the Paper and Allied Products Industry

Year	Number of Employees[a]		Value Added[b]		Labor Intensity	
	Number	% Change	Millions; $2011	% Change	Employees per Million; $2011	% Change
1990	222,267	n/a	$50,899	n/a	4.4	n/a
1991	220,785	-0.7%	$45,433	-10.7%	4.9	11.3%
1992	222,077	0.6%	$44,591	-1.9%	5.0	2.5%
1993	217,353	-2.1%	$41,100	-7.8%	5.3	6.2%
1994	213,815	-1.6%	$43,511	5.9%	4.9	-7.1%
1995	211,179	-1.2%	$61,157	40.6%	3.5	-29.7%
1996	207,835	-1.6%	$48,708	-20.4%	4.3	23.6%
1997	201,540	-3.0%	$47,191	-3.1%	4.3	0.1%
1998	195,053	-3.2%	$48,116	2.0%	4.1	-5.1%
1999	187,519	-3.9%	$48,804	1.4%	3.8	-5.2%
2000	179,280	-4.4%	$52,075	6.7%	3.4	-10.4%
2001	170,661	-4.8%	$46,579	-10.6%	3.7	6.4%
2002	158,857	-6.9%	$47,401	1.8%	3.4	-8.5%
2003	148,092	-6.8%	$43,274	-8.7%	3.4	2.1%
2004	136,646	-7.7%	$43,712	1.0%	3.1	-8.7%
2005	135,590	-0.8%	$43,778	0.2%	3.1	-0.9%
2006	127,931	-5.6%	$45,605	4.2%	2.8	-9.4%
2007	125,483	-1.9%	$43,596	-4.4%	2.9	2.6%
2008	118,512	-5.6%	$42,558	-2.4%	2.8	-3.3%
2009	113,473	-4.3%	$40,911	-3.9%	2.8	-0.4%
2010	110,055	-3.0%	$41,574	1.6%	2.6	-4.6%
Total Percent Change (1990-2010)		**-50.5%**		**-18.3%**		**-39.4%**
Total Percent Change (2000-2010)		**-38.6%**		**-20.2%**		**-23.1%**
Average Annual Rate of Change (1990-2010)		**-3.5%**		**-1.0%**		**-2.5%**

a. Total number of employees reported for Paper Mills (NAICS 322110), Pulp Mills (NAICS 32212), and Paperboard Mills (NAICS 322130). Includes full- and part-time, temporary and intermittent employees. Employee counts are not seasonally adjusted.
b. Value Added reported in the Economic Census (EC) and Annual Survey of Manufacturers (ASM) published by the U.S. Census Bureau.
Sources: U.S. Census 2010x, U.S Census 2008x, U.S Census 2007x, U.S Census 2002x, U.S Census 1997x, U.S Census 1992x,

Petroleum Refining

The Petroleum Refining Industry (NAICS 324110) employed approximately 62,000 workers in 2011 (U.S. Census, 2011x). As shown in *Table 10-6*, overall, during the last two decades, employment in the industry declined by 12 percent, despite a modest increase of 2 percent during 2000s. Further, as discussed in the Petroleum Refining Industry profile (*Appendix E*), during the last two decades, employment in the Petroleum Refining Industry fluctuated due to volatility of crude oil prices and refinery product prices. However, despite these fluctuations, the Petroleum Refining Industry grew substantially since 1990, with value added increasing by 133 percent. Much of the associated decline in labor intensity likely results from increasing mechanization of Petroleum Refineries. If this trend continues, significant employment growth in the Petroleum Refining Industry is not likely even as industry output continues to grow. For a detailed discussion of the Petroleum Refining Industry, see *Appendix E*.

Table 10-6: Total Employment and Labor Intensity in the Petroleum Refining Industry

Year	Number of Employees[a]		Value Added[b]		Labor Intensity	
	Number	% Change	Millions; $2011	% Change	Employees per Million; $2011	% Change
1990	71,900	n/a	$35,801	n/a	2.0	n/a
1991	73,900	2.8%	$29,991	-16.2%	2.5	22.7%
1992	74,800	1.2%	$28,267	-5.7%	2.6	7.4%
1993	73,100	-2.3%	$27,091	-4.2%	2.7	2.0%
1994	72,000	-1.5%	$33,758	24.6%	2.1	-21.0%
1995	70,400	-2.2%	$33,308	-1.3%	2.1	-0.9%
1996	67,200	-4.5%	$35,450	6.4%	1.9	-10.3%
1997	65,448	-2.6%	$41,362	16.7%	1.6	-16.5%
1998	64,920	-0.8%	$31,820	-23.1%	2.0	28.9%
1999	63,619	-2.0%	$41,140	29.3%	1.5	-24.2%
2000	62,118	-2.4%	$46,806	13.8%	1.3	-14.2%
2001	63,258	1.8%	$50,383	7.6%	1.3	-5.4%
2002	62,540	-1.1%	$34,372	-31.8%	1.8	44.9%
2003	60,010	-4.0%	$47,010	36.8%	1.3	-29.8%
2004	60,004	0.0%	$65,627	39.6%	0.9	-28.4%
2005	62,531	4.2%	$118,700	80.9%	0.5	-42.4%
2006	60,855	-2.7%	$122,097	2.9%	0.5	-5.4%
2007	64,839	6.5%	$118,881	-2.6%	0.5	9.4%
2008	66,851	3.1%	$80,536	-32.3%	0.8	52.2%
2009	65,462	-2.1%	$67,918	-15.7%	1.0	16.1%
2010	63,263	-3.4%	$83,267	22.6%	0.8	-21.2%
Total Percent Change (1990-2010)		**-12.0%**		**132.6%**		**-62.2%**
Total Percent Change (2000-2010)		**1.8%**		**77.9%**		**-42.8%**
Average Annual Rate of Change (1990-2010)		**-0.6%**		**4.3%**		**-4.7%**

a. Total number of employees reported for Petroleum Refineries (NAICS 324110). Includes full and part time, temporary and intermittent employees. Employee counts are not seasonally adjusted.
b. Value Added reported in the Economic Census (EC) and Annual Survey of Manufacturers (ASM) published by the U.S. Census Bureau.
Sources: U.S. Census 2010x, U.S Census 2008x, U.S Census 2007x, U.S Census 2002x, U.S Census 1997x, U.S Census 1992x,

Steel

The Steel Industry (NAICS 3311, 3312) employed approximately 142,000 workers in 2011 (U.S. Census, 2011x). As shown in *Table 10-7*, employment in the Steel Industry declined steadily since 1990, declining overall by 47 percent. At the same time, value added grew, however modestly, by 5 percent. As a result, the Steel Industry has become significantly less labor intensive – a reduction of 50 percent since 1990. As discussed in the Steel Industry profile (*Appendix F*), the industry‟s declining labor intensity results from industry consolidation and increased production from minimills, which require less labor than the integrated steel manufacturing process. During the recent recession, Steel Industry production contracted significantly, with value added declining by 65 percent in 2009. However, employment contracted by a smaller amount, 13 percent. As economy began to recover in 2010, Steel Industry production increased by 109 percent while employment remained flat, declining by less than 1 percent. While the Steel Industry is likely to continue to grow in the future, substantial employment growth is not likely as technological changes continue to achieve higher labor productivity. For a detailed discussion of the Steel Industry, see *Appendix F*.

Table 10-7: Total Employment and Labor Intensity in the Steel Industry

Year	Number of Employees[a]		Value Added[b]		Labor Intensity	
	Number	% Change	Millions; $2011	% Change	Employees per Million; $2011	% Change
1990	258,369	n/a	$37,663	n/a	6.9	n/a
1991	245,462	-5.0%	$30,985	-17.7%	7.9	15.5%
1992	238,829	-2.7%	$33,147	7.0%	7.2	-9.0%
1993	229,248	-4.0%	$35,713	7.7%	6.4	-10.9%
1994	226,001	-1.4%	$39,170	9.7%	5.8	-10.1%
1995	224,716	-0.6%	$40,812	4.2%	5.5	-4.6%
1996	220,625	-1.8%	$40,254	-1.4%	5.5	-0.5%
1997	214,075	-3.0%	$43,124	7.1%	5.0	-9.4%
1998	212,875	-0.6%	$41,046	-4.8%	5.2	4.5%
1999	203,664	-4.3%	$36,912	-10.1%	5.5	6.4%
2000	206,332	1.3%	$34,892	-5.5%	5.9	7.2%
2001	188,488	-8.6%	$27,375	-21.5%	6.9	16.4%
2002	173,705	-7.8%	$29,825	9.0%	5.8	-15.4%
2003	160,914	-7.4%	$27,444	-8.0%	5.9	0.7%
2004	154,589	-3.9%	$45,925	67.3%	3.4	-42.6%
2005	145,866	-5.6%	$45,476	-1.0%	3.2	-4.7%
2006	142,721	-2.2%	$45,701	0.5%	3.1	-2.6%
2007	157,027	10.0%	$47,504	3.9%	3.3	5.8%
2008	156,856	-0.1%	$53,783	13.2%	2.9	-11.8%
2009	136,897	-12.7%	$18,950	-64.8%	7.2	147.7%
2010	136,259	-0.5%	$39,522	108.6%	3.4	-52.3%
Total Percent Change (1990-2010)		**-47.3%**		**4.9%**		**-49.7%**
Total Percent Change (2000-2010)		**-34.0%**		**13.3%**		**-41.7%**
Average Annual Rate of Change (1990-2010)		**-3.1%**		**0.2%**		**-3.4%**

a. Total number of employees reported for Iron and Steel Mills and Ferroalloy Manufacturing (NAICS 3311) and Steel Product Manufacturing from Purchased Steel (NAICS 3312). Includes full- and part-time, temporary and intermittent employees. Employee counts are not seasonally adjusted.
b. Value Added reported in the Economic Census (EC) and Annual Survey of Manufacturers (ASM) published by the U.S. Census Bureau.
Sources: U.S. Census 2010x, U.S Census 2008x, U.S Census 2007x, U.S Census 2002x, U.S Census 1997x, U.S Census 1992x,

10.2 Ongoing Employment Effects

This analysis assesses the ongoing employment impacts EPA estimates will occur in the Electric Power Industry, six Primary Manufacturing Industries, and Other Industries, as they adjust to regulatory requirements. This analysis is based on findings from a peer-reviewed study conducted by Morgenstern, Pizer, and Shih, which explores historical relationships between industrial employment and environmental regulations (Morgenstern, et al., 2002).The employment effects analysis presented in this chapter accounts for all compliance costs, regardless of their time, frequency, and duration of incurrence, except for the cost of technology installation downtime.[136] These effects result from meeting compliance requirements on an ongoing basis, with potential increases in the cost of electricity generation or production of other outputs of the affected industries. In the long run, the

[136] EPA could not determine whether the Morgenstern et al. analysis reflects the concept of installation downtime as analyzed by EPA in support of the final rule. For their study, Morgenstern et al. used data collected through the Pollution Abatement Costs and Expenditures (PACE) survey. While the survey asked for technology installation costs, the survey focused on direct outlays as the accounting concept for pollution abatement costs, whereas installation downtime would primarily manifest as lost income. While lost income can be a real cost to businesses, accounting for this loss is less straightforward than reporting the cost of purchasing and installing pollution abatement equipment. Moreover, the PACE Survey instructions do not identify installation downtime as a cost element and provide no guidance for how to estimate this potential cost. Consequently, given the ambiguity of whether the pollution abatement cost data underlying Morgenstern et al. would reflect installation downtime, EPA excluded technology installation downtime from its analysis of the final rule‟s employment effects. For more information on the PACE survey see http://yosemite.epa.gov/ee/epa/eed.nsf/pages/pace2005.html.

confluence of various possible adjustment mechanisms may lead to an overall increase or decrease in employment in directly affected sectors. As discussed in *Section 10.1.1*, adjustments in economy-wide employment will depend on how these sectors adjust to the new regulatory requirements. The ambiguity in the direction of the long-term change in employment in the directly affected sectors is amplified at the economy-wide level when indirect impacts on employment in the environmental protection sector are taken into account. While regulation-induced demand for certain goods and services from the environmental protection sector may represent revenue and employment gains for the sector, they are costs to the regulated industries, thereby making it unclear whether the regulation would result in an overall positive or negative change in employment. Further, it is unclear whether a positive change in the number of people employed represents anything other than workers being diverted from other productive employment as opposed to new additional net employment.

Other potential effects on the overall economic activity and employment beyond the directly affected sectors are also uncertain. For example, in the case of the Electric Power Industry, potential increases in electricity prices caused by regulation can affect household-expenditure profiles and can increase the cost of producing goods and services in industries that consume electricity. Changes in output prices in these downstream-linked industries can lead to further changes in production quantities and employment in those industries, and so on. All of these effects yield a range of employment effects in sectors that are linked directly or indirectly to regulated industries. As the economy changes over time, these relationships are likely to change, perhaps substantially, due both to general technological change and to changes in response to the regulation itself.

Because of the complexity of these interrelated factors, the myriad uncertainties in assessing economy-wide, long-term employment effects of a regulation, and the lack of a robust methodology to account for these factors, EPA focused its analysis on employment changes occurring only in the directly affected sectors. Further, given the different character of potential employment effects associated with ongoing compliance (compared to the relatively more straightforward effects associated with producing and installing compliance equipment), EPA based its methodology on an econometric analysis of industry response to environmental regulations. This analysis accounts for multiple response effects occurring only *within* the Electric Power Industry, the Primary Manufacturing Industries, and Other Industries, and can lead to projected increases or decreases in employment due to regulatory requirements.

10.2.1 Analysis Approach and Data Inputs

As stated above, EPA examined possible ongoing employment effects based on findings from a peer-reviewed study conducted by Morgenstern, Pizer, and Shih. This study explores historical relationships between industrial employment and environmental regulations (Morgenstern, et al., 2002). EPA recently used this study as the basis for estimating employment effects of new regulations affecting the Electric Power Industry.[137]

In their attempts to capture competing forces affecting employment in the regulated industry in the long term, Morgenstern et al. demonstrated that environmental regulations could be understood as requiring regulated firms to add a new output (environmental quality) to their product mixes (Morgenstern, et al., 2002). Although legally compelled to satisfy this new demand, regulated firms must generally pay for production of this additional output with the proceeds of sales of their other (market) products. Satisfying this new demand requires additional inputs, including labor, and may alter the relative proportions of labor and capital used by regulated firms in their production processes. Consequently, Morgenstern et al. decomposed the direct effect of regulation on net employment in the regulated sector into three subcomponents:

[137] For example, EPA used the study to assess the employment effects on the electric power industry of the Final Mercury and Air Toxics Standards (MATS), Cross-State Air Pollution Rule (CSAPR), and Proposed Effluent Guidelines for the Steam Electric Power Generating Category.

- *The Demand Effect*: higher production costs from regulated with the regulation will raise market prices, reducing consumption (and production), thereby reducing demand for labor within the regulated industry. The "extent of this effect depends on the cost increase passed on to consumers as well as the demand elasticity of industry output." (Morgenstern, et al., 2002; p. 416).
- *The Cost Effect*: Assuming that the capital/labor ratio in the production process is held fixed, as "production costs rise, more inputs, including labor, are used to produce the same amount of output," (Morgenstern, et al., 2002; p. 416). For example, to reduce pollutant emissions while holding output levels constant, regulated firms may require additional labor.
- *The Factor-Shift Effect*: Regulated firms" production technologies may be more or less labor intensive after regulated with the regulation (i.e., more/less labor is required relative to capital per dollar of output). "Environmental activities may be more labor intensive than conventional production," meaning that "the amount of labor per dollar of output will rise." However, activities may, instead, be less labor intensive because "cleaner operations could involve automation and less employment, for example." (Morgenstern, et al., 2002; p. 416).

Morgenstern et al. used facility-level U.S Census Bureau data for 1979 through 1991 to estimate the size of each of the three direct employment effect subcomponents, as well as the net effect, for four highly polluting/regulated industries: pulp and paper, plastics, petroleum, and steel. For each of these industries, the study estimated the change in the number of jobs per $1 million (in 1987 dollars) of additional expenditures due to compliance with an environmental regulation.

According to the Morgenstern et al. study results for the four industries, the *demand effect* is expected to have an unambiguously negative effect on employment, the *cost effect* to have an unambiguously positive effect on employment, and the *factor-shift effect* to have an ambiguous effect on employment. Therefore, without more information about the magnitudes of these competing effects, it is not possible to predict the total effect that an environmental regulation will have on overall employment levels in the regulated sector. Overall, however, the Morgenstern et al. results suggest that increased pollution abatement expenditures generally do not cause a significant change in net employment. More specifically, these results indicate that, on average across the four industries studied by Morgenstern et al., each additional $1 million in spending on pollution abatement results in a statistically insignificant net increase of 1.55 jobs (at the 95 percent confidence interval, results range from approximately -2.84 to +5.94 (i.e., 1.55 ± 4.39).[138]

Because Morgenstern et al. coefficients are not available for all industries directly affected by the final rule, EPA"s use of these coefficients for assessing employment effects varies by industry.

Electric Power Industry

The four industries analyzed by Morgenstern et al. do not include the Electric Power Industry. The analyzed industries may differ from the Electric Power Industry in terms of the potential effect of environmental compliance expenditures on employment. Specifically, the control technologies described for this rule likely differ from those in the four industries analyzed by Morgenstern et al.; but it is not possible to assess the magnitude or direction of these differences on employment effects. Consequently, EPA estimated the change in the number of jobs in the Electric Power Industry due to the final rule and other options considered using the *average total* effect coefficient of 1.55 jobs per $1 million ($1987) in spending. For this analysis, EPA estimated average annual costs using the same methodology as that used to estimate social costs discussed in *Chapter 8: Total Social Costs* and restated these costs in 1987 dollars using the Gross Domestic Product (GDP) deflator

[138] These results are similar to Berman and Bui, who find that while air quality regulation in Los Angeles to reduce NOx emissions resulted in large abatement costs, they did not result in substantially reduced employment. "Environmental regulation and labor demand: evidence from the South Coast Air Basin." Journal of Public Economics 79(2): 265-295

index published by the U.S. Bureau of Economic Analysis (BEA). The Agency then multiplied these *average annual costs* by 1.55. EPA also calculated the range in effects based on employment changes estimated at the 95 percent confidence level. The Agency used the same methodology for costs associated with existing and new units.

Primary Manufacturing Industries

Morgenstern et al. estimated coefficients for three of the six Primary Manufacturing Industries: Paper and Allied Products (-1.13 jobs per $1 million ($1987)), Petroleum Refining (2.17 jobs per $1 million ($1987)), and Steel (0.53 jobs per $1 million ($1987)). EPA used these industry-specific coefficients to assess employment effects in these industries. Of these three coefficients, only the one estimated for Petroleum Refining is statistically significant. Because Morgenstern et al. did not estimate coefficients for Aluminum, Chemicals and Allied Products, and Food and Kindred Products Industries, EPA used the same approach as that used for the Electric Power Industry to assess employment effects in these sectors. EPA estimated the change in the number of jobs in these three sectors using the *average total* effect coefficient of 1.55 jobs per $1 million ($1987) in spending.[139] The Agency also calculated the range in effects based on employment changes estimated at the 95 percent confidence level.

Other Industries

For Other Industries, EPA also used the *average total* effect coefficient of 1.55 jobs per $1 million ($1987) in spending and calculated the range in effects based on employment changes estimated at the 95 percent confidence level.[140]

10.2.2 Key Findings for the Final Rule and Other Options Considered

Table 10-8, at the end of this chapter, presents the estimated average annual change in employment in the Electric Power Industry, the Primary Manufacturing Industries, and Other Industries resulting from regulatory requirements for existing units. EPA estimates an overall average annual increase of 204 jobs, with a 95 percent confidence interval ranging from a decrease of 358 jobs to an increase of 765 jobs, for the existing units provision of the final rule. The estimated change in employment varies by industry, with overall average annual increases in all analyzed industries except Paper and Allied Products. EPA estimates that other options considered – Proposal Option 4 and Proposal Option 2 – would result in overall average annual increases of 203 and 1,953 jobs, respectively.

Table 10-9, also at the end of this chapter, presents the estimated average annual change in employment for new units at Electric Generators under each new units option. EPA estimates that the new units provision of the final rule will result in an overall average annual increase of 9 jobs, with a 95 percent confidence interval ranging from a decrease of 16 jobs to an increase of 34 jobs. The Agency also estimates that other new units options considered – Options A, B, and D – would result in overall average annual increases of 80, 31, and 4 jobs, respectively. As shown in *Table 10-10*, EPA estimates that the final rule – including both the existing units and new units provisions – will result in an overall average annual increase of 213 jobs, with a 95 percent confidence interval ranging from a decrease of 374 jobs to an increase of 799 jobs.

As described above, EPA estimated employment changes for the Paper and Allied Products, Petroleum Refining, and Steel sectors using employment effect coefficients that Morgenstern et al. estimated specifically for these

139 This analysis does not account for employment losses associated with potential closures of regulated facilities due to regulatory requirements, as discussed in *Chapter 5: Economic Impact Analysis: Manufacturers*. Such closures, if they occur, could lead to production being made up by other facilities, with potential increases in hiring in those facilities. Accordingly, the analysis presented in this chapter does not duplicate or subsume the estimation of potential employment effects in closing facilities.

140 *Idem*

industries. In contrast, the estimated changes for the Electric Power Industry and the Aluminum, Chemicals and Allied Products, and Food and Kindred Products Industries use the average of estimated employment effects across the four industries covered in Morgenstern et al. As such, the estimates of the employment effect may be more reliable for the Paper and Allied Products, Petroleum Refining, and Steel Industries, than for the Electric Power Industry and the Aluminum, Chemicals and Allied Products, and Food and Kindred Products Industries. However, even for those sectors for which EPA relied on industry-specific coefficients, the estimated employment effects are subject to considerable uncertainty, and whether the actual effects would be within the estimated 95 percent confidence interval is unknown.

Changes in the directly affected industries, as they adapt to the new regulatory requirements, and consequent upstream (e.g., sectors supporting the directly affected industries) and downstream (e.g., electricity consumers and consumers of goods and services produced by the Primary Manufacturing Industries and Other Industries) responses will determine the on-going economy-wide changes in employment. For example, in their attempt to offset increased production costs due to compliance with the final rule, Manufacturers may change their production processes in ways that would reduce their dependence on cooling water, thereby leading to a change in input mix. The change in input mix may result in lower domestic demand for some inputs and higher demand for other inputs, potentially leading to decreased and increased labor demand, respectively, in sectors producing those inputs. These effects due to input substitution are difficult to estimate, particularly without specific information from those industries

Even if regulated facilities are able to reduce the impact of regulatory requirements by changing their production processes in the post-rule environment, production costs may still be higher compared to those before the rule. As a result, regulated facilities may seek to increase their product prices in response to the higher production costs. For example, attempts by Electric Generators to recover increases in electricity generation costs, however small, are likely to result in higher electricity rates. The impact of this increase will vary by region, customer group (e.g., industrial, commercial, transportation, and residential), and by industry, depending on the electricity-use intensity.[141] Further, the extent to which Electric Generators are able to pass their costs to consumers through higher electricity rates, will vary by region. Specifically, Electric Generators operating in regions where electricity prices remain regulated under the traditional cost-of-service rate regulation framework may be able to recover compliance cost-based increases in increased rates.[142] However, cost recovery is less certain for Electric Generators operating in States where electric power generation has been deregulated, and will depend on the competitive circumstances of specifically affected facilities. Because of these and many other interrelated factors not mentioned here, it is difficult to fully assess the upstream and downstream impact of the final rule and the consequent economy-wide changes in employment.

10.2.3 Uncertainties and Limitations

Key uncertainties and limitations to consider for this analysis include:

- This analysis estimates ongoing employment impacts only for the industries that are directly regulated by the final rule and does not include employment effects in the environmental protection economic sector – i.e., the sector comprised of industries supporting the design, construction, and installation of compliance technologies. Employment effects in the industries that design, construct, and install compliance technologies – the environmental protection sector – may be substantial, especially in the near term, as regulated facilities install the equipment needed to comply with the final rule.

141 See *Chapter 7: Electricity Market Analysis* for assessment of the impacts of increased production costs on wholesale electricity prices and *Chapter 4: Economic Impact Analysis – Electric Generators* for analyses of the impacts on retail rates by customer group.

142 However, even for Electric Generators operating under traditional rate regulation, the recovery of cost increases through increased rates is not certain, and will depend on additional factors such as the facility ownership structure and operating model, and the importance and role of market mechanisms in dispatching production of electricity across generating units.

- The analysis also does not account for employment effects in other linked sectors, whether as the suppliers of goods and services to the directly affected sectors or as the purchasers of the outputs of the directly affected sectors. As described in this chapter, as the directly affected sectors respond to the final rule‟s requirements, employment effects are likely in these other linked sectors. Such effects may result from changes in the quantity and mix of production inputs in the directly affected sectors, or from changes in the prices of the outputs of the directly affected sectors, which may in turn induce changes in the input profile and total production quantity of the downstream linked sectors.
- Because Morgenstern et al. did not estimate employment effects for the Electric Power, Aluminum, Chemicals and Allied Products, and Food and Kindred Products Industries and industries included in the Other Industries group, this analysis uses coefficients developed by Morgenstern et al. (2002) for other industries. Consequently, these coefficient estimates do not reflect the specific employment impact in these four regulated sectors due to changes in production costs and prices, output quantity, and/or input factor composition. As a result, it is likely that the employment impacts estimated here will differ, perhaps substantially, from those that would have been estimated using industry-specific coefficients.
- The Morgenstern et al. employment-effect coefficients are based on data for 1979 to 1991. Consequently, these coefficients will not reflect structural, operational, and/or technological changes in the four analyzed industries since that time. If the employment-effect coefficients were estimated using more recent data, the coefficients could be substantially different.
- Finally, the methodology used in Morgenstern et al. assumes that regulations affect facilities in proportion to their total costs. In other words, each additional dollar of regulatory burden affects a facility by an amount equal to that facility„s total costs relative to the aggregate industry costs. By transferring the estimates, EPA assumes a similar distribution of regulatory costs by facility size and that the regulatory burden does not disproportionately fall on smaller or larger facilities.

10.3 Overall Analysis Conclusion

As discussed above, the average industry total effect coefficient used to estimate employment effects for three of six Primary Manufacturing Industries, Electric Power Industry, and Other industries under existing units options, as well as under the new units options (1.55) is statistically insignificant. Further, of the three industry-specific Morgenstern et al. total effect coefficients EPA used in this analysis for Paper and Allied Products, Petroleum Refining, and Steel industries, the total effect coefficient for Petroleum Refining (2.17) is the only coefficient that is statistically significant. However, the estimate for Petroleum Refining industry is only 3.4 percent of the total increase in the number of jobs estimated for the final rule, including existing and new units provisions.

Looking at the coefficients by employment effect factor, the Morgenstern et al. results show that:

- the (positive) *cost effect* is mostly statistically significant,
- the (negative) *demand effect* is insignificant, and
- the (ambiguous) *factor-shift effect* is mostly positive and sometimes significant; the one *factor-shift effect* coefficient that is negative is not statistically significant.

However, the fact that for two of three employment effects accounted by Morgenstern et al. – cost effect and factor-shift effect – the average coefficients estimated by Morgenstern et al. across all four analyzed industries are positive and significant supports the notion that the employment effect of environmental regulations has the potential to be positive. Nevertheless, given that the largest share of the number of jobs gained estimated for the final rule is from use of the statistically insignificant average industry total effect coefficient, while technically accurate, EPA does not have enough confidence in these estimates to rely on them other than to say that the likely employment effects of the final 316(b) rule are not likely to be very substantial.

As discussed throughout this chapter, because of the complexity of numerous interrelated factors, myriad uncertainties, and data constraints, it is difficult to predict how the final rule will affect employment levels, not only in the directly regulated Electric Power Industry, Primary Manufacturing Industries, and Other Industries, but in the entire U.S. economy. EPA does not currently have a robust methodology to fully assess the impact of all possible changes in employment. The analysis of long-term changes in employment levels in the regulated sectors presented here addresses potential employment effects only in the directly affected industries. In contrast, for example, this analysis does not account for employment effects due to increased demand for pollution control equipment that would be produced and installed by other industries.

Employment effects are likely to vary in their magnitude over time and across sectors. Environmental regulations are typically phased in to allow firms time to invest in the necessary technology and process changes to meet the new standards. Noticeable effects of a regulation on employment in the regulated sector typically will not occur until after a regulation takes effect. When a regulation is promulgated, the first response of industry is to order pollution control equipment. As the compliance date of the regulation approaches, the installation of needed pollution control equipment can produce a short-term increase in labor demand for specialized workers within the environmental protection sector, which may or may not include a directly regulated industry sector (Schmalansee and Stavins, 2011). These short-term employment effects essentially occur once as regulated facilities move to comply with the regulation, and are expected to occur to a substantial degree in the industries that produce and install compliance equipment, and are thus largely external to the directly regulated industries. In the short run, spanning the initial technology installation window of 2018 through 2022, the final rule is likely to affect the regulated sectors, construction sector, and other sectors comprising the environmental protection economic sector, based on the type of compliance equipment and services identified in the *Technical Development Document* (*TDD*) (U.S. EPA, 2013x). In aggregate, the environmental protection economic sector is likely to experience a temporary increase in jobs created as more pollution control systems are designed, manufactured, and installed due to the final rule. In addition, because of regional variation in the presence of regulated facilities and supporting industries, and in consumption patterns, it is likely that short- and long-run employment effects will vary across the United States. According to BLS, the current economy-wide unemployment rate (e.g., as of April 2013) is still high, relative to the long-term averages, at 7.5 percent (BLS, 2013). Therefore, it is possible that positive net employment effects in the near term will be due to the potential hiring of idle labor resources by the regulated sectors to plan for and meet new pollution control requirements rather than to workers diverted from other productive employment.

The long-run *economy-wide* regulatory changes in employment, which EPA did not quantify, will depend on how the Electric Power Industry, Primary Manufacturing Industries, and Other Industries will adjust in response to the new regulatory requirements, the indirect upstream and downstream effects of those adjustments on the rest of the economy, as well as the overall state of the economy and labor markets. It is possible that in the long run, as the economy returns to full employment, any changes in employment in the regulated sectors due to the final rule will be offset mostly by employment changes in other sectors. This realization adds further to the uncertainty in estimating employment effects for a substantial number of years into the future.

In the long run, employment effects in the directly affected sectors will depend on a number of economic factors, including changes in labor requirements to operate the infrastructure in general and compliance technology in particular at regulated facilities, the potential to change production processes to become less dependent on cooling water, availability of alternative technologies to meet compliance requirements, and changes in demand for the outputs of the directly affected sectors.

Table 10-8: Ongoing Employment Effects on the Electric Power Industry, Primary Manufacturing Industries, and Other Industries – Existing Units at Existing Facilities (Average Annual Change in the Number of Jobs)[a]

Employment Effect	Total Annual Average Employment Effect (Number of Jobs)	95% Confidence Interval on Total Effect (Number of Jobs)	
		Lower Bound	Upper Bound
Electric Power Industry, Primary Manufacturing Industries, and Other Industries			
Proposal Option 4			
Cost	369	161	577
Factor Shift	385	47	723
Demand	-552	-1,058	-46
Total	**203**	**-356**	**762**
Final Rule – Existing Units			
Cost	398	189	607
Factor Shift	398	58	737
Demand	-593	-1,101	-85
Total	**204**	**-358**	**765**
Proposal Option 2			
Cost	3,204	1,266	5,141
Factor Shift	3,491	340	6,642
Demand	-4,754	-9,491	-18
Total	**1,953**	**-3,274**	**7,180**
Electric Power Industry			
Proposal Option 4			
Cost	286	94	479
Factor Shift	317	4	630
Demand	-421	-892	50
Total	**183**	**-336**	**703**
Final Rule – Existing Units			
Cost	288	94	481
Factor Shift	318	4	633
Demand	-423	-896	50
Total	**184**	**-337**	**706**
Proposal Option 2			
Cost	2,859	937	4,781
Factor Shift	3,167	40	6,293
Demand	-4,206	-8,907	495
Total	**1,831**	**-3,356**	**7,019**
Aluminum Industry			
Proposal Option 4			
Cost	2	0	4
Factor Shift	2	0	5
Demand	-3	-7	1
Total	**1**	**-3**	**6**
Final Rule – Existing Units			
Cost	2	1	4
Factor Shift	2	0	5
Demand	-3	-7	1
Total	**1**	**-3**	**6**
Proposal Option 2			
Cost	4	2	5
Factor Shift	4	1	7
Demand	-5	-9	-1
Total	**2**	**-2**	**7**

Table 10-8: Ongoing Employment Effects on the Electric Power Industry, Primary Manufacturing Industries, and Other Industries – Existing Units at Existing Facilities (Average Annual Change in the Number of Jobs)[a]			
Employment Effect	Total Annual Average Employment Effect (Number of Jobs)	95% Confidence Interval on Total Effect (Number of Jobs)	
		Lower Bound	Upper Bound
Chemicals and Allied Products Industry			
Proposal Option 4			
Cost	22	20	24
Factor Shift	24	22	27
Demand	-32	-36	-28
Total	**14**	**10**	**19**
Final Rule – Existing Units			
Cost	31	29	33
Factor Shift	34	32	37
Demand	-46	-50	-42
Total	**20**	**15**	**24**
Proposal Option 2			
Cost	147	145	148
Factor Shift	162	160	165
Demand	-216	-220	-212
Total	**94**	**90**	**98**
Food and Kindred Products Industry			
Proposal Option 4			
Cost	4	2	5
Factor Shift	4	2	7
Demand	-6	-10	-2
Total	**2**	**-2**	**7**
Final Rule – Existing Units			
Cost	5	3	6
Factor Shift	5	3	8
Demand	-7	-11	-3
Total	**3**	**-1**	**7**
Proposal Option 2			
Cost	18	16	20
Factor Shift	20	17	22
Demand	-26	-30	-22
Total	**11**	**7**	**16**
Paper and Allied Products Industry			
Proposal Option 4			
Cost	17	14	20
Factor Shift	-3	-7	1
Demand	-23	-28	-18
Total	**-9**	**-14**	**-4**
Final Rule – Existing Units			
Cost	32	29	35
Factor Shift	-5	-9	-1
Demand	-43	-48	-38
Total	**-17**	**-22**	**-11**
Proposal Option 2			
Cost	35	32	38
Factor Shift	-6	-10	-2
Demand	-48	-53	-43
Total	**-18**	**-24**	**-13**
Petroleum Refining Industry			
Proposal Option 4			

Table 10-8: Ongoing Employment Effects on the Electric Power Industry, Primary Manufacturing Industries, and Other Industries – Existing Units at Existing Facilities (Average Annual Change in the Number of Jobs)[a]

Employment Effect	Total Annual Average Employment Effect (Number of Jobs)	95% Confidence Interval on Total Effect (Number of Jobs)	
		Lower Bound	Upper Bound
Cost	2	1	2
Factor Shift	5	4	7
Demand	-1	-1	0
Total	**7**	**5**	**8**
Final Rule – Existing Units			
Cost	2	2	3
Factor Shift	6	4	7
Demand	-1	-1	0
Total	**7**	**5**	**9**
Proposal Option 2			
Cost	5	5	6
Factor Shift	14	12	16
Demand	-2	-2	-2
Total	**17**	**15**	**19**
Steel Industry			
Proposal Option 4			
Cost	34	28	39
Factor Shift	32	24	41
Demand	-63	-77	-49
Total	**3**	**-12**	**18**
Final Rule – Existing Units			
Cost	36	31	42
Factor Shift	35	26	43
Demand	-68	-81	-54
Total	**3**	**-12**	**19**
Proposal Option 2			
Cost	132	126	137
Factor Shift	126	117	135
Demand	-245	-259	-231
Total	**13**	**-2**	**28**
Other Industries			
Proposal Option 4			
Cost	2	0	3
Factor Shift	2	-1	5
Demand	-3	-7	1
Total	**1**	**-3**	**6**
Final Rule – Existing Units			
Cost	2	1	4
Factor Shift	2	0	5
Demand	-3	-7	1
Total	**1**	**-3**	**6**
Proposal Option 2			
Cost	4	2	5
Factor Shift	4	2	7
Demand	-6	-10	-2
Total	**2**	**-2**	**7**

a. Numbers may not add up due to rounding.
Source: U.S. EPA Analysis, 2013

Table 10-9: Ongoing Employment Effects on the Electric Power Industry, Primary Manufacturing Industries, and Other Industries – New Units (Average Annual Change in the Number of Jobs)[a]

Employment Effect	Total Annual Average Employment Effect (Number of Jobs)	95% Confidence Interval on Total Effect (Number of Jobs)	
		Lower Bound	Upper Bound
Option A			
Cost	125	41	209
Factor Shift	138	2	275
Demand	-184	-389	22
Total	**80**	**-147**	**306**
Option B			
Cost	49	16	81
Factor Shift	54	1	107
Demand	-71	-151	8
Total	**31**	**-57**	**119**
Final Rule – New Units			
Cost	14	5	23
Factor Shift	15	0	30
Demand	-20	-43	2
Total	**9**	**-16**	**34**
Option D			
Cost	6	2	9
Factor Shift	6	0	12
Demand	-8	-17	1
Total	4	-6	14

a. Numbers may not add up due to rounding.
Source: U.S. EPA Analysis, 2013

Table 10-10: Total Ongoing Employment Effects of the Final Rule on the Electric Power Industry, Primary Manufacturing Industries, and Other Industries (Average Annual Change in the Number of Jobs)[a]

Employment Effect	Total Annual Average Employment Effect (Number of Jobs)	95% Confidence Interval on Total Effect (Number of Jobs)	
		Lower Bound	Upper Bound
Final Rule – Existing Units			
Cost	398	189	607
Factor Shift	398	58	737
Demand	-593	-1,101	-85
Total	**204**	**-358**	**765**
Final Rule – New Units			
Cost	14	5	23
Factor Shift	15	0	30
Demand	-20	-43	2
Total	**9**	**-16**	**34**
Final Rule - Total			
Cost	412	194	630
Factor Shift	413	59	767
Demand	-614	-1,144	-83
Total	**213**	**-374**	**799**

a. Numbers may not add up due to rounding.
Source: U.S. EPA Analysis, 2013

11 Impacts on Small Entities – Regulatory Flexibility Act (RFA) Analysis

The Regulatory Flexibility Act (RFA) of 1980, as amended by the Small Business Regulatory Enforcement Fairness Act (SBREFA) of 1996, requires federal agencies to consider the impact of their regulatory proposals on small entities,[143] to analyze alternatives that minimize those impacts, and to make their analyses available for review and comment by the public. The Act is concerned with three types of small entities: small businesses, small nonprofits, and small government jurisdictions.

The RFA describes the analyses and procedures federal agencies must complete for a proposed rule unless the agency certifies that the rule, if promulgated, would not have a significant economic impact on a substantial number of small entities. A statement of factual basis – e.g., addressing the number of small entities affected by the regulatory action, the expected cost impact on these entities, and evaluation of the economic impacts – must support this certification.

In accordance with RFA requirements, EPA assessed the impact of the final rule and found that the regulation would not have a "significant economic impact on a substantial number of small entities" (SISNOSE) and certified to that finding (no-SISNOSE) at the time of the regulatory proposal. To support the analysis and promulgation of the final rule, EPA again assessed whether the final rule and other options EPA considered in development of this rule, would again qualify for certification for a no-SISNOSE finding. This assessment involved the following steps:

- Identifying the domestic parent entities of facilities subject to the final rule (regulated entities and regulated facilities or Electric Generators and Manufacturers).
- Determining which of those domestic parent entities are small entities, based on Small Business Administration (SBA) entity size criteria.
- Assessing the potential impact of the regulatory options on those small entities by comparing the estimated entity-level, annualized compliance cost to entity-level revenue. Small entities with compliance costs estimated to be at least 1 percent or 3 percent of entity-level revenue would potentially incur *significant impacts*.
- Assessing whether those small entities incurring potentially significant impacts represent a *substantial number of small entities* based on (1) the estimated *absolute numbers* of small entities incurring potentially significant impacts according to the two cost impact criteria, and (2) the *percentage of small entities* in the relevant entity categories that EPA estimated would incur these impacts.

EPA conducted this analysis for the existing units provision of the file rule only; therefore, the term *final rule* refers to the existing units provisions only. EPA undertook the assessment of small entity impacts separately for Manufacturers and Electric Generators, using somewhat different population-level estimation methods. The separate analyses reflect the different levels of information available for Manufacturers and Electric Generators from the 316(b) survey. In particular, the 316(b) survey provides facility-level information for essentially the entire universe of Electric Generators. In contrast, the sample of Manufacturers for which the 316(b) survey provides information is much smaller than the regulated universe of manufacturing facilities. As a result, a more precise analysis of potential entity-level impacts is possible for Electric Generators than for Manufacturers, and the different analytic methods reflect this difference.

[143] Section 603(c) of the RFA provides examples of such alternatives as: (1) the establishment of differing compliance or reporting requirements or timetables that take into account the resources available to small entities; (2) the clarification, consolidation, or simplification of compliance and reporting requirements under the rule for such small entities; (3) the use of performance rather than design standards; and (4) an exemption from coverage of the rule, or any part thereof, for such small entities.

This chapter first describes the analytic approach and findings for Electric Generators (*Section 11.1*) and Manufacturers (*Section 11.1*), and then reviews uncertainties and limitations of these analyses (*Section 11.3*).

Overall, the RFA analysis for Electric Generators found that few small entities would potentially incur a significant impact under the final rule and other options considered. For the final rule, EPA estimates that four to seven small entities will incur costs exceeding 1 percent of revenue, while zero to one small entity will incur costs exceeding 3 percent of revenue. The associated percentages of small entities subject to the rule are 18 to 20 percent at the 1 percent of revenue threshold, and zero to 5 percent at the 3 percent of revenue threshold. These findings are the same for Proposal Option 4. EPA estimates higher small entity impacts for the more expensive Proposal Option 2: six to eight small entities would incur costs exceeding 1 percent of revenue, and two to eight small entities incur costs exceeding 3 percent of revenue. The associated percentages of regulated small entities are correspondingly higher at 21 to 30 percent for the 1 percent of revenue threshold, and 10 to 21 percent for the 3 percent of revenue threshold (see *Table 11-1*).

Table 11-1: Summary of Findings of the Small Entity Impact Analysis for the Final Rule and Other Options Considered, by Regulated Industry Segment and Overalla

Regulatory Option and Regulated Industry Segment	Cost Impact Category			
	Cost ≥1% of Revenue		Cost ≥3% of Revenue	
	Number of Small Entities	% of Small Entities[b]	Number of Small Entities[c]	% of Small Entities[b]
Electric Generators				
Proposal Option 4	4 to 7	18% to 20%	0 to 1	0% to 5%
Final Rule	4 to 7	18% to 20%	0 to 1	0% to 5%
Proposal Option 2	6 to 8	21% to 30%	2 to 8	10% to 21%
Manufacturers[a]				
Proposal Option 4	0	0%	0	0%
Final Rule	3 to 4	8% to 18%	0 to 1	0% to 6%
Proposal Option 2	3 to 4	8% to 18%	0 to 1	0% to 6%
Electric Generators and Manufacturers[a]				
Proposal Option 4	4 to 7	6% to 13%	0 to 1	0% to 3%
Final Rule	7 to 11	11% to 19%	0 to 2	0% to 5%
Proposal Option 2	9 to 12	13% to 24%	2 to 9	3% to 16%

a. Entity counts used in these calculations exclude Manufacturers in Other Industries.
b. Percentage of small entities incurring a cost-to-revenue impact involves range estimates in both the numerator (number of affected entities) and denominator (number of regulated entities).
c. Entities with cost-to-revenue ratios of at least 3 percent are included in the number of entities with cost-to-revenue such ratios of at least 1 percent.
Source: EPA analysis, 2013

The findings for Manufacturers are comparable, with very few small entities estimated to incur a significant impact under the final rule and other options considered. For the final rule, EPA estimates that three to four small parent entities will incur costs exceeding 1 percent of revenue, and zero to one small parent entity will incur costs exceeding 3 percent of revenue. The associated percentages of small entities subject to the final rule are 8 percent to 18 percent at the 1 percent threshold, and zero percent to 6 percent at the 3 percent threshold. These findings are the same for Proposal Option 2. Proposal Option 4, which imposes technology requirements on a smaller subset of facilities, would have a smaller impact on small entities. Under this option, no parent entity would incur costs exceeding 1 percent, and no parent entities would incur costs exceeding 3 percent of revenue (see *Table 11-1*).

Combining the Electric Generators and Manufacturers segments, EPA estimates for the final rule that seven to 11 small entities will incur costs exceeding 1 percent of revenue, while zero to two small entities incur costs exceeding 3 percent of revenue. The corresponding percentages of small entities are 11 to 19 percent at the 1 percent threshold, and zero to 5 percent at the 3 percent threshold. For Proposal Option 4, EPA estimates that four to seven small entities would incur costs exceeding 1 percent of revenue (6 to 13 percent of small entities), and zero to one small entity would incur costs exceeding 1 percent of revenue (zero to 3 percent of small entities). For

Proposal Option 2, nine to 12 small entities would incur costs exceeding the 1 percent threshold (13 to 24 percent small entities), and two to nine small entities would incur costs exceeding the 3 percent threshold (3 to 16 percent of small entities) (see *Table 11-1*).

In summary, under the final rule, EPA estimates that a small number of small parent entities will incur a potentially significant cost impact in the individual regulated industry segments, and overall, for both segments. The maximum number of small entities estimated to incur costs exceeding 1 percent is 11, overall, with seven of these small entities in the Electric Generators segment and four in the Manufacturers segment. The maximum number of small entities with costs estimated to exceed 3 percent is two, overall, with one small entity in each of the Electric Generators and Manufacturers segments. In each case, the *maximum* value reflects the high end of an uncertainty range that is based on different sample weighting approaches. Values in the interior of these ranges may represent more reasonable estimates of the number of small entities incurring significant impacts.

The estimated numbers of entities with significant impacts also represent small percentages of the estimated number of small entities, overall, and in the individual segments. The *maximum* percentage values at the 1 percent of revenue threshold are 19 percent, overall, 20 percent for Electric Generators, and 18 percent for Manufacturers. At the 3 percent threshold, the maximum percentage values are 5 percent, overall, 5 percent for Electric Generators, and 6 percent for Manufacturers. Again, these values reflect the high end of an uncertainty range.

In all instances, the absolute numbers of small entities estimated to incur significant impacts – at the 1 or 3 percent of revenue threshold, and by industry segment and overall – are well below EPA‟s guidance value (100 small entities with a significant impact) for identifying whether a regulation would cause a significant impact on a substantial number of small entities. In addition, the estimated maximum values for percentages of small entities incurring a significant impact do not exceed EPA‟s guidance value (20 percent) for potentially finding that a substantial percentage of small entities incur a significant impact.

Given these findings of very small absolute numbers of small entities estimated to incur significant impacts under the final rule, and low percentages of estimated small entities incurring impacts, EPA concluded that the final rule will not have "a significant impact on a substantial number of small entities" (no SISNOSE), overall and by individual industry segment.

11.1 Analysis of Electric Generators

11.1.1 Analysis Approach and Data Inputs

EPA used the following methodology and assumptions in performing the RFA analysis for Electric Generators.

Identifying Entities that Own Regulated Facilities

Consistent with the entity-level cost-to-revenue analysis (*Chapter 4: Economic Impact Analyses- Electric Generators*), EPA conducted the RFA analysis at the highest level of domestic ownership, referred to as the "domestic parent entity." The analysis included only entities with the largest share of ownership (majority owner) in 532 explicitly and implicitly analyzed Electric Generators (see *Appendix H*). As described below, EPA identified the parent entity for both the explicitly and implicitly analyzed facilities. Considering both categories of facilities supports an assessment of entity-level impact that reflects the number of parent entities for not only the explicitly analyzed Electric Generators and associated parent entities, but also for the implicitly analyzed Electric Generators and associated parent entities.

As described for the entity-level cost-to-revenue analysis, EPA identified the majority owner for each explicitly analyzed facility using the 2010 Questionnaire for the Steam Electric Power Generating Effluent Guidelines (SE industry survey), 2009 and 2011 databases published by the Department of Energy‟s (DOE) Energy Information Administration (EIA), and corporate and financial websites.

Determining Whether Entities that Own Regulated Facilities Are Small

EPA determined the size of each parent entity identified in the previous step using the most recent SBA size threshold guidelines available at the time of the analysis.[144] The criteria for entity size determination vary by the organization/operation category of the parent entity, as follows:

- Privately owned entities
  - Include investor-owned utilities, non-utility entities, and entities with a primary business other than electric power generation.
  - For entities with electric power generation as a primary business, small entities are those with total annual electric output less than 4 million MWh.

For entities with a primary business other than electric power generation, the relevant size criterion varies by NAICS sector, and is either revenue or number of employees (*Table 11-2*): [145]

Table 11-2: NAICS Codes and SBA Size Standards for Entities that Own Electric Generators, With a Primary Business Other Than Electric Power Generation

NAICS Code	NAICS Description	SBA Size Standard
212111	Bituminous Coal and Lignite Surface Mining	500 employees
221210	Natural Gas Distribution	500 employees
331110	Iron and Steel Mills and Ferroalloy Manufacturing	1,000 employees
331315	Aluminum Sheet, Plate, and Foil Manufacturing	750 employees
333611	Turbine and Turbine Generator Set Units Manufacturing	1,000 employees
488320	Marine Cargo Handling	$35.5 million in revenue
491110	Postal Service	$7 million in revenue
522110	Commercial Banking	$175 million in assets
523910	Miscellaneous Intermediation	$7 million in revenue
524126	Direct Property and Casualty Insurance Carriers	1,500 employees
525910	Open-End Investment Funds	$7 million in revenue
525990	Other Financial Vehicles	$7 million in revenue
541990	All Other Professional, Scientific, and Technical Services	$14 million in revenue
551112	Offices of Other Holding Companies	$7 million in revenue
562212	Solid Waste Landfill	$35.5 million in revenue
562219	Other Nonhazardous Waste Treatment and Disposal	$35.5 million in revenue
562920	Materials Recovery Facilities	$19 million in revenue
611310	Colleges, Universities, and Professional Schools	$25.5 million in revenue

Source: SBA, 2013

- Publicly owned entities
  - Include federal, State, municipal, and other political subdivision entities.
  - Facilities owned by federal and State governments were considered to be large; facilities owned by municipalities and other political units with population less than 50,000 were considered to be small.
- Rural Electric Cooperatives
  - Small entities are those with total annual electric output less than 4 million MWh.

To determine whether a majority owner is a small entity according to these criteria, EPA compared the value of the relevant size criterion for the majority owner to the relevant SBA entity-size threshold value. EPA used the following data sources and methodology to estimate the value of the relevant size criterion for each parent entity:

- **Electricity output**: EPA used entity-level electricity sales from the SE industry survey, if the SE industry survey reported those values. For entities with values reported for more than one survey year (i.e., 2007,

[144] To conduct this analysis, EPA used SBA size threshold guidelines published in 2013. The 2013 set of small business size guidelines is available online at http://www.sba.gov/sites/default/files/files/size_table_01072013(1).pdf.

[145] Certain regulated facilities are owned by entities whose primary business is not electric power generation.

2008, and/or 2009), EPA used the average of reported values. For entities with values reported for only one survey year, EPA used the reported value. For entities that did not report electricity sales in the SE survey, EPA used electricity sales from corporate/financial websites, if those values were available. To be consistent with data from the SE survey, EPA searched for electricity sales for at least one of the three questionnaire years (i.e., 2007, 2008, and/or 2009) and used the average of these values as the electricity output measure for determining whether an entity would be classified as small. If corporate/financial websites did not report electricity sales, the Agency used the 2007-2011 average of electricity sales values (retail plus wholesale) from the EIA-861 database, or, for facilities not listed in the EIA861 database, the 2007-2011 average net electricity generation values from the EIA-906/920/923 database.

- **Revenue**: EPA used entity-level revenue values from the SE industry survey, if the SE survey reported those values. For entities with values reported for more than one survey year (i.e., 2007, 2008, and/or 2009), EPA used the average of reported values. For entities with values reported for only one survey year, EPA used the reported value. For entities that did not report revenue values in the SE survey, EPA used revenue values from corporate/financial websites, if those values were available. To be consistent with data from the SE industry survey, EPA searched for revenue for at least one of the three survey years (i.e., 2007, 2008, and/or 2009) and used the average of the reported values for determining entity size. If corporate/financial websites did not report revenue values, the Agency used the 2007-2011 average of revenue values from the EIA-861 database.[146] EPA restated entity revenue values in 2011 dollars using the Gross Domestic Product (GDP) deflator index published by the U.S. Bureau of Economic Analysis (BEA).
- **Employment**: EPA used entity-level employment values from the SE industry survey, if the SE survey reported those values. For entities with values reported for more than one survey year (i.e., 2007, 2008, and/or 2009), EPA used the average of reported values. For entities with values reported for only one survey year, EPA used the reported value. For entities with no employment values reported in the SE industry survey, EPA used revenue values from corporate/financial websites.
- **Population**: EPA obtained population data for municipalities and other non-state political subdivisions from the U.S. Census Bureau (estimated population for 2010).

EPA identified as small those parent entities for which the relevant measure is less than the SBA size criterion and included them in the RFA analysis.

Significant Impact Test for Small Entities

To assess the extent of economic/financial impact on small entities for Electric Generators, EPA relied on the "sales test" and used cost-to-revenue thresholds of 1 and 3 percent as markers of potentially significant impacts. The Agency assumed that entities incurring costs below 1 percent of revenue will not face significant economic impacts, while entities with costs of at least 1 percent but less than 3 percent of revenue have a chance of facing significant economic impacts, with entities incurring costs of at least 3 percent of revenue have a higher probability of significant economic impacts.

EPA developed compliance cost and revenue values for small entities using the same methodology as that outlined for the general entity-level cost-to-revenue analysis discussed in *Chapter 4*. In addition, in the same way as described for the general cost-to-revenue analysis in *Chapter 4*, EPA conducted this RFA analysis using two weighting approaches:

- *Using facility-level weights*: For this case, EPA applied facility-level weights to the estimated compliance costs for Electric Generators identified as being owned by a given parent entity.

146 For two entities, EPA used revenue reported for 2010.

- *Using entity-level weights*: For this case, EPA applied entity-level weights to the calculated number of parent entities estimated to incur costs in each cost-to-revenue range.

Consistent with the analysis discussed in *Chapter 4*, EPA assumed that regulated facilities, and consequently, their parent entities, will not be able to pass any of the increase in their production costs to consumers (zero cost pass-through).

11.1.2 Findings for Regulatory Options

As described above, EPA developed estimates of the number of small Electric Generators entities incurring costs in the specified cost-to-revenue impact ranges using two weighting concepts:

- Using *facility-level weights,* EPA estimates that 20 small entities own 39 regulated facilities (*Table 11-3*). This assessment may overstate the number of facilities and compliance costs at the level of any given small parent entity, but will also likely underestimate the number of affected small parent entities.
- Using *entity-level weights*, EPA estimates that 39 small entities own 39 regulated facilities (*Table 11-3*). This calculation may understate the number of facilities and compliance costs at the level of any given small parent entity, but accounts more comprehensively for the number of small entities that own regulated facilities.

Table 11-4 presents findings from the analyses outlined above in terms of numbers of small entities incurring costs exceeding the significant impact thresholds of 1 percent and 3 percent. EPA estimates that under the final rule, between four and seven entities will incur compliance costs exceeding 1 percent of revenue, representing between 20 and 18 percent of all small entities that own regulated facilities. *Using facility-level weights*, these entities include one small cooperative (100 percent of all small cooperatives) and three municipalities (43 percent of all small municipalities), while using entity-level weights, these entities include seven small cooperatives (100 percent of all small cooperatives). Using facility-level weights, EPA estimates that compliance costs will exceed 3 percent of revenue only for one cooperative (5 percent of all small entities that own regulated facilities). *Using entity-level weights*, EPA estimates that no small entity will incur costs exceeding 3 percent of revenue. EPA estimated the same findings for Proposal Option 4.

EPA estimates that Proposal Option 2 would have a larger impact on small entities that own regulated facilities. The Agency estimates that under this option, between six and eight entities would incur compliance costs exceeding 1 percent of revenue, representing 30 percent and 21 percent of all small entities that own regulated facilities, respectively. Further, EPA estimates that compliance costs would exceed 3 percent of revenue for two to eight small entities (10 percent and 21 percent of all small entities that own regulated facilities, respectively).

Given (1) the small absolute number of small entities estimated to incur a potentially significant cost impact *and* (2) the low percentage of small entities that own Electric Generators, EPA concludes that the final rule will not have "a significant impact on a substantial number of small entities" within the Electric Generators industry segment.

Table 11-3: Number of Regulated Facilities and Entities that Own these Facilities by Ownership Type and Size (assuming two alternative weighting cases)[a,b]

Ownership Type	Small Entity Size Standard	Number of Regulated Facilities			Number of Parent Entities					
					Using Facility-Level Weights			Using Entity-Level Weights[c]		
		Total	Small[c]	% Small	Total	Small	% Small	Total	Small	% Small
Cooperative	4,000,000 MWh output	28	3	9.7%	13	1	31.8%	22	7	31.8%
Federal	assumed large	14	0	0.0%	1	0	0.0%	1	0	0.0%
Investor-owned	4,000,000 MWh output	384	15	3.8%	57	8	14.3%	63	9	14.3%
Municipality	50,000 population served	31	16	52.1%	15	7	48.6%	37	18	48.6%
Nonutility	4,000,000 MWh output	70	6	7.9%	23	4	18.5%	27	5	18.5%
Other Political Subdivision	50,000 population served	10	0	0.0%	4	0	16.7%	6	0	0.0%
State	assumed large	7	0	0.0%	3	0	0.0%	3	0	0.0%
Total		**544**	**39**	**7.1%**	**116**	**20**	**25.2%**	**159**	**39**	**24.5%**

a. For details on weighting cases and facility and entity counts, see *Appendix H.*
b. Ten explicitly and implicitly analyzed facilities are owned by a joint venture of two entities with equal ownership shares.
c. There are a total of 40 small parent entities on an unweighted basis, one of which is another political subdivision entity. This entity owns only implicitly analyzed facilities; consequently, there is no explicitly analyzed entity in the other political subdivision ownership category to represent this implicitly analyzed parent entity. As the result, weighted entity counts do not include one small other political subdivision entity.
d. EPA was unable to determine the size of two parent entities and assumed that these entities are small.
Source: U.S. EPA Analysis, 2013

Table 11-4: Estimated Cost-to-Revenue Impact on Small Entities that Own Electric Generators, by Ownership Type[a,b]

Parent Entity Type[b]	Using Facility-Level Weights				Using Entity-Level Weights			
	Cost ≥1% of Revenue		Cost ≥ 3% of Revenue		Cost ≥1% of Revenue		Cost ≥ 3% of Revenue	
	Number of Small Entities	% of Small Entities	Number of Small Entities	% of Small Entities	Number of Small Entities	% of Small Entities	Number of Small Entities	% of Small Entities
Proposal Option 4								
Rural Electric Cooperative	1	100.0%	1	100.0%	7	100.0%	0	0.0%
Investor-Owned Utility	0	0.0%	0	0.0%	0	0.0%	0	0.0%
Municipality	3	42.9%	0	0.0%	0	0.0%	0	0.0%
Nonutility	0	0.0%	0	0.0%	0	0.0%	0	0.0%
Other Political Subdivision	0	NA	0	NA	0	NA	0	NA
Total	**4**	**20.0%**	**1**	**5.0%**	**7**	**17.9%**	**0**	**0.0%**
Final Rule								
Rural Electric Cooperative	1	100.0%	1	100.0%	7	100.0%	0	0.0%
Investor-Owned Utility	0	0.0%	0	0.0%	0	0.0%	0	0.0%
Municipality	3	42.9%	0	0.0%	0	0.0%	0	0.0%
Nonutility	0	0.0%	0	0.0%	0	0.0%	0	0.0%
Other Political Subdivision	0	NA	0	NA	0	NA	0	NA
Total	**4**	**20.0%**	**1**	**5.0%**	**7**	**17.9%**	**0**	**0.0%**
Proposal Option 2								
Rural Electric Cooperative	1	100.0%	1	100.0%	7	100.0%	7	100.0%
Investor-Owned Utility	1	12.5%	0	0.0%	0	0.0%	0	0.0%
Municipality	3	42.9%	0	0.0%	0	0.0%	0	0.0%
Nonutility	1	25.0%	1	25.0%	1	25.0%	1	25.0%
Other Political Subdivision	0	NA	0	NA	0	NA	0	NA
Total	**6**	**30.0%**	**2**	**10.0%**	**8**	**21.2%**	**8**	**21.2%**

a. Entities with cost-to-revenue ratios of at least 3 percent are included in the number of entities with cost-to-revenue such ratios of at least 1 percent.
b. EPA was not able to obtain revenue and therefore was not able to calculate cost-to-revenue ratio for two small entities.
Source: U.S. EPA Analysis, 2013

11.2 Analysis of Manufacturers

11.2.1 Analysis Approach and Data Inputs

EPA determined whether entities that own Manufacturers are small according to the SBA entity size criteria, in two steps:

- Identify the domestic parent entity of the sample Manufacturers, *and*
- Determine the size of entities that own the sample Manufacturers (for details on sample Manufacturers, see *Appendix H*).

Identification of Domestic Parent Entities

Consistent with the entity-level, cost-to-revenue analysis (*Chapter 5: Economic Impact Analyses - Manufacturers*), EPA conducted the RFA analysis at the highest level of domestic ownership, referred to as the "domestic parent entity." EPA included only entities with the largest share of ownership (majority owner)[147] as reported in the 316(b) survey. As was done for the entity-level cost-to-revenue analysis, EPA used information reported in the 316(b) survey, if available, to identify and characterize the parent entity in terms of information (business sector, revenue and employment) that is relevant for the small entity size determination. In instances where the survey did not provide a response, EPA searched corporate websites and annual reports, and Dun & Bradstreet data (D&B, 2009) to obtain information on parent entity North American Industry Classification System (NAICS) code, revenues, and employment. If parent revenue and/or employment were not available from any of these sources, EPA summed the revenue and/or employment information for all facilities owned by the entity as a lower-bound estimate of these metrics. This backup approach has the potential to understate the size of the parent entity and thus overstate the impact on small entities.

Size Determination of Domestic Parent Entities

EPA identified the size of each entity that owns a sample Manufacturer using the most recent SBA size threshold guidelines at the time of the analysis. These thresholds define the minimum entity-level employment, generation, or revenue size, by industry (by 6-digit NAICS code), below which an entity qualifies as small under SBA guidelines. To determine entity size, EPA used data from the sources listed above.

EPA started with the unique entity-level, 6-digit NAICS codes for entities that own regulated facilities under the regulatory analysis options. [148] *Table 11-5* presents the unique entity-level 6-digit NAICS codes and corresponding SBA size standards used to determine the size of entities that own Manufacturers.

147 Throughout the analyses, EPA refers to the owner with the largest ownership share as the "majority owner" even when the ownership share is less than 51 percent.

148 Where EPA could not determine the entity-level NAICS code, EPA used the facility-level NAICS code for assigning the entity to a NAICS sector. If neither the entity- nor the facility-level NAICS code could be determined, EPA assumed that the parent entity was small. This assumption may overstate the count of small entities and thus, the impact of the final rule and other options considered in development of this rule on small entities.

Table 11-5: Unique 6-Digit Entity-Level NAICS Codes and SBA Size Standards for Manufacturers

NAICS	NAICS Description	SBA Size Threshold
111930	Sugarcane Farming	$750,000 in Revenue
113110	Timber Tract Operations	$7,000,000 in Revenue
211111	Crude Petroleum and Natural Gas Extraction	500 Employees
212210	Iron Ore Mining	500 Employees
212391	Potash, Soda, and Borate Mineral Mining	500 Employees
221122	Electric Power Distribution	4,000,000 MWh of Electric Generation
311221	Wet Corn Milling	750 Employees
311314	Cane Sugar Manufacturing	750 Employees
311313	Beet Sugar Manufacturing	750 Employees
311942	Spice and Extract Manufacturing	500 Employees
313210	Broadwoven Fabric Mills	1,000 Employees
321113	Sawmills	500 Employees
322121	Paper (except Newsprint) Mills	750 Employees
322122	Newsprint Mills	750 Employees
322130	Paperboard Mills	750 Employees
322211	Corrugated and Solid Fiber Box Manufacturing	500 Employees
322220	Paper Bag and Coated and Treated Paper Manufacturing	500 Employees
322291	Sanitary Paper Product Manufacturing	500 Employees
324110	Petroleum Refineries	1,500 Employees
324191	Petroleum Lubricating Oil and Grease Manufacturing	500 Employees
325120	Industrial Gas Manufacturing	1,000 Employees
325180	Other Basic Inorganic Chemical Manufacturing	1,000 Employees
325199	All Other Basic Organic Chemical Manufacturing	1,000 Employees
325211	Plastics Material and Resin Manufacturing	750 Employees
325311	Nitrogenous Fertilizer Manufacturing	1,000 Employees
325320	Pesticide and Other Agricultural Chemical Manufacturing	500 Employees
325412	Pharmaceutical Preparation Manufacturing	750 Employees
325510	Paint and Coating Manufacturing	500 Employees
325992	Photographic Film, Paper, Plate and Chemical Manufacturing	500 Employees
325998	All Other Miscellaneous Chemical Product and Preparation Manufacturing	500 Employees
331110	Iron and Steel Mills and Ferroalloy Manufacturing	1,000 Employees
331210	Iron and Steel Pipe and Tube Manufacturing from Purchased Steel	1,000 Employees
331221	Rolled Steel Shape Manufacturing	1,000 Employees
331222	Steel Wire Drawing	1,000 Employees
331313	Alumina Refining and Primary Aluminum Production	1,000 Employees
331315	Aluminum Sheet, Plate and Foil Manufacturing	750 Employees
331410	Nonferrous Metal (except Aluminum) Smelting and Refining	1,000 Employees
332312	Fabricated Structural Metal Manufacturing	500 Employees
337910	Mattress Manufacturing	500 Employees
339999	All Other Miscellaneous Manufacturing	500 Employees
423310	Lumber, Plywood, Millwork, and Wood Panel Merchant Wholesalers	100 Employees
423930	Recyclable Material Merchant Wholesalers	100 Employees
424510	Grain and Field Bean Merchant Wholesalers	100 Employees
424690	Other Chemical and Allied Products Merchant Wholesalers	100 Employees
424710	Petroleum Bulk Stations and Terminals	100 Employees
447190	Other Gasoline Stations	$14,000,000 in Revenue
522220	Sales Financing	$7,000,000 in Revenue
523910	Miscellaneous Intermediation	$7,000,000 in Revenue
523930	Investment Advice	$7,000,000 in Revenue
524126	Direct Property and Casualty Insurance Carriers	1,500 Employees
525990	Other Financial Vehicles	$7,000,000 in Revenue
531110	Lessors of Residential Buildings and Dwellings	$25,000,000 in Revenue
551112	Offices of Other Holding Companies	$7,000,000 in Revenue
561110	Office Administrative Services	$7,000,000 in Revenue

Source: SBA, 2013

Similar to the general entity-level cost-to-revenue analysis discussed in *Chapter 5*, EPA estimated the number of small entities that own Manufacturers as a range, based on alternative assumptions about the possible ownership of regulated facilities by small entities:

- *Case 1*: Lower bound estimate of number of entities that own regulated facilities; upper bound estimate of total compliance costs that an entity may incur.
- *Case 2*: Upper bound estimate of number of entities that own regulated facilities; lower bound estimate of total compliance costs that an entity may incur.

The rest of this section presents data organized by the entity‟s industry sector. EPA determined an entity‟s sector based on the sample facilities owned by the entity, and their industry sector(s). If all of the sampled facilities owned by the entity are in the same industry sector, then EPA assigned that industry sector to the entity. However, if the sample facilities owned by the entity are in more than one industry sector, then EPA assigned the entity to the "Multiple Industries" entity sector. In this analysis, EPA found that two known facilities in the Other Industries group were owned by entities that also own facilities in the Primary Manufacturing Industries. EPA included these entities in the *Multiple Industries* sector.

Table 11-6 reports the total number of entities that own regulated facilities and the number and percentage of those entities EPA determined to be small, based on these alternative analytic cases.

Table 11-6: Number of Entities by Sector and Size (under alternative ownership cases) [a,b,c]

Industry Sector	Case 1: Lower bound estimate of number of entities that own regulated facilities			Case 2: Upper bound estimate of number of entities that own regulated facilities		
	Total Number of Entities	Number of Small Entities	Percentage of Entities that are Small	Total Number of Entities	Number of Small Entities	Percentage of Entities that are Small
Aluminum	4	2	50.0%	11	4	40.6%
Chemicals and Allied Products	30	5	16.7%	121	21	17.7%
Food and Kindred Products	6	0	0.0%	20	0	0.0%
Paper and Allied Products	37	7	18.9%	104	23	21.8%
Petroleum Refining	16	2	12.5%	25	2	8.4%
Steel	13	1	7.7%	32	2	5.2%
Multiple Industries	4	0	0.0%	14	0	0.0%
Entities that own facilities in Primary Manufacturing Industries	**110**	**17**	**15.5%**	**327**	**52**	**16.0%**

a. For details on weighting cases and facility and entity counts, see *Appendix H*.
b. Excludes entities that own only sample facilities assessed as baseline closures. For details, see *Chapter 5*.
c. Individual numbers may not sum to reported totals due to independent rounding.
d. EPA did not compile comparable information for Other Industries facilities and the entities that own them because it did not have a statistically valid sample of facilities from which to develop such estimates.
Source: U.S. EPA Analysis, 2013

Similar to the RFA analysis conducted for Electric Generators (*Section 11.1*), to assess the economic/financial impact on small entities, EPA compared the annualized, after-tax compliance costs for each identified entity to the entity‟s annual revenue. The Agency identified entities for which annualized compliance costs are at least 1 percent and 3 percent of revenue and evaluated the absolute number and the percentage of entities in each impact category, and by Manufacturing Industry. Consistent with the entity-level cost-to-revenue analysis discussed in *Chapter 5,* the Agency assumed that entities incurring costs below 1 percent of revenue are unlikely to face significant economic impacts. Alternatively, entities with costs of at least 1 percent of revenue have a higher chance of facing significant economic impacts, and entities incurring costs of at least 3 percent of revenue have a still higher likelihood of significant economic impacts.

Chapter 5 provides additional details of how EPA developed these entity-level compliance cost and revenue values.

11.2.2 Findings for Regulatory Options

Table 11-7 presents findings from the analyses outlined above in terms of numbers of small entities incurring costs exceeding the significant impact thresholds of 1 percent and 3 percent:

- Final rule: EPA estimates that three to four small entities that own regulated facilities in the Primary Manufacturing Industries incur costs exceeding 1 percent of revenue threshold (8 to 18 percent of small entities that own regulated facilities); zero to one small entities incur costs exceeding 3 percent of revenue (zero to 6 percent of small entities). The ranges reflect the alternative weighting approaches, Case 1 (lower bound estimate of number of entities that own regulated facilities), and Under Case 2 (upper bound estimate of number of entities that own regulated facilities). For the small entities that own Other Industries facilities, one incurs costs exceeding 1 percent of revenue; none incurs costs exceeding 3 percent of revenue.
- Proposal Option 4: EPA estimates that no small entity would incur costs exceeding 1 percent of revenue or 3 percent of revenue.
- Proposal Option 2: EPA reached the same findings as for the final rule.

Given (1) the small absolute number of small entities estimated to incur a potentially significant cost impact *and* (2) the low percentage of small entities that own Manufacturers, EPA concludes that the final rule will not have "a significant impact on a substantial number of small entities" within the Manufacturers industry segment.

Table 11-7: Estimated Cost-To-Revenue Impact on Small Entities that Own Manufacturers, by Industry [a,b,c]

Industry	Case 1: Lower bound estimate of number of entities that own regulated facilities				Case 2: Upper bound estimate of number of entities that own regulated facilities			
	Cost ≥1% of Revenue		Cost ≥ 3% of Revenue		Cost ≥1% of Revenue		Cost ≥ 3% of Revenue	
	Number of Small Entities	% of Small Entities	Number of Small Entities	% of Small Entities	Number of Small Entities	% of Small Entities	Number of Small Entities	% of Small Entities
Proposal Option 4								
Aluminum	0	0%	0	0%	0	0%	0	0%
Chemicals and Allied Products	0	0%	0	0%	0	0%	0	0%
Food and Kindred Products	0	NA	0	NA	0	NA	0	NA
Paper and Allied Products	0	0%	0	0%	0	0%	0	0%
Petroleum Refining	0	0%	0	0%	0	0%	0	0%
Steel	0	0%	0	0%	0	0%	0	0%
Multiple Industries	0	NA	0	NA	0	NA	0	NA
Entities that own regulated facilities in Primary Manufacturing Industries	**0**	**0%**	**0**	**0%**	**0**	**0%**	**0**	**0%**
Additional entities that own known regulated facilities in Other Industries [d]	1	-	0	-	1	-	0	-
Final Rule								
Aluminum	0	0%	0	0%	0	0%	0	0%
Chemicals and Allied Products	1	20%	1	20%	4	20%	0	0%
Food and Kindred Products	0	NA	0	NA	0	NA	0	NA
Paper and Allied Products	2	29%	0	0%	0	0%	0	0%
Petroleum Refining	0	0%	0	0%	0	0%	0	0%
Steel	0	0%	0	0%	0	0%	0	0%
Multiple Industries	0	NA	0	NA	0	NA	0	NA
Entities that own regulated facilities in Primary Manufacturing Industries	**3**	**18%**	**1**	**6%**	**4**	**8%**	**0**	**0%**
Additional entities that own known regulated facilities in Other Industries [d]	2	-	0	-	2	-	0	-

Table 11-7: Estimated Cost-To-Revenue Impact on Small Entities that Own Manufacturers, by Industry [a,b,c]

	Case 1: Lower bound estimate of number of entities that own regulated facilities				Case 2: Upper bound estimate of number of entities that own regulated facilities			
	Cost ≥1% of Revenue		Cost ≥ 3% of Revenue		Cost ≥1% of Revenue		Cost ≥ 3% of Revenue	
Industry	**Number of Small Entities**	**% of Small Entities**	**Number of Small Entities**	**% of Small Entities**	**Number of Small Entities**	**% of Small Entities**	**Number of Small Entities**	**% of Small Entities**
Proposal Option 2								
Aluminum	0	0%	0	0%	0	0%	0	0%
Chemicals and Allied Products	1	20%	1	20%	4	20%	0	0%
Food and Kindred Products	0	NA	0	NA	0	NA	0	NA
Paper and Allied Products	2	29%	0	0%	0	0%	0	0%
Petroleum Refining	0	0%	0	0%	0	0%	0	0%
Steel	0	0%	0	0%	0	0%	0	0%
Multiple Industries	0	NA	0	NA	0	NA	0	NA
Entities that own regulated facilities in Primary Manufacturing Industries	**3**	**18%**	**1**	**6%**	**4**	**8%**	**0**	**0%**
Additional entities that own known regulated facilities in Other Industries [d]	2	-	0	-	2	-	0	-

a. For details on weighting cases and facility and entity counts, see *Appendix H.*
b. Excludes entities that own only sample facilities assessed as baseline closures.
c. Individual numbers may not sum to reported totals due to independent rounding.
d. EPA reports impact results for small entities owning Other Industries facilities only as the findings from the analysis of those specific facilities for which EPA received survey responses. Because EPA lacks a statistically valid sample of Other Industries facilities, the Agency did not develop population-level estimates of (1) total small entities owning Other Industries facilities, (2) the number of these small entities incurring potentially significant impacts, or (3) the percentage of total regulated small entities that these entities would represent. EPA has no statistically valid basis for developing such estimates.
Sources: U.S. EPA Analysis, 2013

11.3 Uncertainties and Limitations

The RFA analysis for regulated facilities – Electric Generators and Manufacturers – is subject to several uncertainties and limitations, including:

- None of the sample-weighting approaches used for this analysis accounts precisely for the number of parent-entities *and* compliance costs assigned to those entities simultaneously for either Electric Generators or Manufacturers. EPA assesses the values presented in this chapter as reasonable estimates of the numbers of small entities that could incur a significant impact according to the impact concepts.
- To the extent that information reported in the 316(b) survey for Manufacturers and used in this analysis does not reflect 2011 conditions, the number of small parent entities of Manufacturers may be over- or under-stated, and the impact of the final rule and other options considered on parent entities of Manufacturers may be over- or under-estimated.
- The RFA analysis for Electricity Generators relies on facility count-based sample weights to extrapolate costs from the explicitly analyzed facilities to the implicitly analyzed facilities (see *Appendix H*). The use of sample weighting to extend the estimated compliance costs to the implicitly analyzed facilities inherently introduces uncertainty into the analysis. Consequently, the cost estimates generated through applying facility-level weights may over- or under-state the costs that a given parent-entity would incur. This could also be the case with the entity counts in each of the impact magnitude groups (e.g., number of entities with costs exceeding 3 percent of revenue), even if the facility-weights account properly for facility ownership.
- For Electric Generators, the entity-level revenue values from the various data sources (SE industry survey, corporate and financial websites, and EIA databases) are for years ranging from 2007 through 2011. To the extent that the actual 2011 entity revenue values differ, on a constant dollar basis, from the

estimated values, this analysis may over- or under-estimate the impact of the final rule and other options on parent entities of Electric Generators.

- Likewise, for Electric Generators, the entity-level revenue, assets, employment, and electricity sales values for determining entity size, also derive from data for years ranging from 2007 through 2011. To the extent that these historical data-based values would differ from actual 2011 values, the analysis may over- or under-state the number of parent entities that are classified as small.
- As is the case with the general entity-level cost-to-revenue analysis conducted for Electric Generators (*Chapter 4*), the zero cost pass-through assumption used for the RFA analysis is relatively simple and used for analytic convenience. To the extent that some small entities are able to pass at least some compliance costs to consumers through higher electricity prices, this analysis overstates the potential entity-level impact of the final rule and other options considered.

12 Unfunded Mandates Reform Act (UMRA) Analysis

Title II of the Unfunded Mandates Reform Act (UMRA) of 1995, Pub. L. 104-4 requires that federal agencies assess the effects of their regulatory actions on State, local, and Tribal governments, and the private sector. Under UMRA section 202, the promulgating authority – in this case, EPA – generally must prepare a written statement and a cost-benefit analysis, for proposed and final rules with "Federal mandates" that may result in expenditures by State, local, and Tribal governments, in the aggregate, or by the private sector, of $100 million or more in any one year. Before promulgating a regulation for which a written statement is needed, UMRA section 205 generally requires EPA to identify and consider a reasonable number of regulatory alternatives and to adopt the least costly, most cost-effective, or least burdensome alternative that achieves the objectives of the rule. The provisions of section 205 do not apply when they are inconsistent with applicable law. Moreover, section 205 allows EPA to adopt an alternative other than the least costly, most cost-effective, or least burdensome alternative if the Administrator publishes with the rule an explanation of why EPA did not adopt that alternative. Before EPA establishes any regulatory requirements that might significantly or uniquely affect small governments, including Tribal governments, the Agency must have developed a small government agency plan under UMRA section 203. The plan must provide for: (1) notifying potentially affected small governments, (2) enabling officials of affected small governments to have meaningful and timely input in the development of EPA regulatory proposals with significant intergovernmental mandates, and (3) informing, educating, and advising small governments on compliance with regulatory requirements.

Concerning the question of whether the final rule could result in expenditures by State, local, and Tribal governments, or by the private sector, exceeding $100 million in any one year, EPA found the following:

- Electric Generators: EPA estimates that for Electric Generators, the maximum cost to governments (excluding the federal government) in any one year, for compliance with, and administration of, the final rule, is $66.7 million. For the other options EPA considered in development of the final rule, the maximum one-year cost is $66.6 million under Proposal Option 4 and $473.1 million under Proposal Option 2.[149] EPA estimates that the maximum cost to the private sector in any given year for the Electric Generators segment (compliance cost only) is $1.2 billion for the final rule. For other options considered, the maximum one-year cost is $1.2 billion for Proposal Option 4 and $10.6 billion for Proposal Option 2.
- Manufacturers: EPA estimates that for Manufacturers, the maximum cost to governments (excluding the federal government) in any one year, for compliance with, and administration of, the final rule is $1.1 million. For the options considered, the maximum one-year cost is $1.1 million under Proposal Option 4 and $0.9 million under Proposal Option 2. EPA estimates that the maximum cost to the private sector in any one year for the Manufacturers segment (compliance cost only) is $0.4 million for the final rule, and $0.2 billion for Proposal Option 4 and nearly $1.0 billion for Proposal Option 2.

Thus, EPA determined that the final rule contains a federal mandate that may result in expenditures of $100 million or more for State, local, and Tribal governments, in the aggregate, or the private sector in any one year. Accordingly, under UMRA section 202, EPA has prepared a written statement, presented in the preamble to the final rule, that includes (1) a cost-benefit analysis; (2) a summary of State, local, and Tribal input; (3) a discussion related to the least burdensome option requirement; and (3) an analysis of small government burden. This chapter contains additional information to support that statement, including information on compliance and administrative costs, and on impacts to small governments. *Chapter 9* contains information on the cost-benefit analysis, which UMRA provisions also require, and which is summarized in the preamble

[149] Maximum costs are undiscounted costs incurred by the entire universe of regulated facilities in a given year of occurrence, under a given regulatory option.

EPA conducted the UMRA analysis presented in this chapter for the existing units provision of the final rule and other options considered. This analysis generally relies on the analytic conventions described elsewhere in this document. Key considerations for the UMRA analysis include:

- Costs to Manufacturers and Electric Generators to comply with the final rule and other options considered reflect pre-tax cost values.
- Annualized costs are developed from the social cost framework described in *Chapter 8: Total Social Costs*. For this analysis, EPA used annualized 2013 cost values stated in 2011 dollars. All costs reflect weighted values unless otherwise noted.
- Unlike the total cost of compliance presented in *Chapter 8*, however, the costs to the private sector reflect the private concept of net downtime, which is the difference between forgone revenue and reduced operating costs. This contrasts with the social cost of downtime, which is calculated as the total increase in variable costs of electricity generation for the entire industry while units are down. Similarly, energy penalty-related costs for Manufacturers reflect private costs, which are based on the cost of generating additional electricity, revenue from lost electricity sales, and/or cost of purchasing electricity to offset energy penalty effects, depending on a facility"s circumstances. These approaches differ from the social cost calculation, in which energy penalty costs are based only on the cost of generating additional electricity.

The remainder of this chapter reports the impact of the final rule and other options considered on government entities (*Section 12.1*), small government entities (*Section 12.2*), and the private sector (*Section 12.3*). The final section of the chapter summarizes overall findings relative to UMRA requirements (*Section 12.4*).

12.1 UMRA: Analysis of Impact on Government Entities

EPA assessed the burden of the final rule and other options considered on State, local, and tribal government entities that own Electric Generators and Manufacturers. The use of the phrase "government entities" in this section does *not* include the federal government, which owns 14 of the 544 Electric Generators (weighted). In evaluating the magnitude of regulatory impact on government entities, EPA considered two burden concepts:

1. Compliance costs incurred by government entities that own regulated facilities. Because no Manufacturers are government-owned, EPA limited this assessment to Electric Generators.
2. Administrative costs incurred to implement the final rule and other options considered. This assessment applies to both Electric Generators and Manufacturers.

As stated above, EPA performed these assessments only for the existing units provision of the final rule and other options considered. Administrative costs to government entities are based on the permit administration costs for facilities that require State review (see *Section 12.1.2*).

See *Chapter 11: Regulatory Flexibility Act (RFA) Analysis* for information on how EPA identified the owner entities, and determined their type and size.

12.1.1 Compliance Costs

Table 12-1 reports the number of State and local government entities that own Electric Generators, and the number of Electric Generators they own. Overall, EPA estimates that 46 State and local government entities own 64 Electric Generators. Municipalities own the majority (80 percent) of the government-owned Electric Generators, followed by State governments (7 percent) and other political subdivisions (13 percent).[150]

[150] Entity counts include parent entities of explicitly and implicitly analyzed Electric Generators, and are not sample-weighted. Facility counts include explicitly and implicitly analyzed Electric Generators, and are not sample-weighted.

Table 12-1: Government-Owned Electric Generators and Their Parent Entities

Entity Type	Parent Entities[a]	Electric Generators[b]
Municipality	37	47
Other Political Subdivision	6	11
State	3	6
Tribal	0	0
Total	**46**	**64**

a. Counts of entities that own explicitly and implicitly analyzed Electric Generators; these counts do not rely on sample weights.
b. Counts of explicitly and implicitly analyzed Electric Generators; these counts do not rely on sample weights.
Source: U.S. EPA analysis, 2013

EPA estimates that in the aggregate, State and local government entities will incur total annualized cost of $10.0 million under the final rule, with an average and maximum of $0.2 million and $1.2 million per facility, respectively. Other political subdivision entities account for the largest share of this cost (52 percent), followed by municipalities (45 percent), and other political subdivisions (3 percent). Overall, EPA estimates an average cost per facility of less than $50,000 for States, $0.1 million for municipalities, and $0.5 million for other political subdivisions. The highest annualized compliance cost incurred by any single government-owned facility is $1.2 million for a facility owned by other political subdivisions, followed by $0.5 million for a municipal facility, and $0.1 million for a State-owned facility (see *Table 12-2*).

Under Proposal Option 4, EPA estimates that government entities would incur total annualized cost of $9.6 million to comply with regulatory requirements, with the largest share of compliance costs borne by other political subdivisions (54 percent), followed by municipalities (44 percent), and State government entities (2 percent). EPA estimates that under Proposal Option 4 average and maximum costs per facility would be approximately the same as those estimated for the final rule.

Under Proposal Option 2, EPA estimates total annualized compliance costs to government entities would be higher than under the final rule or Proposal Option 4, at approximately $120.2 million, with an average cost of $2.5 million per facility. Again, other political subdivisions account for the largest share of total compliance costs (71 percent), followed by municipalities (26 percent), and State entities (3 percent). The highest annualized compliance cost to any government-owned facility would be $17.4 million, incurred by a facility owned by other political subdivisions.

Table 12-2: Compliance Costs to Government Entities that Own Electric Generators (Millions; $2011)

Ownership Type	Number of Regulated Facilities (weighted)[a]	Total Weighted, Annualized Pre-tax Compliance Cost	Average Annualized Compliance Cost per Facility[b]	Maximum Annualized Compliance Cost per Facility[c]
Proposal Option 4				
Municipality	31	$4.2	$0.1	$0.5
State	7	$0.2	$0.0	$0.0
Other Political Subdivision	10	$5.2	$0.5	$1.2
All Facilities	**48**	**$9.6**	**$0.2**	**$1.2**
Final Rule				
Municipality	31	$4.5	$0.1	$0.5
State	7	$0.3	$0.0	$0.1
Other Political Subdivision	10	$5.2	$0.5	$1.2
All Facilities	**48**	**$10.0**	**$0.2**	**$1.2**
Proposal Option 2				
Municipality	31	$30.9	$1.0	$4.8
State	7	$4.0	$0.5	$1.7
Other Political Subdivision	10	$85.3	$8.8	$17.4
All Facilities	**48**	**$120.2**	**$2.5**	**$17.4**

a. Because *Table 12-2* reports sample-weighted cost estimates, facility counts in this table also reflect sample weighting and differ from the values reported in *Table 12-1* and *Table 12-4*, which are un-weighted values. See *Appendix H: Sample Weights* for discussion of the use of sample weights for estimating costs.
b. EPA calculated average cost per facility using the total number of regulated facilities owned by entities in a given ownership category.
c. Reflects maximum of un-weighted costs to explicitly analyzed facilities only.
d. Costs are less than $50,000.
Source: U.S. EPA analysis, 2013

12.1.2 Administrative Costs

EPA estimates that 46 States and one territory with NPDES permitting authority will incur costs to administer the final rule and options considered.[151] As shown in *Table 12-3*, EPA estimates that State and local government entities will incur annualized costs of $1.0 million to administer the final rule for Electric Generators and Manufacturers; for Proposal Option 4 and Proposal Option 2, government entities would incur $1.0 million and $0.7 million, respectively. Under the final rule and Proposal Option 4, initial permitting activities account for the largest portion of administrative costs, while under Proposal Option 2, annual monitoring, reporting, and recordkeeping activities account for the largest portion of administrative costs.

151 Federal government permitting authorities will also incur costs to administer the final rule. As stated earlier in this chapter, consistent with UMRA analysis requirements, EPA did not account for costs to federal entities in this analysis.

Table 12-3: Annualized Government Administrative Costs to States (Millions; $2011)

Activity	Annualized Cost, Electric Generators	Annualized Cost, Manufacturers	Total Annualized Cost
Proposal Option 4			
Start-Up Activities			$0.0[a]
Initial Permitting Activities	$0.2	$0.2	$0.4
Annual Monitoring, Reporting, and Recordkeeping Activities	$0.3	$0.2	$0.5
Non-Annually Recurring Permitting Activities	$0.0[b]	$0.0[b]	$0.1
Total	**$0.6**	**$0.4**	**$1.0**
Final Rule			
Start-Up Activities			$0.0[a]
Initial Permitting Activities	$0.2	$0.2	$0.4
Annual Monitoring, Reporting, and Recordkeeping Activities	$0.3	$0.2	$0.5
Non-Annually Recurring Permitting Activities	$0.0[b]	$0.0[b]	$0.1
Total	**$0.6**	**$0.4**	**$1.0**
Proposal Option 2			
Start-Up Activities			$0.0[a]
Initial Permitting Activities	$0.0[b]	$0.1	$0.2
Annual Monitoring, Reporting, and Recordkeeping Activities	$0.2	$0.2	$0.4
Non-Annually Recurring Permitting Activities	$0.0[c]	$0.0[b]	$0.0[b]
Total	**$0.2**	**$0.4**	**$0.7**

a. Costs associated with start-up activities are estimated for both Electric Generators and Manufacturers; these costs are less than $20,000.
b. Costs are less than $50,000.
c. Costs are less than $10,000.
Source: U.S. EPA analysis, 2013

12.2 UMRA: Analysis of Impact on Small Governments

As part of the UMRA analysis, EPA also assessed whether the final rule and other options considered would significantly and uniquely affect small governments. Specifically, EPA examined whether the final rule, or the options considered, would affect small governments in a way that is disproportionately burdensome in comparison to the effect on large governments. For this assessment, EPA compared the estimates for small governments of total costs, cost per facility, and average cost per MW, with those values for large governments. EPA also compared the per facility costs incurred for small government-owned facilities with those incurred by non-government-owned facilities. The Agency assessed costs per facility on the basis of both average and maximum annualized cost per facility.

Of 64 government-owned Electric Generators, EPA identified 19 facilities that are owned by 19 small governments. These 19 facilities constitute approximately 30 percent of the total number of government-owned facilities.[152]

[152] Counts exclude federal government entities and regulated facilities they own.

Table 12-4: Government-Owned Electric Generators and their Parent Entities, by Size

Entity Type	Entities[a]			Electric Generators[b]		
	Large	Small	Total	Large	Small	Total
Municipality	19	18	37	29	18	47
Other Political Subdivision	5	1	6	10	1	11
State	3	0	3	6	0	6
Tribal	0	0	0	0	0	0
Total	**27**	**19**	**46**	**45**	**19**	**64**

a. Counts of entities that own explicitly and implicitly analyzed Electric Generators; these are not sample-weighted counts.
b. Counts of explicitly and implicitly analyzed Electric Generators; these are *not* sample-weighted counts. See *Appendix H* for discussion on explicitly and implicitly analyzed facilities and facility sample weights.
Source: U.S. EPA analysis, 2013

As reported in *Table 12-5*, EPA estimates that compliance costs are lower for small government entities in comparison to large government entities or to small private entities in the aggregate and on a per facility basis, regardless of the analyzed option. This finding suggests that the final rule will not, and other options considered would not, uniquely or disproportionately affect small government entities.

For the final rule, EPA estimates that small government entities will incur a total annualized cost of $2.8 million, which is less than the total cost of $7.2 million incurred by large government entities or the total cost of $9.2 million incurred by small private entities. On a per facility basis, EPA estimates that a facility owned by small government entities will on average incur a cost of less than $0.2 million with a maximum of $0.5 million. These costs are less than those estimated for facilities owned by either large government entities (more than $0.2 million per facility with a maximum of $1.2 million) or small private entities ($0.4 million per facility with a maximum of $2.1 million).[153]

EPA"s findings for Proposal Option 4 are very similar to those for the final rule. Again, EPA estimates that the impact of on small government entities would be lower than those on either small large government or small private entities. Under Proposal Option 4, total annualized compliance costs would be $2.6 million for small government entities, compared to $7.0 million for large government entities and $9.1 million for small private entities. On a per facility basis, small government entities would incur on average less than $0.2 million per facility (with a maximum of $0.5 million per facility), compared to more than $0.2 million and $1.2 million per facility estimated for large government and small private entities, respectively (with maximums of $0.4 million and $2.1 million per facility, respectively).

Similar to the final rule and Proposal Option 4, under Proposal Option 2, costs to small government entities would be higher than those estimated for either large government or small private entities. Under Proposal Option 2, total annualized compliance costs would be approximately $2.8 million for small government entities, compared to $117.3 million for large government entities and $69.4 million for small private entities. EPA estimates that on a per facility basis, small government entities would, on average, incur less than $0.2 per facility in compliance costs (with a maximum of $0.5 million) compared to $3.7 million per facility (maximum of $17.4 million) for facilities owned by large government entities, and $3.0 million per facility (maximum of $11.2 million) for facilities owned by small private entities.

153 Excluding federal government entities and regulated facilities they own.

Table 12-5: Compliance Costs to Entities that Own Regulated Electric Generators by Ownership Type and Size (Millions; $2011)

Ownership Type	Entity Size	Number of Facilities (weighted)[a,b]	Total Annualized Pre-Tax Compliance Costs[b]	Average Annualized Pre-tax Compliance Cost per Facility[c]	Maximum Facility Annualized Pre-tax Compliance Cost[d]
Proposal Option 4					
Government (excluding federal)	Small	16	$2.6	$0.2	$0.5
	Large	32	$7.0	$0.2	$1.2
Private[e]	Small	23	$9.1	$0.4	$2.1
	Large	459	$262.7	$0.6	$10.0
All Facilities[f]		**544**	**$295.9**	**$0.5**	**$10.0**
Final Rule					
Government (excluding federal)	Small	16	$2.8	$0.2	$0.5
	Large	32	$7.2	$0.2	$1.2
Private[e]	Small	23	$9.2	$0.4	$2.1
	Large	459	$263.0	$0.6	$10.0
All Facilities[f]		**544**	**$296.7**	**$0.5**	**$10.0**
Proposal Option 2					
Government (excluding federal)	Small	16	$2.8	$0.2	$0.5
	Large	32	$117.3	$3.7	$17.4
Private[e]	Small	23	$69.4	$3.0	$11.2
	Large	459	$3,433.5	$7.5	$62.1
All Facilities[f]		**544**	**$4,051.9**	**$7.5**	**$62.1**

a. Because *Table 12-5* reports cost estimates, which are sample-weighted values, facility counts in this table also reflect sample weighting, and differ from the values reported in *Table 12-1* and *Table 12-4*, which are un-weighted counts. For details on sample weights see *Appendix H*.
b. Ten facilities are owned by a joint venture of two entities with equal ownership shares. For reporting *total* compliance costs to parent entities, EPA assigned 50 percent of facility costs to each entity that owns this facility.
c. EPA calculated average cost per facility using the total number of regulated facilities owned by entities in a given ownership category.
d. Reflects maximum of un-weighted costs to explicitly analyzed facilities only.
e. Facility counts and cost estimates reported for the *private* sector include 28 facilities owned by rural electric cooperatives.
f. Facility counts and cost estimates reported for All Facilities include 14 facilities owned by the federal government and costs estimated for these facilities.
Source: U.S. EPA analysis, 2013

12.3 UMRA: Analysis of Impact on the Private Sector

The final part of the UMRA analysis concerns compliance costs to private entities. EPA estimates total annualized pre-tax compliance costs for private entities that own Electric Generators and Manufacturers to be $354.0 million under the final rule, $330.4 million under Proposal Option 4, and $3.8 billion under Proposal Option 2. EPA estimates that under the final rule, the highest undiscounted pre-tax compliance cost for private entities in any single year will be $1.2 billion in 2020 for Electric Generators and $0.4 billion in 2020 for Manufacturers. EPA estimates maximum values of $1.2 billion in 2021 for Electric Generators and $0.2 billion in 2022 for Manufacturers for Proposal Option 4; for Proposal Option 2 these costs are $10.6 billion in 2023 and $1.0 billion in 2021, respectively.

12.4 UMRA: Analysis Summary

EPA estimates that the final rule and options considered will result in expenditures of at least $100 million for State and local government entities, in the aggregate, or for the private sector in any one year. *Table 12-6* summarizes compliance costs for publicly- and privately-owned entities, and costs to governments (i.e., NPDES permitting authorities) to administer the final rule and other options considered.

Under the final rule, EPA estimates that government entities (excluding federal government) will incur $11.0 million in total annualized costs: $10.0 million in annualized compliance costs for Electric Generators and $0.6 million and $0.4 million in annualized administrative costs for Electric Generators and Manufacturers, respectively. For Electric Generators, the maximum compliance cost to government entities in any one year is

$65.7 million in 2019. The maximum administrative cost in any one year to NPDES authorities is $1.8 million in 2021 for Electric Generators and $1.1 million in 2021 for administering requirements for Manufacturers. EPA estimates that private entities that own Electric Generators and Manufacturers will incur annualized compliance costs of $354.0 million, with a maximum one-year value of $1.2 billion in 2022 for Electric Generators and $0.4 billion in 2020 for Manufacturers.

For Proposal Option 4, EPA estimates that State and local governments would incur $10.6 million in total annualized costs: $9.6 million in annualized compliance costs for Electric Generators and $1.0 million in administrative costs for Electric Generators and Manufacturers. The maximum compliance cost to government entities in any one year is $65.6 million in 2019, while the maximum costs of administering this option for Electric Generators and Manufacturers are $1.8 million in 2021 and $1.1 million in 2021, respectively. EPA estimates total annualized compliance costs of $330.4 million to the private sector, with maximum compliance costs in any one year of $1.2 billion in 2022 for Electric Generators, and $0.2 billion in 2022 for Manufacturers.

For Proposal Option 2, EPA estimates that State and local governments would incur $120.8 million in total annualized costs, of which $120.2 million is the compliance cost for Electric Generators and $0.6 million is the cost of administering this option for Electric Generators and Manufacturers. The maximum compliance cost to government entities in any one year is $472.9 million in 2025, and the maximum costs of administering this option for Electric Generators and Manufacturers are $0.5 million in 2021 and $0.9 million in 2021, respectively. EPA estimates that the private sector would incur total annualized compliance costs of $3.8 billion, with maximum compliance costs in any one year of $10.6 billion in 2023 for Electric Generators, and $1.0 billion in 2021 for Manufacturers .[154]

[154] The timing of maximum cost occurrence depends on: (1) the number of years for installing a given technology and (2) the years in which individual facilities install a technology based on expected timing for renewal of NPDES permits. See *Chapter 3* for more details.

Table 12-6: Summary of UMRA Costs (Millions; $2011) [a,b]

Sector Incurring Costs	Total Annualized Cost			Maximum One-Year Cost		
	Compliance Costs	Government Administrative Costs	Total	Compliance Costs	Government Administrative Costs	Total
Proposal Option 4						
Electric Generators						
Government (excluding federal)	$9.6	$0.6[c]	$10.1	$65.6	$1.8	$66.6
Private	$271.8	N/A	$271.8	$1,203.4	N/A	$1,203.4
Manufacturers						
Government (excluding federal)	$0.0	$0.4	$0.4	$0.0	$1.1	$1.1
Private	$58.6	N/A	$58.6	$231.0	N/A	$231.0
Final Rule						
Electric Generators						
Government (excluding federal) [c]	$10.0	$0.6[c]	$10.6	$65.7	$1.8	$66.7
Private	$272.2	N/A	$272.2	$1,209.6	N/A	$1,209.6
Manufacturers						
Government (excluding federal)	$0.0	$0.4	$0.4	$0.0	$1.1	$1.1
Private	$81.8	N/A	$81.8	$390.1	N/A	$390.1
Proposal Option 2						
Electric Generators						
Government (excluding federal) [c]	$120.2	$0.2[c]	$120.4	$472.9	$0.5	$473.1
Private	$3,502.9	N/A	$3,502.9	$10,587.7	N/A	$10,587.7
Manufacturers						
Government (excluding federal)	$0.0	$0.4	$0.4	$0.0	$0.9	$0.9
Private	$257.3	N/A	$257.3	$984.9	N/A	$984.9

a. Facility counts and cost estimates reported for the *private* sector include 28 facilities owned by rural electric cooperatives.
b. Ten facilities are owned by a joint venture of two entities with equal ownership shares. For reporting *total* compliance costs to parent entities, EPA assigned 50 percent of facility costs to each entity that owns this facility.
c. Costs include less than $20,000 start-up costs to States to administer the final rule and other options considered for Electric Generators and Manufacturers.
Source: U.S. EPA analysis, 2013

13 Other Administrative Requirements

This chapter presents analyses conducted in support of the final rule to address the requirements of Executive Orders and Acts applicable to this regulation. These analyses complement EPA‟s analyses done in accordance with Regulatory Flexibility Act (RFA) and Unfunded Mandates Reform Act (UMRA), which were presented in previous chapters.

13.1 Executive Order 12866: Regulatory Planning and Review and Executive Order 13563: Improving Regulation and Regulatory Review

Under Executive Order 12866 (58 FR 51735, October 4, 1993), EPA must determine whether the regulatory action is "significant" and therefore subject to review by the Office of Management and Budget (OMB) and other requirements of the Executive Order. The order defines a "significant regulatory action" as one that is likely to result in a regulation that may:

- Have an annual effect on the economy of $100 million or more, or adversely affect in a material way the economy, a sector of the economy, productivity, competition, jobs, the environment, public health or safety, or State, local, or Tribal governments or communities; or
- Create a serious inconsistency or otherwise interfere with an action taken or planned by another agency; or
- Materially alter the budgetary impact of entitlements, grants, user fees, or loan programs or the rights and obligations of recipients thereof; or
- Raise novel legal or policy issues arising out of legal mandates, the President‟s priorities, or the principles set forth in the Executive Order.

Executive Order 13563 (76 FR 3821, January 21, 2011) was issued on January 18, 2011. This Executive Order supplements Executive Order 12866 by outlining the President‟s regulatory strategy to support continued economic growth and job creation, while protecting the safety, health, and rights of all Americans. Executive Order 13563 requires considering costs, reducing burdens on businesses and consumers, expanding opportunities for public involvement, designing flexible approaches, ensuring that sound science forms the basis of decisions, and retrospectively reviewing existing regulations.

Pursuant to the terms of Executive Order 12866, EPA determined that the final rule is an "economically significant regulatory action" because it is likely to have an annual effect on the economy of $100 million or more. As such, it is subject to review by the Office of Management and Budget (OMB) under Executive Orders 12866 and 13563. Any changes made in response to OMB suggestions or recommendations will be documented in the docket for this action.

EPA prepared an analysis of the potential benefits and costs associated with this action; this analysis is described in *Chapter 9: Social Costs and Benefits*.

As detailed in earlier chapters of this report, EPA also assessed the impact of the final rule on the wholesale price of electricity (*Chapter 7: Electricity Market Analysis*), retail electricity prices by consumer group (*Chapter 4: Economic Impact Analyses: Electric Generators*), and on employment or labor markets (*Chapter 10: Employment Effects*).

13.2 Executive Order 12898: Federal Actions to Address Environmental Justice in Minority Populations and Low-Income Populations

Executive Order 12898 (59 FR 7629, February 11, 1994) requires that, to the greatest extent practicable and permitted by law, each federal agency must make the achievement of environmental justice part of its mission. E.O. 12898 provides that each federal agency must conduct its programs, policies, and activities that substantially affect human health or the environment in a manner that ensures such programs, policies, and activities do not have the effect of (1) excluding persons (including populations) from participation in, or (2) denying persons (including populations) the benefits of, or (3) subjecting persons (including populations) to discrimination under such programs, policies, and activities because of their race, color, or national origin.

The final rule and other options considered require that the location, design, construction, and capacity of cooling water intake structures (CWIS) at regulated facilities reflect the best technology available for minimizing adverse environmental impact. For several reasons, EPA does not expect that the final rule will have an exclusionary effect, deny persons the benefits of the participation in a program, or subject persons to discrimination because of their race, color, or national origin. In fact, because EPA expects that this rule will help to preserve the health of aquatic ecosystems located in reasonable proximity to regulated facilities, it believes that all populations, including minority and low-income populations, will benefit from improved environmental conditions as a result of this rule.

To meet the objectives of Executive Order 12898, EPA assessed whether the final rule could distribute benefits among population sub-groups in a way that is significantly unfavorable to low income and minority populations. For this analysis, EPA reviewed the profile of populations that would be expected to benefit (the "benefit populations") from reduced IM&E of aquatic organisms as a result of the final rule and other options considered. The analysis considered the benefit populations associated with all 551 regulated facilities – 386 Electric Generators and 165 Manufacturers – that could potentially implement technology improvements as a result of the final rule and other options considered.[155] The majority of these facilities are located inland, and in the eastern half of the United States. For this analysis, EPA defined the benefit population as (1) all individuals who live within a 50-mile radius of the facilities and (2) any additional anglers who live outside of the 50-mile facility buffer and within a 50-mile radius of the reaches nearest to the facilities. Individuals who live within a 50-mile radius of a facility may receive both use (e.g., recreational fishing or wildlife viewing) and non-use benefits from the improved aquatic ecosystem health of the area (e.g., satisfaction from knowing that the overall ecosystem health has improved). Anglers who live within the 50-mile buffer zone are likely to fish the affected water bodies and thus benefit from improved catch rates as a result of the final rule.[156]

For the assessment of the distribution of benefits among population sub-groups, EPA compared on a State-by-State basis, key demographic characteristics of the sub-State populations that are expected to benefit from the final rule with those demographic characteristics at the level of the State. If the demographic profile of the sub-State benefit population was found to be statistically similar to the demographic profile of the State and not exclusionary of minority and low income populations specifically, then the final rule would be assessed as *not* yielding an unfavorable distribution of benefits, from the perspective of the public policy principles of Executive Order 12898.

EPA completed the analysis of the socio-economic characteristics of the populations affected by regulated facilities using the Fish Consumption Pathway (FCP) Module, which reports population estimates by socio-

[155] These are un-weighted explicitly and implicitly analyzed Electric Generators and un-weighted explicitly analyzed Manufacturers with a compliance technology – Cooling Tower and/or IM technology – assigned under the final rule or other options considered; these facility counts exclude baseline closures.

[156] According to the US Fish and Wildlife Service, over 65% of anglers travel less than 50 miles one-way on a typical fishing trip (U.S. DOI, 2006).

economic characteristics (U.S. EPA, 2004c).[157] The two demographic variables of interest for this EJ analysis are those within the FCP Module that best capture the low-income and minority aspects of the populations affected, which are:

- Annual household income: less than $25,000 (low-income) and at least $25,000 (*not* low-income);[158] and
- Race and Ethnicity: white non-Hispanic, white Hispanic, black or African American, Asian or Native Hawaiian or Other Pacific Islander, and American Indian and Alaska Native.

As described above, EPA assumed that the primary groups that benefit from the final rule are (1) all individuals who live within a 50-mile radius of the facilities and (2) any additional anglers who live outside of the 50-mile facility buffer and within a 50-mile radius of the reaches nearest to regulated facilities.[159] To assess whether a lower income or minority group would experience a disproportionately low share of this Rule‟s use and non-use benefits in relation to the general population, the income and race of the affected populations were calculated in the FCP Module and analyzed statistically, using the following procedures:

- The coordinate locations of each of the regulated sample facilities – Existing Generators and Manufacturers – were imported into the FCP Module.
- The FCP module estimated the number of individuals residing within 50 miles of each facility.
- The FCP module calculated the number of additional anglers that fish in the affected reaches but do not live within a 50-mile radius of the facility on the affected reach by estimating the number of anglers within a 50-mile radius of the affected reach and then subtracting the number of anglers within 50 miles of the facility that overlap with the 50-mile radius surrounding the affected reach.
- Areas affected by regulated facilities were spatially defined. They were then superimposed on the FCP Module‟s grid, and cell-level population data from Census 2010 were used to define a demographic profile for the affected populations.
- Once these population estimates were made, the data were exported and examined on a State-by-State basis.
- To assess the presence of Environmental Justice concerns for the final rule and other options considered, EPA compared the composition of the affected populations‟ income and race with the demographic composition of the State population as follows:
    - Calculating a ratio of low- to *not* low-income individuals in the vicinity of regulated facilities and comparing it to the averages within each affected State.
    - Calculating a ratio of minority to white, non-Hispanic individuals in the vicinity of regulated facilities and comparing it to the averages within each affected State.

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157 The FCP Module is part of the Risk-Screening Environmental Indicators (RSEI) Model (U.S. EPA, 2004c).

158 Household data in the FCP Module are available for the following household income categories: less than $10,000; $10,000 to $19,999; $20,000 to $24,999; $25,000 to $29,999; $30,000 to $34,999; $35,000 to $39,999; $40,000 to $49,999; $50,000 to $74,999; $75,000 to $99,999; and more than $100,000. For this analysis as well as previous 316(b) rule analyses, these categories were combined into low- and *not* low-income groups based on the U.S. Department of Health and Human Services‟ poverty guidelines for a family of four living in the contiguous United States or D.C. The current (2013) poverty guideline is $23,550, which falls near the upper end of the $20,000 to $24,999 income range (U.S. HHS, 2013). For the current analysis, EPA used $25,000 as the threshold for separating populations into low- and *not* low-income groups.

159 Users of the resources receive both use and nonuse benefits from the final rule, while non-users of the resource receive only nonuse benefits. Non-users could potentially include all individuals in a given State or other defined benefit region, which could be larger than a State. EPA‟s benefits transfer and stated preference methodologies assign benefits to residents of all States within the affected region. However, EPA notes that the magnitude of nonuse values may be related to the proximity to the affected resource.

- Testing the statistical significance of any *adverse* differences in these observed State-by-State relationships. That is, the differences are only of concern ("adverse") in the context of the Environmental Justice analysis when a calculated ratio for the benefit population is lower than the ratio for the general population. In effect, the analysis uses the observed relationships in individual States as a set of observations for testing the statistical significance of differences across all States.

If the demographic profiles of the benefit populations and general State populations are not statistically different and not exclusionary of low-income and minority populations specifically, then the final rule would be assessed as not yielding an unfavorable distribution of benefits, from the perspective of the public policy principles of Executive Order 12898.

13.2.1 Presence of Low Income Populations in the Benefit Population

Facilities in 48 States are expected to install technologies in response to the rule. *Table 13-1* reports the ratio of low- to *not* low-income individuals for the benefit population and the overall State population, by State. Instances in which the ratio of low- to *not* low-income individuals for the *benefit population* is lower than this ratio for the *overall State population* indicate a lower rate of participation in the final rule"s expected benefits in the low income population group than in the general population.

As reported in *Table 13-1*, following page, the ratio of low income to *not* low-income populations in the benefit populations is lower than the ratio for States" general populations in 23 of the 48 States, but with an average overall difference of 0.00, which indicates an equal rate of participation in the final rule"s expected benefits in the low income population group and the general population. The greatest negative difference, -0.06, occurs in New York, followed by Montana, at -0.05. All other negative differences (21 of the 23 instances of negative difference) are less than 0.03 (as an absolute value). In no State would the low income population be *excluded or denied* participation in the benefits of the final rule – that is, in all States, the ratio is greater than zero for the benefit population. Although the ratio of low income to *not* low-income populations in the benefit populations is lower than the ratio for the general populations in some States, the difference *across States* may not be statistically significant. The following paragraphs review the statistical analysis of these observed relationships.

Table 13-1: Low-Income Population Participation in Final Rule Benefits by State[a]

States	Ratio of Low-Income to *Not* Low-Income Individuals (< $25,000/year) / (>= $25,000/year)		
	Affected by Facilities	**State Total**	**Difference (Affected *minus* State)**
Alabama	0.20	0.21	0.00
Alaska[b]	0.07	0.11	-0.03
Arizona	0.22	0.18	0.04
Arkansas	0.23	0.22	0.01
California	0.15	0.16	-0.01
Colorado	0.19	0.14	0.05
Connecticut	0.16	0.11	0.05
Delaware	0.14	0.13	0.01
Florida	0.16	0.16	0.00
Georgia	0.18	0.19	-0.01
Hawaii[b]	0.10	0.11	-0.01
Illinois	0.15	0.15	0.00
Indiana	0.16	0.16	0.00
Iowa	0.14	0.13	0.01
Kansas	0.15	0.14	0.00
Kentucky	0.18	0.22	-0.03
Louisiana	0.22	0.22	0.00
Maine	0.11	0.15	-0.03
Maryland	0.10	0.10	0.00
Massachusetts	0.12	0.12	0.00
Michigan	0.17	0.17	0.00
Minnesota	0.12	0.12	0.00
Mississippi	0.26	0.27	-0.01
Missouri	0.15	0.16	-0.02
Montana	0.13	0.17	-0.05
Nebraska	0.13	0.14	-0.01
New Hampshire	0.12	0.09	0.03
New Jersey	0.15	0.10	0.04
New Mexico	0.22	0.22	0.00
New York	0.11	0.17	-0.06
North Carolina	0.18	0.19	-0.01
North Dakota	0.14	0.14	0.00
Ohio	0.17	0.17	0.00
Oklahoma	0.19	0.20	-0.01
Oregon	0.15	0.16	-0.02
Pennsylvania	0.13	0.15	-0.01
Rhode Island	0.12	0.14	-0.02
South Carolina	0.19	0.20	-0.01
South Dakota	0.14	0.16	-0.02
Tennessee	0.20	0.20	0.01
Texas	0.18	0.20	-0.02
Utah	0.11	0.12	-0.01
Vermont	0.16	0.13	0.03
Virginia	0.11	0.12	0.00
Washington	0.16	0.14	0.02
West Virginia	0.19	0.22	-0.03
Wisconsin	0.12	0.14	-0.01
Wyoming	0.09	0.11	-0.02
Total	**0.16**	**0.16**	**0.00**
Mean	**0.15**	**0.16**	**0.00**
P-value[c]	**0.33**		

a. The "Affected Population" includes all individuals within 50 miles of a regulated facility and any anglers within 50 miles of the reach nearest to these facilities.
b. Additional angler populations were not counted for Alaska and Hawaii facilities due to lack of RF1 network coverage in those States.
c. A p-value of 0.05 or less would support the hypothesis that the ratio of low-income to high-income individuals in areas affected by facilities is statistically different from the overall low-income to high-income ratios in States with facilities based on a 95% confidence interval.
Source: U.S. EPA Analysis, 2013

To test the statistical significance of these observed State-by-State relationships, EPA compared the ratios of low- to high-income individuals affected by regulated facilities to the ratios of low- to high-income individuals on a State-by-State basis using a one-tail *t*-test. This analysis tests whether the mean of the ratios for the affected populations is lower, in a statistically significant way, than that of the ratios for the States‟ general populations. The analysis is based on the following equation:

$$t = \frac{\overline{X}_a - \overline{X}_s}{\sqrt{\frac{s_a^2}{n_a} + \frac{s_s^2}{n_s}}} \qquad (13\text{-}1)$$

Where:

t	=	t-statistic
$\overline{X}_a$	=	Mean ratio of low-income to other income (i.e., not low-income) individuals within the affected populations sample
$\overline{X}_s$	=	Mean ratio of low-income to other income individuals within the State populations‟ sample
s_a	=	Variance of ratios of low-income to other income individuals within the affected populations sample
s_s	=	Variance of ratios of low-income to other income individuals within the State populations sample
n_a	=	Sample size of affected populations
n_s	=	Sample size of State populations.

From this *t*-test, the ratio of low-income to not low-income individuals in areas affected by regulated facilities is not significantly lower than the overall low-income to high-income ratios based on a p-value, or observed significance level, of 0.33.[160] This finding indicates that lower income populations are not significantly underrepresented in the regulation‟s estimated “benefit population” as compared to the States‟ general populations. The final rule thus does not systematically discriminate against, or exclude or deny participation of, the lower income population group in a way that would be contrary to the intent of E.O. 12898. In particular, EPA observes that the lower income population group is materially present in the benefit population for all States and the amount by which the lower income population group is less present in the overall population is very small. Indeed, in these States, the finding that low income populations are observed to be less present in the potential benefit population, would mean that this population group has systematically incurred less *damage* from the ongoing operation of cooling water intake structures at regulated facilities than the general population of these States. Finally, because *all* regulated facilities are subject to the final rule, there can be no systematic discrimination or exclusion of low income populations from participation in the final rule‟s benefits, based, for example, on selection of only specific facilities to which the final rule would apply.

160 A p-value of 0.05 or less would support the hypothesis that the ratio of low-income to not low-income individuals in areas affected by regulated facilities is significantly different from the overall low-income to high-income ratios in states with regulated facilities based on a 95% confidence interval.

13.2.2 Assessment of Presence of Minority Populations in the Benefit Population

Table 13-2 summarizes the ratio of each minority category to white non-Hispanic individuals affected by the regulated facilities by State. The State with highest ratio of minorities to white, non-Hispanic individuals that are affected by the final rule is Hawaii, with a ratio of 2.98, while North Dakota and South Dakota have the lowest ratio of 0.09.

As reported in *Table 13-2*, minority populations are, on average, more present in the estimated benefit population than in the States‟ general populations. On average, the ratio of minority to white non-Hispanic individuals in the benefit population exceeds the ratio of minority to white non-Hispanic individuals in the general population by 0.03. Thus, on average, minority populations would be expected to participate by a somewhat greater extent than States‟ general populations in the final rule‟s benefits. Of the 48 States with regulated facilities, the difference is negative in 17 States (less presence of minority populations) and is positive in 27 States (greater presence of minority populations). The negative difference exceeds 0.15 (as an absolute value) in four States – Alaska, New Mexico, New York, and Texas.

EPA compared the ratios of minority to white, non-Hispanic individuals in areas affected by regulated facilities versus the ratios of minority to white, non-Hispanic individuals on a State-by-State basis using, again, a one-tail *t*-test. Based on this *t*-test, the ratio of total minority to white non-Hispanic individuals in areas affected by regulated facilities is not significantly lower than the overall total minority to white non-Hispanic ratios in States with regulated facilities based on a p-value of 0.38.[161]

13.2.3 Overall Finding

Based on this comparison of socio-economic characteristics of individuals affected by regulated facilities to the affected States‟ overall populations, neither the low-income population nor minority populations are significantly less present in the estimated benefit population than in the State‟s general populations. As described in the preceding discussion, EPA‟s findings on these questions are slightly stronger for the participation of low income populations in the rule‟s benefits than for minority populations in the rule‟s benefits. However, in both instances, any findings of *lower participation* by the low-income population or minority populations are not statistically significant.

Thus, from this analysis, neither population group participates to a lower extent, in a statistically significant way, in the benefits of the final rule than the general population in States with regulated facilities. EPA judges that the final rule does not systematically discriminate against, or exclude or deny participation of, the lower income population group or minority populations in a way that would be contrary to the intent of E.O. 12898. EPA thus concludes, overall, that the final rule is consistent with the policy intent of E.O. 12898.

161 A p-value of 0.05 or less would support the hypothesis that the ratio of minority to white non-Hispanic individuals in areas affected by regulated facilities is significantly different from the overall minority to white non-Hispanic in States with regulated facilities based on a 95% confidence interval.

Table 13-2: Minority Population Participation in the Final Rule Benefits by State[a]

	Ratio of Racial Categories to White, Non-Hispanic Individuals[b]														
	Affected by Facilities					State Total					Difference (=Affected *minus* State)				
States[c]	White Hispanic	Black	Native American	Asian	All Minorities	White Hispanic	Black	Native American	Asian	All Minorities	White Hispanic	Black	Native American	Asian	All Categories
Alabama	0.05	0.32	0.01	0.02	0.40	0.05	0.39	0.01	0.02	0.47	0.01	-0.07	0.00	0.00	-0.07
Alaska	0.02	0.01	0.12	0.01	0.16	0.06	0.05	0.23	0.10	0.45	-0.04	-0.05	-0.11	-0.09	-0.29
Arizona	0.20	0.02	0.41	0.01	0.65	0.47	0.08	0.09	0.06	0.69	-0.26	-0.05	0.32	-0.04	-0.04
Arkansas	0.08	0.27	0.04	0.02	0.41	0.08	0.21	0.01	0.02	0.32	0.00	0.06	0.03	0.00	0.09
California	0.93	0.21	0.04	0.51	1.69	0.84	0.16	0.04	0.35	1.40	0.09	0.05	0.00	0.16	0.29
Colorado	0.40	0.09	0.04	0.04	0.57	0.26	0.06	0.02	0.04	0.39	0.14	0.03	0.01	-0.01	0.18
Connecticut	0.34	0.36	0.02	0.18	0.89	0.16	0.16	0.01	0.06	0.38	0.18	0.21	0.01	0.12	0.52
Delaware	0.10	0.30	0.01	0.07	0.48	0.10	0.34	0.01	0.05	0.50	0.00	-0.03	0.00	0.02	-0.02
Florida	0.35	0.29	0.01	0.04	0.70	0.36	0.28	0.01	0.05	0.69	0.00	0.01	0.00	0.00	0.01
Georgia	0.14	0.55	0.01	0.06	0.76	0.13	0.55	0.01	0.06	0.76	0.01	-0.01	0.00	0.00	0.00
Hawaii	0.13	0.10	0.02	2.73	2.98	0.13	0.07	0.02	2.20	2.42	0.00	0.03	0.00	0.53	0.56
Illinois	0.19	0.23	0.01	0.06	0.49	0.23	0.23	0.01	0.08	0.55	-0.04	0.00	0.00	-0.01	-0.06
Indiana	0.17	0.21	0.01	0.06	0.45	0.07	0.12	0.00	0.02	0.21	0.11	0.10	0.00	0.04	0.25
Iowa	0.06	0.05	0.01	0.02	0.15	0.05	0.03	0.01	0.02	0.11	0.01	0.02	0.00	0.00	0.03
Kansas	0.08	0.12	0.02	0.03	0.26	0.12	0.08	0.02	0.03	0.25	-0.04	0.05	0.00	0.00	0.01
Kentucky	0.03	0.12	0.00	0.02	0.17	0.03	0.09	0.00	0.01	0.14	0.00	0.02	0.00	0.00	0.03
Louisiana	0.08	0.49	0.01	0.03	0.61	0.06	0.53	0.01	0.03	0.63	0.02	-0.04	0.00	0.00	-0.02
Maine	0.06	0.04	0.01	0.04	0.15	0.01	0.01	0.01	0.01	0.04	0.05	0.03	0.00	0.03	0.11
Maryland	0.16	0.47	0.01	0.13	0.77	0.12	0.55	0.01	0.11	0.78	0.04	-0.07	0.00	0.03	-0.01
Massachusetts	0.10	0.10	0.01	0.06	0.27	0.10	0.10	0.01	0.07	0.28	0.00	0.00	0.00	-0.01	-0.01
Michigan	0.06	0.19	0.01	0.03	0.29	0.05	0.19	0.01	0.03	0.28	0.01	0.00	0.00	0.00	0.01
Minnesota	0.05	0.07	0.01	0.05	0.18	0.05	0.07	0.02	0.05	0.18	0.00	0.00	0.00	0.00	0.00
Mississippi	0.04	0.65	0.01	0.02	0.72	0.04	0.64	0.01	0.02	0.70	0.00	0.01	0.00	0.01	0.02
Missouri	0.05	0.16	0.01	0.03	0.24	0.04	0.15	0.01	0.02	0.21	0.01	0.01	0.00	0.00	0.03
Montana	0.04	0.01	0.06	0.01	0.11	0.03	0.00	0.07	0.01	0.11	0.01	0.00	-0.01	0.00	0.00
Nebraska	0.09	0.06	0.02	0.02	0.19	0.10	0.06	0.02	0.02	0.20	-0.01	0.00	0.00	0.00	-0.01
New Hampshire	0.09	0.09	0.01	0.08	0.27	0.03	0.01	0.00	0.02	0.07	0.06	0.08	0.00	0.06	0.20
New Jersey	0.27	0.36	0.02	0.16	0.81	0.25	0.25	0.01	0.14	0.65	0.01	0.12	0.01	0.02	0.15
New Mexico	0.26	0.01	0.54	0.01	0.82	1.06	0.06	0.25	0.04	1.41	-0.80	-0.05	0.29	-0.03	-0.58
New York	0.14	0.16	0.01	0.10	0.40	0.23	0.30	0.02	0.13	0.68	-0.09	-0.14	-0.01	-0.04	-0.28
North Carolina	0.10	0.32	0.01	0.04	0.47	0.11	0.34	0.02	0.04	0.51	-0.01	-0.02	-0.01	0.00	-0.04
North Dakota	0.02	0.01	0.04	0.01	0.09	0.02	0.01	0.06	0.01	0.11	0.00	0.00	-0.02	0.00	-0.02
Ohio	0.03	0.16	0.00	0.02	0.22	0.03	0.15	0.00	0.02	0.21	0.00	0.00	0.00	0.00	0.01
Oklahoma	0.11	0.12	0.13	0.03	0.39	0.11	0.11	0.13	0.03	0.38	0.00	0.01	0.00	0.00	0.01
Oregon	0.14	0.03	0.02	0.07	0.26	0.13	0.03	0.02	0.05	0.23	0.01	0.01	0.00	0.02	0.03
Pennsylvania	0.07	0.20	0.00	0.05	0.32	0.06	0.14	0.00	0.04	0.24	0.01	0.05	0.00	0.02	0.08
Rhode Island	0.10	0.12	0.01	0.08	0.30	0.13	0.10	0.01	0.04	0.28	-0.03	0.02	0.00	0.04	0.03

Table 13-2: Minority Population Participation in the Final Rule Benefits by State[a]

	Ratio of Racial Categories to White, Non-Hispanic Individuals[b]														
	Affected by Facilities					State Total					Difference (=Affected *minus* State)				
States[c]	White Hispanic	Black	Native American	Asian	All Minorities	White Hispanic	Black	Native American	Asian	All Minorities	White Hispanic	Black	Native American	Asian	All Categories
South Carolina	0.08	0.42	0.02	0.03	0.55	0.07	0.44	0.01	0.02	0.54	0.01	-0.02	0.01	0.01	0.01
South Dakota	0.02	0.00	0.06	0.01	0.09	0.02	0.02	0.11	0.01	0.16	0.00	-0.01	-0.05	-0.01	-0.07
Tennessee	0.06	0.21	0.01	0.02	0.29	0.05	0.22	0.01	0.02	0.30	0.00	-0.01	0.00	0.00	-0.01
Texas	0.59	0.30	0.02	0.09	1.01	0.79	0.27	0.02	0.09	1.17	-0.19	0.03	0.00	0.00	-0.16
Utah	0.16	0.02	0.01	0.05	0.23	0.15	0.02	0.02	0.04	0.22	0.01	0.00	-0.01	0.01	0.02
Vermont	0.11	0.07	0.01	0.03	0.21	0.01	0.01	0.00	0.01	0.04	0.09	0.06	0.00	0.01	0.17
Virginia	0.12	0.42	0.01	0.10	0.66	0.10	0.31	0.01	0.09	0.51	0.02	0.12	0.00	0.01	0.15
Washington	0.18	0.04	0.02	0.07	0.32	0.13	0.05	0.03	0.11	0.32	0.05	-0.02	0.00	-0.04	0.00
West Virginia	0.01	0.07	0.00	0.01	0.10	0.01	0.04	0.00	0.01	0.06	0.00	0.03	0.00	0.00	0.04
Wisconsin	0.08	0.08	0.01	0.04	0.21	0.06	0.08	0.01	0.03	0.18	0.02	0.00	0.00	0.01	0.03
Wyoming	0.10	0.01	0.01	0.01	0.13	0.09	0.01	0.03	0.01	0.14	0.00	0.00	-0.02	0.00	-0.02
Total	**0.20**	**0.23**	**0.01**	**0.08**	**0.53**	**0.23**	**0.20**	**0.02**	**0.08**	**0.53**	**-0.03**	**0.03**	**-0.01**	**0.00**	**0.00**
Mean	**0.14**	**0.18**	**0.04**	**0.11**	**0.48**	**0.15**	**0.17**	**0.03**	**0.10**	**0.45**	**-0.01**	**0.01**	**0.01**	**0.02**	**0.03**
P-values[d]	**0.39**	**0.36**	**0.28**	**0.40**	**0.38**										

a. The "Affected Population" includes all individuals within 50 miles of a regulated facility and any anglers within 50 miles of the reach nearest these facilities.
b. The U.S. Census Bureau (U.S. DOC, 2011) defines ethnic and racial categories as follows: "‟Hispanic or Latino‟ refers to a person of Cuban, Mexican, Puerto Rican, South or Central American, or other Spanish culture or origin regardless of race." "„White‟ refers to a person having origins in any of the original peoples of Europe, the Middle East, or North Africa. It includes people who indicated their race(s) as „White‟ or reported entries such as Irish, German, Italian, Lebanese, Arab, Moroccan, or Caucasian. „Black or African American‟ refers to a person having origins in any of the Black racial groups of Africa. It includes people who indicated their race (s) as „Black, African Am., or Negro,‟ or wrote in entries such as African American, Kenyan, Nigerian, or Haitian. „American Indian and Alaska Native‟ refers to a person having origins in any of the original peoples of North and South America (including Central America), and who maintains tribal affiliation or community attachment. This category includes people who indicated their race (s) as „American Indian or Alaska Native‟ or reported their enrolled or principal tribe, such as Navajo, Blackfeet, Inupiat, Yup‟ik, or Central American Indian groups or South American Indian groups. „Asian‟ refers to a person having origins in any of the original peoples of the Far East, Southeast Asia, or the Indian subcontinent, including, for example, Cambodia, China, Indian, Japan, Korea, Malaysia, Pakistan, the Philippine Islands, Thailand, and Vietnam. It includes people who indicated their race(s) as „Asian Indian,‟ „Chinese,‟ „Filipino,‟ „Korean,‟ „Japanese,‟ „Vietnamese,‟ and „Other Asian‟ or provided other detailed Asian responses. „Native Hawaiian and Other Pacific Islander‟ refers to a person having origins in any of the original peoples of Hawaii, Guam, Samoa, or other Pacific Islands. It includes people who indicated their race(s) as „Native Hawaiian,‟ „Guamanian or Chamorro,‟ „Samoan,‟ or „Other Pacific Islander‟ or provided other detailed Pacific Islander rezones. „Some Other Race‟ includes all other responses not included in the White, Black or African American, American Indian or Alaska Naïve, Asian and Native Hawaiian or Other Pacific Islander race categories described above. Respondents reporting entries such as multiracial, mixed, interracial, or Hispanic or Latino group (for example, Mexican, Puerto Rican, Cuban, or Spanish) in response to the race question are included in this category." For this environmental justice analysis, EPA allocated „some other race‟ among the ethnic and racial categories described above.
c. Additional angler populations were not counted for Alaska and Hawaii facilities due to lack of RF1 network coverage in those States.
d. A p-value of 0.05 or less would support the hypothesis that the ratio of each category to white non-Hispanic individuals in areas affected by facilities is statistically different from the overall ratios of each category to white non-Hispanic in States with facilities based on a 95% confidence interval.

Source: U.S. EPA Analysis, 2013

13.3 Executive Order 13045: Protection of Children from Environmental Health Risks and Safety Risks

Executive Order 13045 (62 FR 19885, April 23, 1997) applies to any rule that (1) is determined to be “economically significant” as defined under Executive Order 12866 and (2) concerns an environmental health or safety risk that EPA has reason to believe might have a disproportionate effect on children. If the regulatory action meets both criteria, the Agency must evaluate the environmental health and safety effects of the planned rule on children and explain why the planned regulation is preferable to other potentially effective and reasonably feasible alternatives considered by the Agency. This final rule is an economically significant rule as defined under Executive Order 12866. However, it does not concern an environmental health or safety risk that would have a disproportionate effect on children. This regulation establishes requirements for cooling water intake structures to protect aquatic organisms. Therefore, EPA determined that the final rule is not subject to Executive Order 13045.

13.4 Executive Order 13132: Federalism

Executive Order 13132 (64 FR 43255, August 10, 1999) requires EPA to develop an accountable process to ensure “meaningful and timely input by State and local officials in the development of regulatory policies that have federalism implications.” “Policies that have federalism implications” are defined in the Executive Order to include regulations that have “substantial direct effects on the States, on the relationship between the national government and the States, or on the distribution of power and responsibilities among the various levels of government.”

Under section 6 of Executive Order 13132, EPA may not issue a regulation that has federalism implications, that imposes substantial direct compliance costs, and that is not required by statute unless the federal government provides the funds necessary to pay the direct compliance costs incurred by State and local governments or unless EPA consults with State and local officials early in the process of developing the regulation. EPA also may not issue a regulation that has federalism implications and that preempts State law, unless the Agency consults with State and local officials early in the process of developing the regulation.

This final rule does not have federalism implications. It will not have substantial direct effects on the States, on the relationship between the national government and the States, or on the distribution of power and responsibilities among the various levels of government, as specified in Executive Order 13132. EPA estimates an average annual burden of $1.0 million, for States to collectively administer the existing units provision of the final rule.[162] Further, the rule will also impose a compliance cost burden on State and local governments on any government entities that own regulated facilities. EPA identified 48 regulated facilities that are owned by State or local government entities; the Agency estimated that under the existing units provision of the final rule these facilities will incur an average annual compliance cost of approximately $0.2 million per facility.[163]

The national regulatory requirements will be implemented through permits issued under the NPDES program. Forty-six States and territories are currently authorized pursuant to section 402(b) of the CWA, to implement the NPDES program. In States not authorized to implement the NPDES program, EPA issues NPDES permits. Under the CWA, States are not required to become authorized to administer the NPDES program. Rather, such authorization is available to States if they operate their programs in a manner consistent with section 402(b) and applicable regulations. Generally, these provisions require that State NPDES programs include requirements that are as stringent as federal program requirements. States retain the ability to implement requirements that are broader in scope or more stringent than federal requirements. (See Section 510 of the CWA.)

162 While this estimate does not include costs to administer the new units provision of the final rule, EPA expects these costs to be small.

163 Cost values were calculated over the 51-year analysis period used for analysis of social costs, discounted and annualized using the 7-percent discount rate (see *Chapters 8* and *12*).

EPA does not expect the final rule to have substantial direct effects on either authorized or nonauthorized States or on local governments because it will not change how EPA and the States and local governments interact or their respective authority or responsibilities for implementing the NPDES program. This rule establishes national requirements for existing electric power and manufacturing facilities with cooling water intake structures. NPDES-authorized States that currently do not comply with the regulations based on this rule might need to amend their regulations or statutes to ensure that their NPDES programs are consistent with federal section 316(b) requirements. (See 40 CFR 123.62(e).) For purposes of this rule, the relationship and distribution of power and responsibilities between the federal government and the State and local governments are established under the CWA (e.g., sections 402(b) and 510); nothing in this rule alters that. Thus, the requirements of section 6 of the Executive Order do not apply to this rule.

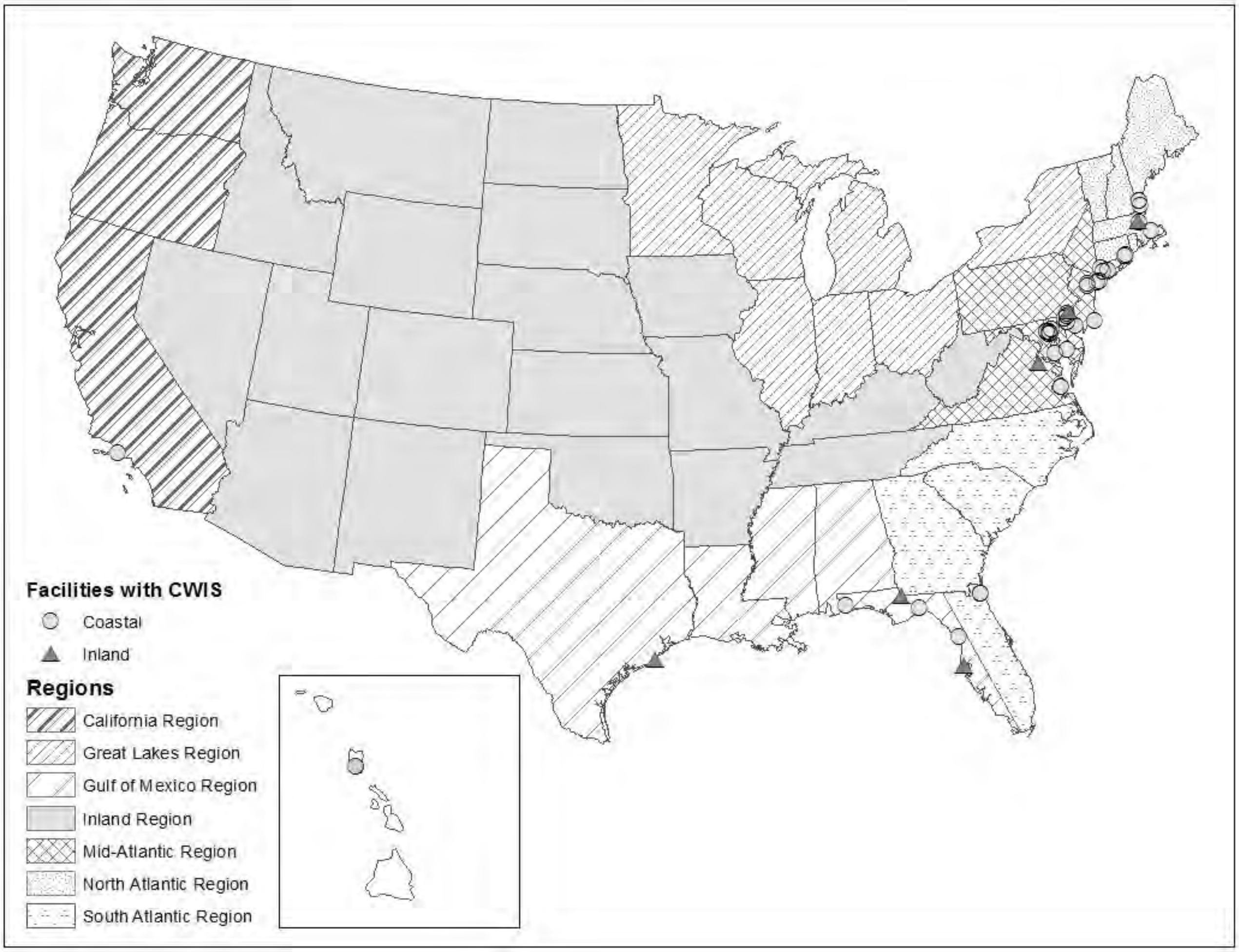
13.5 Executive Order 13158: Marine Protected Areas

A Marine Protected Area (MPA) is "any area of the marine environment that has been reserved by federal, State, tribal, territorial, or local laws or regulations to provide lasting protection for part or all of the natural and cultural resources therein" (Executive Order No. 13158, 2001). In some States, the majority of coastal waters are found within MPAs (e.g., Massachusetts, Hawaii).The ecological importance of MPAs varies widely because of their broad focus on the preservation and maintenance of cultural and natural resources, and/or sustainable production (NMPAC, 2006). Consequently, evaluating the impact of CWISs on the entire universe of MPAs may overstate the nonuse values for the ecological benefits associated with reductions in IM&E; because some MPAs are focused on the preservation of cultural resources, they are likely to be less ecologically important than others. For this reason, EPA focused on MPAs within the National Estuary Program (NEP). The NEP was established in the 1987 amendments to the Clean Water Act (CWA) because the "Nation‟s estuaries are of great importance to fish and wildlife resources and recreation and economic opportunity [and because maintaining] the health and ecological integrity of these estuaries is in the national interest" (Water Quality Act, 1987). In addition to the 28 estuaries designated under the NEP (U.S. EPA, 2008c), EPA included facilities found in Chesapeake Bay (itself protected by the Chesapeake Bay Program [CBP]).

Substantial federal and State resources have been directed to the NEP and Chesapeake Bay Program to enhance conservation of and knowledge about estuaries. Including funds received from federal, State, local and private sources, from 2005 to 2011, NEP spent $2.6 billion to protect and restore aquatic habitat, conduct outreach and research, upgrade stormwater infrastructure, and implement other priority action to benefits the health of the 28 estuaries designated under the NEP. Approximately 12.6 percent, or $325 million, was designated for restoration programs (USEPA, 2012). Between fiscal years 1995 and 2004, direct funding by federal and State governments to restore the Chesapeake Bay averaged $366 million annually (GAO, 2007), with an additional $131 million in direct spending fiscal year 2005 (CBP, 2007). Moreover, recent governmental action is likely to increase federal spending on restoration efforts in the future ("Executive Order No. 13508, Chesapeake Bay Protection and Restoration", 2009). All told, these expenditures reflect high public values for restoring (or protecting) the biological integrity of these ecosystems.

A total of 44 regulated facilities are located on 32 waterbodies within MPAs designed to preserve natural resources and/or to ensure sustainable production (NOAA, 2012; *Table 13-3*). Although these facilities are found in fresh, brackish, and marine waters, the vast majority of facilities located within MPAs are in coastal waters and are most highly concentrated in the Northeastern U.S. (i.e., both coastal and inland facilities) (*Figure 13-1; Table 13-3*). Under the final rule, EPA estimates that 60 percent of regulated facilities found within MPAs obtain reductions in impingement mortality (IM). This estimate is based upon facilities for which sufficient data exist for EPA to estimate technology currently in-place. Additionally, although entrainment may not be reduced at any facilities as a consequence of the final rule, site-specific determinations of BTA may reduce entrainment for some facilities within MPAs.

Figure 13-1: Regulated Facilities with CWISs Located in Marine Protected Areas



Source: NOAA, 2012; U.S. EPA Analysis, 2013

Table 13-3: 316(b) Facilities in Marine Protected Areas, and Improvements in IM&E Technologies for the Final Rule and Other Options Considered

	Number of Facilities with Improved Technologies by Option						Baseline		
	Proposal Option4		Final Rule		Proposal Option 2		Affected Waterbodies	Regulated Facilities	Facilities With Tech Data[a]
Benefits Region	**IM**	**E**	**IM**	**E**	**IM**	**E**			
California	1	0	1	0	1	1	2	2	1
North Atlantic	2	0	2	0	2	2	7	6	6
Mid-Atlantic	8	0	8	0	8	6	24	15	12
South Atlantic	0	0	0	0	0	0	2	1	1
Gulf of Mexico	2	0	2	0	3	3	3	3	3
Great Lakes	0	0	0	0	0	0	0	0	0
Inland	2	0	2	0	2	2	6	5	2
Total	**15**	**0**	**15**	**0**	**16**	**14**	**44**	**32**	**25**

a. EPA does not have adequate data for all facilities to estimate current compliance with the final rule.
Source: U.S. EPA Analysis, 2013

13.7 Executive Order 13175: Consultation and Coordination with Indian Tribal Governments

Executive Order 13175 (65 FR 67249, November 6, 2000) requires EPA to develop an accountable process to ensure "meaningful and timely input by tribal officials in the development of regulatory policies that have tribal implications." "Policies that have tribal implications" is defined in the Executive Order to include regulations that have "substantial direct effects on one or more Indian Tribes, on the relationship between the federal government and the Indian Tribes, or on the distribution of power and responsibilities between the federal government and Indian Tribes."

The final rule does not have tribal implications. It will not have substantial direct effects on tribal governments, on the relationship between the federal government and Indian Tribes, or on the distribution of power and responsibilities between the federal government and Indian Tribes, as specified in Executive Order 13175. The national cooling water intake structure requirements would be implemented through permits issued under the NPDES program. No tribal governments are currently authorized pursuant to section 402(b) of the CWA to implement the NPDES program. In addition, EPA‟s analyses show that no facility subject to the final rule is owned by tribal governments and thus this regulation does not affect Tribes in any way in the foreseeable future. Consequently, Executive Order 13175 does not apply to this regulation.

13.8 Executive Order 13211: Actions Concerning Regulations That Significantly Affect Energy Supply, Distribution, or Use

The OMB implementation memorandum for E.O. 13211 outlines specific criteria for assessing whether a regulation constitutes a "significant energy action" and would have a "significant adverse effect on the supply, distribution or use of energy." [164] Those criteria include:

- Reductions in crude oil supply in excess of 10,000 barrels per day;
- Reductions in fuel production in excess of 4,000 barrels per day;
- Reductions in coal production in excess of 5 million tons per year;
- Reductions in natural gas production in excess of 25 million mcf per year;
- Reductions in electricity production in excess of 1 billion kilowatt-hours per year, or in excess of 500 megawatts of installed capacity;
- Increases in the cost of energy production in excess of 1 percent;
- Increases in the cost of energy distribution in excess of 1 percent;
- Significant increases in dependence on foreign supplies of energy; or
- Having other similar adverse outcomes, particularly unintended ones.

Of the potential significant adverse effects on the supply, distribution, or use of energy (listed above) only four apply to the final rule. Through increases in the cost of generating electricity and shifts in the types of generators employed, the final rule might affect (1) the production of electricity, (2) the amount of installed capacity, (3) the cost of energy production, and (4) the dependence on foreign supplies of energy. EPA used the results from the Electricity Market Analysis (see *Chapter 7*) to analyze this rule for each of these potential effects.

In its energy-effects assessment for the final rule, EPA relied on Integrated Planning Model (IPM) analyses undertaken by EPA for the proposed rule, specifically Market Model Analysis Option 1, which aligns closely with the final rule in terms of the required performance standards. Because of the final rule‟s lower cost and operational impacts, and greater flexibility in compliance schedule, compared to Market Model Analysis Option 1, EPA assesses that the final rule will have lower energy effects than those estimated for Market Model Analysis Option 1. Therefore, based on the analysis done for Market Model Analysis Option 1, EPA estimates that the final

[164] Executive Order 13211 was issued May 18, 2002. The Office of Management and Budget later released an Implementation Guidance memorandum on July 13, 2002.

rule‟s compliance requirements will not cause effects in the electric power sector that would constitute a significant adverse effect under E.O. 13211.

13.8.1 Impact on Electricity Generation

Based on the IPM analysis results, EPA found that Market Model Analysis Option 1 would not reduce electricity production by more than 1 billion kWh hours per year. EPA estimated that the electric power sector, in the aggregate, would generate 29,304,900 KWh less in 2028 (the steady-state post-compliance year) as the result of regulatory requirements under Market Model Analysis Option 1. This is significantly less than the 1 billion KWh reduction required for the regulation to be considered a significant energy action. EPA does recognize that generation from regulated facilities may be reduced more substantially; however, this reduction would be offset by increased production from other electric power facilities, resulting in a small net decrease in overall production. From this assessment, EPA judges that Market Model Analysis Option 1 would not constitute a "significant energy action" and would not cause a "significant adverse effect" based on the criterion of reduced electricity generation. To the extent that the final rule is likely to have less adverse effects on the electric power market than those estimated for Market Model Analysis Option 1, this finding also applies to the final rule.

13.8.2 Impact on Electric Generating Capacity

EPA also estimated that the previously analyzed Market Model Analysis Option 1 would not result in capacity losses exceeding 500 MW. Specifically, EPA estimated that while regulated facilities would lose 1,051 MW of generating capacity by 2028 under Market Model Analysis Option 1, the overall electric power sector would lose only 16 MW of capacity, with new and accelerated capacity additions more than offsetting the loss in capacity in regulated facilities. EPA notes that the capacity losses at regulated facilities generally involve older, less efficient generating units; this capacity is replaced by new, more efficient, and lower pollution-generating capacity.

From this assessment, EPA judges that Market Model Analysis Option 1 would not constitute a "significant energy action" and would not cause a "significant adverse effect" based on the criterion of reduced electricity generating capacity. To the extent that the final rule is likely to have less adverse effects on the electric power market than those estimated for Market Model Analysis Option 1, this finding also applies to the final rule.[165]

13.8.3 Cost of Energy Production

EPA estimated Market Model Analysis Option 1 would not significantly affect the cost of electricity production in either the short or the long run. EPA estimates that in the short run (2015), energy production costs (variable costs per MWh) will increase only slightly, by 0.1 percent and that in the long-run (2028), the change is essentially zero. EPA estimated that the effect on electricity prices would vary by NERC region, increasing by no more than 0.1 percent in any region. From this assessment, EPA judges that Market Model Analysis Option 1 would not constitute a "significant energy action" and would not cause a "significant adverse effect" based on the criterion of increased cost of energy production. To the extent that the final rule is likely to have less adverse effects on the electric power market than those estimated for Market Model Analysis Option 1, this finding also applies to the final rule.

[165] EPA does not consider the loss of capacity to technology installation downtime to fall within the scope of E.O. 13211 because this loss is temporary. However, even if it did, it would be of low consequence. EPA estimates that the Market Model Analysis Option 1 would result in a temporary loss of capacity of 318 MW each year, on average, during the five-year technology installation window of 2013 through 2017. As described in Chapter 4, the downtime capacity loss at any individual plant is for less than a full year, and these capacity losses can be spread over plants in such way that the impact at any time is less than the sum of downtime capacity reductions across the affected plants.

13.8.4 Dependence on Foreign Supply of Energy

EPA‟s electricity market analysis did not explicitly consider the effects of Market Model Analysis Option 1 on foreign imports of energy. However, Market Model Analysis Option 1 would only affect U.S. electric power generators, which are generally not subject to significant foreign competition. Only Canada and Mexico are connected to the U.S. electricity grid, and transmission losses are substantial when electricity is transmitted over long distances. In addition, the effects on installed capacity and electricity prices are estimated to be small. EPA therefore concludes that Market Model Analysis Option 1would not significantly increase dependence on foreign supplies of energy. To the extent that Market Model Analysis Option1 closely corresponds with the final rule in terms of the required performance standards and the universe of regulated facilities, this finding also applies to the final rule.

13.8.5 Overall E.O. 13211 Finding

From these analyses, EPA concludes that the final rule will not have a *significant adverse effect* at a national or regional level. As a result, EPA did not prepare a Statement of Energy Effects. For more detail on effects of this final rule on electricity markets, see *Chapter 7*.

13.9 Paperwork Reduction Act of 1995

The Paperwork Reduction Act of 1995 (PRA) (superseding the PRA of 1980) is implemented by the Office of Management and Budget (OMB) and requires that agencies submit a supporting statement to OMB for any information collection that solicits the same data from more than nine parties. The PRA seeks to ensure that federal agencies balance their need to collect information with the paperwork burden imposed on the public by the collection.

The definition of "information collection" includes activities required by regulations, such as permit development, monitoring, record keeping, and reporting. The term "burden" refers to the "time, effort, or financial resources" the public expends to provide information to or for a federal agency, or to otherwise fulfill statutory or regulatory requirements. PRA paperwork burden is measured in terms of annual time and financial resources the public devotes to meet one-time and recurring information requests (44 U.S.C. 3502(2); 5 C.F.R. 1320.3(b)). Information collection activities may include:

- reviewing instructions;
- using technology to collect, process, and disclose information;
- adjusting existing practices to comply with requirements;
- searching data sources;
- completing and reviewing the response;
- and transmitting or disclosing information.

Agencies must provide information to OMB on the parties affected, the annual reporting burden, and the annualized cost of responding to the information collection, and whether the request significantly impacts a substantial number of small entities. An agency may not conduct or sponsor, and a person is not required to respond to, an information collection unless it displays a currently valid OMB control number. The Office of Management and Budget (OMB) has approved the information collection requirements contained in this rule under the provisions of the Paperwork Reduction Act, 44 U.S.C. 3501 et seq. and has assigned OMB control number 2060–05. The final rule requires applicable facilities to perform several data-gathering activities as part of the permit application process. The information collection requirements include a one-time burden associated with the initial permit application and those activities associated with monitoring and reporting after the permit is issued. EPA estimates a total average annual burden of 725,379 hours for the final rule‟s information collection requirements. In addition, EPA estimates an annual average reporting and record-keeping burden to facilities responding to the final rule of 557hours per respondent (i.e., annual average of 717,005 hours of burden divided among an anticipated annual average of 1,289facilities).[166] EPA estimates a reporting and record-keeping burden to permit Directors, for the review, oversight, and administration of the rule, of 178 hours per respondent (i.e., an annual average of 8,374 hours of burden divided among anticipated 46 States and one territory with NPDES permitting authority on average per year).

13.10 National Technology Transfer and Advancement Act

Section 12(d) of the National Technology Transfer and Advancement Act (NTTAA) of 1995, Pub L. No. 104-113, Sec. 12(d) directs EPA to use voluntary consensus standards in its regulatory activities unless doing so would be inconsistent with applicable law or otherwise impractical. Voluntary consensus standards are technical standards (e.g., materials specifications, test methods, sampling procedures, and business practices) that are developed or adopted by voluntary consensus standard bodies. The NTTAA directs EPA to provide Congress, through OMB, explanations when the Agency decides not to use available and applicable voluntary consensus standards. This final rule does not involve such technical standards. Therefore, EPA is not considering the use of any voluntary consensus standards.

166 The 1,289 figure differs from the total regulated universe of 1,065 facilities and reflects different numbers of generators and manufacturers undertaking activities related to information collection request (ICR) in each of the three years covered by this ICR.

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Appendix A Profile of the Aluminum Industry

A.1 Introduction

EPA‟s *Detailed Industry Questionnaire*, hereafter referred to as the DQ, identified two 3-digit SIC codes in the Nonferrous Metals manufacturing industry (SIC codes 333/335) with at least one existing facility that operates a CWIS, holds a NPDES permit, withdraws at least two million gallons per day (MGD) from a water of the United States, and uses at least 25 percent of its intake flow for cooling purposes (facilities with these characteristics are hereafter referred to as "facilities potentially subject to the Final Existing Facilities regulation" or "regulated facilities"). For the purpose of this analysis, EPA identified a six-digit NAICS code for each of these potential facilities using information from the DQ and public sources (see *Appendix J: Mapping Manufacturers Standard Industrial Classification (SIC) Codes to North American Industry Classification System (NAICS) Codes*). As the result of this mapping, EPA identified four 6-digit NAICS codes in the Nonferrous Metals manufacturing industry (NAICS 331311-5).

For these four NAICS codes, *Table A-1*, below, provides a description of the industry segment, a list of primary products manufactured, and the number of facilities estimated to be potentially subject to the 316(b) Existing Facilities regulation based on the minimum withdrawal threshold of 2 MGD.

Table A-1: Existing Facilities in the Aluminum Industries (NAICS 33131)

NAICS Code	NAICS Description	Important Products Manufactured	Number of Regulated Facilities[a]
Primary Stages of Production (Primary Aluminum)			
331311	Alumina refining	Refining alumina (i.e. aluminum oxide) generally from bauxite.	6
331312	Primary aluminum production	Aluminum from alumina and/or aluminum from alumina and rolling, drawing, extruding, or casting the aluminum they make into primary forms (i.e. bar, billet, ingot, plate, rod, sheet, strip).	7
Secondary Stages of Production (Secondary Aluminum)			
331314	Secondary smelting and alloying of aluminum	Recovered aluminum and aluminum alloys from scrap and/or dross (i.e. secondary smelting) and billet or ingot (except by rolling); manufactured alloys, powder, paste, or flake from purchased aluminum.	3
331315	Aluminum sheet, plate, and foil manufacturing	Flat-rolling or continuous casting sheet, plate, foil, and welded tube from purchased aluminum; recovered aluminum from scrap.	9
Total NAICS 331311-5[b]			26

a. Number of weighted detailed questionnaire survey respondents.
b. Individual numbers may not add up due to independent rounding.
Source: Executive Office of the President, 1987; U.S. EPA 2000; U.S. EPA analysis, 2013.

As shown in *Table A-1*, EPA estimates that, out of an estimated total of 88[167] facilities with a NPDES permit and operating cooling water intake structures in the Aluminum industry (NAICS 331311-5), 25 facilities (or 28 percent) are estimated to be subject to the final rule. EPA also estimated the percentage of total production that occurs at facilities estimated to be subject to the regulatory analysis options. The total value of shipments for the profiled Aluminum Industry (NAICS 3313) from the 2010 Annual Survey of Manufactures is $33.0 billion ($2011). Value of shipments, a measure of the dollar value of production, was selected for the basis of this estimate. Because value of shipments data were not collected using the DQ, these data were not available for the sample of manufacturing facilities potentially subject to the regulatory analysis. Total revenue, as reported on the DQ, was used as a close approximation for value of shipments for these facilities. EPA estimates the total revenue

167 This estimate of the number of facilities holding a NPDES permit and operating a cooling water intake structure is based on the responses from facilities that received the 1999 screener questionnaire.

of facilities in the Aluminum industry subject to the final rule is $15.1 billion ($2011).[168] Therefore, EPA estimates that 46 percent of total domestic aluminum production occurs at facilities estimated to be subject to the final regulation.

Table A-2 provides the crosswalk between NAICS codes and SIC codes for the profiled Aluminum NAICS codes. The table shows that of the profiled 6-digit NAICS codes in the Aluminum industry, alumina refining (NAICS 331311), primary aluminum production (NAICS 331312), and aluminum sheet, plate, and foil manufacturing (NAICS 331315) have a one-to-one relationship to SIC codes. Secondary smelting and alloying of aluminum (NAICS 331314) represents two SIC codes: secondary nonferrous metals (3341) and primary metal products (3399).

Table A-2: Relationships between NAICS and SIC Codes for the Aluminum Industries

NAICS Code	NAICS Description	SIC Code	SIC Description	Number of Establishments (2009)[a]	Value of Shipments (2010; Millions; $2011)	Employment (2010)
331311	Alumina refining	2819	Industrial inorganic chemicals	15	$1,037	1,497
331312	Primary aluminum production	3334	Primary aluminum	65	$4,739	6,648
331314	Secondary smelting and alloying of aluminum	3341	Secondary nonferrous metals	133	$5,197	4,460
		3399	Primary metal products, n.e.c.			
331315	Aluminum sheet, plate, and foil manufacturing	3353	Aluminum sheet, plate, and foil	113	$14,627	16,099

a. The number of establishments relies on data from the 2009 Statistics of U.S. Businesses. Value of Shipments and Employment reflect 2010 data.
Source: U.S. DOC, 2010 ASM; U.S. DOC, 2009 SUSB.

A.2 Summary Insights from this Profile

The key purpose of this profile is to provide insight into the ability of aluminum industry firms to absorb compliance costs under the final rule without material adverse economic/financial effects. The industry‟s ability to absorb compliance costs is primarily influenced by two factors: (1) the extent to which the industry can shift compliance costs to its customers through price increases, and (2) the financial health of the industry and its general business outlook.

A.2.1 Likely Ability to Pass Compliance Costs Through to Customers

As reported in the following sections of this profile, the Aluminum industry on average has a moderate-to-high degree of market concentration, with the profiled Primary Aluminum production segment being slightly more concentrated than the profiled Secondary Aluminum Production segment. This potentially supports the notion that firms in the Primary Aluminum production segment may be able to pass some portion of their compliance-related costs through to consumers while firms in the Secondary Aluminum production segment may not. However, the domestic Primary Aluminum production segment faces significant competition from imports into the U.S. market, which has increased over time and is likely to continue doing so going forward. Substantial competitive pressure from abroad weakens the potential of firms in the Primary Aluminum production segment to pass through to customers a significant portion of their compliance-related costs. The Secondary Aluminum production segment does not appear to be reliant on sales into foreign markets, nor does it seem to face significant competition from imports. As discussed above, given the relatively large proportion of total value of shipments in the profiled Aluminum industry (nearly 50 percent), in addition to the moderate-to-high degree of concentration in the profiled Aluminum industry, and strong competitive pressures from abroad existing only in the Primary

168 To compare revenue values of regulated facilities with the industry value of shipments, EPA brought revenue values for regulated facilities forward to 2010 using industry-specific Producer Price Index (PPI) values published by the Bureau of Labor Statistics (BLS) and stated in 2011 dollars using GDP deflator published by the Bureau of Economic Analysis (BEA).

Aluminum segment, EPA judges that regulated facilities in the profiled Aluminum industry subject to the 316(b) Existing Facilities Regulation may have the potential to recover compliance costs through price increases to customers. However, in an effort to avoid overstating the ability of regulated facilities to pass on compliance costs to consumers, EPA assumes zero cost pass through. In other words, EPA judges that facilities would have to absorb all compliance costs within their operating finances (see following sections and *Appendix K: Cost Pass-Through Analysis*, for further information).

A.2.2 Financial Health and General Business Outlook

Over the last two decades, the aluminum industry, like other U.S. manufacturing industries, has experienced a range of economic/financial conditions, including substantial challenges. In the early 1990s, the domestic aluminum industry was adversely affected by reduced U.S. demand and the dissolution of the Soviet Union, which resulted in substantially increased Russian aluminum exports. Although domestic market conditions improved by middle of that decade, weakness in Asian markets, along with growing Russian exports, dampened performance during the latter half of the 1990s. Demand for aluminum industry products declined again during 2000 through 2002, reflecting recessionary weakness in both the U.S. and world economies, and again resulted in oversupply of aluminum and declining financial performance of facilities in the aluminum industry. As the U.S. economy began to show signs of recovery in 2003, so did the overall aluminum industry with higher demand levels and improved financial performance over the course of 2004 and 2006. Despite increasing costs of energy and other aluminum production inputs, which led to lower aluminum production levels and higher aluminum prices during that time, demand for aluminum grew; increasing prices of steel and copper compared to aluminum led to aluminum substitution in the manufacturing of certain goods like cable, beverage cans, and automobile parts (USGS, 2006c). Higher demand for aluminum also led to smelter restarts and substantial increases in primary aluminum production throughout 2007 and the first half of 2008. The recent recession, however, resulted in lower demand for aluminum, leading to significantly lower aluminum prices and consequent production cuts by aluminum smelters. By June 2009, 54 percent of domestic production smelting capacity was idle (USGS, 2008a). Moreover, relatively high electricity rates in the United States compared to those in other nations diminishes the likelihood that domestic smelters will reopen in the near term (USGS, 2008a). In 2011, production of primary and secondary aluminum rose, after declines in 2008 and 2009, although production has not yet returned to pre-recession levels. While the United States is still somewhat reliant on imports, in 2011 the rise in exports outpaced the increase in imports. Furthermore, domestic smelters increased operations to approximately 64 percent of rated or engineered capacity, after having fallen to 49 percent in 2009 (USGS, 2010c; USGS, 2012c). As the Aluminum industry continues to recover, the industry should be able to absorb additional regulatory compliance costs without a material financial impact.

A.3 Domestic Production

The Primary stages of aluminum production involve mining bauxite ore and refining it into alumina, one of the feedstocks for aluminum metal. Direct electric current is used to split the alumina into molten aluminum metal and carbon dioxide. The molten aluminum metal is then collected and cast into ingots. Technological improvements over the years have improved the efficiency of aluminum smelting, with a particular emphasis on reducing energy requirements. Currently, no commercially viable alternative exists to the electrometallurgical process (Aluminum Association, 2001).

Secondary stages of aluminum production involve recovering aluminum and aluminum alloys from scrap and/or dross, making billet and ingot, and manufacturing of alloys, powder, paste, of flake from purchased aluminum. In 2009, aluminum recovered from purchased scrap was about three million tons, of which about 60 percent came from new (manufacturing) scrap and 40 percent from old scrap (discarded aluminum products). Aluminum recovered from old scrap was equivalent to about 35 percent of apparent consumption (USGS, 2010c). Reclamation of used aluminum beverage cans continues to be a major source of supply for the U.S. aluminum industry, generating large savings in production energy costs (USGS, 2009c). In contrast to the steel industry, aluminum minimills have had limited impact on the profitability of traditional integrated aluminum producers. Aluminum minimills are not able to produce can sheet of the same quality as that produced by integrated facilities. As a result, they are able to compete only in production of commodity sheet products for the building and distributor markets, which are considered mature markets.

In addition, the Secondary stages of aluminum production include manufacturing of semi-fabricated aluminum products. Examples of semi-fabricated aluminum products include (Aluminum Association, undated):

- sheet (cans, construction materials, and automotive parts);
- plate (aircraft and spacecraft fuel tanks);
- foil (household aluminum foil, building insulation, and automotive parts);
- rod, bar, and wire (electrical transmission lines); and
- extrusions (storm windows, bridge structures, and automotive parts).

U.S. aluminum companies are generally vertically integrated. Major aluminum companies own large bauxite reserves, mine bauxite ore and refine it into alumina, produce aluminum ingot, and operate the rolling mills and finishing plants used to produce semi-fabricated aluminum products. As noted above, the Primary stages of aluminum production involves the electrometallurgical process, which is extremely energy intensive. Electricity accounts for approximately 30 percent of total production costs for primary aluminum smelting. The Aluminum industry is therefore a major industrial user of electricity, spending more than two billion dollars annually. Throughout the years aluminum facilities have been pursuing opportunities to reduce their use of electricity as a means of lowering costs. Consequently, in the last 50 years, the average amount of electricity needed to make a pound of aluminum has declined from 12 kilowatt hours to approximately 7 kilowatt hours (Aluminum Association, undated).

A.3.1 Output

At the end of the last decade, the transportation sector was the largest North American market for aluminum, accounting for 6 billion pounds, or 28 percent of total consumption. Other major markets included: containers and packaging (22 percent); building and construction (28 percent); electrical (7 percent); machinery and equipment (7 percent); and consumer durables (6 percent) (Aluminum Association, 2009).

Demand for aluminum reflects the overall state of domestic and world economies, as well as long-term trends in aluminum products use in major end-use sectors. Because aluminum production involves large fixed investments and capacity adapts slowly to fluctuations in demand, the industry has experienced alternating periods of excess capacity and tight supplies. The early 1980s was a period of oversupply, high inventories, and excess capacity. By 1986, excess capacity was closed, inventories were low, and demand increased substantially. The early 1990s were affected by reduced U.S. demand and the dissolution of the Soviet Union, resulting in large increases in Russian exports of aluminum. By the mid-1990s, global production declined, demand rebounded, and aluminum prices rose. Subsequent increased production reflected an overall increase in the demand for aluminum with stronger domestic economic growth, driven by increased consumption by the transportation, container, and construction segments. The economic crises in Asian markets in the later 1990s, along with growing Russian exports, again resulted in a period of oversupply, although U.S. demand for aluminum remained strong.

Demand declined again in 2000 through 2002 due to slower growth in both the domestic and world economies, resulting in oversupply. In addition, production in China increased during this period, and although increased Chinese consumption helped reduce the surplus slightly, the country switched from being a net importer to a net exporter. The U.S. aluminum surplus was mitigated somewhat as demand in the automotive and housing markets remained relatively high through mid-2003. In addition, the California energy crisis in 2000 and 2001 reduced production from primary smelters located in the Pacific Northwest (Aluminum Association, 1999; USGS, 1999a; USGS, 1998d; USGS, 1994a; Value Line, 2001).

Table A-3 shows trends in output of aluminum by Primary and Secondary stages of aluminum production. Secondary aluminum production grew from 24 percent to just under 40 percent of total domestic production over the period from 1991 to 2010. Primary production of aluminum recorded a net decrease over the 20-year period, with a particularly sharp decline in 2001. As noted above, this decrease reflects reduced domestic and world demand for aluminum, and curtailed production at a number of Pacific Northwest mills caused by the California energy crisis (S&P 2001; USGS, 2001c). From 2003 to 2006, the industry experienced a period of decline in total production, despite some increases in the secondary stage of production. Total production remained fairly constant in recent years except for a significant increase in 2007 (approximately 17 percent) and a substantial decline in 2009 (approximately 27 percent). In 2010, total production continued to decline, but to a much lesser extent than in 2009.

Table A-3: U.S. Aluminum Production

	Aluminum Ingot					
	Primary Stages of Production		Secondary Stages of Production		Total Production	
Year	Thousand MT	% Change	Thousand MT	% Change	Thousand MT	% Change
1991	4,121	NA	1,320	NA	5,441	NA
1992	4,042	-1.9%	1,610	22.0%	5,652	3.9%
1993	3,695	-8.6%	1,630	1.2%	5,325	-5.8%
1994	3,299	-10.7%	1,500	-8.0%	4,799	-9.9%
1995	3,375	2.3%	1,510	0.7%	4,885	1.8%
1996	3,577	6.0%	1,580	4.6%	5,157	5.6%
1997	3,603	0.7%	1,530	-3.2%	5,133	-0.5%
1998	3,713	3.1%	1,500	-2.0%	5,213	1.6%
1999	3,779	1.8%	1,570	4.7%	5,349	2.6%
2000	3,688	-2.4%	1,370	-12.7%	5,058	-5.4%
2001	2,637	-28.5%	1,210	-11.7%	3,847	-23.9%
2002	2,707	2.7%	1,170	-3.3%	3,877	0.8%
2003	2,703	-0.1%	1,070	-8.5%	3,773	-2.7%
2004	2,516	-6.9%	1,160	8.4%	3,676	-2.6%
2005	2,481	-1.4%	1,080	-6.9%	3,561	-3.1%
2006	2,284	-7.9%	1,260	16.7%	3,544	-0.5%
2007	2,554	11.8%	1,600	27.0%	4,154	17.2%
2008	2,658	4.1%	1,340	-16.3%	3,998	-3.8%
2009	1,727	-35.0%	1,190	-11.2%	2,917	-27.0%
2010[a]	1,720	-0.4%	1,120	-5.9%	2,840	-2.6%
Total percent change 1991-2010	**-58.3%**		**-15.2%**		**-47.8%**	
Total percent change 2000-2010	**-53.4%**		**-18.2%**		**-43.9%**	
Average annual growth rate[169]	**-4.5%**		**-0.9%**		**-3.4%**	

a. Values for 2010 represent estimates from the USGS 2011 Mineral Commodity Summaries.
Source: USGS, 1995-2011c

Value of shipments and ***value added*** are two common measures of manufacturing output.[170] Change in these values over time provides insight into the overall economic health and outlook for an industry. Value of shipments is the sum of receipts earned from the sale of outputs; it indicates the overall size of a market or the size of a firm in relation to its market or competitors. Value added, defined as the difference between the value of shipments and the value of inputs used to make the products sold, measures the value of production activity in a particular industry.

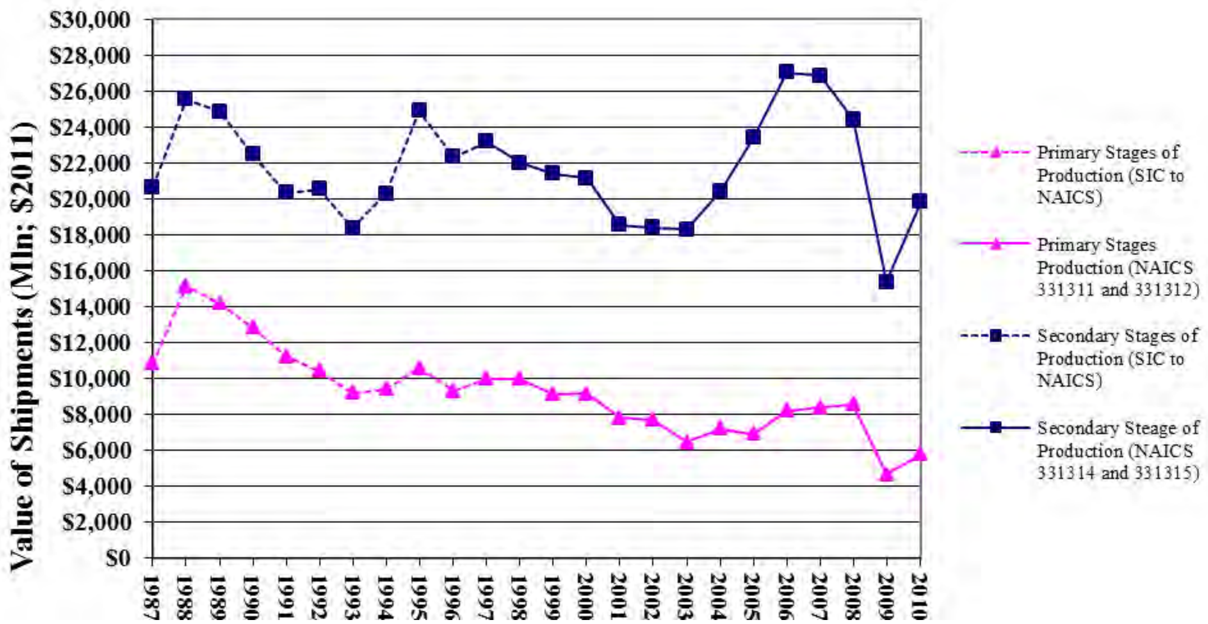
169 In this appendix, average annual growth rate refers to a year-to-year, constant percentage growth mean, which is calculated as the compound annual growth rate between the first and last values. This is the same concept as the geometric mean, if all of the individual year-to-year

170 Terms highlighted in bold and italic font are further explained in the glossary.

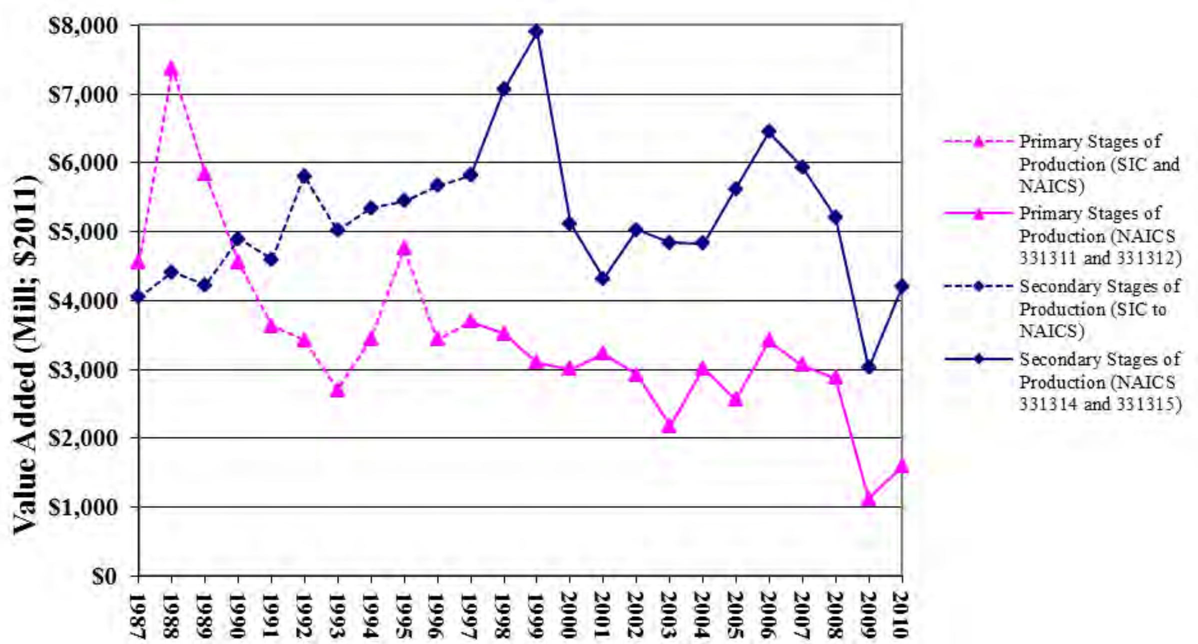
Figure A-1 reports constant dollar value of shipments and value added for the Primary and Secondary stages of aluminum production between 1987 and 2010.

Figure A-1: Value of Shipments and Value Added for Profiled Aluminum Industry Segments (millions, $2011)[a]

Value of Shipments



Value Added



a. Before 1997, the Department of Commerce compiled data in the SIC system; since 1997, these data have been compiled in the North American Industry Classification System (NAICS). For this analysis, EPA converted the NAICS classification data to the SIC code classifications using the *1997 Economic Census Bridge Between NAICS and SIC.*

Source: U.S. DOC, 1988-1991, 1993-1996, 1998-2001, 2003-2006, and 2008-2010 ASM; U.S. DOC, 1987, 1992, 1997, 2002, and 2007 EC.

The pattern in the value of Primary Aluminum shipments is generally the same as that in the quantity of shipments (*Table A-3*). Production trends during 1987 through 2003 reflect trends in demand for aluminum; both production and value of shipments fell with increases in the percentage of domestic demand provided by imports.

A similar trend can be observed for the Secondary Aluminum production during this period, which substitutes in some but not all markets for Primary Aluminum. About half-way through the last decade however, value of shipments for both Primary and Secondary Aluminum began to rise and continued to do so steadily (with a significantly steeper increase in the Secondary Aluminum segment) through 2006-2008, when the current economic recession began. By 2009, both Primary and Secondary Aluminum segments saw significant decreases in value of shipments. In 2010, as the economy began to recover, both profiled segments began to recover as evidenced by more than 20 percent increases in value of shipments that year.

Value added by aluminum production excludes the value of purchased materials and services (including electricity). *Figure A-1* shows more fluctuation in value added during the last decade than in value of shipments for both Primary and Secondary Aluminum production segments, which could be attributed to fluctuating input prices without the industry being able to implement significant price adjustments due to relatively stiff competition from foreign markets. However, beginning in 2003, both value of shipments and value added for Primary and Secondary Aluminum production segments experienced growth, which could be attributed to an overall increase in market demand for aluminum, both domestically and world-wide. During that time, the Primary Aluminum segment experienced greater fluctuations in value added compared to the Secondary Aluminum segment. These fluctuations can be attributed to rising cost of inputs, particularly energy and alumina (USGS, 2009c). However, as the result of recessionary pressures during 2007 through 2009, value of shipments and value added began fell significantly in both profiled Aluminum segments, with Secondary Aluminum segment experiencing larger declines. As economy began to recover in 2010, both segments saw slight improvements in their performance.

Between late 1980s through 1993, value of shipments in the Secondary Aluminum production segment declined and then recovered by mid-decade, before declining again in the late 1990s. As described above, the profiled Secondary Aluminum production segment is comprised of secondary smelting and alloying of aluminum and production of semi-finished aluminum products such as aluminum sheet, plate, and foil. Demand for secondary smelting and alloying of aluminum is primarily driven by demand from semi-finished aluminum products manufacturing firms. Demand for secondary and semi-finished aluminum products reflects demand from transportation, container, construction, and auto industries. Despite the rising cost of aluminum production during most of the last decade, which resulted in higher aluminum prices, world demand for aluminum continued to increase; prices for copper and steel experienced more significant increases compared to those of aluminum, leading to greater aluminum substitution in production of various goods such as cable, beverage cans, and automobile parts (USGS, 2006a). Consequently, increasing demand for aluminum products during the last decade through the recession of 2008 resulted in increased value of shipments. As discussed in the next section, however, prices for the Primary and Secondary Aluminum segment products dropped in 2009, as the result of the recession, only to rebound during 2010 and 2011. Looking forward, experts expect a recovery in aluminum prices, after a major decline in 2012. The outlook for the aluminum industry is positive due to the combination of expected volume gains and higher prices (S&P, 2013b).

Overall, while the Primary Aluminum production segment shows lower values for the constant dollar value of shipments and value added at the end of the analysis period than at the beginning of the period, the Secondary Aluminum production segment shows a lower value for constant dollar value of shipments but a higher value for value added. The declining value of shipments and value added in the Primary Aluminum production segment reflect the increasing role of imports in meeting total U.S. demand and the increased competition this segment faces from foreign markets. Over time, the U.S. producers of Primary Aluminum products have been forced to withstand the cost of rising input costs due to increasing pressure from foreign markets.

A.3.2 Prices

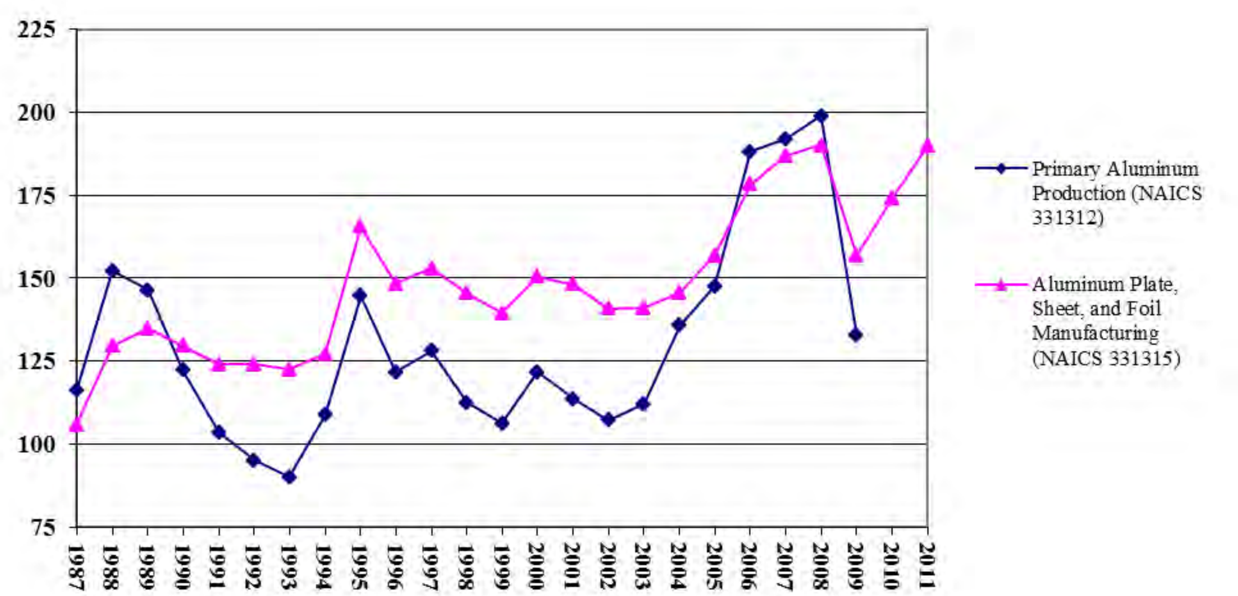
The producer price index (PPI) measures price changes, by segment, from the perspective of the seller, and indicates the overall trend of product pricing, and thus supply-demand conditions, within a segment.

The price trends shown for Primary Aluminum in *Figure A-2* reflect the fluctuations in world supply and demand discussed in the previous section. During the early 1980s, the aluminum industry experienced oversupply, high inventories, excess capacity, and weak demand, resulting in falling prices for aluminum. By 1986, much of the excess capacity had permanently closed, inventories had been worked down, and worldwide demand for aluminum increased strongly. This resulted in price increases through 1988, as shown in *Figure A-2*.

In the early 1990s, the dissolution of the Soviet Union had a major impact on aluminum markets. Large quantities of Russian aluminum that formerly had been consumed internally, primarily in military applications, were sold in world markets to generate hard currency. At the same time, world demand for aluminum was decreasing. The result was increasing inventories and depressed aluminum prices. In response to declining aluminum prices, the United States and five other primary aluminum producing nations signed an agreement in January 1994 to curtail global output, At the time of the agreement, there was an estimated global overcapacity of 1.5 to 2.0 million metric tons per year (S&P, 2000).

By the mid-1990s, production cutbacks, increased demand, and declining inventories led to a sharp rebound of prices. Prices declined again during the late 1990s, however, when the economic crises in Asian markets reduced the demand for aluminum (USGS, 2001e). During 2000, prices rebounded sharply despite the continuing trend of high Russian production and exports. However, economic recession caused prices to fall again through 2002 (S&P, 2001-2004). Prices seen by both profiled segments increased significantly between 2003 and 2007. An increase in global demand, especially in emerging markets like China with cheap shipping and labor rates contributed to price increases during 2006 and 2007. But in 2009, prices dropped in response to the financial crisis and recession that began in 2007/2008. As shown in *Figure A-2*, prices for Aluminum Plate, Sheet and Foil Manufacturing products have recovered since 2009. PPI index data for Primary Aluminum Production are only available up until 2009; however, according to the USGS (2010a), the annual average price of Primary Aluminum metal increased in 2010.

Figure A-2: Producer Price Indexes for Profiled Aluminum Industry Segments[a]



a. Data source does not provide Producer Price Indices for NAICS 331311 and NAICS 331314. PPI index data for Primary Aluminum Production are only available through 2009.
Source: BLS, 2011e.

A.3.3 Number of Facilities and Firms

U.S. Geological Survey data indicate that between 1995 and 2010 the number of Primary Aluminum facilities and the number of domestic firms that own them declined, as shown in *Table A-4*. The number of domestic firms and plants they own declined sharply in 2002 and dropped again in 2004. The bulk of the idled capacity in the beginning of last decade resulted from curtailed production at a number of Pacific Northwest mills caused by the California energy crisis. Most of the smelters outside of this region continued to operate at or near their engineered capacities (S&P 2001; USGS, 2001c; USGS, 2002a). However, by 2007, the amount of idled capacity decreased because new power contracts were obtained by producers, which led to a slight increase in production. Domestic smelters operated at 69 percent of their capacity (USGS, 2008a). Because of the 2008 recession and the resulting decrease in demand for aluminum during the first half of 2009 smelter closures took place in Alcoa, TN; Massena, NY; and Ravenswood, WV, and by the beginning of the fourth quarter of 2009, domestic smelters were operating at only 49 percent of rated or engineered capacity (USGS, 2010c).

Table A-4: Primary Stages of Aluminum Production - Number of Companies and Plants

Year	Number of Companies	Number of Plants
1995	13	22
1996	13	22
1997	13	22
1998	13	23
1999	12	23
2000	12	23
2001	12	23
2002	7	16
2003	7	15
2004	6	14
2005	6	15
2006	6	15
2007	5	13
2008	6	14
2009	6	13
2010	5	9

Source: USGS, 1995-2011c

Table A-5 shows that the number of Primary Aluminum production facilities generally decreased every year between 1990 and 1999 and have generally risen every year after that until 2005, when it began to fluctuate. During the last decade, the number of Primary Aluminum facilities overall increased by nearly 82 percent. The number of facilities in the Secondary Aluminum production segment showed a more consistent trend, increasing nearly every year. Yet, between 2000 and 2009, the number of the Secondary Aluminum facilities decreased by nearly 11 percent due to declines in 2002, 2007 and 2009.

Table A-5: Number of Facilities for Profiled Aluminum Industry Segments

Year[a]	Primary Stages of Aluminum Production[b] Number of Establishments	Primary Percent Change	Secondary Stages of Aluminum Production[c] Number of Establishments	Secondary Percent Change
1990	61	NA	229	NA
1991	64	5.3%	241	5.3%
1992	60	-7.5%	238	-1.0%
1993	52	-13.5%	224	-6.2%
1994	49	-5.8%	227	1.5%
1995	47	-2.5%	227	0.1%
1996	58	22.6%	207	-8.9%
1997	41	-29.2%	214	3.2%
1998	37	-9.9%	226	5.8%
1999	39	5.4%	247	9.3%
2000	44	12.8%	276	11.7%
2001	49	11.4%	289	4.7%
2002	57	16.3%	236	-18.3%
2003	63	10.5%	243	3.0%
2004	78	23.8%	250	2.9%
2005	73	-6.4%	251	0.4%
2006	69	-5.5%	264	5.2%
2007	81	17.4%	253	-4.2%
2008	79	-2.5%	254	0.4%
2009	80	1.3%	246	-3.1%
Total Percent Change 1990-2009	**30.7%**		**7.6%**	
Total Percent Change 2000-2009	**81.8%**		**-10.9%**	
Average Annual Growth Rate	**1.4%**		**0.4%**	

a. Before 1998, these data were compiled in the Standard Industrial Classification (SIC) system; since 1998, these data have been compiled in the North American Industry Classification System (NAICS). For this analysis, EPA converted the NAICS classification data to the SIC code classifications using the *1997 Economic Census Bridge Between NAICS and SIC.*
b. NAICS 331311-2
c. NAICS 331314-5
Source: U.S. DOC, 1990-1997 SBA; U.S. DOC, 1998-2009 SUSB.

From 1990 up until the mid to late 1990s, the number of firms in both the Primary Aluminum and Secondary Aluminum segments declined steadily (*Table A-6*). Both segments than experienced a period of expansion, as the number of firms grew into the middle of the next decade. Between 2000 and 2009, the number of Primary Aluminum production firms more than doubled leading to an overall growth of approximately 63 percent over the two decades. On the other hand, declines in the number of Secondary Aluminum production firms at the end of the last decade offset gains made in the first half of the decade, leading to an overall decline of approximately 15 percent over the two-decade analysis period.

Table A-6: Number of Firms for Profiled Aluminum Industry Segments

Year[a]	Primary Stages of Aluminum Production[b]		Secondary Stages of Aluminum Production[c]	
	Number of Firms	Percent Change	Number of Firms	Percent Change
1990	42	NA	192	NA
1991	46	7.7%	206	7.2%
1992	41	-10.4%	204	-1.0%
1993	38	-7.6%	190	-6.9%
1994	38	-0.9%	185	-2.4%
1995	35	-7.5%	182	-2.0%
1996	44	-27.8%	161	-114%
1997	27	-38.6%	172	7.1%
1998	27	-0.9%	182	5.7%
1999	29	7.4%	199	9.3%
2000	32	10.3%	225	13.1%
2001	38	18.8%	239	6.2%
2002	50	31.6%	190	-20.5%
2003	51	2.0%	197	3.7%
2004	63	23.5%	201	2.0%
2005	62	-1.6%	194	-3.5%
2006	57	-8.1%	209	7.7%
2007	69	21.1%	172	-17.7%
2008	68	-1.4%	164	-4.7%
2009	69	1.5%	164	0.0%
Total Percent Change 1990-2009	**62.4%**		**-14.6%**	
Total Percent Change 2000-2009	**115.6%**		**-27.1%**	
Average Annual Growth Rate	**2.6%**		**-0.8%**	

a. Before 1998, these data were compiled in the SIC system; since 1998, these data have been compiled in the North American Industry Classification System (NAICS). For this analysis, EPA converted the NAICS classification data to the SIC code classifications using the *1997 Economic Census Bridge Between NAICS and SIC.*
b. NAICS 331311-2
c. NAICS 331314-5
Source: U.S. DOC, 1990-1997 SBA; U.S. DOC, 1998-2009 SUSB.

A.3.4 Employment and Productivity

Figure A-3 provides information on employment for the profiled Primary and Secondary Aluminum production segments. Employment trends in the Primary Aluminum segment reflect producers‟ efforts to compete with less labor-intensive minimills through improvements in labor productivity (McGraw-Hill, 2000). Overall, between 1987 and 2010, both the Primary and Secondary Aluminum segments saw substantial declines in employment of approximately 61 percent and more than 38 percent, respectively. Most of this decline can be attributed to the current decade, during which employment in the Primary and Secondary Aluminum segments fell by about 54 percent and nearly 30 percent, respectively.

Figure A-3: Employment for Profiled Aluminum Industry Segments[a]

a. Before 1997, the Department of Commerce compiled data in the SIC system; since 1997, these data have been compiled in the North American Industry Classification System (NAICS). For this analysis, EPA converted the SIC classification data to the NAICS code classifications using the 1997 Economic Census Bridge Between SIC and NAICS.

Source: U.S. DOC, 1988-1991, 1993-1996, 1998-2001, 2002-2006, and 2008-2010 ASM; U.S. DOC, 1987, 1992, 1997, 2002, and 2007 EC.

Table A-7: presents year-over-year changes in value added per labor hour, a measure of labor productivity, for the Primary and Secondary Aluminum production segments between 1987 and 2010. The trend in labor productivity in both segments shows volatility over the entire analysis period, reflecting variations in capacity utilization (*Section A.3.6*). Between 1987 and 2010, labor productivity in the Primary Aluminum segment decreased by 19 percent, with an average annual decline of approximately 1 percent. During the same time, labor productivity in the Secondary Aluminum segment improved by about 62 percent, despite significant declines between 2006 and 2009. During the last decade, however, both profiled segments experienced an improvement in labor productivity with the Primary Aluminum segment showing a 10 percent increase and the Secondary Aluminum segment showing an approximately 16 percent increase.

Table A-7: Productivity Trends for Profiled Aluminum Segments ($2011)

Year[a]	Primary Stages of Aluminum Production				Secondary Stages of Aluminum Production			
	Value Added (millions)	Production Hours (millions)	Value Added/Hour ($/hour)	Value Added/Hour Percent Change	Value Added (millions)	Production Hours (millions)	Value Added/Hour ($/hour)	Value Added/Hour Percent Change
1987	$4,550	32	142	NA	$4,046	51	79	NA
1988	$7,366	37	201	41.6%	$4,408	53	84	5.5%
1989	$5,837	35	167	-16.9%	$4,230	54	79	-5.6%
1990	$4,555	37	123	-26.5%	$4,898	52	94	18.5%
1991	$3,632	38	96	-21.9%	$4,600	51	91	-3.1%
1992	$3,430	38	90	-6.2%	$5,808	52	111	22.7%
1993	$2,705	35	78	-12.8%	$5,019	51	99	-10.7%
1994	$3,444	32	107	36.9%	$5,343	49	108	9.2%
1995	$4,761	34	141	31.3%	$5,448	52	106	-2.7%
1996	$3,440	34	103	-27.0%	$5,664	53	108	2.1%
1997	$3,700	31	119	15.8%	$5,818	52	112	3.6%
1998	$3,518	32	111	-6.4%	$7,063	51	140	25.1%
1999	$3,099	30	102	-8.5%	$7,905	49	162	16.1%
2000	$3,008	29	104	2.2%	$5,120	46	110	-32.0%
2001	$3,228	24	135	29.3%	$4,317	43	100	-9.3%
2002	$2,926	24	122	-9.3%	$5,023	41	123	23.3%
2003	$2,177	21	105	-14.0%	$4,838	41	117	-4.9%
2004	$3,015	19	156	48.5%	$4,834	41	118	0.3%
2005	$2,565	17	150	-3.8%	$5,625	43	130	10.5%
2006	$3,414	16	208	38.7%	$6,445	41	159	22.1%
2007	$3,067	18	167	-19.9%	$5,936	42	140	-11.9%
2008	$2,877	18	156	-6.6%	$5,209	41	129	-8.1%
2009	$1,115	15	75	-51.6%	$3,023	30	101	-21.4%
2010	$1,592	14	115	52.4%	$4,195	33	128	26.8%
Total Percent Change 1987- 2010	**-65.0%**	**-56.8%**	**-19.0%**		**3.7%**	**-35.8%**	**61.5%**	
Total Percent Change 2000- 2010	**-47.1%**	**-52.0%**	**10.2%**		**-18.1%**	**-29.4%**	**16.1%**	
Average Annual Growth Rate	**-4.5%**	**-3.6%**	**-0.9%**		**0.2%**	**-1.9%**	**2.1%**	

a. Before 1997, the Department of Commerce compiled data in the SIC system; since 1997, these data have been compiled in the North American Industry Classification System (NAICS). For this analysis, EPA converted the NAICS classification data to the SIC code classifications using the *1997 Economic Census Bridge Between NAICS and SIC*.

Source: U.S. DOC, 1988-1991, 1993-1996, 1998-2001, 2003-2006, and 2008-2010 ASM; U.S. DOC, 1987, 1992, 1997, 2002, and 2007 EC.

A.3.5 Capital Expenditures

Aluminum production is a highly capital-intensive process. Capital expenditures are needed to modernize, replace, and when market conditions warrant, expand capacity. Environmental requirements may also require substantial capital expenditures.

Table A-8 presents capital expenditures in the Primary and Secondary Aluminum production segments during 1987 through 2010. As shown by the table, capital expenditures in the Primary Aluminum segment fluctuated in the early 1990s, but steadily increased beginning in 1995 and through the remainder of the decade, eventually increasing more than 200 percent. In the last ten years however, this segment has shown large fluctuations in capital expenditures from one year to the next, rising and falling as much as 52 percent in a single year. These changes resulted from the production surges and cutbacks, and capacity fluctuations, in response to supply and demand conditions prevalent in the market for aluminum.

Capital expenditures in the Secondary Aluminum production segment also fluctuated considerably between 1987 and 2007, peaking in 1990, ten years earlier than in the Primary Aluminum segment. Between 1991 and 1993 producers of Secondary Aluminum reduced capital expenditures by approximately 53 percent. Capital expenditures in this segment fluctuated during the remainder of the decade until 2001, after which expenditures decreased more than 60 percent in two years. However, between 2005 and 2007, outlays increased by 70 percent in response to increase in world demand. However, as a result of the recession beginning in 2007/2008, lack of credit to aluminum companies was expected to cause delays in expansion projects in many parts of the world (USGS, 2008a). Indeed, in 2009, capital expenditures in both profiled segments appeared to be impacted by the recession with declines of about 38 percent and 57 percent in the Primary Aluminum segment and the Secondary Aluminum segment, respectively. In 2010, as the world economy began to recover, however slowly, capital expenditures increased by about 6 percent and 53 percent in the Primary Aluminum segment and the Secondary Aluminum segment, respectively.

Table A-8: Capital Expenditures for Profiled Aluminum Segments (millions, $2011)

	Primary Stages of Aluminum Production		Secondary Stages of Aluminum Production	
Year[a]	**Capital Expenditures**	**Percent Change**	**Capital Expenditures**	**Percent Change**
1987	$451	NA	$830	NA
1988	$347	-23.2%	$955	15.0%
1989	$388	12.1%	$997	4.4%
1990	$366	-5.7%	$1,157	16.1%
1991	$388	5.8%	$922	-20.4%
1992	$389	0.4%	$741	-19.6%
1993	$307	-21.2%	$436	-41.2%
1994	$238	-22.4%	$470	7.8%
1995	$258	8.6%	$602	28.0%
1996	$328	27.0%	$615	2.3%
1997	$559	70.3%	$560	-9.0%
1998	$646	15.6%	$508	-9.2%
1999	$588	-9.1%	$561	10.3%
2000	$840	42.9%	$588	4.8%
2001	$468	-44.3%	$792	34.8%
2002	$227	-51.5%	$446	-43.7%
2003	$127	-44.1%	$308	-31.0%
2004	$175	38.0%	$308	-0.2%
2005	$129	-26.1%	$429	39.6%
2006	$166	28.6%	$487	13.5%
2007	$216	30.0%	$726	49.0%
2008	$222	2.4%	$556	-23.4%
2009	$137	-38.0%	$241	-56.6%
2010	$145	5.5%	$370	53.2%
Total Percent Change 1987 - 2010	**-67.9%**		**-55.4%**	
Total Percent Change 2000 - 2010	**-82.8%**		**-37.1%**	
Average Annual Growth Rate	**-4.8%**		**-3.5%**	

a. Before 1997, the Department of Commerce compiled data in the SIC system; since 1997, these data have been compiled in the North American Industry Classification System (NAICS). For this analysis, EPA converted the NAICS classification data to the SIC code classifications using the 1997 Economic Census Bridge Between NAICS and SIC.

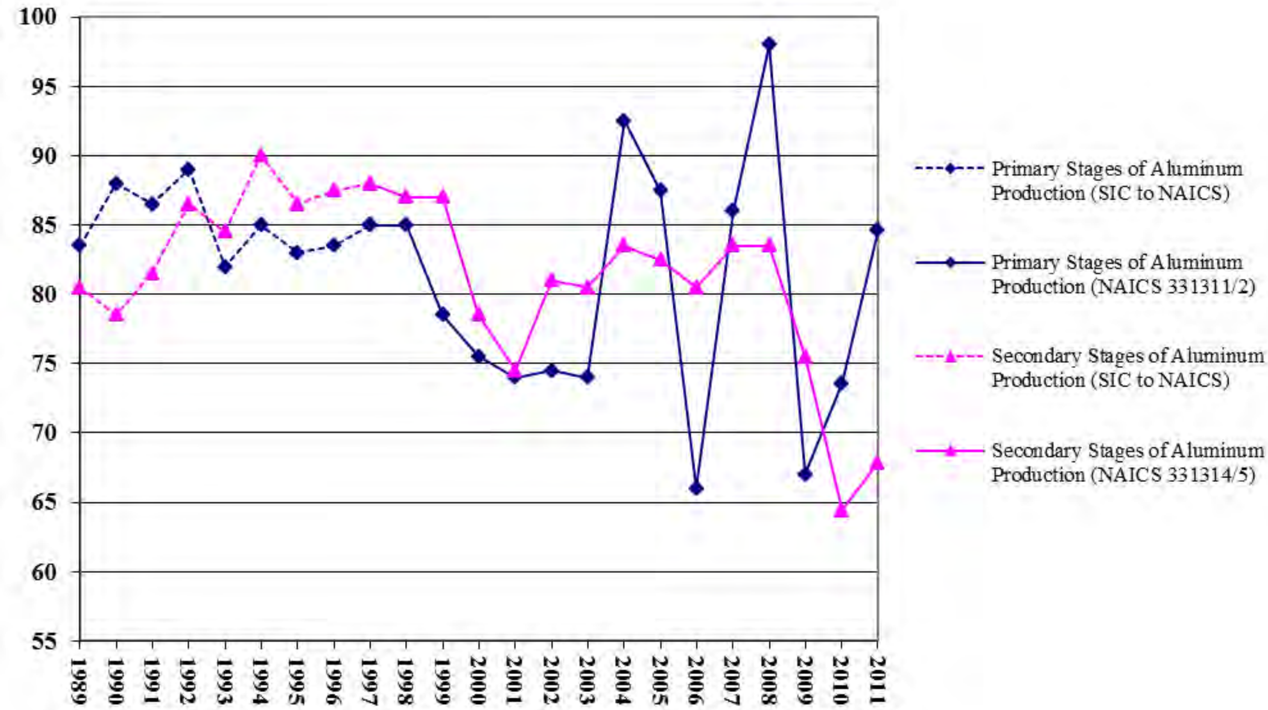
Source: U.S. DOC, 1988-1991, 1993-1996, 1998-2001, 2003-2006, and 2008-2010 ASM; U.S. DOC, 1987, 1992, 1997, 2002, and 2007 EC.

A.3.6 Capacity Utilization

Capacity utilization measures actual output as a percentage of total potential output given the available capacity. Capacity utilization reflects excess or insufficient capacity in an industry and is an indication of whether new investment is likely. Capacity utilization is also closely linked to financial performance for industries with substantial fixed costs, such as the aluminum industry. Like integrated steel mills, the aluminum manufacturing process requires a large capital base to transform raw material into finished product. Because of the resulting high fixed costs of production, earnings can be very sensitive to production levels, with high output levels relative to capacity needed for plants to remain profitable.

Figure A-4 shows capacity utilization from 1989 through 2011 for the two profiled Aluminum Industry segments. As shown, capacity utilization fluctuated substantially throughout the 23-year analysis period for both segments. Between 1989 and 1998, capacity utilization in the Secondary Aluminum production segment increased on average, largely due to high demand for rolled aluminum products, which account for more than 50 percent of all shipments from the aluminum industry. Increased consumption by the transportation segment, the largest end-use segment for the Secondary Aluminum production segment, is responsible for bringing idle capacity into production (McGraw-Hill, 1999). At the same time, capacity utilization in the profiled Primary Aluminum production segment remained approximately the same after some fluctuations during that decade. However, between 1998 and 2001, the general weakening of demand for aluminum products during the Asian economic crisis and later, general economic weakness in domestic and world economies, resulted in a marked fall-off in capacity utilization in both profiled segments. Again, reflecting the economic recovery that began in 2002, capacity utilization in both profiled segments began to rise and by 2008 had risen substantially. While capacity utilization in both profiled segments fluctuated during the current decade, the Primary Aluminum production segment generally experienced larger fluctuations. More recently, as a result of the economic recession that began in 2007/2008, both profiled segments experienced a decline in capacity utilization. While during 2010 and 2011, production in both profiled Aluminum Segments began to increase in response to general economic recovery leading to higher capacity utilization, the recovery in the Secondary Aluminum segment was slightly delayed and seems to have been slower compared to that in the Primary Aluminum segment. Recovery in the Primary Aluminum segment began in 2010, and during 2010 and 2011 capacity utilization in this segment increased by about 26 percent. The Secondary Aluminum segment began to recover in 2011 and during that year its capacity utilization increased by approximately 5 percent.

Figure A-4: Capacity Utilization Rates (Fourth Quarter) for Profiled Aluminum Industry Segments[a,b,c]



a. Before 1997, the Department of Commerce compiled data in the SIC system; since 1997, these data have been compiled in the North American Industry Classification System (NAICS). For this analysis, EPA converted the NAICS classification data to the SIC code classifications using the 1997 Economic Census *Bridge Between NAICS and SIC.*
b. Before 2007, U.S. Census sampled every industry in a specific NAICS6. Beginning in 2007, U.S. Census only sampled certain industries within any NAICS6, and therefore, the data collected before 2007 cannot be directly compared to the data collected in 2007 and beyond.
c. Capacity Utilization for the Primary Aluminum production segment (NAICS 331311/2) for 2007-2009 are for NAICS 331312; 2007-2009 data for NAICS 331311 were not available from the Census Bureau at the time of the analysis.
Source: U.S. DOC, 1989-2011 SPC.

A.4 Structure and Competitiveness

On average, the U.S. Aluminum industry has moderate-to-high industry concentration, with the Primary Aluminum production segment being slightly more concentrated than the Secondary Aluminum production segment. A number of large mergers among aluminum producers have increased the degree of concentration in the industry in recent years. For example, Alcoa (the largest aluminum producer) acquired Alumax (the third largest producer) in 1998 and Reynolds (the second largest producer) in May 2000. Alcan acquired Algroup in 2000 and Pechiney in 2004. As the result of these acquisitions, three companies accounted for 41 percent of primary global aluminum output. In 2007, Rusal and Sual and Rio Tinto acquired Alcan, thereby increasing concentration in the profiles Aluminum Industry. At that time, industry analysts speculated that with a greater degree of concentration, capacity would be more closely managed during varying market conditions, which would likely reduce volatility of industry prices and profits (USGS, 2008a).

A.4.1 Firm Size

The Small Business Administration (SBA) defines a small firm for Primary Aluminum production (NAICS 331311 and 331312) as a firm with 1,000 or fewer employees and for Secondary Aluminum Production (NAICS 331314 and 331315) as a firm with 750 or fewer employees. The Statistics of U.S. Businesses (SUSB) provides employment data for firms with 500 or fewer employees and does not specify data for companies with 500-750 employees for the Primary Production industry and 500-1000 for the Secondary Production industry. Based on 2009 data for firms with up to 500 employees,

- 56 of the 69 firms in the Primary Aluminum production segment had less than 500 employees. Therefore, at least 81 percent of this segment‟s firms are classified as small. These small firms owned 56 facilities, or 70 percent of all facilities in the segment.
- 173 of the 199 firms in the Secondary Aluminum production segment had less than 500 employees. Therefore, at least 87 percent of this segment‟s firms are classified as small. These small firms owned 183 facilities, or 74 percent of all facilities in the segment.

Table A-9 below shows the distribution of firms and facilities in the Primary Aluminum production segment (NAICS 331311 and 331312) and the Secondary Aluminum production segment (NAICS 331314 and 331315) by employment size of the parent firm.

Table A-9: Number of Firms and Facilities by Employment Size Category for the Profiled Aluminum Industry Segments, 2009

Employment Size Category	Primary Stages of Aluminum Production		Secondary Stages of Aluminum Production	
	Number of Firms	Number of Facilities	Number of Firms	Number of Facilities
0-19	44	44	107	107
20-99	9	9	46	49
100-499	3	3	20	27
500+	13	24	26	63
Total	69	80	199	246

Source: U.S.DOC,, 2009 SUSB).

A.4.2 Concentration Ratios

Concentration is the degree to which industry output is concentrated in a few large firms. Concentration is closely related to entry barriers with more concentrated industries generally having higher barriers.

The ***four-firm concentration ratio (CR4)*** and the ***Herfindahl-Hirschman Index (HHI)*** are common measures of industry concentration. The CR4 indicates the market share of the four largest firms. For example, a CR4 of 72 percent means that the four largest firms in the industry account for 72 percent of the industry‟s total value of shipments. The higher the concentration ratio, the less competition there is in the industry, other things being equal.[171] An industry with a CR4 of more than 50 percent is generally considered concentrated. The HHI indicates concentration based on the largest 50 firms in the industry. It is equal to the sum of the squares of the market shares for the largest 50 firms in the industry. For example, if an industry consists of only three firms with market shares of 60, 30, and 10 percent, respectively, the HHI of this industry would be equal to 4,600 ($60^2 + 30^2 + 10^2$). The higher the index, the fewer the number of firms supplying the industry and the more concentrated the industry. Based on the U.S. Department of Justice‟s guidelines for evaluating mergers, markets in which the HHI is under 1,000 are considered unconcentrated, markets in which the HHI is between 1,000 and 1,800 are considered to be moderately concentrated, and those in which the HHI is in excess of 1,800 are considered to be concentrated.

Table A-10 shows that, overall, the concentration ratios for the profiled Primary Aluminum production segment (NAICS 331311 and 331312) have increased for the top four and eight firms, in spite of slight declines in 2007, since 1997. In 2007, the four largest firms in this segment accounted for 90 in the NAICS 331311 sub-segment

171 Note that the measured four-firm concentration ratio and the HHI are very sensitive to how the industry is defined. An industry with a high concentration in domestic production may nonetheless be subject to significant competitive pressures if it competes with foreign producers or if it competes with products produced by other industries (e.g., plastics vs. aluminum in beverage containers). Concentration ratios based on share of domestic production are therefore only one indicator of the extent of competition in an industry.

and 77 percent in the NAICS 331312 sub-segment of total U.S. primary capacity. Consolidation in the industry since the early 1990s has increased market concentration. With the merger of Alcoa, Inc. and Reynolds in May 2000, the single merged company accounted for 50 percent of domestic primary aluminum capacity, and the four largest U.S. producers controlled 72 percent of domestic capacity (Alcoa Inc. for 50 percent, Century Aluminum Co. for almost 10 percent, and Noranda Aluminum Inc. and Ormet Primary Aluminum Corp. for 6 percent each) reported at the end of 2002 (USGS, 2002a). The HHI reported for NAICS 331312 sub-segment is 2,250, indicating that this sector is concentrated. While no 2007 HHI is reported for NAICS 331311sub-segment, given that twenty largest firms in this sub-segment account for the entirety of this sub-segment‟s total value of shipments (CR20=100) together with a high four-firm ratio, it is reasonable to conclude that this sub-segment is also highly concentrated.

As reported in *Table A-10*, in 2007 the profiled Secondary Aluminum production NAICS 331313 and NAICS 331314 sub-segments had HHI of 931 and 1,995, respectively. On average, this segment as a whole can be considered moderately concentrated. Thus, based on these ratios and indices, firms in the profiled Primary Aluminum production segment on average enjoy higher market power than those in the profiled Secondary Aluminum production segment. Consequently, based on market concentration data, while the firms in the Primary Aluminum production segment may be able to pass some of their compliance costs onto their consumers, the firms in the Secondary Aluminum production segment are less likely to be able to do so. However, an accurate assessment of the cost pass-through potential of firms in the Aluminum industry must be considered in conjunction with other measures of market power.

Table A-10: Selected Ratios for the Profiled Aluminum Segments, 1987, 1992, 1997, 2002 and 2007

SIC (S) or NAICS (N) Code	Year[b,c]	Total Number of Firms	Concentration Ratios				
			4 Firm (CR4)	8 Firm (CR8)	20 Firm (CR20)	50 Firm (CR50)	Herfindahl-Hirschman Index
S 2819[a]	1987	427	38%	49%	68%	84%	468
	1992	446	39%	50%	68%	85%	677
N 331311	1997	5	NA	100%	NA	NA	NA
	2002	8	97%	100%	NA	NA	NA
	2007	**12**	**90%**	**99%**	**100%**	**NA**	**NA**
S 3334	1987	34	74%	95%	99%	100%	1,934
	1992	30	59%	82%	99%	100%	1,456
N 331312	1997	13	59%	82%	100%	NA	1,231
	2002	26	85%	98%	100%	100%	NA
	2007	**34**	**77%**	**95%**	**100%**	**100%**	**2,250**
S 3341	1987	365	24%	36%	52%	74%	251
	1992	346	28%	41%	60%	79%	300
N 331314	1997	87	41%	54%	76%	94%	630
	2002	124	45%	58%	79%	96%	694
	2007	**108**	**55%**	**66%**	**83%**	**96%**	**931**
S 3353	1987	39	74%	91%	99%	100%	1,719
	1992	45	68%	86%	99%	100%	1,633
N 331315	1997	41	65%	85%	98%	100%	1,447
	2002	79	71%	87%	97%	100%	1,856
	2007	**89**	**71%**	**87%**	**98%**	**100%**	**1,995**

a. SIC code represents largest percentage of facilities and value of shipments within this NAICS based on the 1997 Bridge Between SIC and NAICS
b. Before 1997, data were compiled in the SIC system; since 1997, these data have been compiled in the NAICS system. For this analysis, EPA converted the NAICS classification data to the SIC code classifications using the *1997 Economic Census Bridge Between NAICS and SIC.*
c The *2002 Census of Manufactures* is the most recent concentration ratio data available.
Source: U.S. DOC, 1987, 1992, 1997, 2002, and 2007 EC.

A.4.3 Foreign Trade

This profile uses two measures of foreign competition: ***export dependence*** and ***import penetration***.

Import penetration measures the extent to which domestic firms are exposed to foreign competition in domestic markets. Import penetration is calculated as total imports divided by total value of domestic consumption in that industry: where domestic consumption equals domestic production plus imports minus exports. Theory suggests that higher import penetration levels will reduce market power and pricing discretion because foreign competition limits domestic firms" ability to exercise such power. Firms belonging to segments in which imports account for a relatively large share of domestic sales would therefore be at a relative disadvantage in their ability to pass-through costs because foreign producers would not incur costs as a result of the Final Existing Facilities Regulation. The estimated import penetration ratio for the entire U.S. manufacturing sector (NAICS 31-33) for 2010 is 28 percent. For characterizing the ability of industries to absorb compliance cost burdens, EPA judges that industries with import ratios close to or above 28 percent would more likely face stiff competition from foreign firms and thus be less likely to succeed in passing compliance costs through to customers.

Export dependence, calculated as exports divided by value of shipments, measures the share of a segment"s sales that is presumed subject to strong foreign competition in export markets. The Final Existing Facilities Regulation would not increase the production costs of foreign producers with whom domestic firms must compete in export markets. As a result, firms in industries that rely to a greater extent on export sales would have less latitude in increasing prices to recover cost increases resulting from regulation-induced increases in production costs. The estimated export dependence ratio for the entire U.S. manufacturing sector for 2010 is 22 percent. For characterizing the ability of industries to absorb compliance cost burdens, EPA judges that industries with export ratios close to or above 22 percent are at a relatively greater disadvantage in potentially recovering compliance costs through price increases since export sales are presumed subject to substantial competition from foreign producers.

Table A-11 reports export dependence and import penetration for both the Primary and Secondary Aluminum production segments, from 1990 through 2010. Imports of Primary Aluminum rose dramatically in 1994, primarily due to the large exports from Russian producers. Representatives of major aluminum producing countries met in late 1993 and 1994 to address the excess global supply of primary aluminum. Those discussions resulted in the Russian Federation"s agreement to reduce production by 500,000 MTs per year, and plans for other producers to cut their production and to assist Russian producers to improve their environmental performance and stimulate the development of internal demand for the Russian production (USGS, 1994a). Nonetheless, imports continued to represent a substantial and increasing share of total U.S. consumption until 2007. From 2007 to 2009, both exports and imports declined by approximately 39 percent and 42 percent, respectively in response to economic recession and consequent decline in demand (44 percent) for Primary Aluminum. As the world economy in general and U.S. economy in particular began to recover in 2010, higher demand for Primary Aluminum resulted in its greater exports and imports. In 2011, domestic primary production rose but remained below 2008 levels. Imports of aluminum increased slightly over 2010 levels while exports of scrap continued to rise (USGS, 2012c).

Between 1990 and 2010, imports in the Primary Aluminum production segment on average grew by more than 4 percent each year while exports declined by more than 3 percent and value of shipments declined by nearly 4 percent each year, thereby indicating a continuous growth in dependence of the U.S. economy on Primary Aluminum imports and a steady decline of U.S. competitiveness on the world aluminum market. In 2010, the import penetration ratio for the Primary Aluminum production segment was 63 percent, which is more than double the U.S. manufacturing industry average of 28 percent. The export dependence ratio for the Primary Aluminum production segment in 2010 was 28 percent compared to the national manufacturing average of 22 percent. This shows that the regulated facilities in the profiled Primary Aluminum production segment are subject to significant international competitive pressures, largely manifesting though the increasing penetration of foreign product into domestic markets as well as declining competitiveness of domestically produced aluminum on world aluminum markets. Consequently, these facilities are not very likely to be able to pass a material share of compliance costs through to consumers.

Facilities in the profiled Secondary Aluminum production segment face lower competition from foreign producers in domestic and foreign markets than facilities in the profiled Primary Aluminum production segment. In the

Secondary Aluminum production segment, between 1990 and 2010 exports and imports experienced an annual average growth, however small, of approximately 1 percent, while value of shipments declined slightly by less than 1 percent. In 2010, the import penetration ratio for the Secondary Aluminum production segment was 14 percent, which is one-half of the U.S. manufacturing industry average of 28 percent. The export ratio for the Secondary Aluminum production segment in 2010 was 15 percent, or seven percentage points below the average for the U.S. manufacturing industry. Consequently, regulated facilities in the profiled Secondary Aluminum production segment would probably be in a better position to recover regulation-induced increases in production costs through price increases compared to regulated facilities in the profiled Primary Aluminum production segment.

Overall, the competitive pressures from foreign firms/markets may offset the finding stated above, that the profiled Aluminum industry would appear to possess market power from being a moderately to highly concentrated industry. While the Primary Aluminum segment appears to be highly concentrated, it is subject to significant international competitive pressures. On the other hand, while competitive pressures in the Secondary Aluminum segment appear to be less significant, this segment exhibits lower level of market concentration. As a result, from a *total market perspective*, the industry is not likely to possess any *substantial* market power advantage in being able to pass compliance costs through to customers as price increases.

Table A-11: Import Share and Export Dependence for the Profiled Aluminum Segments ($2011)						
Year[a]	Value of Imports (millions)	Value of Exports (millions)	Value of Shipments (millions)	Implied Domestic Consumption[b]	Import Penetration[c]	Export Dependence[d]
Primary Stage of Aluminum Production						
1990	$3,063	$3,063	$12,829	$12,829	24%	24%
1991	$2,680	$2,680	$11,228	$11,228	24%	24%
1992	$2,724	$2,724	$10,398	$10,398	26%	26%
1993	$3,628	$3,628	$9,198	$9,198	39%	39%
1994	$5,567	$5,567	$9,396	$9,396	59%	59%
1995	$5,884	$5,884	$10,588	$10,588	56%	56%
1996	$4,891	$4,891	$9,290	$9,290	53%	53%
1997	$6,131	$1,486	$9,971	$14,616	42%	15%
1998	$6,289	$1,327	$9,967	$14,929	42%	13%
1999	$6,326	$1,285	$9,124	$14,165	45%	14%
2000	$6,688	$1,340	$9,139	$14,487	46%	15%
2001	$6,000	$1,069	$7,783	$12,714	47%	14%
2002	$5,959	$925	$7,709	$12,742	47%	12%
2003	$5,986	$848	$6,428	$11,565	52%	13%
2004	$7,645	$1,178	$7,195	$13,662	56%	16%
2005	$8,899	$1,470	$6,925	$14,354	62%	21%
2006	$10,846	$1,941	$8,182	$17,087	63%	24%
2007	$9,980	$1,770	$8,384	$16,595	60%	21%
2008	$9,352	$1,679	$8,544	$16,217	58%	20%
2009	$5,830	$1,072	$4,662	$9,420	62%	23%
2010	$7,017	$1,601	$5,775	$11,191	63%	28%
Total Percent Change 1990 - 2010	**129.1%**	**-47.7%**	**-55.0%**	**-12.8%**		
Total Percent Change 2000 - 2010	**4.9%**	**19.5%**	**-36.8%**	**-22.8%**		
Average Annual Growth Rate	**4.2%**	**-3.2%**	**-3.9%**	**-0.7%**		
Secondary Stages of Aluminum Production						
1990	$2,506	$2,506	$22,446	$22,446	11%	11%
1991	$1,745	$1,745	$20,307	$20,307	9%	9%
1992	$1,847	$1,847	$20,545	$20,545	9%	9%
1993	$1,769	$1,769	$18,365	$18,365	10%	10%
1994	$1,947	$1,947	$20,291	$20,291	10%	10%
1995	$2,727	$2,727	$24,906	$24,906	11%	11%
1996	$2,283	$2,283	$22,330	$22,330	10%	10%
1997	$1,789	$3,314	$23,178	$21,653	8%	14%
1998	$1,918	$3,125	$22,015	$20,808	9%	14%
1999	$1,958	$2,955	$21,397	$20,400	10%	14%
2000	$2,154	$2,997	$21,160	$20,317	11%	14%
2001	$1,877	$2,596	$18,546	$17,827	11%	14%
2002	$2,016	$2,272	$18,402	$18,147	11%	12%
2003	$2,095	$2,283	$18,279	$18,092	12%	12%
2004	$2,550	$2,775	$20,396	$20,171	13%	14%
2005	$3,468	$3,165	$23,385	$23,688	15%	14%
2006	$3,998	$3,722	$27,018	$27,295	15%	14%
2007	$3,710	$3,765	$26,858	$26,803	14%	14%
2008	$3,316	$3,979	$24,437	$23,774	14%	16%
2009	$1,852	$2,750	$15,382	$14,483	13%	18%
2010	$2,648	$3,065	$19,823	$19,407	14%	15%
Total Percent Change 1990 - 2010	**5.7%**	**22.3%**	**-11.7%**	**-13.5%**		
Total Percent Change 2000 - 2010	**23.0%**	**2.3%**	**-6.3%**	**-4.5%**		
Average Annual Growth Rate	**0.3%**	**1.0%**	**-0.6%**	**-0.7%**		

a. Before 1998, the Department of Commerce compiled data in the SIC system; since 1998, these data have been compiled in the North American Industry Classification System (NAICS). For this analysis, EPA converted the NAICS classification data to the SIC code classifications using the 1997 Economic Census Bridge Between NAICS and SIC.
b. Calculated by EPA as shipments + imports - exports.
c. Calculated by EPA as imports divided by implied domestic consumption.
d. Calculated by EPA as exports divided by shipments.
Source: U.S. ITC, 1990-2010.

Table A-12 shows trends in exports and imports for the profiled Primary and Secondary Aluminum production segments separately. U.S. aluminum companies have a large overseas presence, which makes it difficult to analyze import data. Reported import data may reflect shipments from an overseas facility owned by a U.S. firm. The import data therefore do not provide a completely accurate picture of the extent to which foreign companies have penetrated the domestic market for aluminum. This table shows that imports have grown substantially in both profiled segments between 1993 and 2010. Exports of Primary Aluminum declined significantly, with some fluctuation over the period. Exports of Secondary Aluminum, on the other hand, increased by more than 30 percent, also with some fluctuations during this analysis period. Overall, both profiled segments experienced a decline in exports and imports during 2007 through 2009 in response to economic recessionary pressures; however, this trend seems to have reversed in 2010 in response to economic recovery.

Table A-12: Trade Statistics for Aluminum and Semi-fabricated Aluminum Products (Quantities in thousand metric tons; Values in millions, $2011)

	Primary Aluminum Production				Secondary Aluminum Production			
	Import[a]		Export[b]		Import[a]		Export[b]	
Year	Quantity	Value	Quantity	Value	Quantity	Value	Quantity	Value
1993	1,840	$3,113	400	$783	400	$1,212	594	$2,144
1994	2,480	$4,935	339	$760	507	$1,534	719	$2,619
1995	1,930	$5,126	369	$958	622	$2,282	812	$3,638
1996	1,910	$4,144	417	$930	498	$1,749	760	$3,247
1997	2,060	$4,688	352	$812	562	$2,035	882	$3,678
1998	2,400	$4,848	265	$595	649	$2,272	893	$3,607
1999	2,650	$4,908	318	$672	735	$2,320	907	$3,347
2000	2,490	$5,149	273	$598	791	$2,668	845	$3,041
2001	2,560	$4,910	192	$400	683	$2,202	751	$2,649
2002	2,790	$4,967	206	$414	796	$2,363	706	$2,312
2003	2,870	$5,142	214	$423	653	$1,818	690	$2,288
2004	3,250	$6,887	298	$662	724	$2,284	795	$2,788
2005	3,660	$8,094	329	$755	927	$3,072	886	$3,299
2006	3,440	$9,927	346	$995	914	$3,547	923	$3,931
2007	2,950	$8,847	349	$1,017	801	$3,276	887	$3,980
2008	2,790	$8,154	308	$929	693	$2,892	929	$4,197
2009	2,900	$5,133	262	$532	499	$1,604	739	$2,929
2010	2,650	$6,240	284	$724	666	$2,318	786	$3,299
Total Percent Change 1993-2010	**44.02%**	**100.46%**	**-29.00%**	**-7.56%**	**66.50%**	**91.30%**	**32.32%**	**53.84%**
Total Percent Change 2000-2010	**6.43%**	**21.19%**	**4.03%**	**21.10%**	**-15.80%**	**-13.10%**	**-6.98%**	**8.49%**
Average Annual Growth Rate	**2.17%**	**4.18%**	**-1.99%**	**-0.46%**	**3.04%**	**3.89%**	**1.66%**	**2.57%**

a. Table 10: U.S. Imports for Consumption of Aluminum, by Class
b. Table 9: U.S. Exports of Aluminum, by Class
Source: USGS, 1993-2010a.

A.5 Financial Condition and Performance

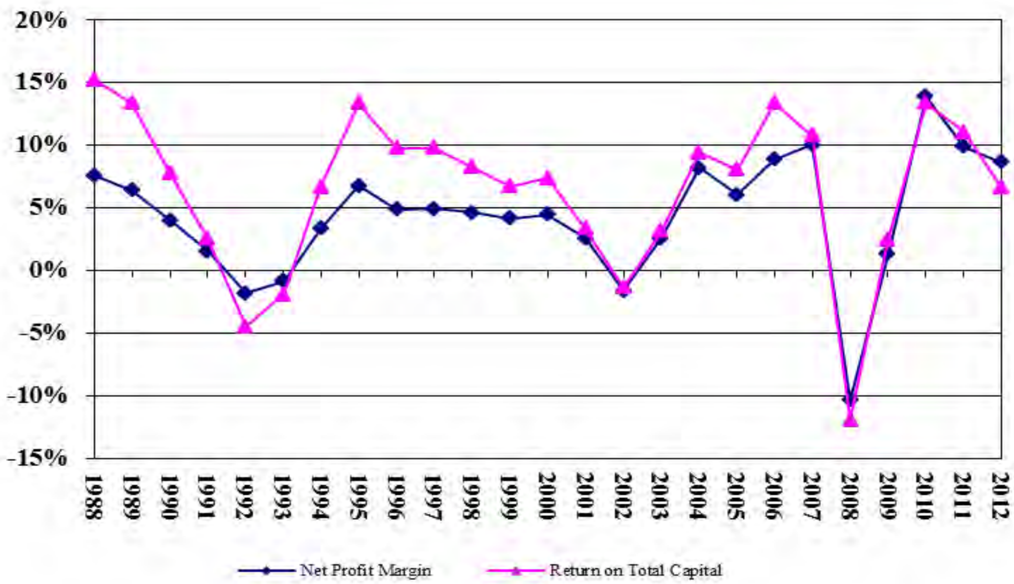
The financial performance and condition of the aluminum industry are important determinants of its ability to absorb the costs of regulatory compliance without material, adverse economic/financial impact. To provide insight into the industry‟s financial performance and condition, EPA reviewed two key measures of financial performance over the period 1988 to 2012: ***net profit margin*** and ***return on total capital***. EPA calculated these measures using data from the Quarterly Financial Report for Manufacturing, Mining, and Trade Corporations (QFR) published by the U.S. Census Bureau. Financial performance in the most recent financial reporting period (2010) is obviously not a perfect indicator of conditions at the time of regulatory compliance. However, examining the trend and deviation from the trend through the most recent reporting period gives insight into where the industry *may be* in terms of financial performance and condition, at the time of compliance. In addition, the volatility of performance against the trend, in itself, provides a measure of the potential risk faced by the industry in a future period in which compliance requirements are faced: all else equal, the more volatile the historical performance, the more likely the industry *may be* in a period of relatively weak financial conditions at the time of compliance.

Net profit margin is calculated as after-tax income before nonrecurring gains and losses as a percentage of sales or revenues, and measures profitability, as reflected in the conventional accounting concept of net income. Over time, the firms in an industry, and the industry collectively, must generate a sufficient positive profit margin if the industry is to remain economically viable and attract capital. Year-to-year fluctuations in profit margin stem from a several factors, including: variations in aggregate economic conditions (including international and U.S. conditions), variations in industry-specific market conditions (e.g., short-term capacity expansion resulting in overcapacity), or changes in the pricing and availability of inputs to the industry‟s production processes (e.g., the cost of energy to the aluminum production process). The extent to which these fluctuations affect an industry‟s profitability, in turn, depends heavily on the fixed vs. variable cost structure of the industry‟s operations. In a capital intensive industry such as the aluminum industry, the relatively high fixed capital costs as well as other fixed overhead outlays, can cause even small fluctuations in output or prices to have a large positive or negative affect on profit margin.

Return on total capital is calculated as annual pre-tax income divided by the sum of current portion of long-term debt due in one year or less, long-term debt due in more than one year, all other noncurrent liabilities and total stockholders‟ equity (total capital). This concept measures the total productivity of the capital deployed by a firm or industry, regardless of the financial source of the capital (i.e., equity, debt, or liability element). As such, the return on total capital provides insight into the profitability of a business‟ assets independent of financial structure and is thus a “purer” indicator of asset profitability than return on equity. In the same way as described for net profit margin, the firms in an industry, and the industry collectively, must generate over time a sufficient return on capital if the industry is to remain economically viable and attract capital. The factors causing short-term variation in net profit margin will also be the primary sources of short-term variation in return on total capital.

Figure A-5 shows net profit margin and return on total capital for the aluminum industry between 1998 and 2012. The graph shows considerable volatility in both metrics. Financial performance declined significantly between 1988 and 1992, reflecting general economic weaknesses and oversupply in the market (McGraw-Hill, 2000). By the mid-1990s, performance improved as demand recovered and aluminum prices increased. Between 2000 and 2002 financial performance declined again, reflecting economic downturn in both the United States and world economies. Financial health of the Aluminum industry began to improve after that and continued to do so until it significantly deteriorated in 2008 as a result of recession that affected every industry in the nation. During the fourth quarter of 2008 and early 2009, a number of smelters closed and the price of aluminum continued to decline (USGS, 2008a). However, as the economy began to recover during the latter part of 2009 and 2010, both net profit margin and return on total capital increased and, in 2010, exceeded pre-recessionary levels. In 2011, one smelter that has closed in 2009 was reopened while five potlines, which closed in late 2008 and early 2009, were restarted (USGS, 2012c). After a steep increase in 2010, profit margin and return on total capital declined in 2011 and 2012, moving towards each indicators long-term average.

Figure A-5: Net Profit Margin and Return on Total Capital for the Non-Ferrous Metals Industry



Source: U.S. DOC, 1988-2010 QFR.

A.6 Facilities Operating Cooling Water Intake Structures

Section 316(b) of the Clean Water Act applies to point source facilities that use or propose to use a cooling water intake structure that withdraws cooling water directly from a surface waterbody of the United States. In 1982, the Primary Metals industries as a whole (including Steel and Non-ferrous producers) withdrew 1,312 billion gallons of cooling water, accounting for approximately 1.7 percent of total industrial cooling water intake in the United States.[172] The industry ranked 3rd in industrial cooling water use, behind the electric power generation industry, and the chemical industry (1982 Census of Manufactures).

This section provides information for facilities in the profiled aluminum segments estimated to be subject to regulation under the regulatory analysis options. Existing facilities that meet all of the following conditions would have been subject to the regulation under the three regulatory analysis options:

- Use a cooling water intake structure or structures, or obtain cooling water by any sort of contract or arrangement with an independent supplier who has a cooling water intake structure; or their cooling water intake structure(s) withdraw(s) cooling water from waters of the United States, and at least twenty-five (25) percent of the water withdrawn is used for contact or non-contact cooling purposes;
- Have an National Pollutant Discharge Elimination System (NPDES) permit or are required to obtain one; and
- Meet the applicability coverage criteria for the Final Regulation specific regulatory analysis option in terms of design intake flow (i.e., 2 MGD).

[172] Data on cooling water use are from the 1982 Census of Manufactures. 1982 was the last year in which the Census of Manufactures reported cooling water use.

EPA initially identified the set of facilities that were estimated to be *potentially* subject to the 316(b) Existing Facilities Regulation based on a minimum applicability threshold of 2 MGD; this section focuses on these facilities for the petroleum segment.[173]

A.6.1 Waterbody and Cooling Water Intake System Type

Table A-13, shows the distribution of facilities by type of water body and cooling system.

Table A-13: Number of Facilities Estimated Subject to the 2 MGD All Option by Waterbody Type and Cooling Water Intake System for the Profiled Aluminum Segments

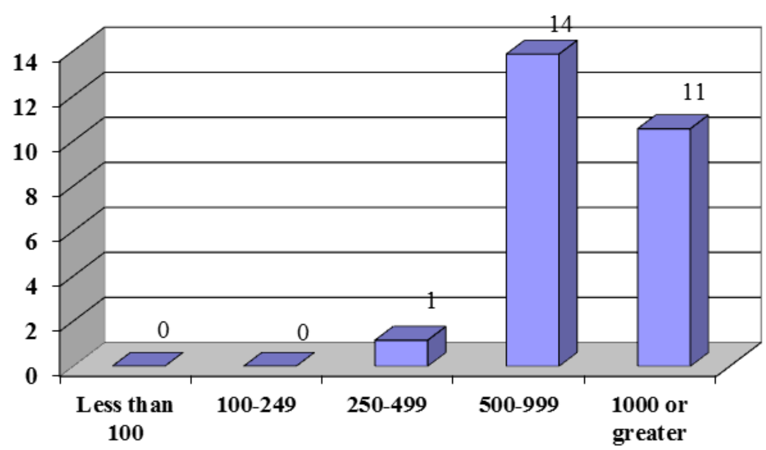
	Cooling Water Intake System				
	Recirculating[a]		Once-Through		
Water Body Type	Number	% of Total	Number	% of Total	Total
Estuary/Tidal River	0	0%	4	21%	4
Freshwater Stream/River	3	73%	14	64%	17
Lake or Reservoir	1	27%	0	0%	1
Great Lake	0	0%	3	15%	3
Total	**4**	**17%**	**21**	**83%**	**26**

a. Includes facilities that have cooling towers as well as those that use ponds.
Source: U.S. EPA, 2000; U.S. EPA analysis, 2013.

A.6.2 Facility Size

The 316(b) facilities in the aluminum industry subject to the regulation under the regulatory analysis options are relatively large. *Figure A-6*, shows the number of regulated facilities by employment size category.

Figure A-6: Number of Regulated Facilities Estimated Subject to the 316(b) Existing Facilities Regulation by Employment Size for the Profiled Aluminum Segments



Source: U.S. EPA, 2000; U.S. EPA analysis, 2013.

A.6.3 Firm Size

EPA used the Small Business Administration (SBA) small entity size standards to determine the number of Section 316(b) profiled aluminum industry facilities owned by small firms. Firms in the Primary Production of Aluminum segment are defined as small if they have 1000 or fewer employees; firms in the Secondary Production

[173] EPA applied sample weights to the sampled facilities to account for non-sampled facilities and facilities that did not respond to the survey. For more information on EPA"s 2000 Section 316(b) Industry Survey, please refer to the Information Collection Request (U.S. EPA, 2000).

segment are defined as small if they have 750 or fewer employees. EPA estimates there are seven small entity-owned facilities, and 18 large entity-owned facilities in the Aluminum industry subject to the regulation.

Appendix B Profile of the Chemicals and Allied Products Industry

B.1 Introduction

EPA‟s *Detailed Industry Questionnaire*, hereafter referred to as the DQ, identified 13 four-digit SIC codes in the Chemical and Allied Products Industry (SIC 28) with at least one existing facility that operates a CWIS, holds a NPDES permit, withdraws at least two million gallons per day (MGD) from a water of the United States, and uses at least 25 percent of its intake flow for cooling purposes (facilities with these characteristics are hereafter referred to as "facilities potentially subject to the 316(b) Existing Facilities Regulation" or "regulated facilities"). For this analysis, EPA identified a six-digit NAICS code for each of these potential facilities using the information from DQ and public sources (see *Appendix J: Mapping Manufacturers Standard Industrial Classification (SIC) Codes to North American Industry Classification System (NAICS) Codes*). As the result of this mapping, EPA identified 15 6-digit NAICS codes in the Chemicals and Allied Products manufacturing industry (NAICS 325).

For each of the 15 NAICS codes, *Table B-1*, following page, provides a description of the industry segment, a list of primary products manufactured, the total number of the DQ respondents (weighted to represent a national total of facilities that hold a NPDES permit and operate cooling water intake structures), and the number of facilities estimated to be potentially subject to Final 316(b) Existing Facilities Regulation based on the minimum withdrawal threshold of 2 MGD (see *Chapter 1: Introduction* for more details on the final rule applicability criteria).

Table B-1: Facilities in the Chemicals and Allied Products Industry (NAICS 325)

NAICS	NAICS Description	Important Products Manufactured	Number of Regulated Facilities[a]
Basic Chemicals (NAICS 3251XX)			
325110	Petrochemical mfg	Acyclic hydrocarbons such as ethylene, propylene, and butylene and cyclic aromatic hydrocarbons such as benzene and toluene made from refined petroleum or liquid hydrocarbons.	13
325120	Industrial gas mfg	Industrial organic and inorganic gases in compressed, liquid, and solid forms.	4
325131	Inorganic dye & pigment mfg	Inorganic dyes and pigments such as antimony, copper, lead, and titanium based pigments.	9
325181	Alkalies & chlorine mfg	Alkalies such as chlorine, sodium, and hydroxide using an electrolysis process.	19
325188	All other basic inorganic chemical mfg	Basic inorganic chemicals except industrial gases, inorganic dyes and pigments, alkalies and chlorine, and carbon black.	32
325199	All other basic organic chemical mfg	Basic organic chemical products, (except aromatic petrochemicals, industrial gases, synthetic organic dyes and pigments, gum and wood chemicals, cyclic crudes and intermediates, and ethyl alcohol).	38
Total Basic Chemicals			**115**
Resins and Synthetics (NAICS 3252XX)			
325211	Plastics material & resin mfg	Resins, plastics materials, and nonvulcanizable thermoplastic elastomers and mixing and blending resins on a custom basis; noncustomized synthetic resins.	25
325221	Cellulosic organic fiber mfg	Cellulosic (i.e. rayon and acetate) fibers and filaments in the form of monofilament, filament yarn, staple, or tow.	1
325222	Noncellulosic organic fiber mfg	Noncellulosic (i.e. nylon, polyolefin, and polyester) fibers and filaments in the form of monofilament, filament yarn, staple, or tow.	9
Total Resins and Synthetics			34
Pesticides and Fertilizers (SIC 3253XX)			
325311	Nitrogenous fertilizer mfg	Nitrogenous fertilizer materials and mixing ingredients into fertilizer; fertilizer from animal or sewage waste.	9
325312	Phosphatic fertilizer mfg	Phosphatic fertilizer material and phosphatic material mixed into fertilizer.	1
Total Pesticides and Fertilizers			**10**
Pharmaceuticals (3254XX)			
325411	Medicinal & botanical mfg	Uncompounded medicinal chemicals and their derivatives (i.e. generally for use by pharmaceutical preparation manufacturers); grading, grinding, and milling uncompounded botanicals.	2
325412	Pharmaceutical preparation mfg	In-vivo diagnostic substances and pharmaceutical preparations (except biological) intended for internal and external consumption in dose forms, such as ampoules, tablets, capsules, vials, ointments, powders, solutions, and suspensions.	6
Total Pharmaceuticals			**8**
Other Chemical Segments[c]			
325611	Soap & other detergent mfg	Soaps and other detergents, such as laundry detergents, dishwashing detergents, toothpaste gels, tooth powders, and natural glycerin.	4
325998	All other miscellaneous chemical product & preparation mfg	Chemical products excluding basic chemicals, resins, and synthetic rubber; cellulosic and noncellulosic fiber and filaments; pesticides, fertilizers, and other agricultural chemicals; pharmaceuticals and medicines; paints, coating and adhesives; soap, cleaning compounds, and toilet preparations; printing inks; explosives; custom compounding of purchased resins; and photographic films, paper, plates, and chemicals.	9
Total Other			**13**
Total Chemicals and Allied Products (NAICS 325)			
Total NAICS Code 325			**179**

a. Number of weighted detailed questionnaire survey respondents.
b. Individual numbers may not add up due to independent rounding.
c. Not included in analysis.
Source: Executive Office of the President, 1987; U.S. EPA 2000; U.S. EPA analysis, 2012.

As shown in *Table B-1*, EPA estimates that, out of an estimated total of 6,945[174] facilities with a NPDES permit and operating cooling water intake structures in the Chemicals and Allied Products Industry (NAICS 325), 179 facilities (or 3 percent) would be subject to the final rule. The total value of shipments for the Chemicals and Allied Products Industry (NAICS 325) from the 2010 Annual Survey of Manufactures, published by the U.S. Census Bureau, is $716.2 billion ($2011). Value of shipments, a measure of the dollar value of production, was selected for the basis of this estimate. Because the DQ did not collect value of shipments data, these data were not available for regulated facilities. Total revenue, as reported on the DQ, was used as a close approximation for value of shipments for these facilities. EPA estimated the total revenue of facilities expected to be subject to regulation to be $103.0 billion ($2011).[175] Therefore, EPA estimates that 14 percent of total production in the chemical industry occurs at facilities estimated to be subject to regulation under the final rule.

The DQ responses indicate that four chemical segments account for a significant majority of the Chemicals and Allied Products industry facilities subject to the 316(b) Final Existing Facilities Regulation: (1) Basic Chemicals (including NAICS codes 325110, 325120, 325131, 328181, 325188, 325199); (2) Resins and Synthetics (including NAICS codes 325211, 325221, and 325222); (3) Pesticides and Fertilizers (including NAICS codes 325311 and 325312); and (4) Pharmaceuticals (including NAICS codes 325411, and 325412). This profile therefore provides detailed information for these four industry segments.

Table B-2 on the following page provides the cross-walk between NAICS codes and SIC codes for the profiled chemical NAICS codes. The table shows that some NAICS code industry segments have 1 to 1 relationships to SIC codes, while the other NAICS codes in the four profiled chemical segments correspond to two SIC codes.

Table B-2: Relationship between NAICS and SIC Codes for the Chemicals and Allied Products Industry (2010)

NAICS Code	NAICS Description	SIC Code	SIC Description	Number of Establishments (2009)[a]	Value of Shipments (2010; Millions; $2011)	Employment (2010)
Basic Chemicals						
325110	Petrochemical manuf-g	2865	Cyclic crudes & intermediates	50	$79,828	8,632
		2869	Industrial organic chemicals, n.e.c.			
325120	Industrial gas manuf-g	2869	Industrial organic chemicals, n.e.c.	493	$7,356	9,445
		2813	Industrial gases			
325131	Inorganic dye and pigment manuf-g	2816	Inorganic pigments	87	$5,174	5,549
		2819	Industrial inorganic chemicals, n.e.c.			
328181	Alkalies & chlorine manuf-g	2812	Alkalies & chlorine	44	$6,112	5,661
325188	All other inorganic chemical manuf-g	2819	Industrial inorganic chemicals, n.e.c.	637	$24,302	29,838
		2869	Industrial organic chemicals, n.e.c.			
325199	All other organic chemical manuf-g	2869	Industrial organic chemicals, n.e.c.	729	$82,703	64,301
		2899	Chemical preparations, n.e.c.			

174 This estimate of the number of facilities potentially subject to regulation is based on the universe of facilities that received the 1999 screener questionnaire.

175 To compare revenue values of regulated facilities with the industry value of shipments, EPA brought revenue values for regulated facilities forward to 2010 using industry-specific Producer Price Index (PPI) values published by the Bureau of Labor Statistics (BLS) and stated in 2011 dollars using GDP deflator published by the Bureau of Economic Analysis (BEA).

Resins and Synthetics						
325211	Plastics material & resin manuf-g	2821	Plastics materials & resins	1,036	$81,590	58,275
325221	Cellulosic organic fiber manuf-g	2823	Cellulosic manmade fibers	18	$814	1,157
325222	Noncellulosic organic fiber manuf-g	2824	Organic fibers, noncellulosic	105	$6,122	12,560
Pharmaceuticals						
325311	Nitrogenous fertilizer manuf-g	2873	Nitrogenous fertilizers	152	$7,324	4,529
325312	Phosphatic fertilizer manuf-g	2874	Phosphatic fertilizers	73	$8,776	5,839
Pesticides and Fertilizers						
325411	Medicinal & botanical manuf-g	2833	Medicinals & botanicals	384	$11,458	25,672
325412	Pharmaceutical preparation manuf-g	2834	Pharmaceutical preparations	974	$140,594	138,644
		2835	Diagnostic substances			

a. The number of establishments is based on data from the 2009 Statistics of U.S. Businesses. Value of Shipments and Employment reflect 2010 data.
Source: U.S. DOC, 2010 ASM; U.S. DOC, 2009 SUSB.

B.2 Summary Insights from this Profile

A key purpose of this profile is to provide insight into the ability of chemicals firms to absorb compliance costs under the final rule without material adverse economic/financial effects. The industry‟s ability to absorb compliance costs is primarily influenced by two factors: (1) the extent to which the industry may be expected to shift compliance costs to its customers through price increases, and (2) the financial health of the industry and its general business outlook.

B.2.1 Likely Ability to Pass Compliance Costs Through to Customers

As reported in the following sections of this profile, the chemicals industry has a variable level of concentration, with some industry segments exhibiting relatively low concentration while others show somewhat higher concentration. Regardless of the domestic industry concentration level and its implications for market power, the U.S. Chemicals and Allied Products industry faces increasing competitive pressure from abroad, which substantially limits any apparent ability of firms to pass a significant portion of their compliance-related costs through to customers. In addition, the relatively low share of total industry output that is estimated subject to the regulation under each analysis option also diminishes a firms‟ ability to shift compliance costs to customers. For these reasons, in its analysis of regulatory impacts for the chemicals industry, EPA judges that regulated facilities would be unable to pass compliance costs through to customers; i.e., regulated facilities must absorb all compliance costs (see following sections, *Appendix K*: *Cost Pass-Through Analysis*, and *Chapter 5: Economic Impact Analysis for Manufacturers*, for further information).

B.2.2 Financial Health and General Business Outlook

Over the last two decades, the Chemicals and Allied Products industry, like other U.S. manufacturing industries, has experienced a range of economic/financial conditions and a number of substantial challenges. In the early 1990s, the domestic Chemicals and Allied Products industry was affected by reduced U.S. demand as the economy entered a recessionary period. Although domestic market conditions improved by mid-decade, weakness in Asian markets, along with other domestic economic factors, dealt a serious blow to the chemicals industry in 1998. A significant drop in demand for Chemicals and Allied Products during the economic recession of the early 2000s resulted in record low capacity utilization and a significant drop in capital expenditures. All profiled Chemicals and Allied Products Industry segments except Pharmaceuticals saw significant declines in exports, imports, value of shipments as well as value added. As the U.S. economy began to recover, the domestic Chemicals and Allied Products industry saw continuous improvements in demand levels and consequent improvement of financial performance during 2003 to 2005. By 2007, value of shipments significantly grew, prices were at record highs, and labor productivity increased, with the Pharmaceuticals industry segment performing especially well. Beginning in 2008, the Chemicals and Allied Products industry faced a substantial drop in demand due to the economic recession. This economic downturn forced firms in the Chemicals and Allied Products industry to realign their research and development capabilities, marking a shift in companies‟ long-term strategies and prompting them to identify growth opportunities in areas such as energy, food and water (Jagger, 2009). In 2011, the Diversified Chemicals sub-industry index fell by more than 8 percent, while the S&P 15000 index dropped only 0.3 percent; however, it has increased by 14 percent year to date through June 29 compared to an 8 percent rise in the S&P 1500 (S&P, 2012). Experts expect continued strong performance, projecting a positive outlook for the industry in 2013 (S&P, 2013e). With the recent positive trend in the industry, the Chemicals and Allied Products industry should be able to absorb additional regulatory compliance costs without a material financial impact.

B.3 Domestic Production

The U.S. Chemical and Allied Products industry includes a large number of companies that, in total, produce more than 70,000 different chemical products. These products range from commodity materials used in other industries to finished consumer products such as soaps and detergents. The industry accounts for over $630 billion of total manufacturing value added (Bassi and Yudken, 2009).

The Chemical and Allied Products industry as a whole is highly energy-intensive. This is especially the case for basic chemicals as well as certain specialty chemical segments (i.e., industrial gases). The industry relies upon energy inputs not only for fuel and power for its operations, but also as raw materials in the manufacturing of many of its products. For example, oil and natural gas are raw materials (termed “feedstocks”) for the manufacture of organic chemicals. However, various technology developments throughout the years have allowed the industry to become less energy intensive; the U.S. chemical industry has reduced its fuel and power energy consumed per unit of output by 53 percent since 1974 (ACC, 2009). In addition, the recent drop in domestic natural gas prices relative to global crude oil prices has placed domestic petrochemical firms at a comparative advantage, in terms of improved feedstock cost, over other regions of the world (S&P, 2012).

B.3.1 Output

Figure B-1 shows constant dollar ***value of shipments*** and ***value added*** for the four profiled Chemicals and Allied Products industry segments between 1988 and 2010.[176] Value of shipments and value added are two common measures of manufacturing output. Change in these values over time provides insight into the overall economic health and outlook for an industry. ***Value of shipments*** is the sum of receipts earned from the sale of outputs; it indicates the overall size of a market or the size of a firm in relation to its market or competitors. ***Value added***, defined as the difference between the value of shipments and the value of inputs used to make the products sold, measures the value of production activity in a particular industry.

Figure B-1 shows that between 1988 and 1993, the Basic Chemicals segment experienced a slight decrease in both value of shipments and value added, followed by volatility through 1998. Mid-1990s were marked by increased competition in the global market for petrochemicals, which comprise a large portion of basic chemical products. The increased competition stems from the considerable capacity expansions for these products seen in developing nations during that time (McGraw-Hill, 2000). Both value of shipments and value added declined in 2001 as the Basic Chemicals segment faced decreased demand due to economic slowdown. During 2002, as the economy began to show the first signs of recovery, value of shipments and value added began to grow steadily and rapidly and continued to do so through 2007-2008, when global economy again began to decline. During

[176] Terms highlighted in bold and italic font are further explained in the glossary.

2009, the Basic Chemicals segment experienced a significant drop in value of shipments and value added of approximately 28 percent and 21 percent, respectively. However, the segment seems to have recovered during the following year, when its value of shipments and value added grew by nearly 28 percent and 33 percent, respectively.

Overall, during 1988 through 2007-2008, the profiled Resins and Synthetics, and Pesticides and Fertilizers segments remained more stable than the Basic Chemicals segment. In the early 1990s, domestic producers benefited from the relatively weak dollar, which made U.S. products more competitive in the global market. During the latter part of the 1990s, the strength of the U.S. economy bolstered domestic end-use markets, offsetting the effect of reduced U.S. export sales, which resulted from increased global competition and a strengthened dollar (McGraw-Hill, 2000). The global economic slowdown that began in 2000 led to decreased production, in particular, of chemical goods that are used in the production processes of other industries, notably steel, apparel, textiles, forest products, and technology. During 2002 through 2007-2008, the value of shipments and value added of both the Resins and Synthetics and Pesticides and Fertilizers segments remained relatively stable. During 2008 and 2009, as the result of global recessionary pressures, both segments experienced significant declines in value of shipment and value added; however, while the Resins and Synthetics sector seems to have recovered during 2010, the Pesticides and Fertilizers segment experienced further declines.

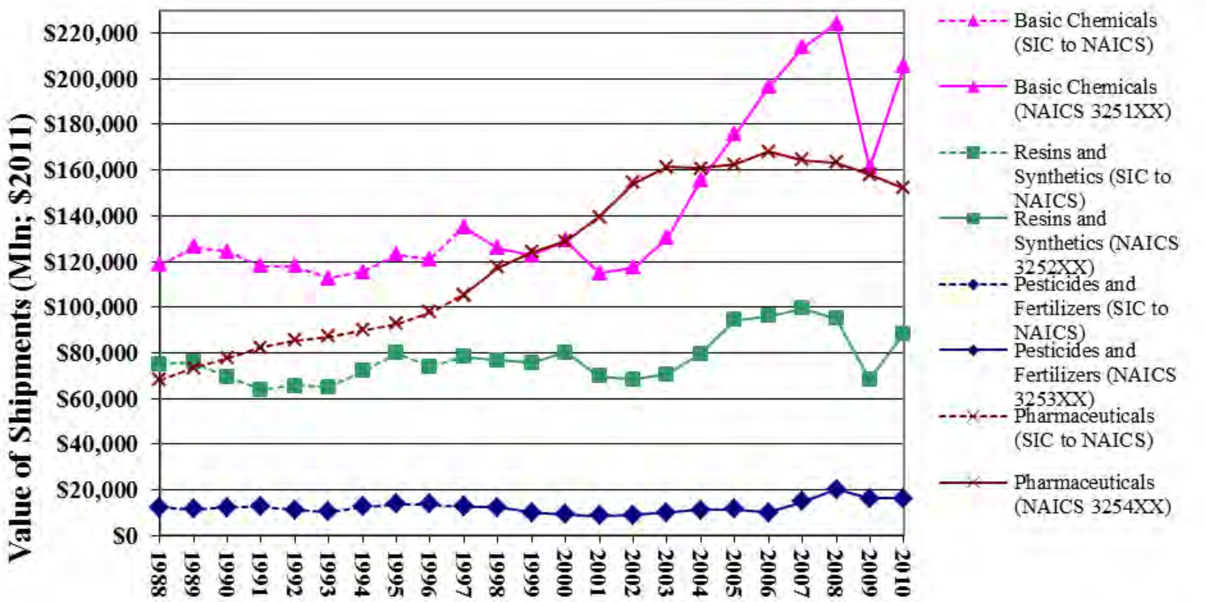
Of the four profiled industry segments, the Pharmaceuticals segment saw the least volatility coupled with significant overall growth. During 1988 through 2006, value of shipments and value added in the Pharmaceuticals segment experienced nearly steady increases; however, since 2006, this segment has seen steady declines in both value of shipments and value added.

While all four profiled segments grew over the last two decades, the Pharmaceuticals segment grew the most, despite modest contractions during the latter part of the last decade. Between 1988 and 2010, value of shipments and value added in this segment *on average* grew by 4 percent each year and more than doubled as a result. The Basic Chemicals came second, with value of shipments and value added increasing by more than 73 percent and 40 percent, respectively. During the same time, value of shipments and value added in the Resins and Synthetics segment grew only by 18 percent and 1 percent, respectively. The Pesticides and Fertilizers segment experienced significantly stronger growth during the last decade with value of shipments growing by more than 76 percent and value added more than doubling (compared to the two-decade growth of 32 percent and 43 percent, respectively).

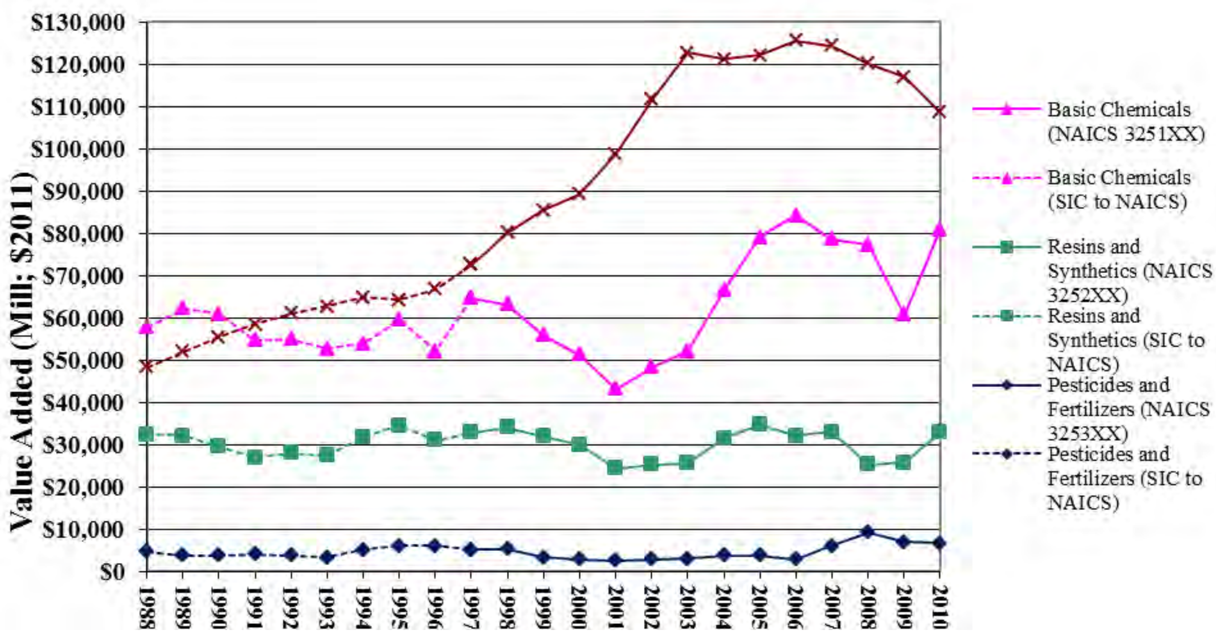
The composition of the Chemicals and Allied Products industry has changed over time, with increasing emphasis being placed on high-technology fields such as pharmaceuticals, biotechnology, and advanced materials. The recent recession caused declines in industry-wide output. However, this downturn is motivating companies to seek new ways to grow and realign research and development capabilities to seek new growth opportunities in renewable energy and food production (Jagger, 2009). Indeed, as discussed earlier, the Basic Chemicals and the Resins and Synthetics segments already seem to have recovered growing significantly during 2010.While the Pesticides and Fertilizers segment still saw a decline in its value of shipments and value added during 2010, this decline was significantly smaller compared to that during 2009, signaling potential recovery. The Pharmaceuticals segment began to see modest contractions during prosperous pre-recessionary years and recent recessionary pressures did not seem to have accelerated this trend. This performance trend should better position regulated facilities in the Chemicals and Allied Products industry to absorb compliance costs of the final rule.

Figure B-1: Value of Shipments and Value Added for Profiled Chemicals and Allied Products Industry Segments (millions, $2011)[a]

Value of Shipments



Value Added



a. Before 1997, the Department of Commerce compiled data in the SIC system; since 1997, these data have been compiled in the North American Industry Classification System (NAICS). For this analysis, EPA converted the NAICS classification data to the SIC code classifications using the *1997 Economic Census Bridge Between NAICS and SIC.*

Source: U.S. DOC, 1988-1991, 1993-1996, 1998-2001, 2003-2006, and 2008-2010 ASM; U.S. DOC, 1987, 1992, 1997, 2002, and 2007 EC.

Table B-3 provides the Federal Reserve System‟s index of industrial production for the 4 profiled industry segments, showing trends in production since 1990. This index reflects total output in physical terms, whereas value of shipments and value added reflect the value of output in economic terms. *Table B-3* shows varying trends in the four segments since 1990, but sharp declines in production in all segments except Pharmaceuticals during 2000 through 2001. These declines were caused by the marked slowdown in the U.S. economy, which affected demand in major chemical-using segments such as steel, apparel, textiles, forest products, and the technology sectors (Chemical Marketing Reporter, 2001).

Between 1990 and 2011, the Pharmaceuticals segment saw the largest increase in production exceeding 66 percent, while the Basic Chemicals and Resins and Synthetics experienced increases of less than 5 percent. During the same time, the Pesticides and Fertilizers segment experienced an overall production decline of more than 10 percent. During the last decade, production growth in the Pharmaceuticals segment was significantly smaller, at 10 percent. The Basic Chemicals segment also saw a modest increase in production of approximately 6 percent. However, production in the Resins and Synthetics and Pesticides and Fertilizers segments declined by approximately 15 percent and 4 percent, respectively.

Table B-3: Industrial Production Index for Chemicals and Allied Products Industry Segments (Annual Averages)

Year	Basic Chemicals[a]		Resins and Synthetics[b]		Pesticides and Fertilizers[c]		Pharmaceuticals[d]	
	Index 2007=100	Percent Change	Index 2007=100	Percent Change	Index 2007=100	Percent Change	Index 2007=100	Percent Change
1990	81.2	NA	80.5	NA	104.1	NA	50.5	NA
1991	77.6	-4.5%	78.6	-2.3%	100.6	-3.4%	54.0	7.0%
1992	78.5	1.2%	83.2	5.8%	104.9	4.2%	53.3	-1.2%
1993	75.5	-3.8%	84.0	1.0%	105.8	0.8%	53.5	0.4%
1994	76.2	0.9%	90.7	8.0%	105.6	-0.2%	55.7	4.0%
1995	76.1	-0.1%	91.3	0.6%	105.2	-0.4%	57.9	4.1%
1996	76.0	-0.1%	89.4	-2.1%	107.3	2.0%	61.4	6.0%
1997	81.8	7.6%	95.0	6.3%	111.3	3.8%	64.7	5.4%
1998	79.0	-3.4%	99.0	4.3%	113.7	2.1%	70.4	8.7%
1999	82.7	4.7%	100.0	1.0%	102.4	-9.9%	73.2	4.0%
2000	79.9	-3.4%	97.0	-3.0%	96.9	-5.4%	76.2	4.1%
2001	72.2	-9.7%	87.7	-9.6%	89.2	-7.9%	82.0	7.7%
2002	76.8	6.4%	89.3	1.8%	92.1	3.2%	87.8	7.1%
2003	79.2	3.1%	87.4	-2.1%	96.3	4.5%	90.9	3.5%
2004	86.3	9.0%	90.5	3.5%	100.4	4.3%	91.3	0.4%
2005	86.7	0.4%	96.9	7.1%	104.2	3.8%	94.9	3.9%
2006	89.0	2.7%	94.9	-2.0%	108.6	4.3%	98.8	4.1%
2007	100.0	12.3%	100.0	5.4%	100.0	-7.9%	100.0	1.2%
2008	88.3	-11.7%	85.0	-15.0%	86.5	-13.5%	97.7	-2.3%
2009	73.1	-17.2%	73.8	-13.2%	90.9	5.1%	91.8	-6.0%
2010	86.3	18.1%	85.7	16.0%	94.8	4.3%	85.1	-7.3%
2011	84.5	-2.1%	82.3	-3.9%	93.1	-1.8%	83.8	-1.5%
Total Percent Change 1990-2011	**4.0%**		**2.3%**		**-10.6%**		**66.1%**	
Total Percent Change 2000-2011	**5.7%**		**-15.2%**		**-3.9%**		**10.0%**	
Average Annual Growth Rate[177]	**0.2%**		**0.1%**		**-0.5%**		**2.4%**	

a. NAICS 3251.
b. NAICS 3252.
c. NAICS 3253
d. NAICS 3254
Source: Federal Reserve Board of Governors, 2012c

177 In this appendix, average annual growth rate refers to a year-to-year, constant percentage growth mean, which is calculated as the compound annual growth rate between the first and last values. This is the same concept as the geometric mean, if all of the individual year-to-year

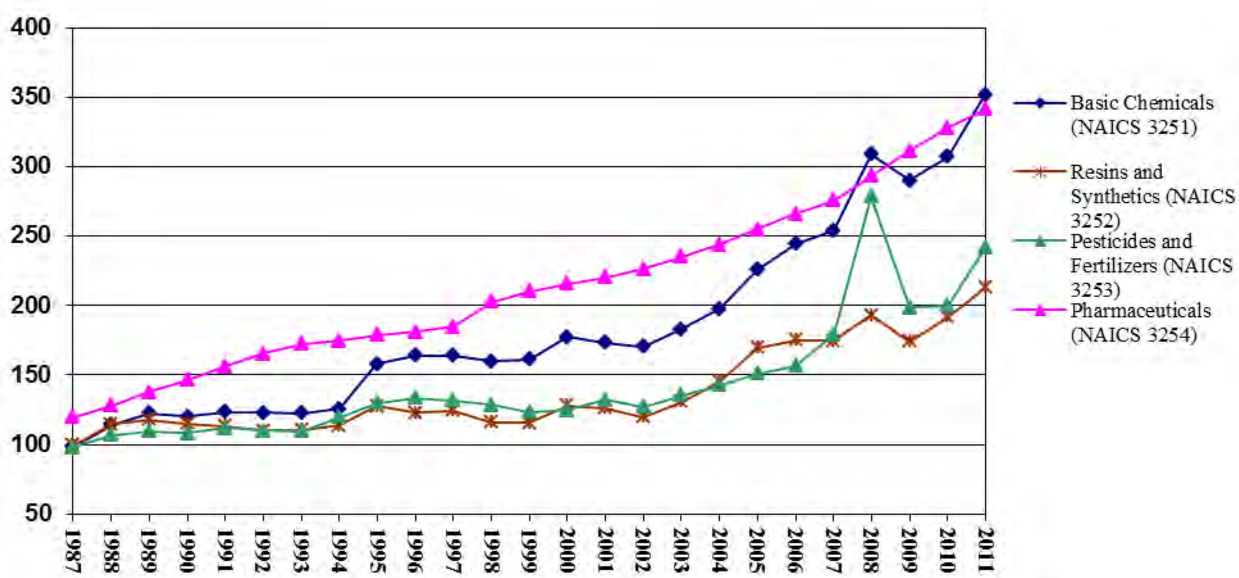
B.3.2 Prices

The ***Producer Price Index (PPI)*** measures price changes, by segment, from the perspective of the seller, and indicates the overall trend of product pricing, and thus supply-demand conditions, within a segment.

Chemicals product prices fluctuate in large part as a result of varying energy prices. For instance, basic petrochemicals, which comprise the majority of organic chemical products and are a part of the Basic Chemicals segment, depend heavily on energy commodities as inputs to the production process – energy input costs may account for up to 85 percent of total product costs. The prices of natural gas and oil therefore influence the production costs and the selling price for these products. High basic petrochemical prices affect prices for chemical intermediate and final end products. The cyclical nature of market supply and demand conditions also significantly influence prices for commodity chemical products. Finally, all analyzed chemicals industry segments are characterized by large existing capital investments and production capacity, which can lead to fluctuations in prices in response to imbalances in supply and demand.

Figure B-2 shows PPI for the profiled Chemicals and Allied Products Industry segments for 1987 through 2010. All profiled segments except Pharmaceuticals saw some volatility during that time in response to changing economic conditions, energy prices, and changes in operating processes. For instance, the price jump for the Resins and Synthetics and Basic Chemicals segments in 2000 is the result of an increase in the price of natural gas – feedstock for 70 percent of U.S. ethylene production (Chemical Marketing Reporter, 2001). Price increases for Resins and Synthetics also reflected a shift by U.S. producers away from production of commodity resins to specialty and higher value-added products (McGraw-Hill, 2000). Overall, during 1987 through 2008, selling prices increased for all four profiled chemicals industry segments, especially during the last decade. As the result of recent recession, prices for all profiled segments except Pharmaceuticals declined significantly during 2009, but recovered by 2011.

Figure B-2: Producer Price Indexes for Profiled Chemicals and Allied Products Industry Segments



Source: BLS, 2011a.

B.3.3 Number of Facilities and Firms

According to Statistics of U.S. Businesses, the number of facilities in the Basic Chemicals segment remained relatively stable between 1990 and 1997, followed by five consecutive years of decreases in the number of facilities. In 2003, however, the number of facilities increased again and remained relatively flat for the next few years. Overall, between 1990 and 2009, the number of facilities in the Basic Chemicals segment declined by more than 6 percent. During the same time period, the Resins and Synthetics and Pharmaceuticals segments saw overall increases of approximately 93 and 46 percent, respectively, while the number of facilities in the Pesticides and Fertilizers segment remained relatively constant, declining by less than 1 percent. Above-average increases in the number of facilities in the Resins and Synthetics segment reported during 1995 and 1996 reflected growth in demand for plastics in a number of end-uses (McGraw-Hill, 2000). During 2009, all profiled segments except the Pesticides and Fertilizers segment saw a reduction in the number of facilities; the number of facilities in the Pesticides and Fertilizers segment remained the same. It is possible that some facilities became unprofitable and closed down as the result of increasing costs and lower demand as the result of recent recessionary pressures.

Table B-4: Number of Facilities for Profiled Chemicals and Allied Products Industry Segments

Year[a]	Basic Chemicals[b]		Resins and Synthetics[c]		Pesticides and Fertilizers[d]		Pharmaceuticals[e]	
	Number of Facilities	Percent Change	Number of Facilities	Percent Change	Number of Facilities	Percent Change	Number of Facilities	Percent Change
1990	2,181	NA	601	NA	227	NA	933	NA
1991	2,275	4.3%	621	3.3%	228	0.4%	962	3.1%
1992	2,261	-0.6%	555	-10.6%	251	10.1%	1,013	5.4%
1993	2,283	1.0%	600	8.1%	250	-0.4%	1,044	3.0%
1994	2,261	-0.9%	595	-0.8%	233	-6.8%	981	-6.0%
1995	2,234	-1.2%	659	10.8%	239	2.6%	1,005	2.4%
1996	2,152	-3.7%	741	12.4%	252	5.4%	1,142	13.7%
1997	2,247	4.4%	705	-4.9%	215	-14.7%	1,190	4.2%
1998	2,157	-4.0%	677	-4.0%	221	2.8%	1,241	4.3%
1999	2,135	-1.0%	700	3.4%	222	0.5%	1,249	0.6%
2000	2,113	-1.0%	714	2.0%	222	0.0%	1,251	0.2%
2001	2,065	-2.3%	744	4.2%	223	0.5%	1,257	0.5%
2002	1,976	-4.3%	806	8.3%	207	-7.2%	1,244	-1.0%
2003	2,042	3.3%	907	12.5%	189	-8.7%	1,268	1.9%
2004	2,065	1.1%	905	-0.2%	193	2.1%	1,280	0.9%
2005	2,021	-2.1%	924	2.1%	193	0.0%	1,281	0.1%
2006	2,022	0.0%	906	-1.9%	188	-2.6%	1,317	2.8%
2007	2,076	2.7%	926	2.2%	198	5.3%	1,368	3.9%
2008	2,142	3.2%	1,195	29.0%	225	13.6%	1,399	2.3%
2009	2,040	-4.8%	1,159	-3.0%	225	0.0%	1,358	-2.9%
Total Percent Change 1990-2009	**-6.5%**		**92.8%**		**-0.9%**		**45.6%**	
Total Percent Change 2000-2009	**-3.5%**		**62.3%**		**1.4%**		**8.6%**	
Average Annual Growth Rate	**-0.4%**		**3.5%**		**0.0%**		**2.0%**	

a. Before 1997, data were compiled in the SIC system; since 1997, these data have been compiled in the North American Industry Classification System (NAICS). For this analysis, EPA converted the SIC classification data to the NAICS code classifications using the 1997 Economic Census Bridge Between SIC and NAICS.
b. NAICS 3251.
c. NAICS 3252.
d. NAICS 3253
e. NAICS 3254
Source: U.S. DOC, 1990-1997 SBA; U.S. DOC, 1998-2009 SUSB.

Table B-5 shows the number of firms in the four profiled chemical segments between 1990 and 2009. The trend in the number of firms during this analysis period is similar to that in the number of facilities. During the last two decades, the Resins and Synthetics segment saw the largest increase in the number of firms (nearly 152 percent) followed by the Pharmaceuticals segment (nearly 45 percent), and the Pesticides and Fertilizers segment (approximately 9 percent). During the same time, the number of firms in the Basic Chemicals segment remained practically unchanged, declining only by less than 1 percent; however, during the last decade the number of firms in this segment increased by more than 8 percent.

The number of firms in the Basic Chemicals segment peaked in 1994, and then declined almost steadily during 1995 through 2005; in 2006 the number of firms began to increase and continued to do so through 2008. The Resins and Synthetics and Pesticides and Fertilizers segment saw a number of sharp increases and declines throughout the entire analysis period, never really stabilizing. The number of firms in the Pharmaceuticals segment dropped significantly in 1995 but in 2006 the number of firms in this segment began to increase and continued to do so through 2008. During 2009, all four profiled segments saw a reduction in the number of firms probably as the result of industry contraction caused by global recession. Further, the recent increasing cost of feedstock (largely crude oil) and other factors increasing production costs has led to consolidation and mergers of national and multinational chemical companies (MBendi, 2010).

Table B-5: Number of Firms for Profiled Chemicals and Allied Products Industry Segments

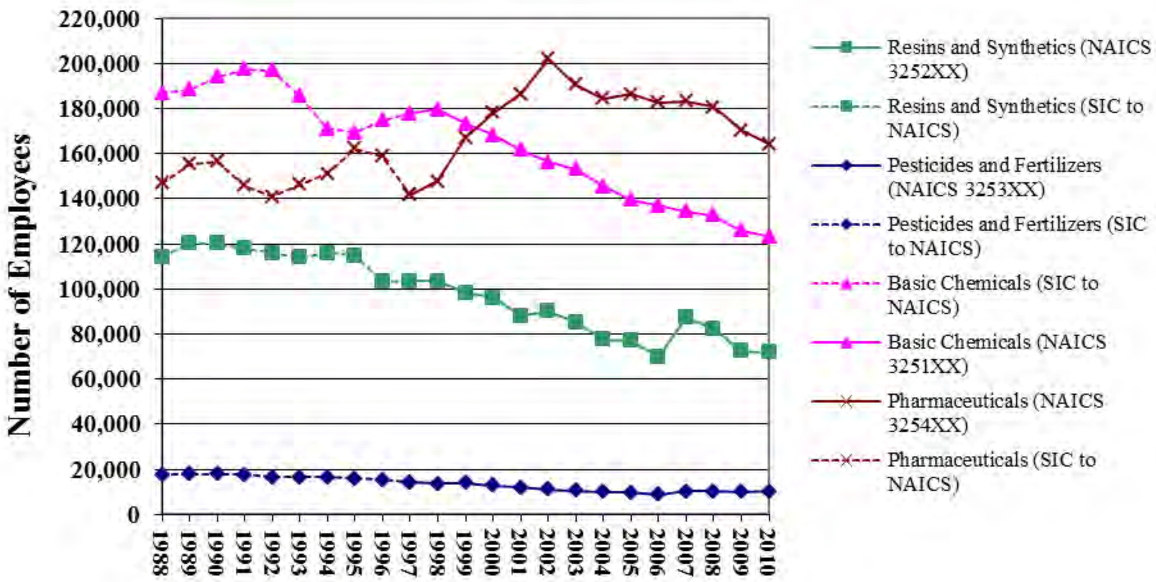
Year[a]	Basic Chemicals[b]		Resins and Synthetics[c]		Pesticides and Fertilizers[d]		Pharmaceuticals[e]	
	Number of Firms	Percent Change	Number of Firms	Percent Change	Number of Firms	Percent Change	Number of Firms	Percent Change
1990	1,189	NA	353	NA	163	NA	799	NA
1991	1,227	3.2%	380	7.6%	161	-1.2%	835	4.4%
1992	1,267	3.3%	319	-16.1%	180	11.8%	872	4.5%
1993	1,294	2.1%	350	9.7%	177	-1.7%	908	4.1%
1994	2,245	73.5%	595	70.0%	233	31.6%	981	8.1%
1995	1,251	-44.3%	409	-31.3%	166	-28.8%	859	-12.5%
1996	1,161	-7.2%	477	16.6%	181	9.0%	991	15.3%
1997	1,222	5.2%	434	-9.0%	174	-3.9%	1,033	4.3%
1998	1,136	-7.0%	395	-9.0%	173	-0.6%	1,073	3.8%
1999	1,096	-3.5%	411	4.1%	175	1.2%	1,076	0.3%
2000	1,090	-0.5%	429	4.4%	174	-0.6%	1,073	-0.3%
2001	1,085	-0.5%	456	6.3%	178	2.3%	1,074	0.1%
2002	1,020	-6.0%	518	13.6%	165	-7.3%	1,053	-2.0%
2003	1,091	7.0%	635	22.6%	146	-11.5%	1,065	1.1%
2004	1,086	-0.5%	622	-2.0%	150	2.7%	1,074	0.8%
2005	1,085	-0.1%	653	5.0%	154	2.7%	1,074	0.0%
2006	1,105	1.8%	647	-0.9%	152	-1.3%	1,107	3.1%
2007	1,158	4.8%	662	2.3%	162	6.6%	1,140	3.0%
2008	1,249	7.9%	905	36.7%	178	9.9%	1,179	3.4%
2009	1,178	-5.7%	889	-1.8%	177	-0.6%	1,158	-1.8%
Total Percent Change 1990-2009	**-0.9%**		**151.8%**		**8.6%**		**44.9%**	
Total Percent Change 2000-2009	**8.1%**		**107.2%**		**1.7%**		**7.9%**	
Average Annual Growth Rate	**0.0%**		**5.0%**		**0.4%**		**2.0%**	

a. Before 1997, data were compiled in the SIC system; since 1997, these data have been compiled in the NAICS. For this analysis, EPA converted the SIC classification data to the NAICS code classifications using the 1997 Economic Census Bridge Between SIC and NAICS.
b. NAICS 3251.
c. NAICS 3252.
d. NAICS 3253
e. NAICS 3254
Source: U.S. DOC, 1990-1997 SBA;U.S. DOC, 1998-2009 SUSB.

B.3.4 Employment and Productivity

Figure B-3 provides information on ***employment*** from the Annual Survey of Manufactures and Economic Census. During the last two decades, with the exception of minor short-lived fluctuations, employment in the Basic Chemicals and Resins and Synthetics segments generally declined. This decrease reflects the industry‟s restructuring and downsizing efforts, which are intended to reduce costs in response to competitive challenges. During the same time period, employment in the Pharmaceuticals segment fluctuated significantly, but began to fall in 2002 and continued to do so almost steadily through 2010. The Pesticides and Fertilizers segment experienced the least amount of fluctuation in employment but had fairly significant employment losses relative to the small size of this segment. Between 1988 and 2010, only the Pharmaceuticals segment showed an overall increase in industry employment of nearly 12 percent. The Pesticides and Fertilizers segment had the largest overall reduction in employment of approximately 41 percent, with the Basic Chemicals and Resins and Synthetics segments coming very close with 34 percent and 37 percent, respectively. During the last decade, however, all four profiled segment saw significant declines in employment, possibly due to the industry‟s restructuring and downsizing efforts.

Figure B-3: Employment for Profiled Chemicals and Allied Products Industry Segments[a]



a. Before 1997, the Department of Commerce compiled data in the SIC system; since 1997, these data have been compiled in the North American Industry Classification System (NAICS). For this analysis, EPA converted the SIC classification data to the NAICS code classifications using the 1997 Economic Census Bridge Between SIC and NAICS.

Source: U.S. DOC, 1988-1991, 1993-1996, 1998-2001, 2003-2006, and 2008-2010 ASM; U.S. DOC, 1987, 1992, 1997, 2002, and 2007 EC.

Table B-6 presents the change in value added per labor hour, a measure of ***labor productivity***, for each of the profiled industry segments during 1988 through 2010. Productivity trends in each segment show considerable volatility through the 1990s into the 2000s. For the Basic Chemicals segment, productivity gains during this early period segment reflect firms‟ attempts to reduce costs by restructuring production and materials handling processes in response to maturing domestic markets and increased global competition (S&P, 2001a). During 1988 through 2010, all four segments saw significant increases in productivity. Much of this growth occurred between 2000 and 2010, when productivity increased by 110 percent in the Basic Chemicals segment, 60 percent in the Resins and Synthetics segment, 184 percent in the Pesticides and Fertilizers segment, and 33 percent in the Pharmaceuticals segment. The complexity of the industry is increasing, requiring highly developed skills and workers with better training and education. In addition, scientifically trained personnel – such as chemists, chemical engineers, agronomists, toxicologists, and biologists – are in high demand. Increases in spending and productivity for the chemical industry are not expected to reverse the loss in chemicals industry employment (C&EN, 2010).

Table B-6: Productivity Trends for Profiled Chemicals and Allied Products Industry Segments ($2011)

Year[a]	Basic Chemicals			Resins and Synthetics			Pesticides and Fertilizers			Pharmaceuticals		
	Prod. Hours (mill.)	Value Added/Hour		Prod. Hours (mill.)	Value Added/Hour		Prod. Hours (mill.)	Value Added/Hour		Prod. Hours (mill.)	Value Added/Hour	
		$/hr.	% Change		$/hr.	% Change		$/hr	% Change		$/hr	% Change
1988	229	252	NA	166	195	NA	25	186	NA	133	365	NA
1989	228	274	8.6%	172	187	-4.6%	26	147	-21.1%	137	380	4.3%
1990	234	260	-5.0%	170	173	-7.1%	27	135	-7.8%	136	407	7.0%
1991	239	229	-11.8%	167	162	-6.6%	27	151	11.6%	134	437	7.4%
1992	240	229	0.0%	166	169	4.3%	26	143	-5.2%	146	419	-4.2%
1993	229	230	0.3%	164	168	-0.8%	25	135	-5.6%	147	427	1.9%
1994	212	254	10.4%	168	189	12.9%	26	200	47.9%	153	424	-0.7%
1995	214	279	9.9%	167	206	9.0%	26	228	14.1%	177	363	-14.4%
1996	220	237	-14.9%	156	199	-3.6%	25	241	5.6%	175	381	5.0%
1997	213	304	27.8%	156	211	6.2%	22	234	-2.8%	154	471	23.4%
1998	211	299	-1.4%	153	223	5.7%	22	244	4.3%	154	520	10.4%
1999	201	278	-7.2%	146	219	-2.0%	21	157	-35.7%	166	517	-0.6%
2000	204	252	-9.4%	146	205	-6.1%	19	146	-7.1%	178	502	-2.8%
2001	194	223	-11.6%	130	188	-8.6%	18	145	-0.9%	187	528	5.1%
2002	189	256	14.9%	130	195	3.7%	17	167	15.6%	189	593	12.3%
2003	188	277	8.3%	127	202	3.6%	17	180	8.0%	189	650	9.7%
2004	181	368	32.9%	119	266	31.9%	16	234	29.7%	183	664	2.1%
2005	175	451	22.7%	118	293	10.1%	15	256	9.3%	186	658	-1.0%
2006	170	497	10.1%	107	300	2.4%	14	205	-19.7%	186	675	2.6%
2007	169	465	-6.4%	127	260	-13.2%	15	387	88.5%	183	679	0.6%
2008	166	467	0.4%	117	216	-17.0%	16	582	50.3%	167	718	5.8%
2009	154	393	-15.7%	97	264	22.3%	16	445	-23.5%	162	722	0.5%
2010	153	528	34.3%	100	327	23.9%	16	414	-6.9%	163	668	-7.4%
1988-2010	**-33.2%**	**109.7%**		**-39.6%**	**67.3%**		**-36.1%**	**122.9%**		**22.6%**	**83.2%**	
2000-2010	**-24.9%**	**109.9%**		**-31.2%**	**59.3%**		**-15.7%**	**184.0%**		**-8.5%**	**33.0%**	
Average Annual Growth Rate	**-1.8%**	**3.4%**		**-2.3%**	**2.4%**		**-2.0%**	**3.7%**		**0.9%**	**2.8%**	

a. Before 1997, the Department of Commerce compiled data in the SIC system; since 1997, these data have been compiled in the NAICS. For this analysis, EPA converted the NAICS classification data to the SIC code classifications using the 1997 Economic Census Bridge Between NAICS and SIC.

Source: U.S. DOC, 1988-1991, 1993-1996, 1998-2001, 2003-2006, and 2008-2010 ASM; U.S. DOC, 1987, 1992, 1997, 2002, and 2007 EC.

B.3.5 Capital Expenditures

The Chemicals and Allied Products industry is relatively capital-intensive. According to the *2007 Economic Census*, facilities in NAICS 325 had aggregate capital spending of approximately $16.7 billion in 2007. Capital-intensive industries are characterized by large, technologically complex manufacturing facilities, which reflect the economies of scale required to manufacture products efficiently. ***New capital expenditures*** are needed to extensively modernize, expand, and replace existing capacity to meet growing demand. *Table B-7* shows that all four profiled Chemicals and Allied Products industry segments experienced substantial increases in capital expenditures through the 1990s. Much of the growth in capital expenditures was driven by investment in capacity expansions to meet the increase in global demand for chemical products. Domestically, the continued substitution of synthetic materials for other basic materials and rising living standards caused consistent growth in the demand for chemical commodities (S&P, 2001a). Expenditures declined somewhat during the early 2000s due to a weakening economy. Capital expenditures in the Basic Chemicals and Resins and Synthetics segments increased during the middle of the last decade only to decline between 2008 and 2010. Capital expenditures in the Pharmaceuticals segment overall declined throughout the latter half of the decade. Only the Pesticides and Fertilizers segment saw an increase in capital expenditures over the entire period of analysis. Toward the end of the last decade, the industry began to look towards new capital expenditure strategies for growth in the near future, hoping to capitalize on long-term societal "megatrends," including increased use of renewable energy and the need for improved food and water supplies (Jagger, 2009).

Table B-7: Capital Expenditures for Profiled Chemicals and Allied Products Industry Segments (in millions, $2011)

	Basic Chemicals		Resins and Synthetics		Pesticides and Fertilizers		Pharmaceuticals	
Year[a]	Capital Expenditures	Percent Change	Capital Expenditures	Percent Change	Capital Expenditures	Percent Change	Capital Expenditures	Percent Change
1988	$6,036	NA	$3,976	NA	$307	NA	$3,191	NA
1989	$7,778	28.9%	$4,500	13.2%	$415	35.1%	$3,531	10.6%
1990	$8,593	10.5%	$5,213	15.8%	$372	-10.5%	$3,173	-10.1%
1991	$8,672	0.9%	$4,798	-7.9%	$632	70.1%	$3,482	9.8%
1992	$8,405	-3.1%	$3,731	-22.2%	$764	20.9%	$4,554	30.8%
1993	$6,497	-22.7%	$4,423	18.5%	$486	-36.4%	$4,435	-2.6%
1994	$5,850	-9.9%	$4,591	3.8%	$473	-2.6%	$4,503	1.5%
1995	$7,789	33.1%	$4,332	-5.6%	$514	8.5%	$4,983	10.7%
1996	$9,535	22.4%	$3,794	-12.4%	$687	33.7%	$4,759	-4.5%
1997	$9,179	-3.7%	$4,775	25.9%	$1,072	55.9%	$4,845	1.8%
1998	$9,054	-1.4%	$5,358	12.2%	$981	-8.5%	$4,400	-9.2%
1999	$8,024	-11.4%	$5,586	4.3%	$762	-22.3%	$4,702	6.9%
2000	$6,990	-12.9%	$3,542	-36.6%	$450	-41.0%	$5,700	21.2%
2001	$6,203	-11.3%	$2,879	-18.7%	$423	-6.1%	$6,279	10.2%
2002	$5,207	-16.1%	$3,022	5.0%	$419	-1.0%	$6,253	-0.4%
2003	$4,463	-14.3%	$2,088	-30.9%	$329	-21.3%	$6,186	-1.1%
2004	$4,833	8.3%	$2,259	8.2%	$321	-2.4%	$6,903	11.6%
2005	$5,176	7.1%	$2,835	25.5%	$346	7.6%	$5,349	-22.5%
2006	$6,048	16.8%	$2,824	-0.4%	$422	22.0%	$4,569	-14.6%
2007	$7,584	25.4%	$3,326	17.8%	$487	15.5%	$5,369	17.5%
2008	$6,300	-16.9%	$2,771	-16.7%	$847	73.7%	$3,752	-30.1%
2009	$6,138	-2.6%	$2,260	-18.4%	$1,038	22.6%	$2,965	-21.0%
2010	$5,339	-13.0%	$1,835	-18.8%	$673	-35.2%	$2,804	-5.4%
Total Percent Change 1988 - 2010	**-11.5%**		**-53.8%**		**118.9%**		**-12.1%**	
Total Percent Change 2000 - 2010	**-23.6%**		**-48.2%**		**49.6%**		**-50.8%**	
Average Annual Growth Rate	**-0.6%**		**-3.5%**		**3.6%**		**-0.6%**	

a. Before 1997, the Department of Commerce compiled data in the SIC system; since 1997, these data have been compiled in the NAICS. For this analysis, EPA converted the NAICS classification data to the SIC code classifications using the *1997 Economic Census Bridge Between NAICS and SIC*.

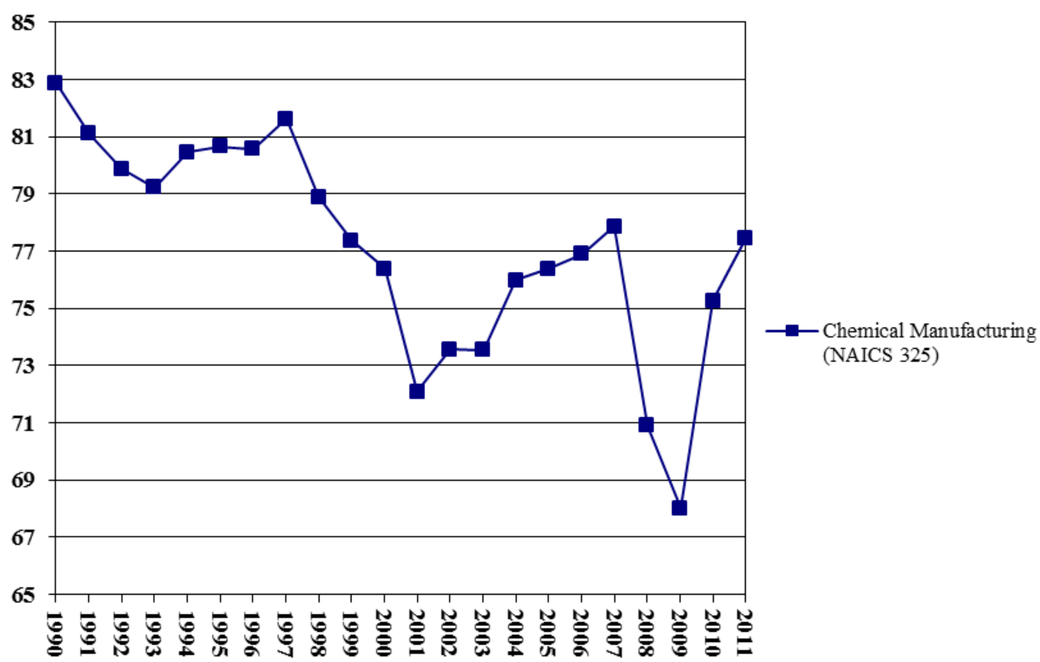
Source: U.S. DOC, 1988-1991, 1993-1996, 1998-2001, 2003-2006, and 2008-2010 ASM; U.S. DOC, 1987, 1992, 1997, 2002, and 2007 EC.

B.3.6 Capacity Utilization

Capacity utilization measures actual output as a percentage of total potential output given the available capacity. Capacity utilization reflects excess or insufficient capacity in an industry and is an indication of whether new investment is likely. To take advantage of economies of scale, chemical commodities are typically produced in large facilities. Capacity additions in this industry are often made on a relatively large scale and can substantially affect the industry‟s capacity utilization rates.

Figure B-4 presents capacity utilization from 1990 to 2011 for the entire Chemicals and Allied Products industry (NAICS 325). Capacity utilization for the industry fluctuated throughout the 1990s, dropping from 1990 through 1993, increasing gradually through 1997, and then dropping rapidly to a low of 72 percent in 2001. The next eight years showed recovery, with increases in capacity utilization each year except during the recessions of 2001 and 2008. Following a period of consistent increases in capacity utilization, the Chemicals and Allied Products industry conserved cash by cutting capital spending by 20.1 percent at the beginning of the 2008 recession, according to the American Chemistry Council (C&EN, 2010). Overall, between 1990 and 2011, capacity utilization in the Chemicals and Allied Products industry fell by 7 percent. As the U.S. economy recovers, companies in the Chemicals and Allied Products industry could still find themselves with significant excess capacity, despite recent cuts in capacity investments, and may not return to making major investments until 2011 (C&EN, 2010).

Figure B-4: Capacity Utilization Rates for Profiled Chemicals and Allied Products Industry Segments[a,b,c]



a. Before 1997, the Department of Commerce compiled data in the SIC system; since 1997, these data have been compiled in the North American Industry Classification System (NAICS). For this analysis, EPA converted the NAICS classification data to the SIC code classifications using the 1997 Economic Census *Bridge Between NAICS and SIC*.
b. Before 2007, U.S. Census sampled every industry in a specific NAICS6. Beginning in 2007, U.S. Census only sampled certain industries within any NAICS6, and therefore, the data collected before 2007 cannot be directly compared to the data collected in 2007 and beyond.
c. Data are for NAICS 325: Chemical Manufacturing.
Source: Federal Reserve Board of Governors, 2012a

B.4 Structure and Competitiveness

The Chemicals and Allied Products industry continues to restructure and reduce costs in response to competitive challenges, including global oversupply for commodities. In the early 1990s, the chemical industry"s cost-cutting came largely from restructuring and downsizing. The industry has taken steps to improve productivity, and consolidated to cut costs. Companies seeking growth within these relatively mature industry segments have made acquisitions to achieve production or marketing efficiencies. The Resins and Synthetics segment, for example, experienced sizable consolidations in the late 1990s into 2000 (S&P, 2001a). In the most recent decade, there has been a significant increase in trade activity for all profiled Chemicals and Allied Products industry segments, with particularly notable growth in imports of pesticides, fertilizers, and pharmaceutical products. Consolidation and restructuring efforts have also been very strong since 2000, as global chemical merger and acquisition activity climbed from $33 billion to $55 billion in 2005 to 2007 alone (Chang, 2008).

B.4.1 Firm Size

The Small Business Administration (SBA) defines small firms in the chemical industries according to the firm‟s number of employees. Firms in the Basic Chemicals segment (325110, 325120, 325131, 328181, 325188, and 325199) and Resins and Synthetics (NAICS codes 325211, 325221, and 325222) are defined as small if they have 1,000 or fewer employees (except for NAICS 325211, for which the threshold is 750 or fewer employees). Firms in the NAICS industry 325311 and 325312 of the Pesticides and Fertilizers segment are considered small if they have 1,000 or fewer and 500 or fewer employees, respectively. Firms in Pharmaceuticals (NAICS codes 325411 and 325412) are defined as small if they have 750 or fewer employees. The size categories reported in the Statistics of U.S. Businesses (SUSB) do not correspond with the SBA size classifications, therefore preventing precise use of the SBA size threshold in conjunction with SUSB data.

The SUSB data presented in *Table B-8* show that in 2009, 953 of 1,178 firms in the Basic Chemicals segment had less than 500 employees. Therefore, at least 81 percent of firms in this segment were classified as small. These small firms owned 1068 facilities, or 52 percent of all facilities in the segment. In the Resins and Synthetics Industry segment, 762 of 889 firms, or 86 percent, had less than 500 employees in 2009. These small firms owned 837 of 1,159 facilities (72 percent) in this segment. In the Pesticides and Fertilizers segment, 84 percent of firms (149 of 177) had fewer than 500 employees, owning 67 percent of all facilities in that segment. And for the Pharmaceuticals segment, 1,021 of the 1,170 firms (87 percent) had less than 500 employees, and these firms accounted for 76 percent of the total number of facilities.

Table B-8 below shows the distribution of firms and facilities in the four profiled segments by the employment size of the parent firm.

Table B-8: Number of Firms and Facilities by Firm Size Category for Profiled Chemical Segments, 2009

	Basic Chemicals		Resins and Synthetics		Pesticides and Fertilizers		Pharmaceuticals	
Year	Number of Firms	Number of Facilities	Number of Firms	Number of Facilities	Number of Firms	Number of Facilities	Number of Firms	Number of Facilities
0-19	536	538	374	375	103	103	649	649
20-99	262	283	272	290	37	38	230	237
100-499	155	247	116	172	9	10	142	170
500+	225	972	127	322	28	74	149	336
Total	**1,178**	**2,040**	**889**	**1,159**	**177**	**225**	**1,170**	**1,392**

Source: U.S. DOC, Statistics of U.S. Businesses, 2009 (U.S. DOC, 2009).

B.4.2 Concentration Ratios

Concentration is the degree to which industry output is concentrated in a few large firms. Concentration is closely related to entry barriers with more concentrated industries generally having higher barriers.

The four-firm concentration ratio (CR4) and the ***Herfindahl-Hirschman Index (HHI)*** are common measures of industry concentration. The CR4 indicates the market share of the four largest firms. For example, a CR4 of 72 percent means that the four largest firms in the industry account for 72 percent of the industry‟s total value of shipments. The higher the concentration ratio, the less competition there is in the industry, other things being equal.[178] An industry with a CR4 of more than 50 percent is generally considered concentrated. The HHI indicates

[178] The measured concentration ratio and the HHF are very sensitive to how the industry is defined. An industry with a high concentration in domestic production may nonetheless be subject to significant competitive pressures if it competes with foreign producers or if it competes with products produced by other industries (e.g., plastics vs. aluminum in beverage containers). Concentration ratios based on share of domestic production are therefore only one indicator of the extent of competition in an industry.

concentration based on the largest 50 firms in the industry. It is equal to the sum of the squares of the market shares for the largest 50 firms in the industry. For example, if an industry consists of only three firms with market shares of 60, 30, and 10 percent, respectively, the HHI of this industry would be equal to 4,600 ($60^2 + 30^2 + 10^2$). The higher the index, the fewer the number of firms supplying the industry and the more concentrated the industry. Based on the U.S. Department of Justice‟s guidelines for evaluating mergers, markets in which the HHI is under 1,000 are considered unconcentrated, markets in which the HHI is between 1,000 and 1,800 are considered to be moderately concentrated, and those in which the HHI is in excess of 1,800 are considered to be concentrated.

Of the profiled Chemicals and Allied Products segments, as shown in *Table B-9*, the following industry sub-sectors were highly concentrated in 2007: Petrochemical Manufacturing (NAICS 325110), Noncellulosic Organic Fiber Manufacturing (NAICS 325222), and Alkalies and Chlorine manufacturing (NAICS 325181). HHI and CH4 values indicated that Industrial Gas Manufacturing (NAICS 325120), Inorganic Dye and Pigment Manufacturing (NAICS 325131), Medicinal and Botanical manufacturing (NAICS 325411), and Nitrogenous Fertilizer Manufacturing (NAICS 325311) were all moderately concentrated. In contrast, Plastics Material and Resin Manufacturing (NAICS 325211), Pharmaceutical Preparation Manufacturing (NAICS 325412), Other Basic Inorganic Chemical Manufacturing (NAICS 325188), and Other Basic Organic Chemical Manufacturing (NAICS 325199) would be considered competitive. The diversity of products in some of the profiled industry segments, however, makes generalizations about concentration less reliable than in industry segments with a more limited product slate. That is, within a single NAICS code, the numbers of producers may vary substantially by individual product – firms may possess relatively high market power in products with a smaller number of competing producers even though the total NAICS code would appear to have a relatively low concentration. On the basis of concentration information, some industry segments would therefore appear to be moderately concentrated; accordingly, firms in these segments might possess a moderate degree of market power and thus the ability to pass compliance costs through to customers as price increases. However, as discussed above and more specifically in the following section, competition from foreign producers in both domestic and export markets, increasingly restrains the discretionary pricing power of U.S. firms in the profiled industry segments.

Table B-9: Selected Ratios for SIC and NAICS Codes Within Profiled Chemicals and Allied Products Industry Segments in 1987, 1992, 1997, 2002, and 2007

SIC (S) or NAICS (N) Code	Year [a]	Concentration Ratios				
		4 Firm (CR4)	8 Firm (CR8)	20 Firm (CR20)	50 Firm (CR50)	Herfindahl-Hirschman Index
Basic Chemicals						
S 2869	1987	31%	48%	68%	86%	376
	1992	29%	43%	67%	86%	336
N 325110	1997	60%	83%	98%	100%	1,187
	2002	85%	94%	100%	100%	2,662
	2007	**80%**	**94%**	**100%**	**100%**	**2,535**
S 2813	1987	77%	88%	95%	98%	1,538
	1992	78%	91%	96%	99%	1,629
N 325120	1997	64%	85%	96%	99%	1,223
	2002	64%	82%	97%	99%	1,218
	2007	**68%**	**88%**	**98%**	**100%**	**1,415**
S 2816	1987	64%	76%	94%	99%	1,550
	1992	69%	79%	93%	99%	1,910
N 325131	1997	67%	79%	95%	100%	1,848
	2002	69%	82%	96%	100%	1,704
	2007	**61%**	**77%**	**96%**	**100%**	**1,265**
S 2812	1987	72%	93%	99%	100%	2,328
	1992	75%	90%	99%	100%	1,994
N 325181	1997	78%	92%	100%	100%	2,870
	2002	73%	90%	100%	100%	1,786
	2007	**84%**	**96%**	**100%**	**100%**	**2,392**
S 2819	1987	38%	49%	68%	84%	468
	1992	39%	50%	68%	85%	677
N 325188	1997	31%	42%	63%	82%	394
	2002	21%	33%	56%	80%	217
	2007	**20%**	**33%**	**56%**	**79%**	**224**
S 2869	1987	31%	48%	68%	86%	376
	1992	29%	43%	67%	86%	336
N 325199	1997	25%	38%	57%	80%	256
	2002	22%	36%	57%	80%	238
	2007	**32%**	**43%**	**61%**	**80%**	**361**
Resins and Synthetics						
S 2821	1987	20%	33%	61%	89%	248
	1992	24%	39%	63%	90%	284
N 325211	1997	26%	39%	64%	89%	304
	2002	32%	46%	68%	88%	443
	2007	**32%**	**47%**	**68%**	**85%**	**400**
S 2823	1987	NA	100%	NA	NA	NA
	1992	98%	NA	NA	NA	NA
N 325221	1997	100%	NA	NA	NA	NA
	2002	93%	NA	NA	NA	NA
	2007	**89%**	**99%**	**100%**	**NA**	**NA**
S 2824	1987	76%	92%	98%	100%	2,403
	1992	74%	90%	98%	100%	2,158
N 325222	1997	69%	87%	98%	100%	1,708
	2002	57%	82%	96%	100%	1,262
	2007	**70%**	**81%**	**93%**	**99%**	**2,071**
Pesticides and Fertilizers						
S 2873	1987	33%	55%	82%	97%	486
	1992	48%	67%	91%	99%	792
N 325311	1997	54%	76%	94%	99%	903
	2002	54%	79%	95%	98%	977
	2007	**61%**	**83%**	**92%**	**97%**	**1,136**
S 2874	1987	48%	74%	98%	99%	880
	1992	62%	83%	98%	99%	1,528

Table B-9: Selected Ratios for SIC and NAICS Codes Within Profiled Chemicals and Allied Products Industry Segments in 1987, 1992, 1997, 2002, and 2007

SIC (S) or NAICS (N) Code	Year [a]	Concentration Ratios				
		4 Firm (CR4)	8 Firm (CR8)	20 Firm (CR20)	50 Firm (CR50)	Herfindahl-Hirschman Index
N 325312	1997	71%	88%	99%	100%	1,675
	2002	78%	93%	100%	100%	1,853
	2007	**83%**	**93%**	**98%**	**100%**	**NA**
Pharmaceuticals						
S 2833	1987	72%	80%	89%	95%	2,588
	1992	76%	84%	91%	97%	2,999
N 325411	1997	62%	73%	85%	93%	2,059
	2002	64%	73%	83%	92%	2,704
	2007	**54%**	**61%**	**75%**	**87%**	**1,424**
S 2834	1987	22%	36%	65%	88%	273
	1992	26%	42%	72%	90%	341
N 325412	1997	36%	50%	71%	89%	462
	2002	36%	53%	76%	89%	530
	2007	**35%**	**54%**	**76%**	**90%**	**457**

a. Before 1997, data were compiled in the SIC system; since 1997, these data have been compiled in the NAICS system. For this analysis, EPA converted the NAICS classification data to the SIC code classifications using the *1997 Economic Census Bridge Between NAICS and SIC.*
Source: U.S. DOC, 1987, 1992, 1997, 2002, and 2007 EC.

B.4.3 Foreign Trade

The Chemicals and Allied Products industry is one of the largest exporters in the United States. In fact, U.S. manufacturers produce 19 percent of the world"s chemicals, more than any other country (ACC, 2009).

This profile uses two measures of foreign competition: ***export dependence*** and ***import penetration***.

Import penetration measures the extent to which domestic firms are exposed to foreign competition in domestic markets. Import penetration is calculated as total imports divided by total value of domestic consumption in that industry: where domestic consumption equals domestic production plus imports minus exports. Theory suggests that higher import penetration levels will reduce market power and pricing discretion because foreign competition limits domestic firms" ability to exercise such power. Firms belonging to segments in which imports account for a relatively large share of domestic sales would therefore be at a relative disadvantage in their ability to pass-through costs because foreign producers would not incur costs as a result of the final rule. The estimated import penetration ratio for the entire U.S. manufacturing sector (NAICS 31-33) for 2010 is 28 percent. For characterizing the ability of industries to absorb compliance cost burdens, EPA judges that industries with import ratios close to or above 28 percent would more likely face stiff competition from foreign firms and thus be less likely to succeed in passing compliance costs through to customers.

Export dependence, calculated as exports divided by value of shipments, measures the share of a segment"s sales that is presumed subject to strong foreign competition in export markets. The final rule would not increase the production costs of foreign producers with whom domestic firms must compete in export markets. As a result, firms in industries that rely to a greater extent on export sales would have less latitude in increasing prices to recover cost increases resulting from regulation-induced increases in production costs. The estimated export dependence ratio for the entire U.S. manufacturing sector for 2010 is 22 percent. For characterizing the ability of industries to absorb compliance cost burdens, EPA judges that industries with export ratios close to or above 22 percent are at a relatively greater disadvantage in potentially recovering compliance costs through price increases since export sales are presumed subject to substantial competition from foreign producers.

Table B-10 presents trade statistics for each of the profiled Chemicals and Allied Products industry segments. Both export dependence and import penetration experienced increases in each of these segments between 1990 and 2010.

Globalization of markets has become a key factor in the Basic Chemicals segment, with both import penetration and export dependence growing substantially over the 21-year analysis period - imports more than quadrupled and exports nearly doubled. The greater growth in imports underscores the increasing competition from foreign producers in domestic and world markets.

Increased globalization has also affected the Resins and Synthetics segment. Imports and exports of resins and synthetics have increased significantly over the 21-year analysis period, reflecting the continued growth in the global market. As with the Basic Chemical segment, this segment has shown substantial overall increases in values of imports and exports with total growth of 218 percent and 141 percent, respectively during the last two decades. Import penetration grew more quickly than export dependence in this segment due to declining export opportunities and increased foreign competition in domestic markets. Nevertheless, the United States remained a net exporter of resins and synthetics, despite these trends. The market for pesticides and fertilizers has also become increasingly competitive. Significant capacity expansions for pesticides and fertilizers worldwide increased competition in domestic markets from imports and began to limit export opportunities for U.S. producers. Through 1999, the segment still exported more than it imported. However, this balance recently changed as imports exceeded exports from 2000 through 2010. From 1990 through 20s0, imports in the profiled Pesticides and Fertilizers segment grew by 446 percent, while exports declined 2 percent. The Pharmaceuticals segment had by far the largest surge in trade activity over the observed period, with imports growing over fourteen-fold, and exports increasing by 578 percent.

In 2010, import penetration ratios in the Basic Chemicals and Resins and Synthetics segments were 24 and 18 percent respectively, compared to 28 percent reported for the U.S. manufacturing industry as a whole. Therefore, neither of these two profiled segments faces strong competition from foreign firms in U.S. markets. At the same time, the import penetration ratio was 46 percent for the Pesticides and Fertilizers segment and 41 percent for the Pharmaceuticals segment, suggesting that businesses in these segments do face strong competition from foreign firms in the U.S. markets. Further, between 1990 and 2010 import penetration ratios for all profiled segments rose significantly, which could indicate that foreign firms have begun aggressive pursuit of these U.S. markets.

In 2010, the export dependence ratio was 24 percent for the Basic Chemicals segment, 35 percent for the Resins and Synthetics segment, 26 percent for the Pesticides and Fertilizers segment, and 23 percent for the Pharmaceuticals segment compared to 22 percent reported for the U.S. manufacturing industry as a whole. Therefore, all 4 segments likely face significant competitive pressure in retaining their positions in the foreign markets. Further, for all profiled chemical industry segments except Pesticides and Fertilizers, export dependence has been, for the most part, steadily increasing during the last two decades. All profiled segments except Pharmaceuticals were affected by the economic recession and experienced declines in export dependence, either in 2009 or 2010. Given these levels of exposure to competition from foreign firms in domestic and export markets, the profiled chemicals industry segments likely have limited discretionary power to recover compliance costs expected to be incurred as the result of the Final Existing Facilities Regulation through price increases.

Recent trends in international chemicals markets imply that U.S. producers in the profiled Chemicals and Allied Products industry will continue to face strong competition from foreign producers. However, trade is also expected to play an important role in industry growth as increased importance is given to bilateral and multilateral trade agreements. Free Trade Area of the Americas (FTAA) and other free trade agreements with Chile and Vietnam offer U.S. chemical companies the opportunity to expand exports to these regions/countries. Trade barriers such as higher tariff rates are falling in many countries as a result of commitment to the Chemical Tariff Harmonization Agreement. These developments are favorable for increasing exports from the United States. At the same time, industry exposure to fluctuations in regional and global economic conditions is on the rise due to the increasing share of imports in domestic consumption (AllBusiness, 2009).

Table B-10: Trade Statistics for Profiled Chemicals and Allied Products Industry Segments ($2011)						
Year[a]	Value of Imports (millions)	Value of Exports (millions)	Value of Shipments (millions)	Implied Domestic Consumption[b]	Import Penetration[c]	Export Dependence[d]
Basic Chemicals						
1990	$15,441	$20,508	$124,294	$119,228	13%	16%
1991	$15,574	$20,967	$117,809	$112,416	14%	18%
1992	$16,040	$20,749	$117,788	$113,079	14%	18%
1993	$15,721	$20,173	$112,509	$108,056	15%	18%
1994	$18,138	$22,632	$115,449	$110,955	16%	20%
1995	$21,385	$27,370	$123,043	$117,057	18%	22%
1996	$22,642	$25,688	$121,005	$117,958	19%	21%
1997	$24,848	$29,499	$134,988	$130,337	19%	22%
1998	$24,638	$26,801	$125,634	$123,471	20%	21%
1999	$26,251	$27,082	$122,779	$121,949	22%	22%
2000	$31,447	$30,289	$129,120	$130,279	24%	23%
2001	$30,440	$28,994	$114,750	$116,197	26%	25%
2002	$29,583	$27,963	$117,399	$119,020	25%	24%
2003	$32,591	$31,448	$130,321	$131,463	25%	24%
2004	$37,528	$36,242	$155,373	$156,660	24%	23%
2005	$44,179	$37,929	$175,705	$181,955	24%	22%
2006	$45,585	$42,922	$196,275	$198,937	23%	22%
2007	$48,587	$46,853	$213,699	$215,433	23%	22%
2008	$58,210	$50,991	$224,141	$231,360	25%	23%
2009	$39,297	$39,790	$161,039	$160,545	24%	25%
2010	$49,033	$49,355	$205,476	$205,154	24%	24%
Total Percent Change 1990-2010	**217.5%**	**140.7%**	**65.3%**	**72.1%**		
Total Percent Change 2000-2010	**55.9%**	**63.0%**	**59.1%**	**57.5%**		
Average Annual Growth Rate	**6%**	**4%**	**3%**	**3%**		
Resins and Synthetics						
1990	$4,163	$12,377	$69,353	$61,139	7%	18%
1991	$4,064	$13,751	$63,852	$54,165	8%	22%
1992	$4,606	$12,550	$65,362	$57,418	8%	19%
1993	$5,530	$12,436	$64,923	$58,018	10%	19%
1994	$6,799	$14,210	$71,854	$64,443	11%	20%
1995	$7,902	$17,247	$79,858	$70,513	11%	22%
1996	$7,898	$17,312	$73,987	$64,573	12%	23%
1997	$8,280	$17,420	$78,045	$68,904	12%	22%
1998	$8,397	$16,206	$76,615	$68,805	12%	21%
1999	$8,704	$15,942	$75,600	$68,362	13%	21%
2000	$9,898	$18,330	$79,985	$71,553	14%	23%
2001	$9,315	$16,854	$69,747	$62,209	15%	24%
2002	$9,350	$17,071	$68,288	$60,568	15%	25%
2003	$10,343	$17,989	$70,662	$63,016	16%	25%
2004	$11,653	$21,153	$79,387	$69,887	17%	27%
2005	$14,520	$23,564	$94,417	$85,373	17%	25%
2006	$15,048	$26,164	$95,972	$84,856	18%	27%
2007	$14,299	$29,386	$99,283	$84,196	17%	30%
2008	$14,518	$31,122	$94,876	$78,272	19%	33%

Table B-10: Trade Statistics for Profiled Chemicals and Allied Products Industry Segments ($2011)						
Year[a]	Value of Imports (millions)	Value of Exports (millions)	Value of Shipments (millions)	Implied Domestic Consumption[b]	Import Penetration[c]	Export Dependence[d]
2009	$9,839	$24,619	$68,307	$53,528	18%	36%
2010	$12,794	$31,415	$88,526	$69,905	18%	35%
Total Percent Change 1990-2010	**207.3%**	**153.8%**	**27.6%**	**14.3%**		
Total Percent Change 2000-2010	**29.3%**	**71.4%**	**10.7%**	**-2.3%**		
Average Annual Growth Rate	**6%**	**5%**	**1%**	**1%**		
Pesticides and Fertilizers						
1990	$1,839	$4,084	$12,157	$9,912	19%	34%
1991	$1,662	$4,581	$12,456	$9,538	17%	37%
1992	$1,675	$3,586	$11,110	$9,199	18%	32%
1993	$1,953	$2,680	$10,302	$9,576	20%	26%
1994	$2,150	$3,891	$12,539	$10,799	20%	31%
1995	$2,250	$4,508	$13,589	$11,331	20%	33%
1996	$2,208	$4,240	$13,714	$11,681	19%	31%
1997	$3,114	$4,201	$12,639	$11,552	27%	33%
1998	$3,118	$4,433	$12,379	$11,064	28%	36%
1999	$2,961	$3,978	$9,944	$8,928	33%	40%
2000	$3,457	$3,051	$9,126	$9,533	36%	33%
2001	$3,992	$2,739	$8,511	$9,764	41%	32%
2002	$3,236	$2,684	$8,829	$9,380	34%	30%
2003	$4,743	$2,932	$9,917	$11,728	40%	30%
2004	$5,595	$3,183	$11,174	$13,586	41%	28%
2005	$7,520	$3,430	$11,402	$15,493	49%	30%
2006	$6,803	$3,354	$10,118	$13,566	50%	33%
2007	$8,782	$3,695	$14,660	$19,747	44%	25%
2008	$14,060	$7,739	$20,143	$26,464	53%	38%
2009	$6,302	$4,004	$16,293	$18,591	34%	25%
2010	$10,040	$4,171	$16,100	$21,969	46%	26%
Total Percent Change 1990-2010	**446.0%**	**2.1%**	**32.4%**	**121.6%**		
Total Percent Change 2000-2010	**190.4%**	**36.7%**	**76.4%**	**130.5%**		
Average Annual Growth Rate	**9%**	**0%**	**1%**	**4%**		
Pharmaceuticals						
1990	$5,467	$5,154	$77,532	$77,845	7%	7%
1991	$6,632	$5,596	$82,271	$83,307	8%	7%
1992	$7,742	$6,572	$85,466	$86,636	9%	8%
1993	$7,681	$6,693	$87,026	$88,015	9%	8%
1994	$8,530	$6,797	$89,759	$91,492	9%	8%
1995	$10,614	$6,834	$92,570	$96,350	11%	7%
1996	$13,599	$7,466	$97,745	$103,878	13%	8%
1997	$17,763	$11,306	$105,316	$111,773	16%	11%

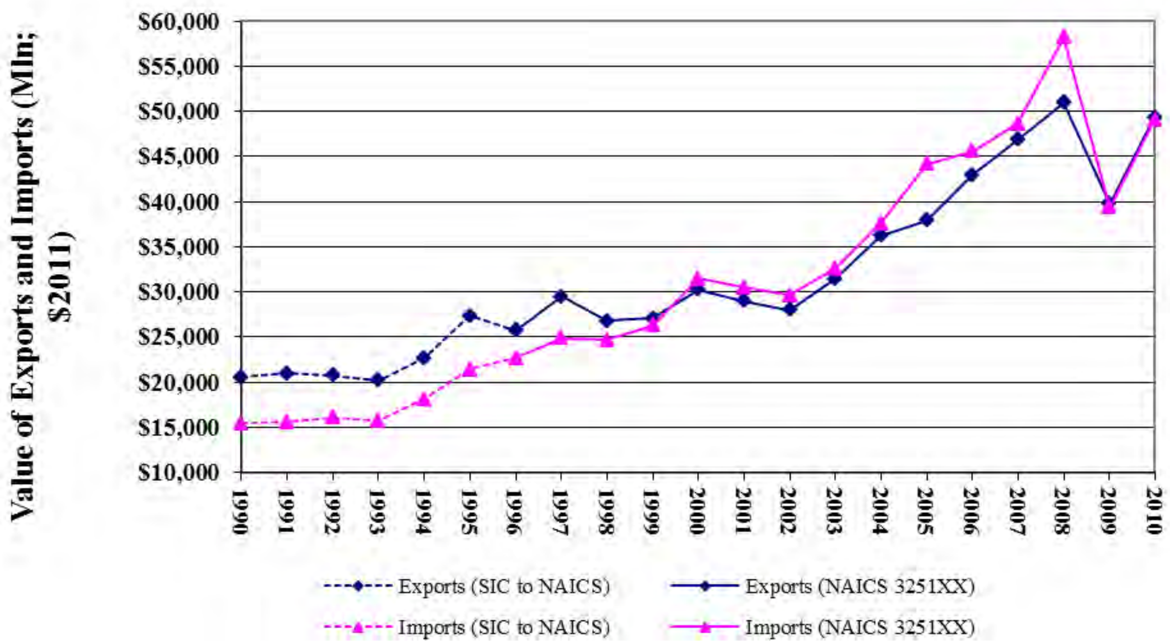
Table B-10: Trade Statistics for Profiled Chemicals and Allied Products Industry Segments ($2011)

Year[a]	Value of Imports (millions)	Value of Exports (millions)	Value of Shipments (millions)	Implied Domestic Consumption[b]	Import Penetration[c]	Export Dependence[d]
1998	$22,658	$13,191	$117,210	$126,678	18%	11%
1999	$29,398	$15,081	$123,989	$138,305	21%	12%
2000	$35,420	$17,204	$128,852	$147,067	24%	13%
2001	$40,338	$19,734	$139,526	$160,130	25%	14%
2002	$47,727	$19,637	$154,403	$182,493	26%	13%
2003	$56,618	$22,804	$161,340	$195,155	29%	14%
2004	$59,050	$26,594	$160,883	$193,339	31%	17%
2005	$60,395	$26,941	$162,456	$195,910	31%	17%
2006	$67,796	$28,532	$168,059	$207,323	33%	17%
2007	$72,120	$29,885	$164,545	$206,780	35%	18%
2008	$78,360	$32,020	$163,216	$209,556	37%	20%
2009	$79,310	$33,976	$158,057	$203,390	39%	21%
2010	$80,879	$34,928	$152,052	$198,002	41%	23%
Total Percent Change 1990-2010	**1379.4%**	**577.7%**	**96.1%**	**154.4%**		
Total Percent Change 2000-2010	**228.3%**	**203.0%**	**118.0%**	**134.6%**		
Average Annual Growth Rate	**14%**	**10%**	**3%**	**5%**		

a. Before 1997, data were compiled in the SIC system; since 1997, these data have been compiled in the NAICS system. For this analysis, EPA converted the NAICS classification data to the SIC code classifications using the *1997 Economic Census Bridge Between NAICS and SIC.*
b. Calculated by EPA as shipments + imports - exports.
c. Calculated by EPA as imports divided by implied domestic consumption.
d. Calculated by EPA as exports divided by shipments.
Source: U.S. ITC, 1989-2010.

Figure B-5: Value of Imports and Exports for Profiled Chemicals and Allied Products Industry Segments[a]

Basic Chemicals



Resins and Synthetics

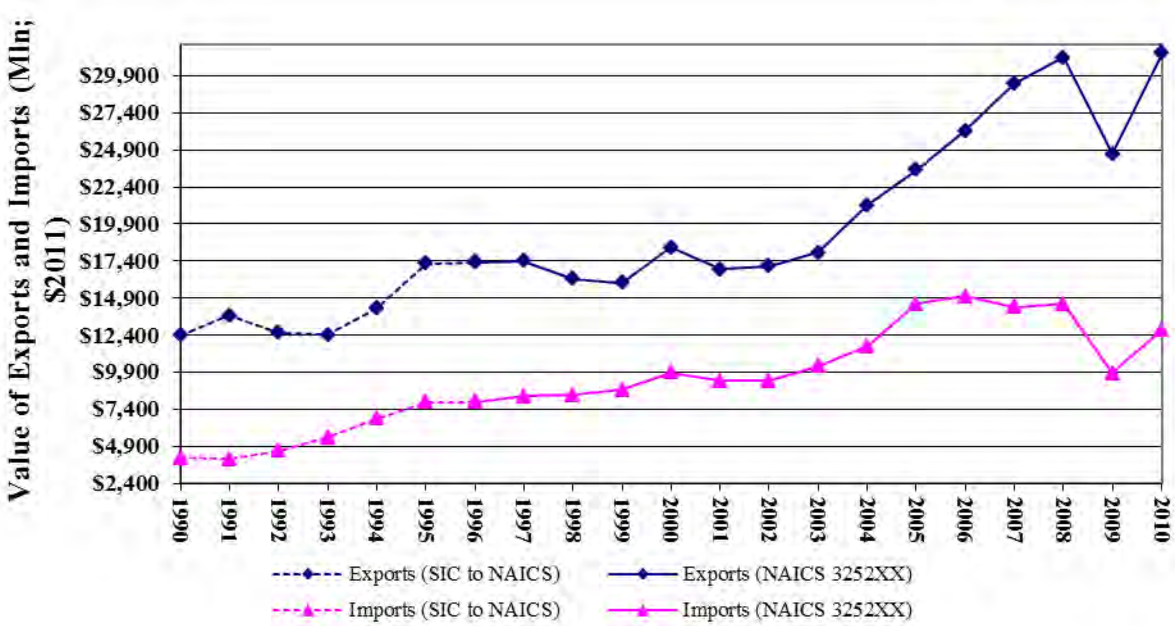
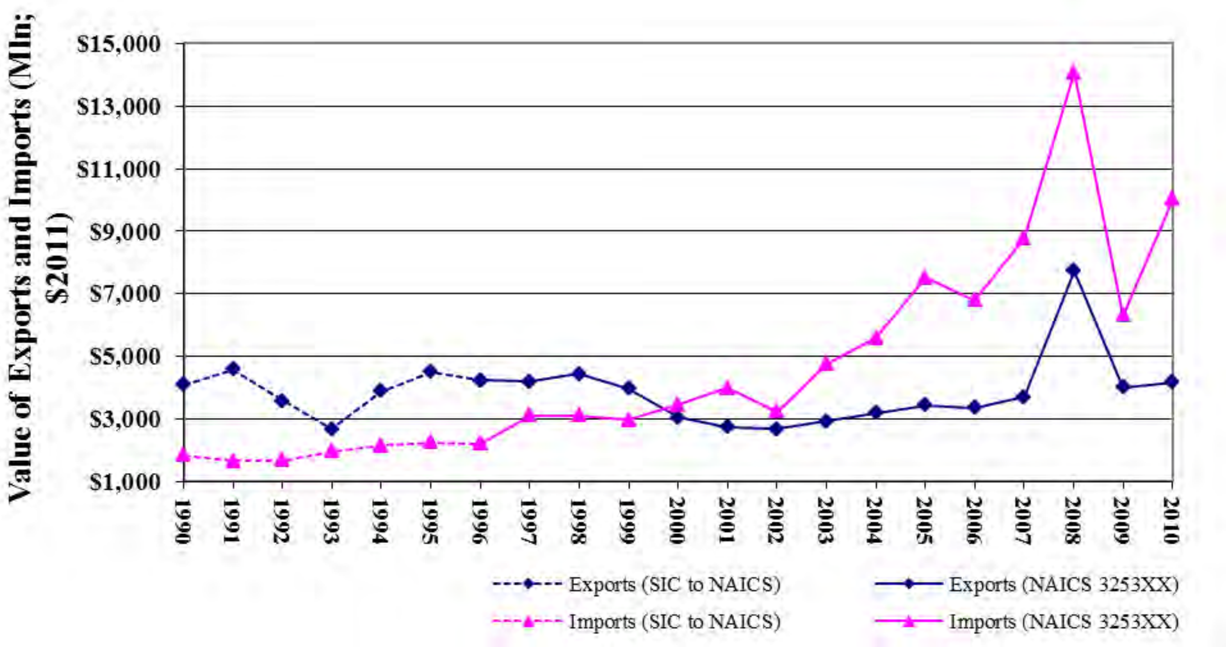
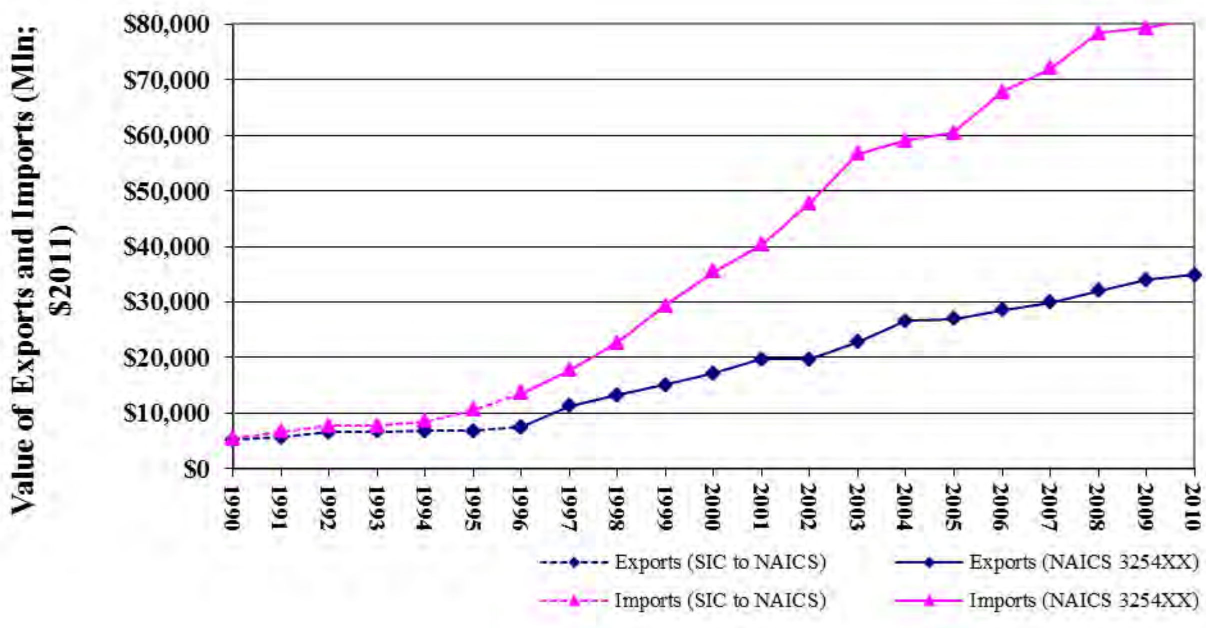


Figure B-5: Value of Imports and Exports for Profiled Chemicals and Allied Products Industry Segments[a]

Pesticides and Fertilizers



Pharmaceuticals



a. Before 1997, the Department of Commerce compiled data in the SIC system; since 1997, these data have been compiled in the North American Industry Classification System (NAICS). For this analysis, EPA converted the NAICS classification data to the SIC code classifications using the 1997 Economic Census Bridge Between NAICS and SIC.

Source: U.S. ITC, 1989-2011.

B.5 Financial Condition and Performance

The financial performance and condition of the chemical industry are important determinants of its ability to absorb the costs of regulatory compliance without material, adverse economic/financial impact. To provide insight into the industry's financial performance and condition, EPA reviewed two key measures of financial performance over the period 1988 to 2012: ***net profit margin*** and ***return on total capital***. EPA calculated these measures using data from the Quarterly Financial Report for Manufacturing, Mining, and Trade Corporations (QFR) published by the U.S. Census Bureau. Financial performance in the most recent financial reporting period (2008) is obviously not a perfect indicator of conditions at the time of regulatory compliance. However, examining the trend, and deviation from the trend, through the most recent reporting period gives insight into where the industry *may be*, in terms of financial performance and condition, at the time of compliance. In addition, the volatility of performance against the trend, in itself, provides a measure of the *potential* risk faced by the industry in a future period in which compliance requirements are faced: all else equal, the more volatile the historical performance, the more likely the industry *may* be in a period of relatively weak financial conditions at the time of compliance.

Net profit margin is calculated as after-tax income before nonrecurring gains and losses as a percentage of sales or revenues, and measures profitability, as reflected in the conventional accounting concept of net income. Over time, the firms in an industry, and the industry collectively, must generate a sufficient positive profit margin if the industry is to remain economically viable and attract capital. Year-to-year fluctuations in profit margin stem from several factors, including: variations in aggregate economic conditions (including international and U.S. conditions), variations in industry-specific market conditions (e.g., short-term capacity expansion resulting in overcapacity), or changes in the pricing and availability of inputs to the industry‟s production processes (e.g., the cost of energy to the chemical process). The extent to which these fluctuations affect an industry‟s profitability, in turn, depends heavily on the fixed vs. variable cost structure of the industry‟s operations. In a capital intensive industry such as the chemical and allied products industry, the relatively high fixed capital costs as well as other fixed overhead outlays, can cause even small fluctuations in output or prices to have a large positive or negative affect on profit margin.

Return on total capital is calculated as annual pre-tax income divided by the sum of current portion of long-term debt due in 1 year or less, long-term debt due in more than 1 year, all other noncurrent liabilities and total stockholders‟ equity (total capital). This concept measures the total productivity of the capital deployed by a firm or industry, regardless of the financial source of the capital (i.e., equity, debt, or liability element). As such, the return on total capital provides insight into the profitability of a business‟ assets independent of financial structure and is thus a "purer" indicator of asset profitability than return on equity. In the same way as described for *net profit margin*, the firms in an industry, and the industry collectively, must generate over time a sufficient return on capital if the industry is to remain economically viable and attract capital. The factors causing short-term variation in *net profit margin* will also be the primary sources of short-term variation in *return on total capital*.

Figure B-6 presents net profit margin and return on total capital for public-reporting firms in two chemical industry segments – (1) Basic Chemicals, Resins, and Synthetics Manufacturing, which covers profiled segments Basic Chemicals and Resins and Synthetics and (2) Pharmaceuticals and Medicines Manufacturing – from1988 through 2012. *Figure B-6* also presents net profit margin and return on total capital for public-reporting firms in Other Chemicals segment – from 1992 through 2010.[179] The first segment corresponds approximately to the profiled Basic Chemicals and Resins and Synthetics industry segments; the second segment corresponds approximately to the profiled Pharmaceuticals industry segment; and the third segment corresponds to the profiled Pesticides and Fertilizers industry segment. The financial performance information reported in *Figure B-6* confirms the trends and performance discussed above in this section.

179 For the Other Chemicals QFR segment, which includes the profiled Pesticides and Fertilizers segment, QFR data are available only since 1992. In addition to NAICS 3253: Pesticide, Fertilizer, and Other Agricultural Chemical Manufacturing, which corresponds to the profiled Pesticides and Fertilizers segment, the QFR Other Chemicals segment includes NAICS 3255: Paint, Coating, and Adhesive Manufacturing; NAICS 3256: Soap, Cleaning Compound, and Toilet Preparation Manufacturing, and NAICS 3259: Other Chemical Product and Preparation Manufacturing.

As shown in *Figure B-6*, the Basic Chemicals and Resins and Synthetics segments have seen moderate volatility of financial performance over the analysis period. Return on total capital moved off a post-recession low near -3 percent in 1992 to achieve levels of 7 to 10 percent during 1995-1997. Recovery of demand accompanied by industry restructuring and downsizing accounted for the upturn in performance. During the latter part of the 1990s decade, though, increased competition from foreign producers and demand weakness in Asian markets eroded this performance. As a result, return on capital fell gradually through 2000. In 2001, a series of factors – high energy and raw material prices at the start of the year, overcapacity, the terrorist attacks, and slowing U.S. and global economies at the end of the year – led to a further sharp decline in return on capital performance of approximately percent to less than one percent. Starting in 2002, however, return on total capital showed steady improvement, increasing to nearly 10 percent by 2005 and then leveling out prior to the economic recession of 2008. Net profit margin shows a similar, though less volatile, trend, with declines in 2000 through 2001, followed by steady improvement between 2002 and 2005. In 2005, net profit margin reached a peak value of 6.6 percent, before dipping in 2008 along with the general trend of the economy. In 2009 and 2010, both net profit margin and return on total capital rose as the economy recovered. Return on total capital continued to rise steeply in 2011, followed by a decline in 2012, while net profit margin increased at a slower rate in 2011 and again in 2012.

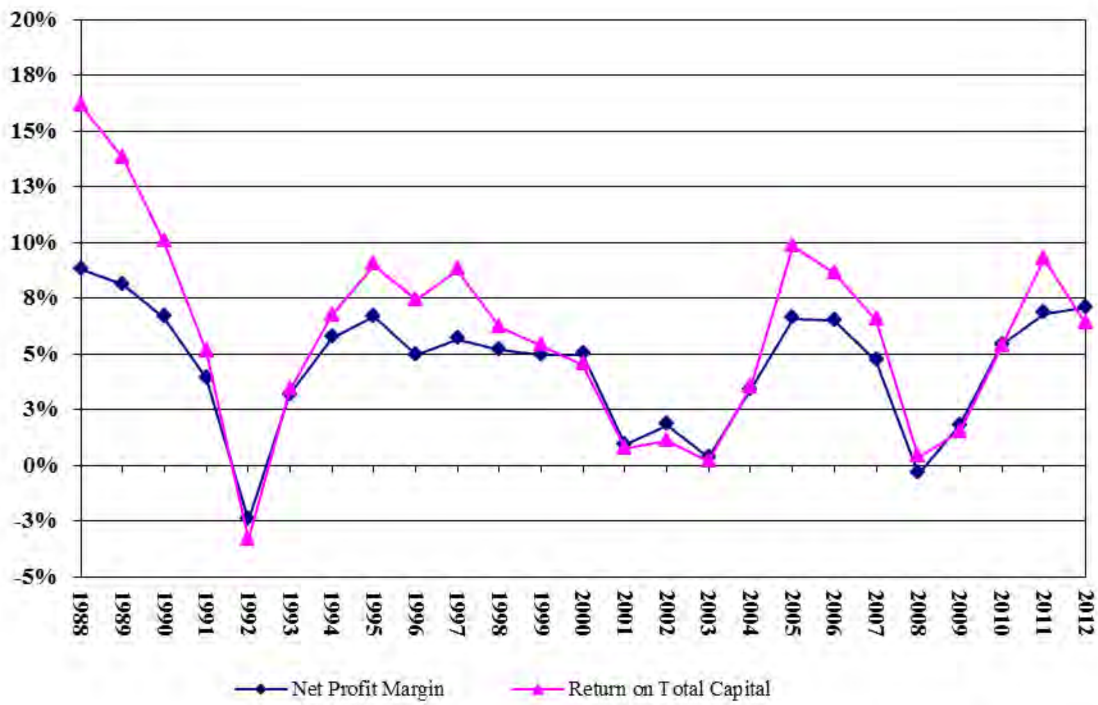
The same factors largely influenced performance in the Pharmaceuticals and Medicines Manufacturing segment over the 21-year period. Performance in this segment was stronger than that in the other industry segments and followed a less volatile pattern. Net profit margins rose from a low near 12 percent in 1993 to a peak of 15.9 percent in 1998. Since then, performance trended down to reach a low of approximately 14 percent in 2000. This segment achieved steady, though moderate improvement during 2002 to 2004, and then rose rapidly to reach a period high level of 21.7 percent in 2008. Return on total capital again shows a similar, though more volatile, trend compared to net profit margin. In 2009, both net profit margin and return on total capital continued to rise, only to be followed by relatively sharp declines in 2010. In 2011, net profit margin and return on total capital increased. In 2012, return on total capital declined while net profit margin continued to rise, though slightly.

The Other Chemicals industry segment, which includes the profiled Pesticides and Fertilizers segment, was susceptible to the same economic influences mentioned in the previous two paragraphs. The financial performance of this segment was more volatile than the Pharmaceutical segment but more stable than the Basic Chemicals segment. Both the net profit margin and return on total capital for this segment followed a similar pattern: performance was extremely transient for the first decade, peaking in 1996 and then falling sharply until 2001. In the 2000s decade, the financial health of this industry was much more stable and has been rising since 2001, with the exception of 2005. However, current levels of performance still have not reached the same peak level they rose to in 1996. Both net profit margin and return on total capital declined in 2009, but performance improved slightly in 2010. Net profit margin began to decline in 2011, while return on total capital did not decline until 2012.

Overall, the majority of profiled segments of the chemical industry were not greatly affected by the recent economic downturn. The Basic Chemicals and Resins and Synthetics segments were most affected, with steep declines into 2008, but have since recovered.

Figure B-6: Net Profit Margin and Return in Total Capital for the Chemicals and Allied Products Industry Segments

Basic Chemicals, Resins, and Synthetics Manufacturing



Pharmaceuticals and Medicines Manufacturing

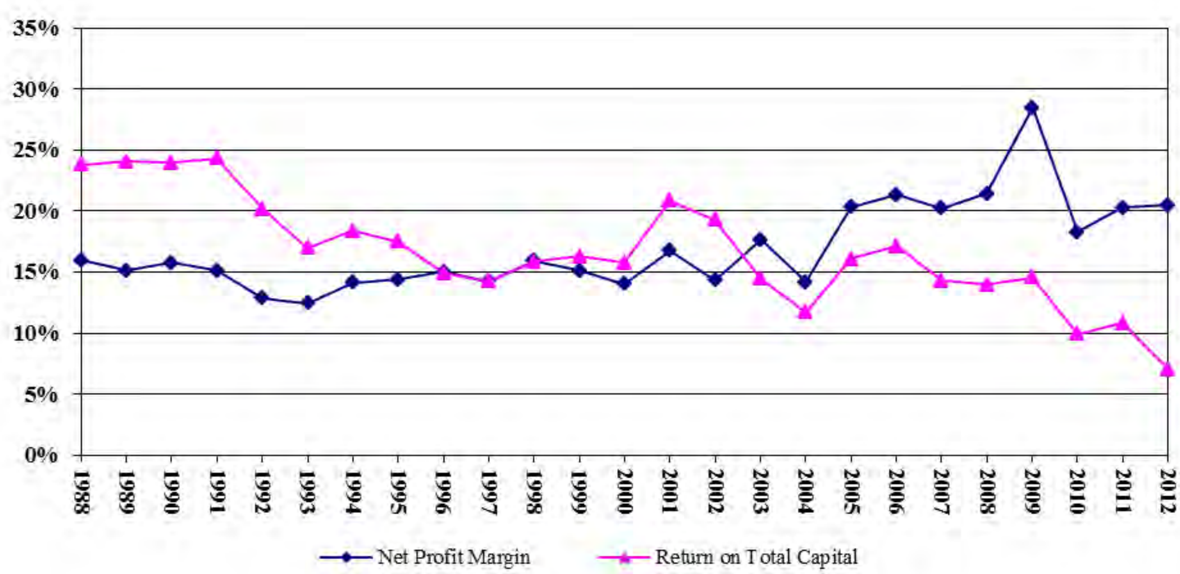
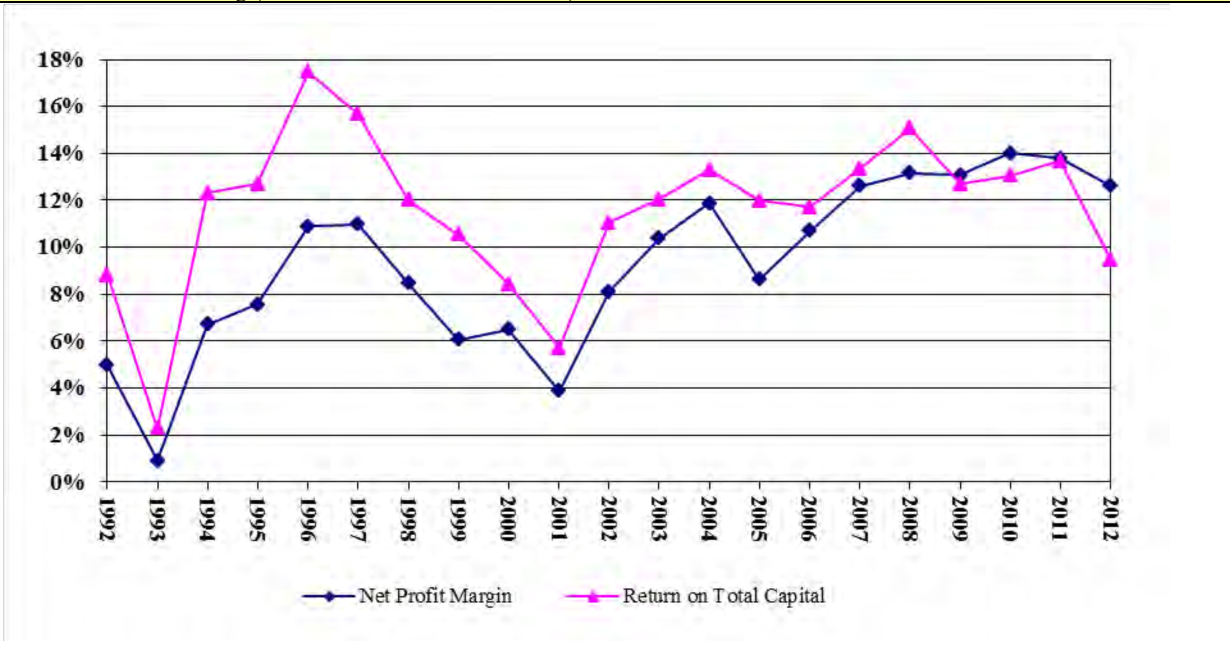


Figure B-6: Net Profit Margin and Return in Total Capital for the Chemicals and Allied Products Industry Segments

Other Chemicals Manufacturing (Incl. Pesticides and Fertilizers)



Source: U.S. DOC, 1988-2010 QFR.

B.6 Facilities Operating Cooling Water Intake Structures

Section 316(b) of the Clean Water Act applies to point source facilities that use or propose to use a cooling water intake structure that withdraws cooling water directly from a surface waterbody of the United States. In 1982, the Chemicals and Allied Products industry withdrew 2,797 billion gallons of cooling water, accounting for approximately 3.6 percent of total industrial cooling water intake in the United States.[180] The industry ranked 2nd in industrial cooling water use behind the electric power generation industry (1982 Census of Manufactures).

This section provides information for facilities in the profiled chemical and allied products segments estimated to be subject to regulation under the regulatory analysis options. Existing facilities that meet all of the following conditions could have been subject to regulation under the three regulatory analysis options:

- Use a cooling water intake structure or structures, or obtain cooling water by any sort of contract or arrangement with an independent supplier who has a cooling water intake structure; or their cooling water intake structure(s) withdraw(s) cooling water from waters of the United States, and at least twenty-five (25) percent of the water withdrawn is used for contact or non-contact cooling purposes;
- Have a National Pollutant Discharge Elimination System (NPDES) permit or are required to obtain one; and
- Meet the applicability criteria for the specific regulatory analysis option in terms of design intake flow (i.e., 2 MGD).

The regulatory analysis options also cover substantial additions or modifications to operations undertaken at such facilities. EPA initially identified the set of facilities that were estimated to be *potentially* subject to the 316(b)

180 Data on cooling water use are from the 1982 Census of Manufactures. 1982 was the last year in which the Census of Manufactures reported cooling water use.

Existing Facilities Regulation based on a minimum applicability threshold of 2 MGD; this section focuses on these facilities for the petroleum segment.[181]

B.6.1 Waterbody and Cooling System Type

Table B-11, shows the distribution of facilities by type of water body and cooling system for each option.

Table B-11: Number of Facilities Estimated Subject to the 316(b) Existing Facilities Regulation by Waterbody Type and Cooling Water Intake System for the Profiled Chemical Segments

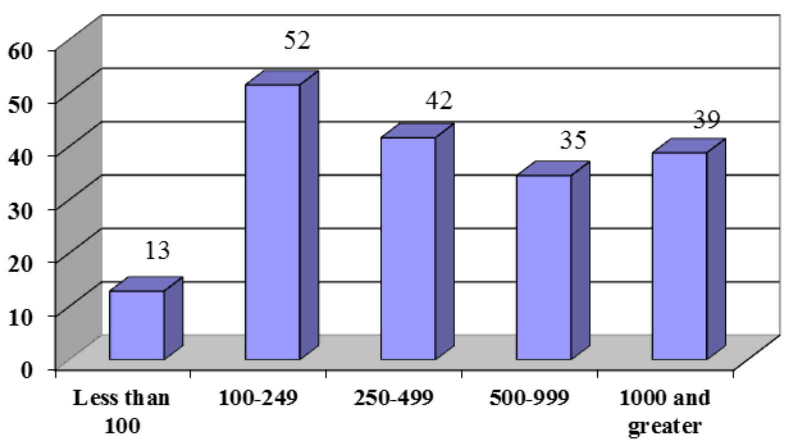
Waterbody Type	Recirculating		Combination		Once-Through		Other		Total
	No.	% of Total	No.	% of Total	No.	% of Total	No.	% of Total	
Estuary/ Tidal River	0	0%	13	36%	3	3%	0	0%	16
Ocean	0	0%	0	0%	9	10%	0	0%	9
Lake/Reservoir	4	12%	6	17%	4	5%	0	0%	15
Freshwater River/ Stream[a]	30	88%	17	47%	62	68%	10	70%	119
Great Lake	0	0%	0	0%	13	14%	4	30%	17
Total[b]	**35**	**20%**	**36**	**21%**	**91**	**52%**	**14**	**8%**	**175**

a. Four freshwater facilities‟ cooling water intake system types are unknown.
b. Individual numbers may not add to total due to independent rounding.
Source: U.S. EPA, 2000; U.S. EPA analysis, 2013.

B.6.2 Facility Size

The facilities in the Inorganic Chemicals, Plastics Materials and Resins and Organic Chemicals segments that are estimated subject to regulation under each analysis option are relatively large, with the vast majority of facilities employing more than 100 employees. *Figure B-7*, shows the number of facilities in the profiled chemical segments by employment size category for each analysis option.

Figure B-7: Number of Facilities Estimated Subject to the 316(b) Existing Facilities Regulation by Employment Size for Profiled Chemicals and Allied Products Industry Segments



Source: U.S. EPA, 2000; U.S. EPA analysis, 2013.

181 EPA applied sample weights to the sampled facilities to account for non-sampled facilities and facilities that did not respond to the survey. For more information on EPA‟s 2000 Section 316(b) Industry Survey, please refer to the Information Collection Request (U.S. EPA, 2000).

B.6.3 Firm Size

EPA used the Small Business Administration (SBA) small entity size standards to determine the number of facilities in the three profiled chemical segments that are owned by small firms. Firms in the Basic Chemicals segment (NAICS codes 325110, 325120, 325131, 325181, 325188, and 325199), firms in the Resins and Synthetics sector (NAICS codes 325221, and 325222), and firms in the Pesticides and Fertilizer segment (NAICS code 32311) are defined as small if they have 1,000 or fewer employees except firms in NAICS 32521 as well as firms in the Pharmaceutical segment (NAICS codes 325411 and 325412), which are defined as small if they have 750 or fewer employees; remaining firms in the Pesticides and Fertilizer segment (NAICS 325312) are defined as small if they have 500 or fewer employees. EPA estimates that 26 small entity-owned facilities and 154 large entity-owned facilities in the Chemical segment will be subject to the 316(b) Existing Facilities regulation.[182]

[182] EPA did not have sufficient survey data to determine the size of entities owning four facilities. EPA assumed these facilities to be small entity-owned facilities in order to not understate the effect of this rule on small entities.

Appendix C Profile of Food and Kindred Products Industry

C.1 Introduction

EPA‟s *Detailed Industry Questionnaire*, hereafter referred to as the DQ, identified five 4-digit SIC codes in the Food and Kindred Products manufacturing industry (SIC 20) with at least one existing facility that operates a CWIS, holds a NPDES permit, withdraws at least two million gallons per day (MGD) from a water of the United States, and uses at least 25 percent of its intake flow for cooling purposes (facilities with these characteristics are hereafter referred to as "facilities potentially subject to the 316(b) Existing Facilities regulation" or "regulated facilities"). For the purpose of this analysis, EPA identified a six-digit NAICS code for each of these potential facilities using the information from DQ and public sources (see *Appendix J: Mapping Manufacturers Standard Industrial Classification (SIC) Codes to North American Industry Classification System (NAICS) Codes*). As the result of this mapping, EPA identified five 6-digit NAICS codes in the Food and Kindred Products manufacturing industry (NAICS 322).

For each of these five analyzed 6-digit NAICS codes, *Table C-1* following page, provides a description of the industry segment, a list of primary products manufactured, the total number of detailed questionnaire respondents (weighted to represent a national total of facilities that hold a NPDES permit and operate cooling water intake structures), and the number of facilities estimated to be potentially subject to the section final rule based on the minimum withdrawal threshold of 2 MGD (see *Chapter 1: Introduction* for more details on the final rule applicability criteria). Although the respondent DQs fall in only five of the 48 four-digit SIC codes that map onto 52 NAICS codes within the Food and Kindred Products industry, EPA knows of no basis to exclude any of the remaining four-digit SIC codes (or six-digit NAICS codes) from consideration in this profile. Accordingly, this profile focuses on the entirety of SIC 20 that map onto NAICS 311/3121, Food and Kindred Products.

Table C-1: Existing Facilities in the Food and Kindred Products Industry (NAICS 311/3121)

NAICS	NAICS Description	Important Products Manufactured	Number of Regulated Facilities
311221	Wet corn milling	Corn oil cake and meal; corn starch; corn syrup; dextrose, fructose; glucose; high fructose syrup; starches	14
311312	Cane sugar refining	Cane sugar; molasses; granulated sugar; raw sugar; cane syrup (all made from sugarcane); molasses, blackstrap; granulated sugar; refined sugar; syrup (all made from purchased raw cane or sugar syrup)	14
311313	Beet sugar mfg	Beet sugar; molasses; granulated sugar; liquid sugar; powdered sugar; syrup (all made from sugar beets)	7
312140	Distilleries	Distilled and blended liquors, except brandy; gin; rum; vodka; whiskey; cocktails; cordials; eggnog; grain alcohol for medicinal and beverage purposes	3
		Total NAICS 311/3121[a]	**37**

a. Individual numbers may not add up to total due to independent rounding.
Source: Executive Office of the President, 1987; U.S. EPA, 2000; U.S. EPA analysis, 2013.

The Food and Kindred Products industry includes facilities that process or manufacture food and beverages for human consumption, feed for animals, and other related products. Statistics for the industry were previously recorded under the Standard Industry Classification (SIC) code of 20, for Food and Kindred Products. SIC 20 included nine industry groups at the three-digit SIC level, and 48 industries at the four-digit SIC level. Under the SIC system, beverage manufacturing was included in SIC 20, the Food and Kindred Products sector. In 1997, the U.S. Census Bureau began reporting economic activity in the North American Industry Classification System (NAICS), which replaced the SIC system (U.S. DOC, 1997). Under NAICS, the previous SIC 20 sector is recorded in one 3-digit NAICS sector (NAICS 311) and one 4-digit NAICS sector (NAICS 3121), Beverage Manufacturing. Because the analysis period for this profile extends across the SIC-to-NAICS transition, most of the data series presented in the profile include data both the SIC and NAICS frameworks: in general, for years prior to 1997, data are in the SIC framework; for 1997 and after, data are in the NAICS framework. *Table C-2* summarizes the relationship between SIC and NAICS codes used for this profile and provides summary information on the relevant NAICS sectors from the 2010 Annual Survey of Manufacturers and 2009 Statistics of U.S. Businesses, both published by the U.S. Census Bureau.

Table C-2: Relationship between NAICS and SIC Codes for the Petroleum Refining Industry

NAICS Code	NAICS Description	SIC Code	SIC Description	Number of Establishments (2009)[b]	Value of Shipments (2010; Millions; $2011)	Employment (2010)
311 (Excl. 311811[a])	Food Manufacturing	20-- (excl. 2082, 2084-6, and 2097)	Food and Kindred Products	24,731	$656,721	1,315,188
3121	Beverage Manufacturing	2082	Malt Beverages	4,119	$94,840	118,719
		2084	Wines, Brandy, and Brandy Spirits			
		2085	Distilled and Blended Liquors			
		2086	Bottled and Canned Soft Drinks and Carbonated Waters			
		2097	Manufactured Ice			

a. NAICS 311811: Retail Bakeries is not a part of manufacturing sectors in the SIC framework. Because Annual Survey of Manufacturers, used to analyze Food and Kindred Products manufacturing sector, provides data only for manufacturing sectors, EPA excluded NAICS 311811 from the totals to the Food and Kindred Products sector.
b. The most recent data on number of establishments is available for 2009 from Statistics of U.S. Businesses. Value of Shipments and Employment reflect 2010 data.
Sources: U.S. DOC, 2010 ASM; U.S. DOC, 2009 SUSB

C.2 Summary Insights from this Profile

The key purpose of this profile is to provide insight into the ability of firms in the Food and Kindred Products industry to absorb compliance costs from the regulatory analysis options without material adverse economic/financial effects. The industry‟s ability to absorb compliance costs is primarily influenced by two factors: (1) the extent to which the industry may be expected to shift compliance costs to its customers through price increases and (2) the financial health of the industry and its general business outlook.

C.2.1 Likely Ability to Pass Compliance Costs Through to Customers

As reported in the following sections of this profile, the Food Manufacturing and Beverage Manufacturing segments face somewhat limited foreign competitive pressures, and, based on this factor, would have some latitude to pass through to customers any increase in production costs resulting from regulatory compliance. However, within the U.S. market, the Food Manufacturing and Beverage Manufacturing segments have relatively low concentrations. Although niche product and/or regional segments are likely to face lighter overall competition, the lack of industry concentration, as described later in this profile, suggests that firms in this industry may have little ability to recover compliance costs through increased prices – particularly if the increased costs do not occur in a relatively uniform way throughout the industry. Given the likelihood that only a relatively small subset of facilities and firms in this industry will face additional costs as a result of the regulatory options considered for the section 316(b) Existing Facilities Regulation, EPA judges that a conservative assumption of no-cost-pass-through is appropriate for analysis of the impact on this industry. Consequently, for the cost and economic impact analysis, EPA assumed that regulated facilities would absorb all compliance costs within their operating finances (see following sections and *Appendix K: Cost Pass-Through Analysis*, for further information).

C.2.2 Financial Health and General Business Outlook

Unlike the more cyclical sectors in the other profiled Primary Manufacturing Industries, the profiled Food and Kindred Products industry, being a consumer staples industry, was not as strongly affected by the economic downturns that occurred in the early 2000s and in 2008-2009. During the last two decades, this industry has maintained relatively healthy financial performance and steady growth despite economic fluctuations, increasing government regulations, and changing consumer preferences and behavior. To remain competitive, firms in the Food and Kindred Products industry have been able to promptly respond to changing economic, business, and regulatory environment by offering a greater variety of products while consistently and cost-effectively producing high quality products (Rockwell Automation, 2008). Extremely high prices for many food commodities brought a cash windfall in much of 2006-2008 for the industry. However, more recently, the global financial crisis has created new challenges as consumers move to cheaper food options and increasingly cook at home (Plunkett Research, 2010). The industry has exhibited substantially less fluctuation in capacity utilization and financial performance than more cyclical industries, such as the other five Primary Manufacturing Industries. Although foreign competition increased, the industry also experiences significantly less international competition than firms in the other Primary Manufacturing Industries, as indicated by the industry‟s lower reliance on export sales and the lower extent of import penetration in domestic markets.

On the whole, the Food and Kindred Products industry has seen an increase in the level of capital expenditures during the last two decades, despite fluctuations, and has correspondingly recorded a rise in labor productivity in spite of multiple annual declines over the period. However, in the last decade capital expenditures actually declined and the recent financial crisis led to significant declines in employment at the end of the period. These factors suggest that the industry‟s capital equipment base had been maintained and regularly improved during the 1990s but that the business may face inordinate needs for capital expenditure due, for example, to offset the past decade in which capital outlays seem to have substantially retrenched. Within the broader Food and Kindred Products industry, the Food Manufacturing segment has generally achieved more stable growth and financial performance than the Beverage segment.

In 2012, the Packaged Foods and Meats index rose 6.9 percent compared to a 13.7 percent rise in the S&P 1500. For 2013, the outlook for this sub-industry of the Food and Kindred Products is neutral. In the long-term, experts believe that growth opportunities will lie in appealing to consumers‟ interest in healthier eating (S&P, 2013a). The Soft Drinks sub-industry, another segment of the Food & Kindred Products sector, saw a 4.6 percent increase in 2012. The outlook for the Soft Drinks sub-industry is neutral, with experts expecting growth in line with the overall market (S&P, 2012g). The Distiller & Vintners sub-industry index increased 29.9 percent in 2012 and has a positive outlook for 2013 (S&P, 2012b).

Given the proven ability of the profiled Food and Kindred Products industry to withstand economic fluctuations, regulatory changes, and constantly changing consumer behavior and business environment together with recent industry trends may suggest that going forward, the profiled Food and Kindred Products industry is very likely to continue its moderate steady growth accompanied by relatively healthy financial performance. Further, EPA judges that the profiled Food and Kindred Products industry is currently in better economic/financial condition overall than the other profiled Primary Manufacturing Industries and that this industry should be able to absorb the cost of final rule compliance requirements without material adverse financial impact.

C.3 Domestic Production

At the beginning of this decade, the profiled Food and Kindred Products industry was one the largest manufacturing industries in the United States, with the Food Manufacturing and Beverage segments accounting for approximately one-sixth of U.S. industrial activity in 2000 (McGraw-Hill, 2000). In 2009, U.S. total food sales exceeded $1.5 trillion (Plunkett Research, 2010), and the Food Manufacturing segment alone accounts for over 10 percent of all manufacturing shipments (U.S. DOC, 2008). The industry is considered mature, however, and firms are constantly seeking new avenues for increased sales in domestic and foreign markets. With total food industry shipments growing more slowly than GDP, U.S. producers have actively sought growth opportunities in overseas markets. Although exports still make up a small share of domestic shipments, changes in global food consumption could lead to increased demand and trade for processed food products going forward. As developing countries experience growth in income, the demand for higher quality food products, such as meat products, present an opportunity for U.S. firms to increase exports. In developed countries, consumer demand for food is driven mainly by convenience and specialty food products (U.S. DOC, 2008).

C.3.1 Output

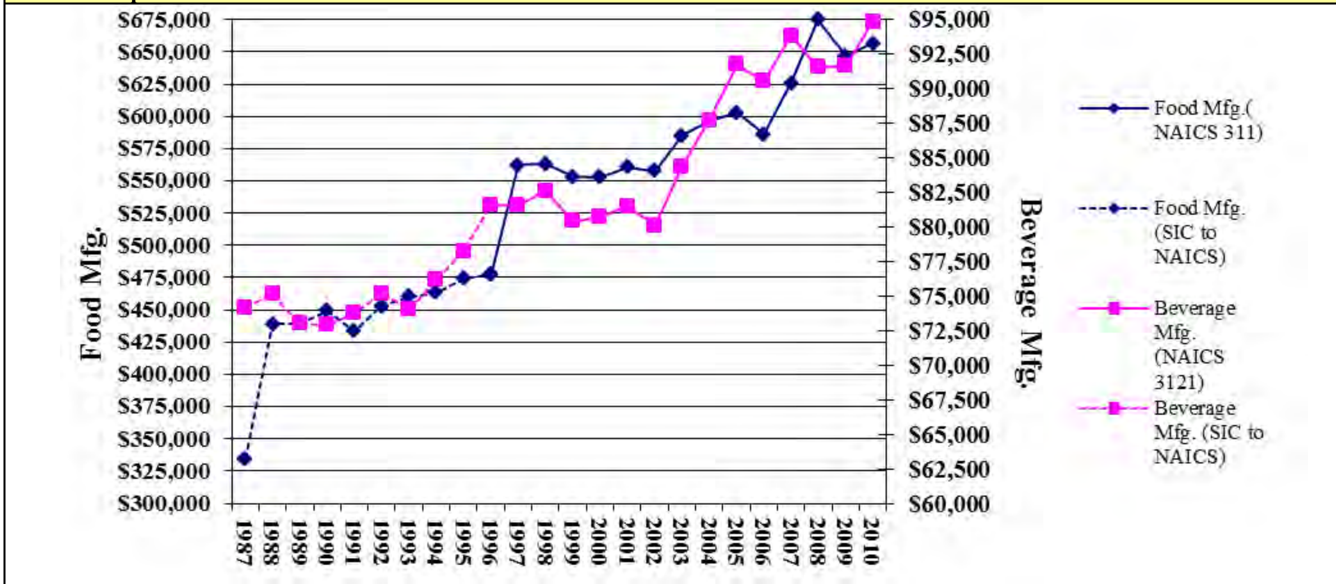
Figure C-1, following page, shows trends in constant dollar ***value of shipments*** and ***value added*** for the Food Manufacturing and Beverage Manufacturing segments.[183] Change in these values over time provides insight into the overall economic health and outlook for an industry. Value of shipments is the sum of receipts earned from the sale of outputs; it indicates the overall size of a market or the size of a firm in relation to its market or competitors. Value added, defined as the difference between the value of shipments and the value of inputs used to make the products sold, measures the value of production activity in a particular industry.

Over-time trends in value of shipments and value added show that both the Food Manufacturing and Beverage Manufacturing segments have achieved generally stable performance over the 1987-2010 analysis period: these industries have not been substantially affected by fluctuations in the performance trend of the U.S. economy. The lack of major swings in shipments and value added results largely from the consumer staple-character of the industry. At the end of the 1987-2010 analysis period, both profiled segments ended with a higher total value of shipments and value added: constant dollar value of shipments in the profiled Food Manufacturing and Beverage Manufacturing segments increased by about 96 percent and 28 percent, respectively, while value added increased by 109 percent and 42 percent, respectively. The general trends indicate that firms in these industry segments have been able to increase shipments and value added, which is a sign that these firms have been successful in finding ways to expand their market and continue to grow.

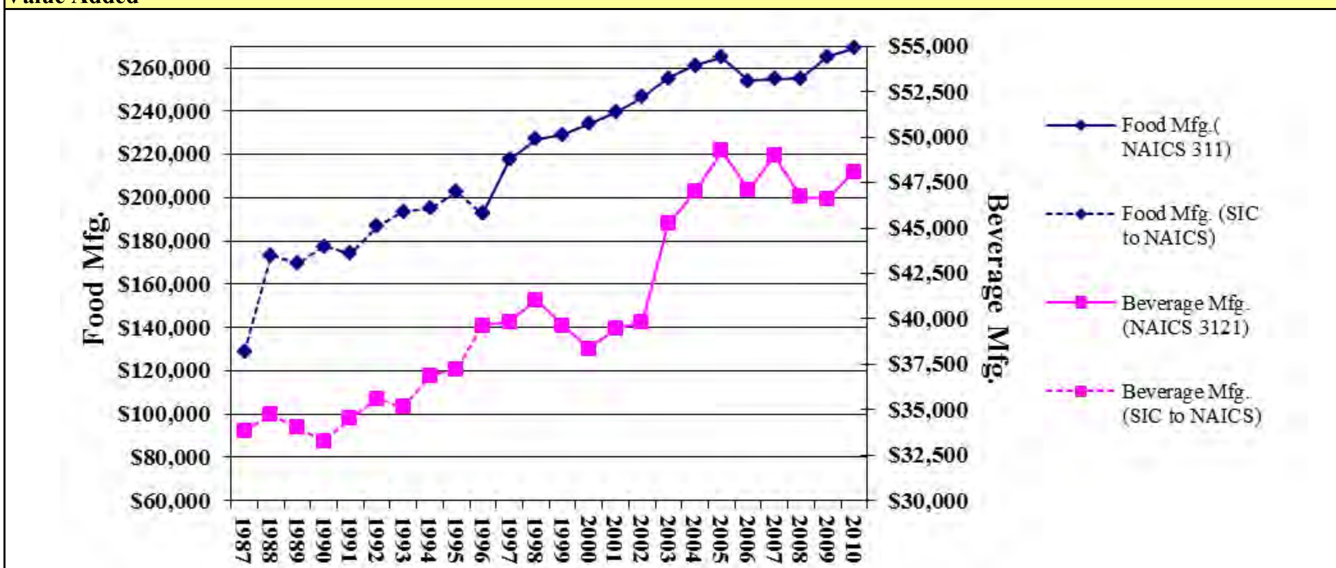
[183] Terms highlighted in bold and italic font are further explained in the glossary.

Figure C-1: Value of Shipments and Value Added for Profiled Aluminum Industry Segments (millions, $2011)a Profiled Food Manufacturing and Beverage Manufacturing Segments (millions, $20110)a

Value of Shipments



Value Added



a. Before 1997, the Department of Commerce compiled data in the SIC system; since 1997, these data have been compiled in the North American Industry Classification System (NAICS). For this analysis, EPA converted the NAICS classification data to the SIC code classifications using the *1997 Economic Census Bridge Between NAICS and SIC*.

Source: U.S. DOC, 1988-1991, 1993-1996, 1998-2001, 2003-2006, and 2008-2010 ASM; U.S. DOC, 1987, 1992, 1997, 2002, and 2007 EC.

Table C-3 provides the Federal Reserve System‟s index of industrial production for the profiled Food Manufacturing and Beverage Manufacturing segments, showing trends in production between 1990 and 2011. This index more closely reflects total output in physical terms, whereas value of shipments and value added reflect the economic value of production. The production index is expressed as a percentage of output in the base year, 2007. With the exception of modest decreases in production during 1996, 2008, 2009 and 2010, the Food Manufacturing segment has seen year-to-year production increases throughout the analysis period, with an overall increase in production of 29 percent (8 percent during the last decade). Being less of a consumer staple industry segment, the Beverage Manufacturing segment saw slightly more fluctuations during the analysis period and experienced an overall increase of 37 percent for the entire period (26 percent during the last decade). Food manufacturers continue to invest in greater automation in manufacturing processes with budgeted spending for plant equipment, upgrades, computers, and automation remaining at steady levels. With the recent national concerns over food safety and increasing food safety regulations, food manufacturers will likely also begin investing in additional technological processes to meet increasing food safety requirements (U.S. DOC, 2008).

Table C-3: U.S. Food and Beverage Manufacturing Industry Industrial Production Index

	Food Manufacturing[a]		Beverage Manufacturing[b]	
Year	**Index 2007=100**	**Percent Change**	**Index 2007=100**	**Percent Change**
1990	78.1	NA	74.6	NA
1991	79.5	1.8%	75.6	1.3%
1992	81.0	1.9%	75.9	0.5%
1993	83.1	2.7%	75.8	-0.2%
1994	83.6	0.6%	79.0	4.2%
1995	85.8	2.6%	79.5	0.7%
1996	84.0	-2.1%	83.0	4.3%
1997	86.3	2.8%	84.3	1.6%
1998	90.1	4.4%	85.6	1.5%
1999	91.2	1.1%	81.3	-5.0%
2000	92.7	1.7%	81.1	-0.2%
2001	92.8	0.0%	80.9	-0.2%
2002	95.0	2.4%	81.2	0.3%
2003	95.6	0.7%	86.3	6.3%
2004	95.6	0.0%	89.7	4.0%
2005	98.6	3.1%	94.8	5.7%
2006	99.5	0.9%	94.4	-0.5%
2007	100.0	0.5%	100.0	5.9%
2008	98.7	-1.3%	95.2	-4.8%
2009	98.2	-0.6%	98.6	3.6%
2010	98.0	-0.1%	98.4	-0.2%
2011	100.3	2.3%	102.1	3.8%
Total Percent Change 1990-2011	**28.5%**		**37.0%**	
Total Percent Change 2000-2011	**8.2%**		**26.0%**	
Average Annual Growth Rate[184]	**1.2%**		**1.5%**	

a. NAICS 311
b. NAICS 3121
Source: Federal Reserve Board of Governors, 2012c

C.3.2 Prices

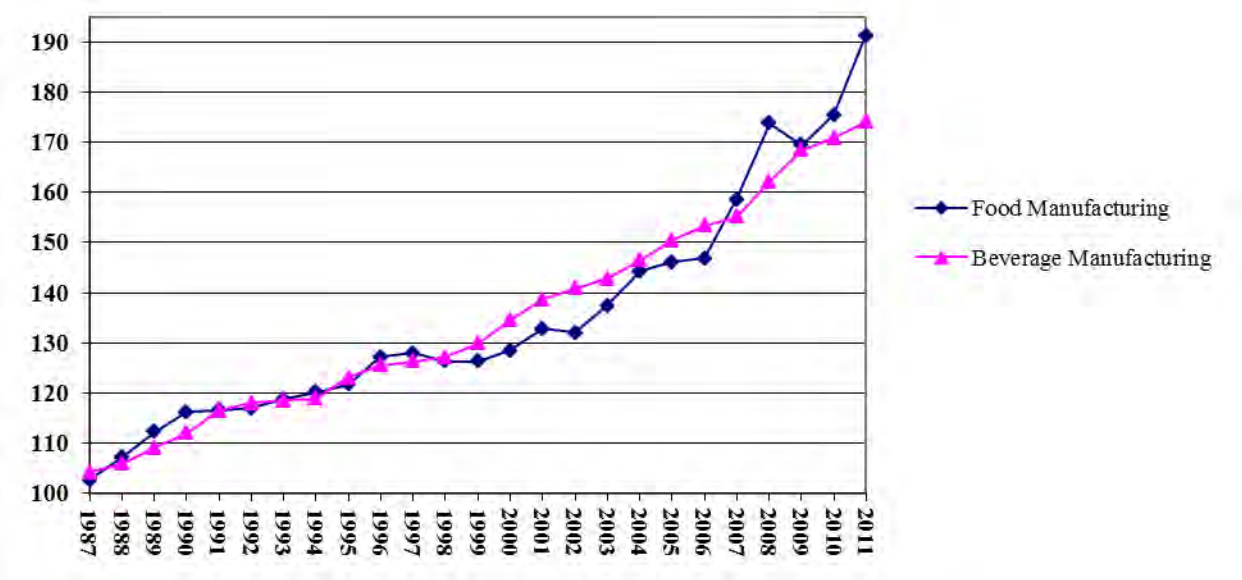
The ***producer price index*** (PPI) measures price changes, by segment, from the perspective of the seller, and indicates the overall trend of product pricing, and thus supply-demand conditions, within a segment.

As shown in *Figure C-2*, price levels in the profiled Food Manufacturing and Beverage Manufacturing segments have risen steadily between 1987 and 2011, with an average annual growth rate of more than 2 percent. Total spending on food makes up about 13 percent of a household‟s total average annual expenditures. Of the average $6,111 in food spending, $3,417 is used for food to be consumed in the home and $2,694 is used for food consumed away from home. Prepared meals, ready-to-serve products, ethnically diverse food products, and organic food are showing increased demand as the U.S. population becomes older, more frugal, more diverse, and increasingly concerned about nutrition (U.S. DOC, 2008). The Beverage Manufacturing segment has also seen a steady increase in consumer spending over the last two decades despite being more susceptible to economic

184 In this appendix, average annual growth rate refers to a year-to-year, constant percentage growth mean, which is calculated as the compound annual growth rate between the first and last values. This is the same concept as the geometric mean, if all of the individual year-to-year

fluctuations. Further, industry experts expect the Beverage Manufacturing industry segment to continue the modest but stable upward trend as manufacturers address consumer concerns about appropriate beverage size and environmentally friendly packaging (CID, 2010). The Food Manufacturing segment saw a slight decline in 2009 due to the most recent recession but then experienced steep rises in prices in 2010 and even more so in 2011.

Figure C-2: Producer Price Indexes for Food Manufacturing and Beverage Manufacturing Segments



Source: BLS, 2011b.

C.3.3 Number of Facilities and Firms

Table C-4 and *Table C-5* present the number of facilities and firms for the Food Manufacturing and Beverage Manufacturing segments between 1990 and 2009. As reported in the *Statistics of U.S. Businesses*, between 1990 and 2009, the number of facilities in the Food Manufacturing segment increased by 48 percent. The number of firms in this segment grew by about 54 percent during this time period. During the same analysis period, the number of facilities and number of firms in the Beverage Manufacturing segment increased even more dramatically, by 87 percent and 99 percent, respectively. During the last decade, however, the Food Manufacturing saw a number of mergers and acquisitions (U.S. DOC, 2008). Consequently, while the number of facilities and firms in the Beverage Manufacturing grew by 50 percent and 57 percent, respectively, during the last decade, the Food Manufacturing segment saw smaller increases in both of 24 percent and 25 percent, respectively.

Table C-4: Number of Facilities Owned by Firms in the Food and Beverage Manufacturing Segments[a]

Year	Food Manufacturing		Beverage Manufacturing	
	Number of Facilities	Percent Change	Number of Facilities	Percent Change
1990	16,740	NA	2,200	NA
1991	16,790	0.3%	2,211	0.5%
1992	17,824	6.2%	2,287	3.4%
1993	18,114	1.6%	2,281	-0.3%
1994	17,795	-1.8%	2,293	0.5%
1995	17,726	-0.4%	2,333	1.7%
1996	18,587	4.9%	2,576	10.4%
1997	18,558	-0.2%	2,660	3.3%
1998	20,088	8.2%	2,601	-2.2%
1999	19,954	-0.7%	2,671	2.7%
2000	19,902	-0.3%	2,748	2.9%
2001	20,340	2.2%	3,033	10.4%
2002	19,136	-5.9%	3,099	2.2%
2003	19,873	3.9%	3,082	-0.5%
2004	19,667	-1.0%	3,222	4.5%
2005	19,339	-1.7%	3,376	4.8%
2006	19,126	-1.1%	3,556	5.3%
2007	25,796	34.9%	3,960	11.4%
2008	25,760	-0.1%	4,050	2.3%
2009	24,731	-4.0%	4,119	1.7%
Total Percent Change 1990-2009	**47.7%**		**87.2%**	
Total Percent Change 2000-2009	**24.3%**		**49.9%**	
Average Annual Growth Rate	**2.1%**		**3.4%**	

a. Before 1998, data were compiled in the SIC system; since 1998, these data have been compiled in the North American Industry Classification System (NAICS). For this analysis, EPA converted the NAICS classification data to the SIC code classifications using the 1997 Economic Census Bridge Between NAICS and SIC.

Source: U.S. DOC, 1990-1997 SBA; U.S. DOC, 1998-2009 SUSB.

Table C-5: Number of Firms in the Food and Beverage Manufacturing Segments[a]

Year	Food Manufacturing		Beverage Manufacturing	
	Number of Firms	Percent Change	Number of Firms	Percent Change
1990	13,346	NA	1,789	NA
1991	13,418	0.5%	1,818	1.6%
1992	14,409	7.4%	1,875	3.1%
1993	14,698	2.0%	1,867	-0.4%
1994	14,378	-2.2%	1,893	1.4%
1995	14,330	-0.3%	1,954	3.2%
1996	15,189	6.0%	2,192	12.2%
1997	15,189	0.0%	2,235	2.0%
1998	16,656	9.7%	2,137	-4.4%
1999	16,559	-0.6%	2,196	2.8%
2000	16,533	-0.2%	2,267	3.2%
2001	16,960	2.6%	2,558	12.8%
2002	15,796	-6.9%	2,616	2.3%
2003	16,561	4.8%	2,576	-1.5%
2004	15,511	-6.3%	2,692	4.5%
2005	15,274	-1.5%	2,839	5.5%
2006	15,093	-1.2%	2,998	5.6%
2007	21,591	43.1%	3,388	13.0%
2008	21,501	-0.4%	3,477	2.6%
2009	20,595	-4.2%	3,554	2.2%
Total Percent Change 1990-2009	**54.3%**		**98.7%**	
Total Percent Change 2000-2009	**24.6%**		**56.8%**	
Average Annual Growth Rate	**2.3%**		**3.7%**	

a. Before 1998, data were compiled in the SIC system; since 1998, these data have been compiled in the North American Industry Classification System (NAICS). For this analysis, EPA converted the NAICS classification data to the SIC code classifications using the 1997 Economic Census Bridge Between NAICS and SIC.

Source: U.S. DOC, 1990-1997 SBA; U.S. DOC, 1998-2009 SUSB.

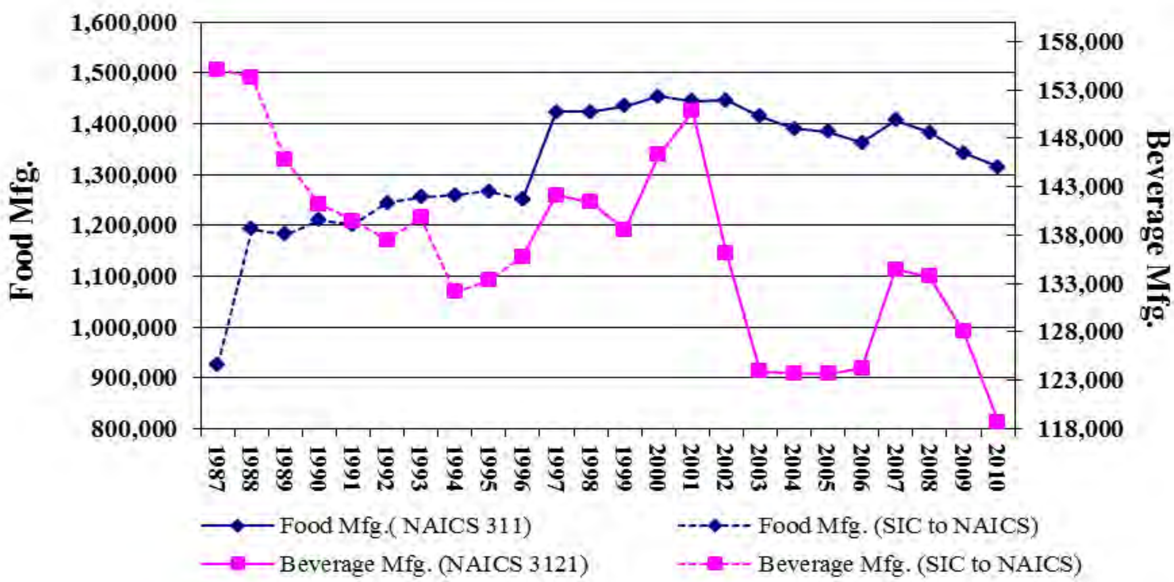
C.3.4 Employment and Productivity

The U.S. Food and Kindred Products industry is among the most modern in the world. A steady trend of industry growth and accompanying capital outlays have both increased production capacity and led to installation of increasingly modern and more efficient, higher technology, production equipment. Indeed, spending for production, packaging and process control equipment is the most robust automation capital area (see *Section C.3.5*, below). The more advanced technology production equipment requires a more skilled labor force; therefore, the key to future productivity gains are said to lie in better skills training of line operators and supervisors. At the same time, more advanced technology equipment has resulted in more automated production process and has reduced the number of employees needed per dollar of production (Higgins, 2005).

Figure C-3 presents ***employment*** for the two profiled segments between 1987 and 2010. As shown in *Figure C-3,* between 1987 and 2010, employment exhibited different behavior in the two profiled segments. Other than sharp increases in 1988 and 1997, employment in the Food Manufacturing segment was relatively stable, decreasing by no more than 3 percent and increasing by no more than 4 percent. Over the entire analysis period, employment in the Food Manufacturing segment increased by 42 percent. During the last decade, however, employment in this segment fell by 10 percent. This drop in employment is likely the result of heavy investments in technology and increased automation and production improvements, which persisted in the Food Manufacturing segment in the last decade and have allowed companies to increase output while relying on fewer employees (U.S. DOC, 2008). In the latter years of the past decade, employment in the Food Manufacturing segment has followed a steady downward trend.

The Beverage Manufacturing segment has experienced more volatility over the last two decades. Between 1987 and 1994, employment in the Beverage Manufacturing segment fell nearly every year, before reversing this trend and experiencing gains through 2001. These employment gains, however, were followed by consecutive significant declines of nearly 10 and 9 percent in 2002 and 2003, respectively. After relatively stable few years, 2007 saw a significant employment increase of over 8 percent. However, this increase in employment in the Beverage Manufacturing segment was followed by a major decline between 2007 and 2010.

Figure C-3: Employment for Food Manufacturing and Beverage Manufacturing Segments[a]



a. Before 1997, the Department of Commerce compiled data in the SIC system; since 1997, these data have been compiled in the North American Industry Classification System (NAICS). For this analysis, EPA converted the NAICS classification data to the SIC code classifications using the 1997 Economic Census *Bridge Between NAICS and SIC.*

Source: U.S. DOC, 1988-1991, 1993-1996, 1998-2001, 2003-2006, and 2008-2010 ASM; U.S. DOC, 1987, 1992, 1997, 2002, and 2007 EC.

Table C-6 presents the change in value added per labor hour, a measure of ***labor productivity***, for the two profiled industry segments between 1987 and 2010. As shown in this table, labor productivity in the Food and Beverage Manufacturing segments has generally grown steadily and at an average annual rate of approximately 1 and 2 percent, respectively. However, labor productivity in the Beverage Manufacturing segment has shown a greater degree of fluctuation, with both annual increases and decreases in productivity exceeding 10 percent during the last decade. Overall, the Beverage manufacturing segment saw a greater increase in productivity during the last two decades, 59 percent, compared to a 30 percent productivity gain in the Food Manufacturing segment, with substantial gains occurring during the last decade. Technology improvement in the industry has played an important role in increasing production during the last decade, as automation has allowed output levels to increase without significant increases in employment (U.S. DOC, 2008).

Table C-6: Productivity Trends for Food and Beverage Manufacturing Segments ($2011)[a]

	Food Manufacturing				Beverage Manufacturing			
		Production	Value Added/Hour			Production	Value Added/Hour	
Year	Value Added ($ millions)	Hours (millions)	$/hr	Percent Change	Value Added ($ millions)	Hours (millions)	$/hr	Percent Change
1987	$128,652	1,325	97	NA	$33,824	148	228	NA
1988	$173,363	1,711	101	4.3%	$34,713	145	239	4.5%
1989	$169,530	1,708	99	-2.1%	$34,018	142	240	0.7%
1990	$177,426	1,788	99	0.0%	$33,264	140	237	-1.3%
1991	$174,218	1,776	98	-1.1%	$34,508	139	248	4.4%
1992	$186,838	1,877	100	1.5%	$35,614	140	254	2.6%
1993	$193,652	1,901	102	2.3%	$35,158	144	244	-3.9%
1994	$195,166	1,933	101	-0.9%	$36,878	138	267	9.1%
1995	$202,677	1,938	105	3.6%	$37,210	139	268	0.4%
1996	$192,814	1,911	101	-3.6%	$39,611	139	285	6.5%
1997	$217,598	2,200	99	-2.0%	$39,841	149	268	-6.1%
1998	$226,922	2,232	102	2.8%	$41,023	148	278	3.7%
1999	$228,963	2,270	101	-0.8%	$39,607	140	283	1.9%
2000	$234,125	2,284	102	1.6%	$38,341	153	251	-11.4%
2001	$239,376	2,259	106	3.4%	$39,439	150	263	5.1%
2002	$246,676	2,236	110	4.1%	$39,850	139	286	8.8%
2003	$255,103	2,239	114	3.3%	$45,225	138	327	14.1%
2004	$261,118	2,203	119	4.0%	$46,995	132	355	8.7%
2005	$264,854	2,195	121	1.8%	$49,239	135	364	2.4%
2006	$254,072	2,156	118	-2.3%	$47,115	138	342	-5.9%
2007	$254,763	2,236	114	-3.4%	$48,978	148	331	-3.2%
2008	$255,088	2,228	115	0.5%	$46,724	146	319	-3.6%
2009	$265,291	2,163	123	7.1%	$46,601	143	326	2.2%
2010	$269,230	2,125	127	3.3%	$48,087	132	364	11.5%
Total Percent Change 1987- 2010	**109.3%**	**60.5%**	**30.4%**		**42.2%**	**-10.7%**	**59.3%**	
Total Percent Change 2000 - 2010	**15.0%**	**-7.0%**	**23.6%**		**25.4%**	**-13.6%**	**45.2%**	
Average Annual Growth Rate	**3.3%**	**2.1%**	**1.2%**		**1.5%**	**-0.5%**	**2.0%**	

a. Before 1997, data were compiled in the SIC system; since 1997, these data have been compiled in the North American Industry Classification System (NAICS). For this analysis, EPA converted the NAICS classification data to the SIC code classifications using the 1997 Economic Census Bridge Between NAICS and SIC.

Source: U.S. DOC, 1988-1991, 1993-1996, 1998-2001, 2003-2006, and 2008-2010 ASM; U.S. DOC, 1987, 1992, 1997, 2002, and 2007 EC.

C.3.5 Capital Expenditures

The profiled Food and Kindred Products Manufacturing industry is capital intensive, and has invested substantially in capital to implement automation, introduce process controls, and reduce inventories in order to ultimately improve yield and reduce labor costs. Capital-intensive industries are characterized by a large value of capital equipment per dollar value of production. In order to modernize, expand, and replace existing capacity, new ***capital expenditures*** are needed. In 2010, total capital expenditures for the Food Manufacturing and Beverage Manufacturing segments amounted to about $17 billion. Approximately 85 percent of that spending (see *Table C-7*) occurred in the Food Manufacturing segment.

Between 1987 and 2010, capital expenditures in the Food Manufacturing segment increased by nearly 80 percent at an average annual rate of approximately 3 percent, peaking at about $17 billion in 1999. The Beverage Manufacturing segment has also seen substantial growth in capital expenditures during this time period. Between 1987 and 2010, expenditures in this segment increased by 23 percent, at an average annual rate of 1 percent and peaking at nearly $4 billion in 2002. During the last decade, however, capital expenditures in the Food and Beverage Manufacturing industry segments declined by approximately 7 and 23 percent, respectively.

Table C-7: Capital Expenditures for Food and Beverage Manufacturing Segments (millions, $2011)[a]

Year	Food Manufacturing		Beverage Manufacturing	
	Capital Expenditures	Percent Change	Capital Expenditures	Percent Change
1987	$7,896	NA	$2,099	NA
1988	$10,035	27.1%	$2,174	3.5%
1989	$10,751	7.1%	$2,099	-3.4%
1990	$11,432	6.3%	$1,847	-12.0%
1991	$11,316	-1.0%	$2,082	12.8%
1992	$11,998	6.0%	$2,143	2.9%
1993	$11,285	-5.9%	$1,890	-11.8%
1994	$11,637	3.1%	$2,210	16.9%
1995	$13,418	15.3%	$2,540	15.0%
1996	$12,692	-5.4%	$2,476	-2.5%
1997	$14,364	13.2%	$3,191	28.9%
1998	$15,143	5.4%	$2,943	-7.8%
1999	$16,518	9.1%	$2,982	1.3%
2000	$15,310	-7.3%	$3,357	12.6%
2001	$14,289	-6.7%	$3,139	-6.5%
2002	$13,466	-5.8%	$3,750	19.5%
2003	$13,049	-3.1%	$2,855	-23.9%
2004	$12,998	-0.4%	$2,831	-0.9%
2005	$13,596	4.6%	$3,392	19.8%
2006	$13,831	1.7%	$3,363	-0.9%
2007	$13,977	1.1%	$3,169	-5.8%
2008	$16,243	16.2%	$3,594	13.4%
2009	$14,031	-13.6%	$3,014	-16.1%
2010	$14,240	1.5%	$2,590	-14.1%
Total Percent Change 1987- 2010	**80.3%**		**23.4%**	
Total Percent Change 2000 - 2010	**-7.0%**		**-22.9%**	
Average Annual Growth Rate	**2.6%**		**0.9%**	

a. Before 1997, data were compiled in the SIC system; since 1997, these data have been compiled in the North American Industry Classification System (NAICS). For this analysis, EPA converted the NAICS classification data to the SIC code classifications using the 1997 Economic Census Bridge Between NAICS and SIC.

Source: U.S. DOC, 1988-1991, 1993-1996, 1998-2001, 2003-2006, and 2008-2010 ASM; U.S. DOC, 1987, 1992, 1997, 2002, and 2007 EC.

C.3.6 Capacity Utilization

Capacity utilization measures output as a percentage of total potential output from available capacity. Capacity utilization reflects excess or insufficient capacity in an industry and is an indication of whether new investment is likely. The degree of fluctuation in capacity utilization is also an indicator of the relative stability of demand and business conditions in an industry.

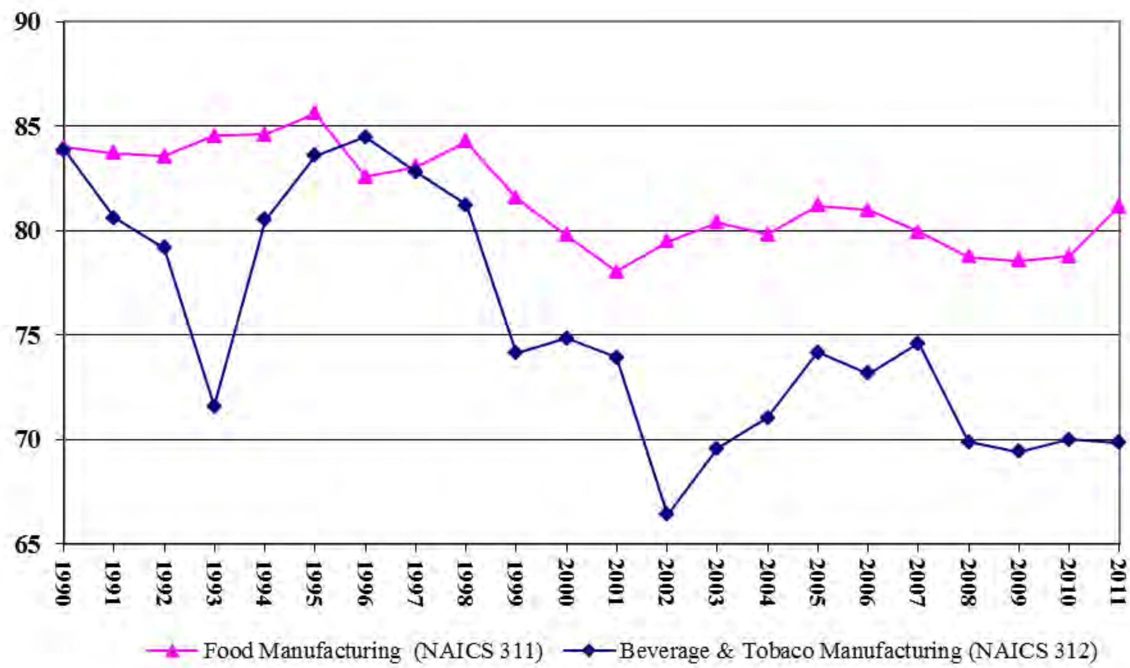
As shown in *Figure C-4*, between 1990 and 2011, capacity utilization in the Food Manufacturing and Beverage and Tobacco Manufacturing[185] industry segments generally trended downward. The Food Manufacturing segment, however, did not experience the volatility that the Beverage and Tobacco Manufacturing segment experienced over the same period. Food Manufacturing capacity utilization rates have generally remained within the 78 and 86 percent range, while the Beverage and Tobacco Manufacturing segment experienced a high of 85 percent in 1996, followed by a significant decline to below 69 percent by 2009. Further, the Beverage and Tobacco Manufacturing segment was significantly affected by economic downturns in the early 1990s and early and late 2000s, when its capacity utilization significantly dropped to 72, 66, and 69 percent, respectively. Between

185 The Census Bureau provides capacity utilization data are available only for the 3-digit NAICS sector NAICS 312: Beverage and Tobacco Manufacturing sector. The Census Bureau does not provide capacity utilization data for the 4-digit NAICS sector NAICS 3121: Beverage Manufacturing.

1990 and 2011, capacity utilization declined in both segments, although the Beverage and Tobacco Manufacturing segment experienced a more substantial drop: while capacity utilization in the Food Manufacturing segment declined by a about 3 percent, capacity utilization in the Beverage and Tobacco Manufacturing declined by nearly 17 percent.

Again, significantly less fluctuation in capital utilization in the profiled Food Manufacturing segment during the analysis period, suggests that this segment is characterized by a lower degree of susceptibility to economic changes compared to the profiled Beverage Manufacturing segment. This pattern is likely to continue going forward. That overall capacity utilization remained at a moderate level throughout the analysis period for both profiled segments – roughly between 66 and 86 percent – implies that the profiled Food and Beverage Manufacturing segments do not face requirements for large outlays for capital expansion in the near term.

Figure C-4: Capacity Utilization for Food Manufacturing and Beverage and Tobacco Manufacturing[a]



a. The Federal Reserve provides capacity utilization data for the combined NAICS 312 (Beverage and Tobacco Manufacturing) sectors. The Federal Reserve does not provide capacity utilization data for just the Beverage Manufacturing sector.

Source: Federal Reserve Board of Governors, 2012a

C.4 Structure and Competitiveness

Food Manufacturing and Beverage Manufacturing companies range in size from multi-billion dollar corporations to small producers with revenues a fraction of the size of the large producers. Many of the companies in these segments are diversified producers of multiple food or beverage products. Because food is a necessary purchase, demand is less affected by the ups and downs of the economy than for other industries.

The Food Manufacturing segment has consolidated over the last two decades as companies moved to diversify their product offerings and gain market share. This segment has also looked abroad to tap into the emerging markets of foreign countries. According to the Food Institute, 99 mergers and acquisitions occurred among food processing companies in 2006, up from 94 in 2005, but down from 168 in 2000 (U.S. DOC, 2008). These acquisitions and mergers permit companies to acquire more efficient manufacturing plants, close inefficient plants, expand product lines, and increase market share in a mature market (U.S. DOC, undated). Some recent mega-mergers in the Food Manufacturing segment include the Kraft Foods‟ acquisition of Nabisco, General Mills‟ acquisition of Pillsbury, and Tyson‟s bringing beef and pork firm IBP into its lineup. In 2008 and 2009, mergers and acquisitions were concentrated in the restaurant industries with limited M&A activity among food processing companies (The Food Institute Report, 2009).

The Beverage Manufacturing segment recorded acquisitions and mergers during the last decade, although not nearly as many as the Food Manufacturing segment. Product differentiation is a key strategy for larger firms to increase brand awareness and market share (Yahoo, 2005a). As sales in the United States slowed, firms in the non-alcoholic beverage industry saw their largest gains from non-U.S. markets. In fact, in 2008 alone, PepsiCo had three international deals (Value Line, 2004).

In the alcoholic beverage sub-segment, Anheuser-Busch lost the rank of world‟s largest brewer due to the merger of Inbrew and Brazil‟s Ambev. The merger between Adolph Coors and Molson further consolidated the industry. Brewers began to look for acquisitions in China, which is seen as an untapped market. Constellation Brands purchased the Robert Mondavi Corporation, a leader in wine making, and began to work in a joint venture with the French vintner Domaines Barons de Rothschild. Diageo and France‟s Pernod Ricard bought Seagrams Company, after outbidding the tandem of Bacardi and Brown-Forman. In recent years, Sazerac Company has purchased Constellation Brands‟‟ value spirits business, and Sabmiller and Molson Coors Brewing Company have merged (Yahoo, 2005a).

C.4.1 Firm and Facility Size

For almost all NAICS codes in the Food Manufacturing and Beverage Manufacturing segments, the Small Business Administration defines a small firm as having fewer than 500 employees. The exceptions are NAICS codes 311221, 311312, 311313, 311821, and 312140, which are considered small if the firm has fewer than 750 employees, and NAICS codes 311223, 311225, 311230, and 311422, which are deemed small if the firm employs fewer than 1,000 employees. The size categories reported in *Statistics of U.S. Businesses* (SUSB) do not correspond with the SBA size classifications, therefore preventing precise use of the SBA size threshold in conjunction with SUSB data. *Table C-8* reports the size distribution of firms and facilities in the Food Manufacturing and Beverage Manufacturing segments for 2009. As shown in the table, small establishments dominate both segments:

- 20,049 of 20,595 (97 percent) firms in the *Food Manufacturing* segment had fewer than 500 employees. These small firms owned 21,099 facilities, or 85 percent of all facilities in the segment.
- 3,485 of 3,554 (98 percent) firms in the *Beverage Manufacturing* segment had fewer than 500 employees. These small firms owned 3,553 facilities, or 86 percent of all Beverage Manufacturing facilities.

Because some six-digit NAICS codes within the Food Manufacturing and Beverage Manufacturing segments have small business size thresholds of greater than 500 employees, the reported numbers and percentages of businesses with fewer than 500 employees represent lower bounds of the number and percentage of small businesses in these industry segments.

In general, the percentage of small firms in the food and beverage industry is comparable to the percentage of small firms in all manufacturing industries combined. In 2006, approximately 97 percent of the firms in NAICS 311 and 3121 had fewer than 500 employees, compared to almost 99 percent for all manufacturing firms (U.S. SBA, 2006). However, compared to the Primary Manufacturing Industries, the Food Manufacturing and Beverage Manufacturing industries have a significantly higher percentage of firms within the industry identified as small. As noted below, however, the larger companies within each segment dominate in terms of producing the majority of shipments for each segment, with the 50 largest firms in Food Manufacturing accounting for 51 percent of shipments, while the 50 largest companies in Beverage Manufacturing producing an even greater share of shipments, at 83 percent of the total (see *Table C-9*, following page).

Table C-8: Number of Firms and Facilities by Size Category for Food and Beverage Manufacturing Segments, 2009

Employment Size Category	Food Manufacturing[a]		Beverage Manufacturing[b]	
	No. of Firms	No. of Facilities	No. of Firms	No. of Facilities
0-19	15,022	15,078	2,870	2,874
20-99	3,757	4,072	495	518
100-499	1,270	1,949	120	161
500+	546	3,632	69	566
Total	**20,595**	**24,731**	**3,554**	**4,119**

a. NAICS 311
b. NAICS 3121
Source: U.S.DOC, 2009 SUSB.

C.4.2 Concentration Ratios

Concentration is the degree to which industry output is concentrated in a few large firms. Concentration is closely related to entry barriers, with more concentrated industries generally having higher barriers.

The four-firm ***concentration ratio*** (CR4) and the ***Herfindahl-Hirschman Index*** (HHI) are common measures of industry concentration. The CR4 indicates the market share of the four largest firms. For example, a CR4 of 72 percent means that the four largest firms in the industry account for 72 percent of the industry‟s total value of shipments. The higher the concentration ratio, the less competition there is in the industry, other things being equal.[186] An industry with a CR4 of more than 50 percent is generally considered concentrated. The HHI indicates concentration based on the largest 50 firms in the industry. It is equal to the sum of the squares of the market shares for the largest 50 firms in the industry. For example, if an industry consists of only three firms with market shares of 60, 30, and 10 percent, respectively, the HHI of this industry would be equal to 4,600 ($60^2 + 30^2 + 10^2$). The higher the index, the fewer the number of firms supplying the industry and the more concentrated the industry. Based on the U.S. Department of Justice‟s guidelines for evaluating mergers, markets in which the HHI is under 1,000 are considered unconcentrated, markets in which the HHI is between 1,000 and 1,800 are considered to be moderately concentrated, and those in which the HHI is in excess of 1,800 are considered to be concentrated.

As shown in *Table C-9*, based on the most recent data, the Food Manufacturing segment has an HHI of 102, and the Beverage Manufacturing segment has an HHI of 483. At these HHI levels, the two industry segments, especially the Food Manufacturing segment, appear unconcentrated. With relatively low concentration in the affected industries, firms are unlikely to possess the market power to recover regulatory compliance costs through price increases, particularly if those costs do not apply relatively uniformly and broadly throughout the industry.

The concentration ratios also show that each profiled segment operates in unconcentrated markets. The Beverage Manufacturing segment has the higher concentration of the two segments, with a CR4 of 39 percent. This is slightly lower than the 50 percent threshold, which would indicate some market concentration. The CR4 for the Food Manufacturing segment is considerably lower at only 15 percent. In this segment, the top 50 companies control roughly half of the market, indicating a relatively unconcentrated market segment. In the Beverage Manufacturing segment, the top 50 companies control 83 percent of the market. As noted above, however, mergers and acquisitions are occurring in both segments, which will likely lead to increased concentration in the future. Also, certain sub-segments within each segment can be highly concentrated. For example, within the soft drink market, Coca-Cola claims around 50 percent of the global market, followed by Pepsi with roughly 21 percent and Cadbury-Schweppes with 7 percent (Yahoo, 2005a).

[186] Note that the measured concentration ratio and the HHF are very sensitive to how the industry is defined. An industry with a high concentration in domestic production may nonetheless be subject to significant competitive pressures if it competes with foreign producers or if it competes with products produced by other industries (e.g., plastics vs. aluminum in beverage containers). Concentration ratios based on share of domestic production are therefore only one indicator of the extent of competition in an industry.

Table C-9: Selected Ratios for Food Manufacturing and Beverage Manufacturing Segments

NAICS Code	Year	Total Number of Firms	Concentration Ratios: 4 Firm (CR4)	8 Firm (CR8)	20 Firm (CR20)	50 Firm (CR50)	Herfindahl-Hirschman Index
311	1997	21958	14%	22%	35%	51%	91
	2002	23334	17%	25%	40%	53%	119
	2007	21355	15%	23%	38%	51%	102
3121	1997	2169	41%	52%	66%	79%	532
	2002	2445	40%	53%	69%	82%	512
	2007	3160	39%	52%	71%	83%	483

Source: U.S. DOC, 1987, 1992, 1997, 2002, and 2007 EC.

C.4.3 Foreign Trade

This profile uses two measures of foreign competition: ***export dependence*** and ***import penetration***.

Import penetration measures the extent to which domestic firms are exposed to foreign competition in domestic markets. Import penetration is calculated as total imports divided by total value of domestic consumption in that industry: where domestic consumption equals domestic production plus imports minus exports. Theory suggests that higher import penetration levels will reduce market power and pricing discretion because foreign competition limits domestic firms‟ ability to exercise such power. Firms belonging to segments in which imports account for a relatively large share of domestic sales would therefore be at a relative disadvantage in their ability to pass-through costs because foreign producers would not incur costs as a result of the final rule. The estimated import penetration ratio for the entire U.S. manufacturing sector (NAICS 31-33) for 2010 is 28 percent. For characterizing the ability of industries to absorb compliance cost burdens, EPA judges that industries with import ratios close to or above 28 percent would more likely face stiff competition from foreign firms and thus be less likely to succeed in passing compliance costs through to customers.

Export dependence, calculated as exports divided by value of shipments, measures the share of a segment‟s sales that is presumed subject to strong foreign competition in export markets. The final rule would not increase the production costs of foreign producers with whom domestic firms must compete in export markets. As a result, firms in industries that rely to a greater extent on export sales would have less latitude in increasing prices to recover cost increases resulting from regulation-induced increases in production costs. The estimated export dependence ratio for the entire U.S. manufacturing sector for 2010 is 22 percent. For characterizing the ability of industries to absorb compliance cost burdens, EPA judges that industries with export ratios close to or above 22 percent are at a relatively greater disadvantage in potentially recovering compliance costs through price increases since export sales are presumed subject to substantial competition from foreign producers.

Table C-10 presents trade statistics for the profiled Food and Kindred Products industry.[187] Imports and exports play a small role in this industry, with 2010 import penetration and export dependence ratios of 7.9 and 7.6 percent, respectively. Both measures of foreign competition are well below the 2010 U.S. manufacturing averages. Given just these measures, it would be reasonable to assume that these segments do not face significant foreign competitive pressures, and would have more latitude in passing through to customers any increase in production costs resulting from regulatory compliance. However, as noted above, the HHI of the Food Manufacturing and Beverage Manufacturing segments is 102 and 483, respectively suggesting firms in these segments have low market power, limiting their ability to pass through any increase in production costs.

[187] Due to data limitations, it is not possible to accurately separate the Food and Beverage Manufacturing segments.

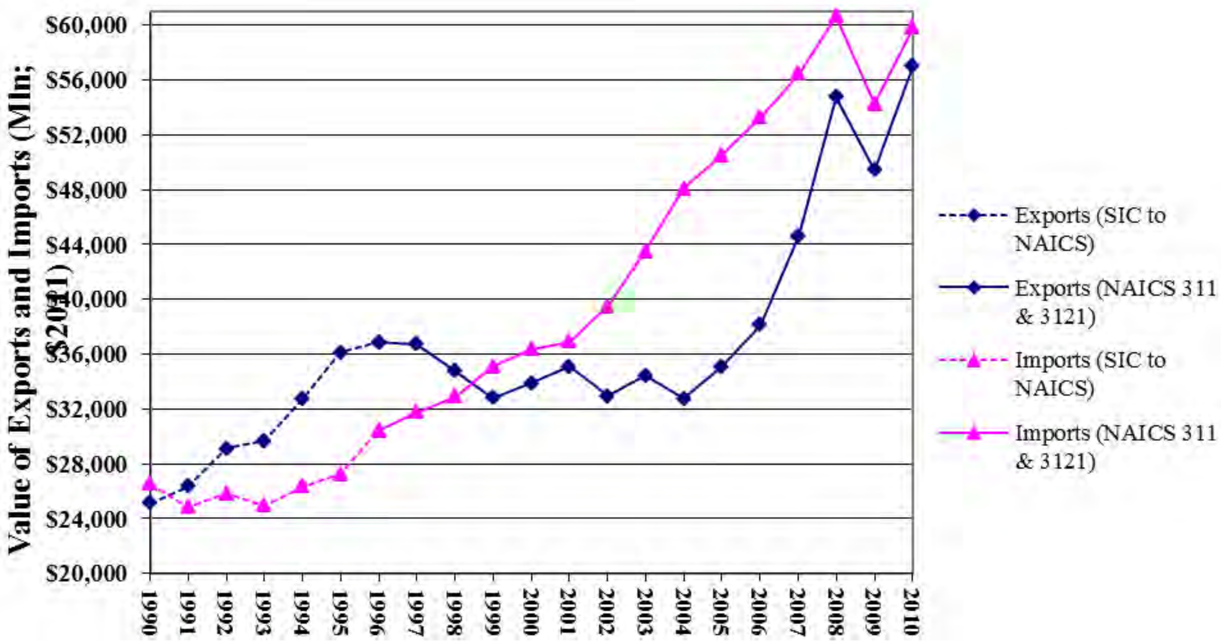
Table C-10: Trade Statistics for Profiled Food and Kindred Products Industry[a]

Year	Value of Imports (millions, $2011)	Value of Exports (millions, $2011)	Value of Shipments (millions, $2011)	Implied Domestic Consumption[b]	Import Penetration[c]	Export Dependence[d]
1990	$26,532	$25,141	$522,290	$523,681	5.1%	4.8%
1991	$24,867	$26,366	$507,082	$505,582	4.9%	5.2%
1992	$25,829	$29,094	$527,922	$524,656	4.9%	5.5%
1993	$24,968	$29,691	$534,254	$529,531	4.7%	5.6%
1994	$26,372	$32,737	$539,596	$533,231	4.9%	6.1%
1995	$27,246	$36,135	$552,471	$543,582	5.0%	6.5%
1996	$30,402	$36,856	$559,217	$552,763	5.5%	6.6%
1997	$31,761	$36,743	$643,879	$638,897	5.0%	5.7%
1998	$32,919	$34,776	$645,784	$643,927	5.1%	5.4%
1999	$35,100	$32,794	$633,691	$635,997	5.5%	5.2%
2000	$36,336	$33,881	$633,455	$635,909	5.7%	5.3%
2001	$36,933	$35,092	$642,347	$644,189	5.7%	5.5%
2002	$39,486	$32,934	$638,055	$644,607	6.1%	5.2%
2003	$43,504	$34,437	$669,496	$678,562	6.4%	5.1%
2004	$48,090	$32,767	$684,390	$699,713	6.9%	4.8%
2005	$50,509	$35,086	$694,567	$709,990	7.1%	5.1%
2006	$53,275	$38,134	$676,672	$691,812	7.7%	5.6%
2007	$56,435	$44,623	$719,524	$731,337	7.7%	6.2%
2008	$60,648	$54,768	$766,377	$772,257	7.9%	7.1%
2009	$54,268	$49,458	$738,583	$743,393	7.3%	6.7%
2010	$59,811	$57,003	$751,561	$754,368	7.9%	7.6%
Total Percent Change 1990 – 2010	**125.4%**	**126.7%**	**43.9%**	**44.1%**		
Total Percent Change 2000 - 2010	**64.6%**	**68.2%**	**18.6%**	**18.6%**		
Average Annual Growth Rate	**4%**	**4%**	**2%**	**2%**		

a. Before 1997, data were compiled in the SIC system; since 1997, these data have been compiled in the North American Industry Classification System (NAICS). For this analysis, EPA converted the NAICS classification data to the SIC code classifications using the *1997 Economic Census Bridge Between NAICS and SIC.*
b. Calculated by EPA as shipments + imports - exports.
c. Calculated by EPA as imports divided by implied domestic consumption.
d. Calculated by EPA as exports divided by shipments.
Source: U.S. ITC, 1989-2010.

As shown in *Figure C-5*, between 1990 and 2010, imports of Food and Kindred Products steadily increased at an average annual rate of 4 percent leading to an overall increase of 125 percent (65 percent during the last decade). Exports of Food and Kindred Products also increased during this time period at an average annual rate of 4 percent leading to an overall increase of 127 percent (68 percent during the last decade). While imports experienced a relatively steady increase, exports fluctuated significantly during the analysis period: Exports increased between 1990 and 1996, declined for the next three years, remained relatively steady through 2004, and then increased through 2008. Both exports and imports declined in 2009 but then returned to an upward trend in 2010. During most of the 1990s, the Food and Kindred Products industry recorded a trade surplus, even though the value of imports was steadily growing. However, in 1999, this trend reversed itself and during the last decade, the Food and Kindred Products industry was characterized by trade deficit. Starting in 2005, however, exports have been growing at a higher rate than imports, thereby shrinking the deficit.

Figure C-5: Value of Imports and Exports for Profiled Food and Kindred Products Industry (millions, $2011)[a]



a. Before 1997, the Department of Commerce compiled data in the SIC system; since 1997, these data have been compiled in the North American Industry Classification System (NAICS). For this analysis, EPA converted the NAICS classification data to the SIC code classifications using the *1997 Economic Census Bridge Between NAICS and SIC.*
Source: U.S. ITC, 1989-2010.

C.5 Financial Condition and Performance

As discussed above, the profiled Food and Kindred Products industry overall is not as susceptible to economic fluctuations and, consequently, its financial performance is not as closely linked to macroeconomic cycles as it is in other, more cyclical manufacturing industries. As products from these segments are generally "consumer staples," they are not as strongly affected by swings in the U.S. economy as the other 5 Primary Manufacturing industries. As a result, businesses in these segments have been able to maintain a moderate level of positive financial performance over the analysis time period, including the U.S. recessions of early 1990 and early and late 2000s, which more substantially affected other profiled Primary Manufacturing industries such as Pulp and Paper Manufacturing and Steel Manufacturing.

This profile uses two measures of financial condition and performance: ***Net Profit Margin*** and ***Return on Total Capital***.

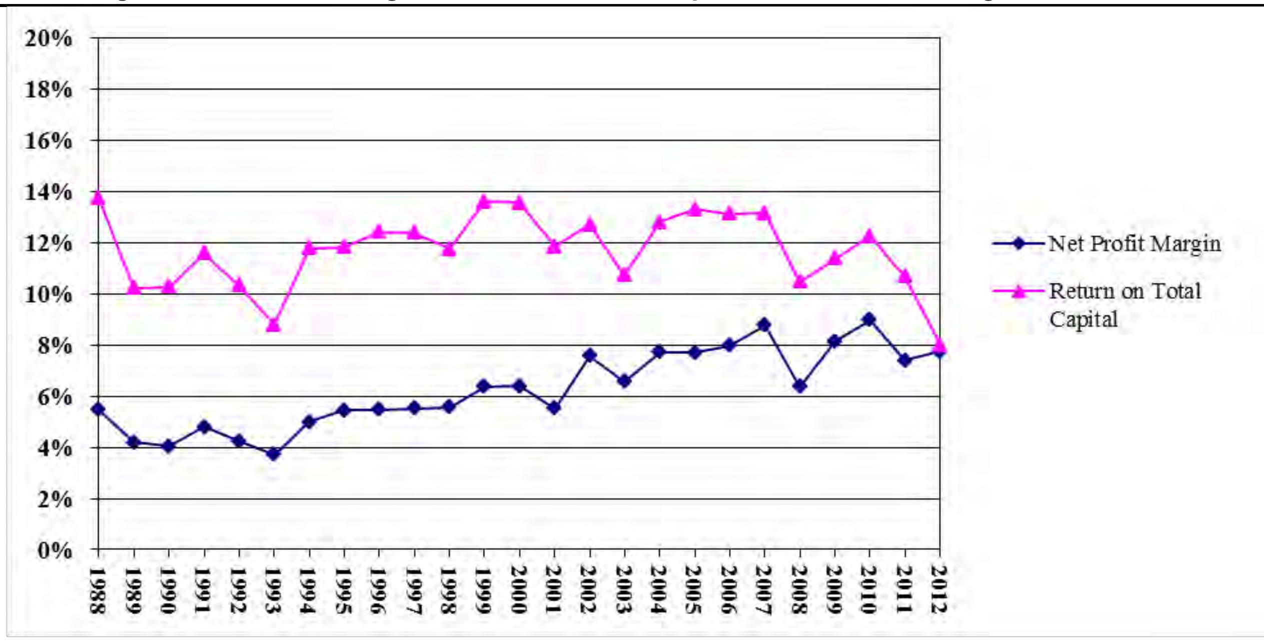
Net profit margin is calculated as after-tax income before nonrecurring gains and losses as a percentage of sales or revenue, and measures profitability, as reflected in the conventional accounting concept of net income. Over time, the firms in an industry, and the industry collectively, must generate a sufficient profit margin if the industry is to remain economically viable and attract capital. Year-to-year fluctuations in profit margin stem from several factors, including: variations in aggregate economic conditions (including international and U.S. conditions), variations in industry-specific market conditions (e.g., short-term capacity expansion resulting in overcapacity), or changes in the pricing and availability of inputs to the industry‟s production processes (e.g., the cost of energy to the manufacturing process). The extent to which these fluctuations affect an industry‟s profitability, in turn, depends heavily on the fixed vs. variable cost structure of the industry‟s operations. In a capital intensive industry such as the food and beverage industry, the relatively high fixed capital costs as well as other fixed overhead outlays, can cause even small fluctuations in output or prices to have a large positive or negative affect on profit margin.

Return on total capital is calculated as annual pre-tax income divided by the sum of current portion of long-term debt due in 1 year or less, long-term debt due in more than one year, all other noncurrent liabilities and total stockholders‟ equity (total capital). This concept measures the total productivity of the capital deployed by a firm or industry, regardless of the financial source of the capital (i.e., equity, debt, or liability element). As such, the return on total capital provides insight into the profitability of a business‟ assets independent of financial structure and is thus a "purer" indicator of asset profitability than return on equity. In the same way as described for net profit margin, the firms in an industry, and the industry collectively, must generate over time a sufficient return on capital if the industry is to remain economically viable and attract capital. The factors causing short-term variation in net profit margin will also be the primary sources of short-term variation in return on total capital.

Figure C-6 shows a trend in net profit margins and return on total capital for Food and Kindred Products industry firms between 1988 and 2012. Despite some fluctuations in response to recessions in 1993, 2001, and 2008, when both profit margins and return on total capital fell slightly but recovered shortly after, this industry reported positive profit margins and return on total capital over the entire analysis period. After the most recent recession in 2008, both net profit margin and return on total capital rose in 2009 and 2010. In 2011 both indicators declined while in 2012 net profit margin saw a slight increase as return on total capital continued to decline. In 2012, return on total capital remained below its long-term average, while net profit margin was slightly above its long-term average.

That demand for food and beverages remained high during otherwise weak economic conditions, indicates that the profiled industry segments should be able to continue robust financial performance over the foreseeable future, thus suggesting strong ability to absorb the costs associated with the final rule. In the long term, the Food and Beverage Manufacturing industry will continue to focus on and adjust to consumer lifestyles and tastes, including both opportunities in developing international markets and the particular needs of an aging U.S. population. Future growth opportunities might include introduction and distribution of products that appeal to consumers‟ interest in healthier eating and environmental sustainability (S&P, 2010d).

Figure C-6: Net Profit Margin and Return on Total Capital for Food and Beverage Manufacturers



Source: U.S. DOC, 1988-2010 QFR.

C.6 Facilities Operating Cooling Water Intake Structures

Point source facilities that use or propose to use a cooling water intake structure that withdraws cooling water directly from a surface water body of the United States are potentially subject to Section 316(b) of the Clean Water Act. In 1982, the Food and Kindred products industry withdrew 272 billion gallons of cooling water, accounting for approximately 5 percent of total manufacturing cooling water intake in the United States. The industry ranked sixth in industrial cooling water use, behind the electric power generation industry, chemical, primary metals, petroleum and coal products, and paper and allied products industries (U.S. DOC, 1982).

This section provides information for the facilities in the Food and Kindred Products industry that EPA estimates to be subject to regulation under the regulatory analysis options. Existing facilities that meet all of the following conditions would have been subject to regulation under the three regulatory analysis options:

- Have a National Pollutant Discharge Elimination System (NPDES) permit or are required to obtain one;
- Use or propose to use one or more cooling water intake structures to withdraw water from waters of the United States;
- Use at least twenty-five (25) percent of the water withdrawn exclusively for contact or non-contact cooling purposes; and
- Meet the applicability coverage criteria for the final regulation specific regulatory analysis option in terms of design intake flow (i.e., 2 MGD).

EPA initially identified the set of facilities that were estimated to be *potentially* subject to the 316(b) Existing Facilities Regulation based on a minimum applicability threshold of 2 MGD; this section focuses on these facilities for the petroleum segment).[188]

[188] EPA applied sample weights to the sampled facilities to account for non-sampled facilities and facilities that did not respond to the survey. For more information on EPA‟s 2000 Section 316(b) Industry Survey, please refer to the Information Collection Request (U.S. EPA, 2000).

C.6.1 Waterbody and Cooling System Type

Table C-11, reports the distribution of the Food and Kindred Products industry facilities by type of water body and cooling water intake system.

Table C-11: Number of Food and Kindred Products Facilities Estimated Subject to the 316(b) Existing Facilities Regulation by Waterbody Type and Cooling Water Intake System

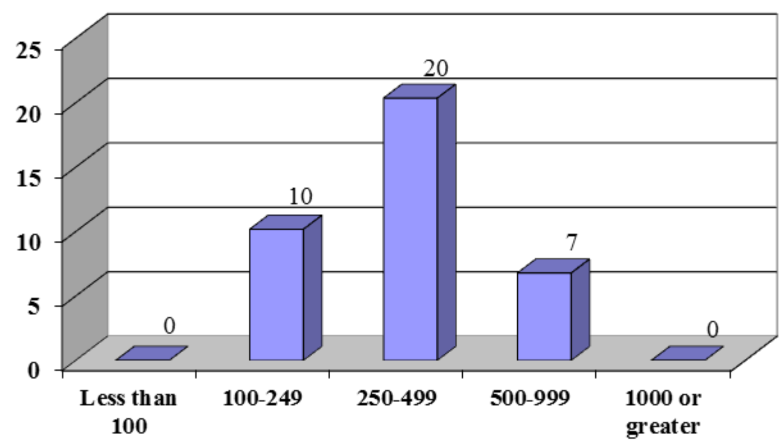
Waterbody Type	Recirculating[b]		Combination		Once-Through		Other		Total
	No.	% of Total	No.	% of Total	No.	% of Total	No.	% of Total	
Estuary/Tidal River	0	0%	0	0%	7	50%	0	0%	7
Freshwater River/ Stream	14	100%	3	50%	7	50%	3	100%	27
Great Lake	0	0%	3	50%	0	0%	0	0%	3
Total[a]	**14**	**36%**	**7**	**18%**	**14**	**36%**	**3**	**9%**	**37**

a. Individual numbers may not add up to total due to independent rounding.
b. Includes facilities that have cooling towers as well as those that use ponds.
Source: U.S. EPA, 2000; U.S. EPA analysis, 2013.

C.6.2 Facility Size

Figure C-7, shows the employment size category for the Food and Kindred Products industry facilities estimated subject to regulation under the regulatory analysis options.

Figure C-7: Number of Facilities Estimated Subject to the Final 316(b) Existing Facilities Regulation by Employment Size for the Combined Food Manufacturing and Beverage Segments



Source: U.S. EPA, 2000; U.S. EPA analysis, 2013.

C.6.3 Firm Size

EPA used the Small Business Administration (SBA) small entity size standards to determine the number of facilities in the Food and Kindred Products facility dataset that are owned by small firms. EPA estimates that no small entity-owned facilities and 37 large entity-owned facilities in this industry segment will be subject to the final regulation.

Appendix D Profile of the Paper and Allied Products Industry

D.1 Introduction

EPA‟s *Detailed Industry Questionnaire*, hereafter referred to as the DQ, identified five 4-digit SIC codes in the Paper and Allied Products manufacturing industry (SIC 26) with at least one existing facility that operates a CWIS, holds a NPDES permit, withdraws at least two million gallons per day (MGD) from a water of the United States, and uses at least 25 percent of its intake flow for cooling purposes (facilities with these characteristics are hereafter referred to as "facilities potentially subject to the 316(b) Existing Facilities regulation" or "regulated facilities"). For the purpose of this analysis, EPA identified a six-digit NAICS code for each of these potential facilities using the information from DQ and public sources (see *Appendix J: Mapping Manufacturers Standard Industrial Classification (SIC) Codes to North American Industry Classification System (NAICS) Codes*). As the result of this mapping, EPA identified six 6-digit NAICS codes in the Paper and Allied Products manufacturing industry (NAICS 322).

For each of these six analyzed 6-digit NAICS codes, *Table D-1*, following page, provides a description of the industry segment, a list of primary products manufactured, the total number of detailed questionnaire respondents (weighted to represent a national total of facilities that hold a NPDES permit and operate cooling water intake structures), and the number of facilities estimated to be potentially subject to the final rule based on the minimum withdrawal threshold of 2 MGD (see *Chapter 1: Introduction* for more details on the final rule applicability criteria).

Table D-1: Existing Facilities in the Paper and Allied Products Industry (NAICS 322)

NAICS	NAICS Description	Important Products Manufactured	Number of Regulated Facilities[a]
322110	Pulp Mills	Pulp from bagasse, linters, rags, straw, wastepaper, and wood manufactured by chemical, mechanical, or semichemical processes without making paper for paperboard.	33
32212	Paper Mills	Paper from wood pulp and other fiber pulp, converted paper products; integrated operations of producing pulp and manufacturing paper if primarily shipping paper or paper products.	136
322130	Paperboard Mills	Paperboard, including paperboard coated on the paperboard machine, from wood pulp and other fiber pulp; and converted paperboard products; integrated operations of producing pulp and manufacturing paperboard if primarily shipping paperboard or paperboard products.	48
Total			***217***
Other Paper and Allied Products Segments			
322222	Coated and Laminated Paper Manufacturing	Cutting and coating paper, cutting a laminating paper and other flexible materials (except plastics film), laminating aluminum and other metal foils for non-packaging uses from purchased foil.	3
322224	Uncoated Paper and Multiwall Bag Manufacturing	Uncoated, multiwall, paper bags manufactured from purchased paper.	3
322299	All Other Converted Paper Products Manufacturing	Containers, bags, coated and treated paper, stationary products, and sanitary paper products from paper and paperboard products; converted pulp products (i.e. egg cartons, food trays, and other food containers) from molded pulp.	3
Total Other			***8***
Total Paper and Allied Products (NAICS 322)			
Total NAICS Code 322			**225**

[a] Number of weighted detailed questionnaire survey respondents.
[b] Individual numbers may not add up due to independent rounding.
Source: Executive Office of the President, 1987; U.S. EPA, 2000; U.S. EPA analysis, 2013.

As shown in *Table D-1*, EPA estimates that out of an estimated total of 563 facilities[189] with a NPDES permit and operating cooling water intake structures in the Paper and Allied Products Industry (NAICS 322), that 225 (40 percent) are expected to be subject to the 316(b) Final Existing Facilities Regulation. EPA also estimated the percentage of total industry production that occurs at facilities estimated to be subject to regulation under each analysis option. Total value of shipments for the Paper and Allied Products industry (NAICS 322) from the 2010 Annual Survey of Manufactures (ASM), published by the U.S. Census Bureau, is $173.6 billion ($2011). Value of shipments, a measure of the dollar value of production, was selected for the basis of this estimate. Because the DQ did not collect value of shipments data, these data were not available for the potential existing facilities. Total revenue, as reported on the DQ, was used as a close approximation for value of shipments for these facilities. EPA estimated the total revenue of facilities in the paper industry expected to be subject to the 316(b) Existing Facilities regulation is $66.8 billion ($2011).[190] Therefore, EPA estimates that the percentage of total production in the paper industry that occurs at facilities estimated to be subject to regulation is 39 percent.

The responses to the DQ indicate that three segments account for most of the existing Manufacturers in the Paper and Allied Products industry: (1) Pulp Mills (NAICS 322110), (2) Paper Mills (NAICS 32212), and (3)

189 This estimate of the number of facilities potentially subject to regulation is based on the universe of facilities that received the 1999 screener questionnaire.

190 To compare revenue values of regulated facilities with the industry value of shipments, EPA brought revenue values for regulated facilities forward to 2010 using industry-specific Producer Price Index (PPI) values published by the Bureau of Labor Statistics (BLS) and stated in 2011 dollars using GDP deflator published by the Bureau of Economic Analysis (BEA).

Paperboard Mills (NAICS 322130). The remainder of this profile therefore focuses on these three industry segments.

Table D-2 provides the cross-walk between NAICS codes and SIC codes for the profiled paper NAICS codes. The table shows that both Pulp Mills and Paperboard Mills have a 1 to 1 relationship to their SIC codes. A large portion of SIC code 2621 (84 percent based on value of shipments) corresponds to Newsprint Mills. NAICS 322121, classified as Paper (except newsprint) Mills, corresponds to three SIC codes (2621, 2676, and 3842).

Table D-2: Relationship between NAICS and SIC Codes for the Paper and Allied Products Industry

NAICS Code	NAICS Description	SIC Code	SIC Description	Number of Establishments (As of 2009)[a]	Value of Shipments (As of 2010; Millions; $2011)	Employment (As of 2010)
322110	Pulp mills	2611	Pulp mills	40	$4,328	6,296
322121	Paper (except newsprint) mills	2621	Paper Mills	246	$45,358	64,405
		2676	Sanitary Paper Products			
		3842	Surgical Appliances and Supplies			
322122	Newsprint mills	2621	Paper Mills	25	$3,371	4,171
322130	Paperboard mills	2631	Paperboard mills	181	$27,958	35,183

a. The most recent data on number of establishments is available for 2009 from Statistics of U.S. Businesses. Value of Shipments and Employment reflect 2010 data.

Sources: U.S. DOC, 2010 ASM; U.S. DOC, 2009 SUSB.

D.2 Summary Insights from this Profile

A key purpose of this profile is to provide insight into the ability of pulp and paper firms to absorb compliance costs under the final rule without material adverse economic/financial effects. The industry‟s ability to absorb compliance costs is primarily influenced by the following two factors: (1) the extent to which the industry may be expected to shift compliance costs to its customers through price increases and (2) the financial health of the industry and its general business outlook.

D.2.1 Likely Ability to Pass Compliance Costs Through to Customers

As reported in the following sections of this profile, the Paper and Allied Products industry is relatively unconcentrated, which would suggest that firms in this industry may face difficulty in passing through to customers a significant portion of their compliance-related costs. The domestic Pulp Mills industry segment also faces significant competitive pressures from abroad, further curtailing the potential of firms in this industry to pass through to customers a significant portion of their compliance-related costs. The domestic Paper Mills and Paperboard Mills industry segments do not face as significant foreign competitive pressures, and, based on this factor, would have more latitude in passing through to customers any increase in production costs resulting from regulatory compliance. However, foreign pressure is likely to increase as capacity in foreign countries, particularly China, continues to grow and exert pressure on the domestic market. As discussed above, given the proportion of total value of shipments in the industry estimated to be subject to regulation under each analysis option, EPA judges that regulated facilities in the Paper and Allied Products industry subject to the 316(b) Existing Facilities Regulation are not likely to be able to recover compliance costs through prices increases to customers. For these reasons, in its analysis of regulatory impacts for the pulp and paper industry, EPA assumed that regulated facilities would be unable to pass compliance costs through to customers: i.e., they must absorb all compliance costs within their operating finances (see following sections and *Appendix K: Cost Pass-Through Analysis* for more information).

D.2.2 Financial Health and General Business Outlook

Over the past two decades, the Paper and Allied Products industry, like other U.S. manufacturing industries, has experienced a range of economic/financial conditions, including substantial challenges. Going into 2000, the industry"s financial performance started to improve from the erratic conditions of 1990s, but the subsequent recession and global economic downturn, coupled with continuing overproduction, led to declining financial results that persisted through 2003. Financial performance in 2004 through 2007 showed significant improvement and steady growth. However, during the recent economic recession, the Paper and Allied Products industry"s revenues and overall market value once again decreased significantly, but less so than the overall S&P 500 trend (McNutt, 2009).

Throughout the past decade, the Paper and Allied Products industry continued to face increased foreign competition, global and domestic overcapacity, and difficulty adapting to changing business conditions (McNutt, Cenatempo & Kinstrey, 2004). The industry outlook for 2013 is neutral, with continuing high pricing levels, due to improvements in economic activity and increasing employment levels, being offset by negative long-term demand trends (S&P, 2013f). With a number of indicators showing recovery since the recent financial downturn, businesses potentially regulated by the final rule are likely to absorb additional regulatory compliance costs without incurring a significant financial impact.

D.3 Domestic Production

The Paper and Allied Products industry is one of the top ten U.S. manufacturing industries; the larger forest products industry, which includes the paper and allied products subsector, accounts for approximately 5 percent of the nation"s GDP (AF&PA, 2009). Growth in the paper industry is generally tied closely to overall gross domestic product (GDP) growth. Although, the domestic market consumes over 90 percent of total U.S. Paper and Allied Products industry output, beginning in 2000, exports took on an increasingly important role, and growth in a number of foreign paper and paperboard markets became a key factor in the health and expansion of the U.S. industry (McGraw-Hill, 2000). The Paper and Allied Products industry is considered mature, with growth slower than that of the GDP, and over the years U.S. producers have continued to seek growth opportunities in overseas markets. Although exports still represent a small share of domestic shipments for the Paper and Paperboard mills segment, they exert an important marginal influence on capacity utilization. Prices and industry profits, which are sensitive to capacity utilization, have therefore become increasingly sensitive to trends in global markets.

The U.S. Paper and Allied Products industry has a worldwide reputation as a high quality, high volume, and low-cost producer. The industry benefits from many key operating advantages, including a large domestic market; the world"s highest per capita consumption; a modern manufacturing infrastructure; adequate raw material, water, and energy resources; a highly skilled labor force; and an efficient transportation and distribution network (Stanley, 2000). Over the last two decades, U.S. producers have faced growing competition from new facilities constructed overseas, however (McGraw-Hill, 2000). The 2009 AF&PA Annual Survey of Paper, Paperboard, and Pulp Capacity reports that the average annual rate of contraction from 2001 to 2007 hovered around 1 percent, largely as a result of foreign competition and more recently, the domestic economic recession (AF&PA, 2009). Industry capacity for multiple paper grades continued to decline in more recent years as producers sought a balance in supply and demand for categories of production suffering from overcapacity (S&P, 2013f).

The Paper and Allied Products industry is a major energy user, second only to the chemicals and metals industries. However, 56 percent of total energy used in 1998-1999 was self-generated electricity (McGraw-Hill, 2000). The use of renewable resources (biomass, black liquor, hydroelectric, etc.) for energy production has increased steadily over the past several decades, rising from 40 percent of total industry energy consumption in 1972 to 56 percent in 2000. Renewable resource-based energy was estimated to account for about 60 percent of consumption in 2004 (Paper Age, 2004a).

With the slowing of the U.S. economy in 2000, and the onset of recession in 2001, the resulting drop in demand and prices put pressure on companies in the industry to eliminate excess capacity. Through aggressive consolidation and streamlining of their operations, facilities sought to lower expenses through elimination of older and less cost efficient operations. In 2002, paper companies eliminated three million tons of capacity, with similar reductions expected in 2003 (Value Line, 2003). While this consolidation led to a balance in supply and demand and subsequent relative financial soundness, the Paper and Paperboard industry segment suffered from the 2008-2009 recession with nearly all grades and segments recording declines in global consumption. One exception, tissue paper, grew 1.0 – 1.5 percent in 2009 (Uutela, 2010).

The connection between business activity and office paper demand is eroding as electronic substitution, such as online bill paying, email, internet publications, and electronic readers, become viable substitutes for several uses of paper (S&P, 2010b). For instance, in 1999, newsprint demand was at its peak but with the advent and growing popularity of the internet, domestic newsprint demand has fallen 57 percent in ten years (Timonen, 2010). However, paper as a means for transmitting and storing information is far from being obsolete. Global paper consumption increased dramatically in the decade prior to the economic recession, and will continue to rise especially in developing countries (Environmental Paper Network, 2007).

D.3.1 Output

The Paper and Allied Products industry has experienced continued globalization and cyclical patterns in production and earnings over the last two decades. Capital investments in the 1980s resulted in significant overcapacity. U.S. producers experienced record sales in 1995. In 1996, lower domestic and foreign demand, coupled with declining prices, caused the industry‟s total shipments to decline by 2.2 percent. Three consecutive years of increasing demand and slowly increasing prices led to better industry performance at the end of the 1990s. During these years, domestic producers controlled operating rates to allow drawdown of high inventories and to achieve higher capacity utilization. U.S. producers also placed a greater emphasis on foreign markets both through export sales and investments in overseas facilities (McGraw-Hill, 2000). The Paper industry segment recorded improved sales and stronger earnings in 1999 and early 2000, but began to experience declines in sales in the second half of 2000, reflecting reduced paper and packaging demand due to the slowdown in the U.S. economy and a growth in imports (S&P, 2001c). Most products were characterized by weak demand, reduced production and price reductions in 2001, due to continuing reductions in domestic demand (Paperloop Inc., 2001). Annual sales in the United States in 2001 dropped 1.5 percent, while earnings at the top 31 U.S. corporations fell by nearly 75 percent, partly due to a decrease in prices of up to 15 percent (Paun et al. 2004).

Capacity for the U.S. Paper and Paperboard segment declined annually from 2001 to 2003, in contrast to annual increases in capacity for the previous two decades. Capacity declined 1.9 percent in 2001, 1.3 percent in 2002, and 0.4 percent in 2003, and remained largely unchanged from 2004 to 2006 due to increased foreign competition, mature domestic markets, and competition from other media (Paper Age, 2004b). Overcapacity has been a problem within the industry. As the world economy began to slow in the early 2000s, demand in the United States and abroad waned, forcing producers to limit production to prevent oversupply and keep pricing levels from dropping further (S&P, 2004b). In addition to production downtime, many older, less efficient, single mill operations were permanently closed. In 2001, pulp production decreased 7.3 percent to 53 million tons, while paper and paperboard production decreased 5.5 percent to 81 million tons (Paun et al. 2004). During the rest of the decade, however, the overall production for the U.S. Paper and Allied Products industry remained relatively flat until the recession of 2008-2009, when production of all grades began to decline.[191] Only tissue production remained strong during the recessionary period (McNutt, 2009). During 2009 alone, total printing-writing paper shipments experienced a 17 percent decline, shipments for Kraft paper fell by 16 percent and containerboard by 9.5 percent (AF&PA, 2009). Although these industry segments showed decline in total output, the last quarter of

[191] Grades are product categories such as containerboard, packaging, printing & writing papers, newsprint, and tissue.

2009 saw relative production increases from the previous months, and signaled the beginning of recovery from the economic downturn.

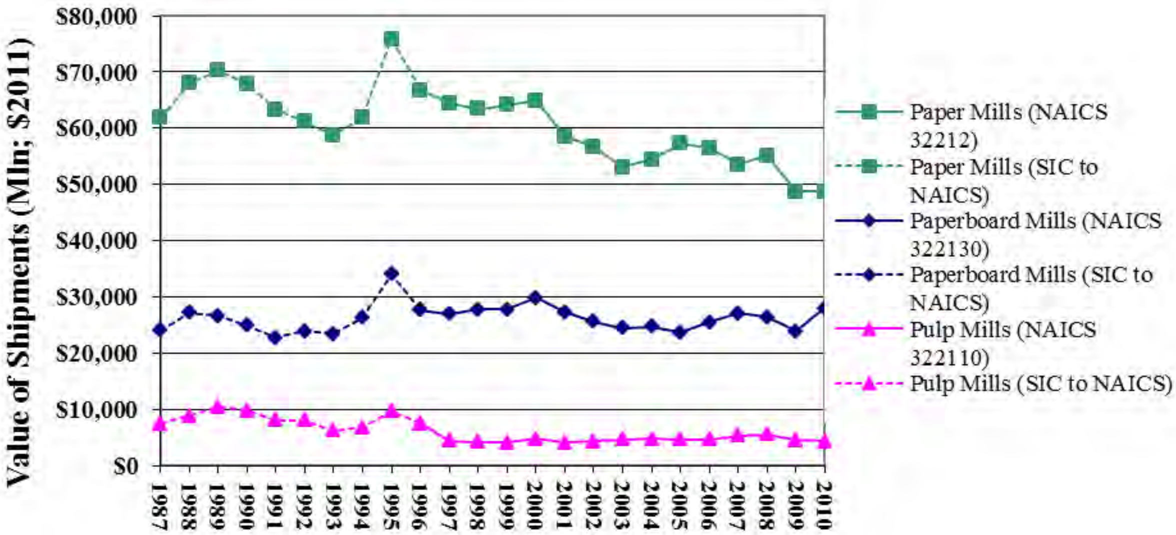
Figure D-1 shows the trend in ***value of shipments*** and ***value added*** for the three profiled segments.[192] Value of shipments and value added, two common measures of manufacturing output, provide insight into an industry‟s overall economic health and outlook. ***Value of shipments*** is the sum of receipts from the sale of outputs; it indicates the overall size of a market or the size of a firm in relation to its market or competitors. ***Value added*** measures the value of production activity in a particular industry and is calculated as the difference between the value of shipments and the value of inputs from other industries used to make the products sold.

Between 1987 and 2010, the Paper and Allied Products industry performed erratically, with swings in value of shipments and value added generally following the performance trend of the aggregate U.S. economy. Of the three profiled industry segments, the Paperboard Mills segment recorded an overall increase in the total value of shipments and value added during the 24-year analysis period, while both the Paper Mills and the Pulp Mills segments recorded real declines over the same period, with Pulp Mills faring the worst. Moreover, the recent downturn in the housing market has been particularly disruptive for this industry. Stagnant new home sales have left saw mills unable to sell lumber products, forcing many to shut down operations. As a result, these closings have caused the price of inputs such as wood chips and kraft pulp to increase. The combination of rising input prices and a sharp decline in demand has led manufacturers to sell their products at a loss thereby reducing the total value of shipments for this industry in recent years (Great American Group, 2009). During 2010, value of shipments has continued to decline in the Pulp Mills segment, though to a lesser extent. In the Paper Mills segment value of shipments increased by less than 1 percent while in the Paperboard Mills segment it increased by 17 percent. While projections for long-term demand trends remain negative, prices are expected to remain relatively high in 2013 (S&P, 2013f).

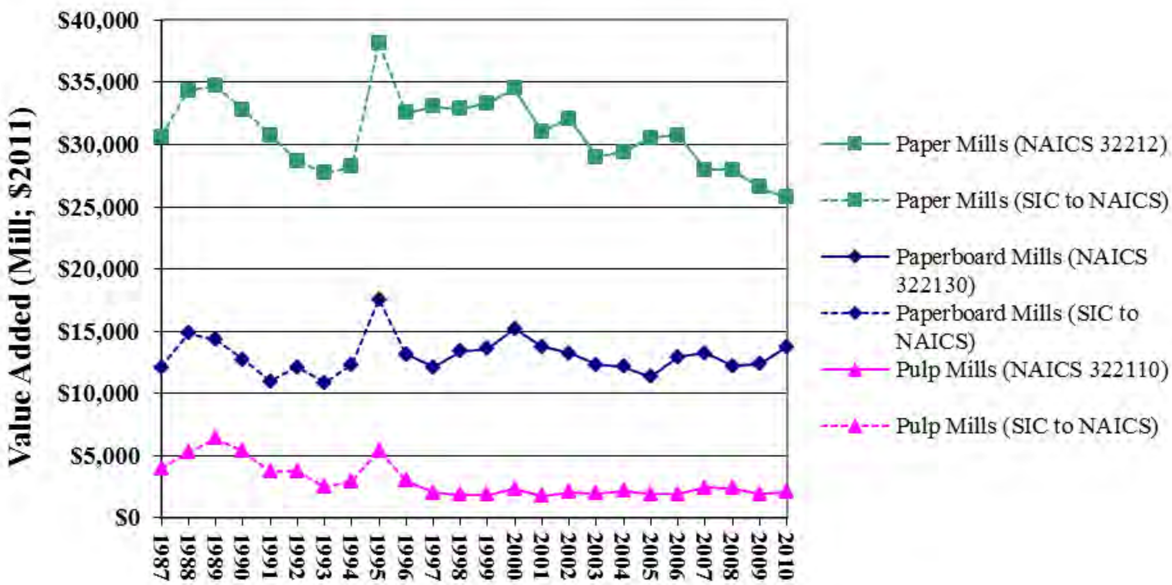
[192] Terms highlighted in bold and italic font are further explained in the glossary.

Figure D-1: Value of Shipments and Value Added for Profiled Paper and Allied Products Segments (Millions, $2011)[a]

Value of Shipments



Value Added



a. Before 1997, the Department of Commerce compiled data in the SIC system; since 1997, these data have been compiled in the North American Industry Classification System (NAICS). For this analysis, EPA converted the SIC classification data to the NAICS code classifications using the 1997 Economic Census Bridge Between SIC and NAICS.

Source: U.S. DOC, 1988-1991, 1993-1996, 1998-2001, 2003-2006, and 2008-2010 ASM; U.S. DOC, 1987, 1992, 1997, 2002, and 2007 EC.

Table D-3 provides the Federal Reserve System‟s index of industrial production for the profiled Pulp and Paper industry segments, which shows trends in production between 1990 and 2011. This index more closely reflects total output in physical terms, whereas value of shipments and value added reflect the economic value of production. The production index is expressed as a percentage of output in the base year, 2007. Overall, between 1990 and 2011, production for all three segments declined, with the Paper Mills segment experiencing the largest decline of 27 percent. During 2008 and 2009, production fell in all three profiled segments as the result of economic recession, with the Pulp Mills segment experiencing the largest reduction of approximately 16 percent. Industrial production in the Pulp Mills segment continued to decline significantly in 2010 but has rebounded in

2011 with a nearly 7 percent increase. In the Paper Mills and Paperboard segments, industrial production recovered slightly in 2010 only to decline in 2011.

Table D-3: U.S. Pulp and Paper Industry Industrial Production Index (Annual Averages)

Year	Pulp Mills[a]		Paper Mills[b]		Paperboard Mills[c]	
	Index 2007=100	Percent Change	Index 2007=100	Percent Change	Index 2007=100	Percent Change
1990	85.3	NA	116.7	NA	95.1	NA
1991	86.6	1.6%	112.8	-3.3%	94.2	-1.0%
1992	91.1	5.2%	111.5	-1.2%	98.4	4.4%
1993	76.5	-16.0%	110.8	-0.6%	100.5	2.1%
1994	81.0	5.9%	117.0	5.6%	106.3	5.8%
1995	87.1	7.5%	121.0	3.4%	110.2	3.7%
1996	79.9	-8.3%	113.9	-5.9%	105.0	-4.7%
1997	79.5	-0.4%	112.7	-1.0%	107.6	2.5%
1998	81.7	2.7%	113.3	0.5%	108.7	1.0%
1999	82.3	0.8%	118.4	4.5%	110.2	1.4%
2000	81.2	-1.4%	116.0	-2.0%	105.6	-4.1%
2001	82.9	2.1%	107.6	-7.3%	101.5	-3.9%
2002	101.3	22.3%	106.9	-0.7%	102.1	0.6%
2003	102.7	1.3%	103.3	-3.3%	98.6	-3.5%
2004	98.5	-4.0%	106.9	3.4%	98.1	-0.5%
2005	95.0	-3.6%	107.6	0.7%	93.7	-4.5%
2006	93.2	-1.9%	105.8	-1.7%	96.3	2.7%
2007	99.9	7.2%	100.0	-5.5%	100.0	3.9%
2008	97.8	-2.2%	99.1	-0.9%	91.7	-8.3%
2009	83.2	-14.9%	87.1	-12.1%	87.1	-5.0%
2010	72.2	-13.3%	87.6	0.6%	95.0	9.0%
2011	77.0	6.7%	85.2	-2.8%	94.2	-0.9%
Total Percent Change 1990- 2011	**-9.7%**		**-27.0%**		**-1.0%**	
Total Percent Change 2000 - 2011	**-5.1%**		**-26.6%**		**-10.8%**	
Average Annual Growth Rate[193] 1990 - 2011	**-0.5%**		**-1.5%**		**0.0%**	

a. NAICS 32211.
b. NAICS 32212.
c. NAICS 32213.
Source: Federal Reserve Board of Governors, 2012c

D.3.2 Prices

The ***producer price index (PPI)*** measures price changes, by segment, from the perspective of the seller, and indicates the overall trend of product pricing, and thus supply-demand conditions, within a segment.

Price levels in the U.S. Paper and Allied Products industry closely reflect domestic and foreign demand, and industry capacity and operating rates, which determine supply (S&P, 2001c). Prices tend to be volatile due to mismatches between short-term supply and demand. The industry is very capital intensive, and development of new capacity requires several years. Prices therefore tend to increase when demand and capacity utilization rise, and drop sharply when demand softens or when new capacity comes on line. In the past, producers have been reluctant to cut production when demand declines because fixed capital costs are a substantial portion of total manufacturing costs; this reluctance has occasionally caused persistent oversupply. During the economic

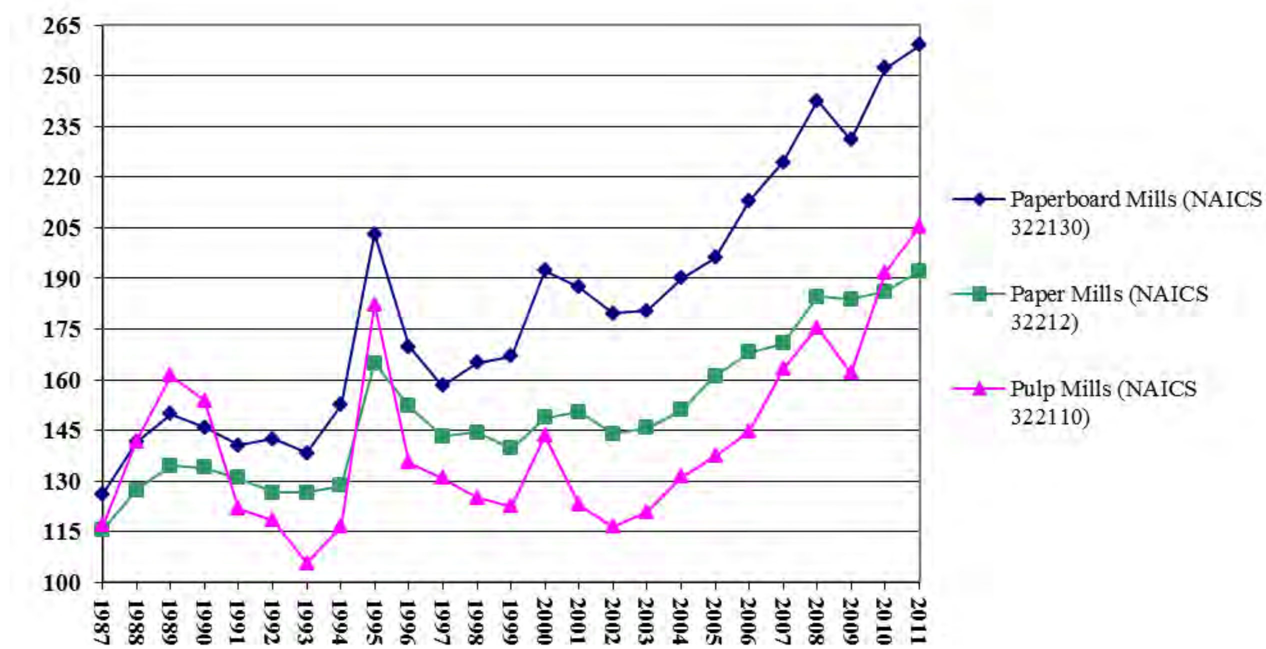
193 In this appendix, average annual growth rate refers to a year-to-year, constant percentage growth mean, which is calculated as the compound annual growth rate between the first and last values. This is the same concept as the geometric mean, if all of the individual year-to-year

slowdown of 2001, however, producers appeared more willing to cut output to prevent sharp reductions in prices (Ince, 1999; S&P, 2001c).

As shown in *Figure D-2*, the Paper and Allied Products industry suffered from low prices throughout the early 1990s. The depressed prices resulted from the paper boom of the late 1980s. Prices recovered in the mid-1990s before declining again in the latter part of that decade. Entering the 2000s decade, prices in the Paper and Allied Products industry reversed course and rose, before experiencing declines in 2001 and 2002, as prices for most paper grades dropped between 5 and 15 percent (Value Line, 2003). Faced with substantial declines in demand during those years, producers cut production, endured downtime, and closed less efficient facilities to prevent major price declines for paper products (S&P, 2001c). Prices started to level off near the end of 2002, and proceeded to rise during 2003 through 2007.

In 2008, Paper and Allied Products industry prices reached near historical peak levels. Overall, following the recession, prices remained comparable to the strong 2008 averages. Prices for many grades of paper trended higher for most of 2008 due in part to capacity closures. Market pulp prices have fallen sharply and quickly in 2009 (McNutt, 2009). Paperboard prices also fell drastically in 2009. However, Paper and Allied Products industry manufacturers have exhibited more resilient prices compared to other industries during the current economic downturn (Cody, 2009). As the world economy began to recover in 2010, so did the prices for all three profiled segments; in fact, in 2010, prices increased to levels that surpassed the 2008 averages.

Figure D-2: Producer Price Indexes for Profiled Paper and Allied Products Segments



Source: BLS, 2011c.

D.3.3 Number of Facilities and Firms

Table D-4 and *Table D-5* present the number of facilities and firms for the three profiled Paper and Allied Products industry segments between 1990 and 2009. During the last two decades, the number of facilities and firms in all three segments behaved erratically, with drastic increases and declines from one year to the next. Overall, the number of facilities declined in all three profiled segments, with Paper Mills experiencing the largest decline of more than 39 percent at an average annual decline rate of approximately 3 percent. During the last decade however, the Paperboard Mills experienced the largest decline in the number of facilities of nearly 24 percent.

One reason for this decline in the number of facilities in the Pulp Mills sector was the increase in the number of mills that produce de-inked recycled market pulp and thus displace demand for virgin pulp mill product. These are secondary fiber processing plants that use recovered paper and paperboard as their sole source of raw material. Producers of de-inked market pulp have experienced strong demand over the past several years in both U.S. and foreign markets. In fact, U.S. de-inked recycled market pulp capacity more than doubled between 1994 and 1998 (McGraw-Hill, 2000). The secondary fiber share of total papermaking fiber production increased steadily during the decade, reaching 37 percent in 1999 (McGraw-Hill, 2000). Overcapacity in the 1990s limited the construction of new facilities. In 1998 and 1999, alone, 0.6 and 2.5 million tons of paper and paperboard capacity were removed from the capacity base. Over the same period, more than one million tons of pulp capacity was removed (Pponline, 1999). In 2001 and 2002, 8.2 million tons of capacity closed, mostly in containerboard, market pulp, and print and writing papers (Paper Age, 2004c).

In terms of firms, however, the three profiled sectors behaved differently during the last two decades. Between 1990 and 2009, the number of parent firms in the Paper Mills and Paperboard Mills segments decreased by approximately 27 percent and 19 percent, respectively. However, during the last decade, while the number of firms in the Paperboard Mills segment decreased by 21 percent, the Paper Mills segment experienced an increase of approximately 2 percent. Between 1990 and 2009, the number of firms in the Pulp Mills segment on average remained the same, even though during the last decade it declined by approximately 14 percent.

There has been extensive restructuring and consolidation in the Paper Mills segment during the second half of 2000s decade, especially for containerboard producers – resulting in a higher concentration of top producers. Boxboard and newsprint manufacturers have also experienced a significant number of closures. Newsprint is perceived to be the weakest subsector of the Paper and Allied Products industry, and may face additional consolidation in the future (McNutt, 2009). Whereas it seems that other Paper and Allied Products industry product categories have merely suffered from volatility in the U.S. and global economy, newsprint and graphic papers have demonstrated long-term decline in demand and susceptibility to closures due to increasing competition from electronic products (AF&PA, 2009).

During 2007-2008, the number of firms and facilities in all three profiled Paper and Allied Products industry segments decreased due to industry contraction caused by global recession. As the global economy began to recover in 2009, all three profiled segments saw an increase in the number of firms, while the number of facilities either continued to decline or remained unchanged. It is possible that in their attempts to gain or to maintain their financial stability, the incumbent firms closed some of their older and higher cost facilities and sold off other facilities to newly emerging entities.

Table D-4: Number of Facilities Owned by Firms in the Profiled Paper and Allied Products Segments

Year[a]	Pulp Mills[b]		Paper Mills[c]		Paperboard Mills[d]	
	Number of Facilities	Percent Change	Number of Facilities	Percent Change	Number of Facilities	Percent Change
1990	46	NA	327	NA	226	NA
1991	53	15.2%	349	6.7%	228	0.9%
1992	44	-17.0%	324	-7.2%	222	-2.6%
1993	46	4.5%	306	-5.6%	217	-2.3%
1994	52	13.0%	316	3.3%	218	0.5%
1995	53	1.9%	317	0.3%	219	0.5%
1996	62	17.0%	344	8.5%	228	4.1%
1997	41	-33.9%	259	-24.7%	214	-6.1%
1998	44	7.3%	235	-9.4%	232	8.4%
1999	45	2.3%	242	3.2%	233	0.4%
2000	48	6.7%	240	-1.0%	238	2.1%
2001	51	6.3%	238	-0.8%	247	3.8%
2002	44	-13.7%	271	14.0%	231	-6.5%
2003	38	-13.6%	287	5.9%	221	-4.3%
2004	43	13.2%	385	2.4%	221	0.0%
2005	43	0.0%	368	-4.4%	210	-5.0%
2006	44	2.3%	348	-5.4%	205	-2.4%
2007	26	-18.2%	328	-5.7%	187	-8.8%
2008	40	11.1%	275	-16.2%	189	1.1%
2009	40	0.0%	271	-1.5%	181	-4.2%
Total Percent Change 1990-2009	**-13.0%**		**-39.3%**		**-19.9%**	
Total Percent Change 2000-2009	**-16.7%**		**-12.9%**		**-23.9%**	
Average Annual Growth Rate	**-0.7%**		**-2.6%**		**-1.2%**	

a. Before 1997, data were compiled in the SIC system; since 1997, these data have been compiled in the North American Industry Classification System (NAICS). For this analysis, EPA converted the SIC classification data to the NAICS code classifications using the 1997 Economic Census *Bridge Between SIC and NAICS*.
b. NAICS 322110.
c. NAICS 32212.
d. NAICS 322130.
Source: U.S. DOC, 1990-1997 SBA; U.S. DOC, 1998-2009 SUSB.

Table D-5: Number of Firms in the Profiled Paper and Allied Products Segments

Year[a]	Pulp Mills[b]		Paper Mills[c]		Paperboard Mills[d]	
	Number of Firms	Percent Change	Number of Firms	Percent Change	Number of Firms	Percent Change
1990	31	NA	238	NA	102	NA
1991	37	19.4%	274	14.7%	102	0.0%
1992	29	-21.6%	256	-6.3%	95	-6.9%
1993	32	10.3%	248	-3.1%	99	4.2%
1994	37	15.6%	261	5.1%	96	-3.0%
1995	32	-13.5%	259	-0.7%	93	-3.1%
1996	43	34.4%	277	6.7%	101	8.6%
1997	27	-37.2%	232	-16.1%	85	-15.8%
1998	32	18.5%	158	-31.9%	95	11.8%
1999	33	3.1%	169	7.0%	95	0.0%
2000	36	9.1%	171	1.2%	105	10.5%
2001	40	11.1%	179	4.7%	116	10.5%
2002	27	-32.5%	224	25.1%	107	-7.8%
2003	27	0.0%	210	-6.3%	90	-15.9%
2004	31	14.8%	226	7.6%	92	2.2%
2005	30	-3.2%	211	-6.6%	88	-4.3%
2006	31	3.3%	197	-6.6%	87	-1.1%
2007	26	-16.1%	198	0.5%	80	-8.0%
2008	29	11.5%	169	-14.6%	81	1.3%
2009	31	6.9%	174	3.0%	83	2.5%
Total Percent Change 1990-2009	**0.0%**		**-27.0%**		**-18.6%**	
Total Percent Change 2000-2009	**-13.9%**		**1.8%**		**-21.0%**	
Average Annual Growth Rate	**0.0%**		**-1.6%**		**-1.1%**	

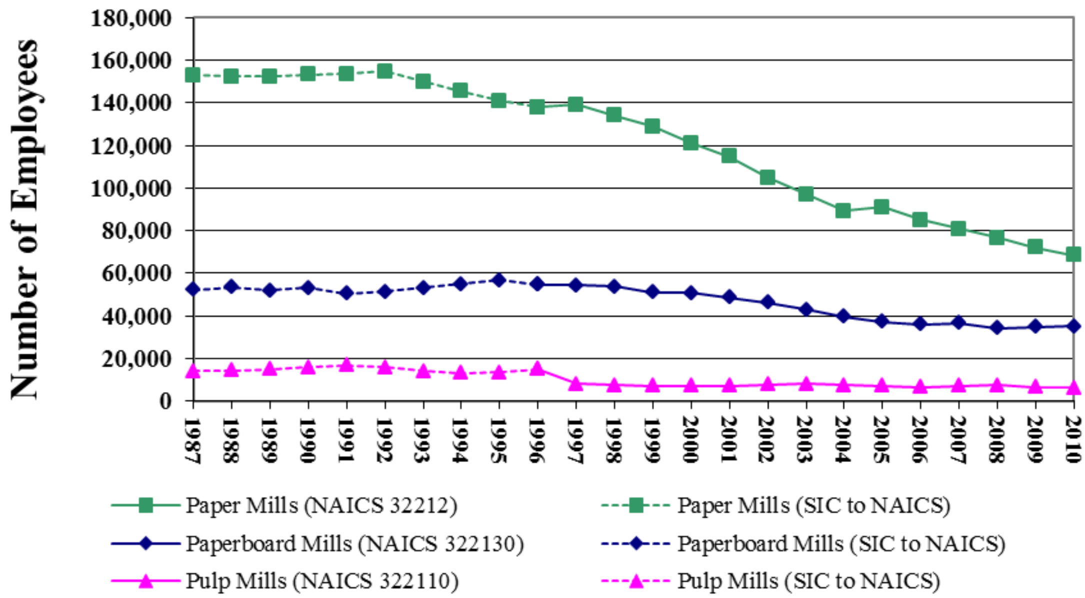
a. Before 1997, data were compiled in the SIC system; since 1997, these data have been compiled in the North American Industry Classification System (NAICS). For this analysis, EPA converted the NAICS classification data to the SIC code classifications using the 1997 Economic Census *Bridge Between NAICS and SIC*.
b. NAICS 322110.
c. NAICS 32212.
d. NAICS 322130.
Source: U.S. DOC, 1990-1997 SBA; U.S. DOC, 1998-2009 SUSB.

D.3.4 Employment and Productivity

The U.S. Paper and Allied Products industry is among the most modern in the world. It has a highly skilled labor force and is characterized by large capital expenditures, which have been principally aimed at productivity improvements.

Beginning in 1987 through the mid-1990s, ***employment*** in the three profiled Paper and Allied Products industry segments remained relatively constant. Since 1996, employment at Pulp Mills has dropped considerably, decreasing by 58 percent by 2010. Paper Mills also saw a substantial reduction in the workforce of more than 50 percent in the same period. Employment in Paperboard Mills fell the least over this period, but still declined by nearly 36 percent. Part of this employment loss is attributable to firms closing older and higher cost facilities with lower employee productivity (McNutt, Cenatempo & Kinstrey, 2004). Pulp, Paper, and Paperboard Mills have faced serious losses in employment in the latter part of the 2000s decade, losing roughly 81,000 jobs between January of 2000 and December of 2009. The majority of layoff events occurred in 2001 and 2009 during recessionary periods, but layoffs diminished considerably in the third and fourth quarters of 2009 (BLS, 2010). Employment in the Paperboard Mills segment began increase in 2009 and continued through 2010. Despite the signs of global economic recovery, for the Pulp Mills and Paper Mills segments, employment losses continued through 2010. *Figure D-3* presents employment for the three profiled Paper and Allied Products industry segments between 1987 and 2010.

Figure D-3: Employment for Profiled Paper and Allied Products Segments[a]



a. Before 1997, the Department of Commerce compiled data in the SIC system; since 1997, these data have been compiled in the North American Industry Classification System (NAICS). For this analysis, EPA converted the SIC classification data to the NAICS code classifications using the 1997 Economic Census Bridge Between SIC and NAICS.

Source: U.S. DOC, 1988-1991, 1993-1996, 1998-2001, 2003-2006, and 2008-2010 ASM; U.S. DOC, 1987, 1992, 1997, 2002, and 2007 EC.

Table D-6 presents the change in value added per labor hour, a measure of ***labor productivity***, for each of the profiled Paper and Allied Products industry segments between 1987 and 2010. The table shows that labor productivity in the Pulp Mills segment has been relatively volatile, posting several double-digit gains and losses between 1987 and 2010. These changes were primarily driven by fluctuations in value added and production levels. Overall, productivity in Pulp Mills on average increased by nearly 1 percent annually, resulting in an overall increase of nearly 19 percent during this period. Productivity in the Paper Mills and Paperboard Mills increased by approximately 81 percent and 70 percent at an average annual rate of 3 percent and 2 percent, respectively. The effect of the current recession on productivity has been mixed, historically speaking (McNutt, 2009). One segment, Paper Mills, continued to see rises in productivity during the recession while the other two segments experienced decreases in productivity. In 2010, all there of the segments saw significant rises in productivity.

Table D-6: Productivity Trends for Profiled Paper and Allied Products Segments ($2011)

Year[a]	Pulp Mills				Paper Mills				Paperboard Mills			
	Value Added ($ mil)	Prod. Hrs. (mil)	Value Added/Hour $/hr	Value Added/Hour Percent Change	Value Added ($ mil)	Prod. Hrs. (mil)	Value Added/Hour $/hr	Value Added/Hour Percent Change	Value Added ($ mil)	Prod. Hrs. (mil)	Value Added/Hour $/hr	Value Added/Hour Percent Change
1987	$3,990	24	167	NA	$30,657	248	124	NA	$12,092	89	137	NA
1988	$5,269	24	220	32.1%	$34,368	251	137	11.0%	$14,842	91	163	19.6%
1989	$6,417	25	253	14.6%	$34,713	249	139	1.5%	$14,335	89	161	-1.7%
1990	$5,359	28	193	-23.4%	$32,797	248	132	-5.0%	$12,743	91	141	-12.4%
1991	$3,706	28	134	-30.6%	$30,732	250	123	-7.0%	$10,995	87	127	-9.7%
1992	$3,781	26	144	7.1%	$28,682	254	113	-8.3%	$12,128	88	137	7.9%
1993	$2,478	23	107	-25.4%	$27,726	252	110	-2.4%	$10,897	90	121	-11.8%
1994	$2,968	22	136	27.0%	$28,233	244	116	5.0%	$12,310	94	131	8.5%
1995	$5,441	23	241	76.8%	$38,137	238	160	38.7%	$17,579	98	180	37.1%
1996	$3,000	24	126	-47.9%	$32,547	235	139	-13.6%	$13,161	95	139	-23.0%
1997	$2,019	13	156	24.5%	$33,061	236	140	0.9%	$12,111	93	130	-6.2%
1998	$1,860	12	149	-4.4%	$32,865	225	146	4.4%	$13,391	90	148	14.1%
1999	$1,883	12	161	7.7%	$33,307	218	153	4.7%	$13,614	86	158	6.6%
2000	$2,334	12	196	22.0%	$34,519	202	170	11.5%	$15,222	86	176	11.5%
2001	$1,766	12	148	-24.9%	$31,032	190	164	-4.0%	$13,781	83	165	-6.3%
2002	$2,064	13	164	11.2%	$32,075	173	185	13.1%	$13,262	75	176	6.3%
2003	$1,999	13	151	-8.2%	$28,975	164	177	-4.3%	$12,300	74	165	-6.0%
2004	$2,173	13	167	11.0%	$29,396	155	190	7.1%	$12,143	67	180	9.2%
2005	$1,903	12	155	-7.3%	$30,552	161	190	0.2%	$11,323	63	178	-1.0%
2006	$1,939	12	158	1.9%	$30,725	146	211	10.7%	$12,941	62	210	17.8%
2007	$2,425	13	188	19.0%	$27,949	138	203	-3.7%	$13,222	64	207	-1.2%
2008	$2,399	13	180	-4.0%	$27,964	132	212	4.4%	$12,194	60	202	-2.7%
2009	$1,924	11	171	-5.4%	$26,603	122	219	3.2%	$12,384	58	213	5.8%
2010	$2,079	11	198	15.8%	$25,745	115	224	2.3%	$13,750	59	233	9.0%
Total % Change 1987-2010	**-47.9%**	**-56.0%**	**18.5%**		**-16.0%**	**-53.6%**	**81.0%**		**13.7%**	**-33.3%**	**70.4%**	
Total Percent Change 2000-2010	**-11.0%**	**-11.6%**	**0.7%**		**-25.4%**	**-43.1%**	**31.1%**		**-9.7%**	**-31.5%**	**32.0%**	
Average Annual Growth Rate	**-2.8%**	**-3.5%**	**0.7%**		**-0.8%**	**-3.3%**	**2.6%**		**0.6%**	**-1.7%**	**2.3%**	

a. Before 1997, data were compiled in the SIC system; since 1997, these data have been compiled in the North American Industry Classification System (NAICS). For this analysis, EPA converted the SIC classification data to the NAICS code classifications using the 1997 Economic Census *Bridge Between SIC and NAICS.*

Source: U.S. DOC, 1988-1991, 1993-1996, 1998-2001, 2003-2006, and 2008-2010 ASM; U.S. DOC, 1987, 1992, 1997, 2002, and 2007 EC.

D.3.5 Capital Expenditures

The Paper and Allied Products industry is highly cyclical and capital intensive. Capital-intensive industries are characterized by a large value of capital equipment per dollar value of production. ***New capital expenditures*** are needed to modernize, expand, and replace existing capacity. The total level of capital expenditures for the profiled Paper and Allied Products industry was $3.5 billion in 2010. The Paper Mills and Paperboard Mills segments accounted for approximately 89 percent of that spending (see *Table D-7*). Most of the spending is for production improvements (through existing machine upgrades, retrofits, or new installed equipment), environmental concerns, and increased recycling (McGraw Hill, 2000). The total capital expenditure during recent years has been considerably less, in real terms, than what was spent in the early 1990s, as producers became wary of adding too much capacity that might lead to oversupply and depressed prices.

Overall, during 1987 through 2010, the Paper Mills segment experienced the largest reduction in capital expenditures (64 percent), followed by the Paperboard Mills segment (6 percent) and the Pulp Mills segment (2 percent). The Department of Commerce estimates that environmental spending accounted for about 14 percent of all capital outlays made by the U.S. Paper and Allied Products industry since the 1980s, and the Cluster Rule promulgated in 1998 is expected to have encouraged increased environmental expenditures (S&P, 2001c). North American producers have improved production asset quality in the latter half of the 2000s through incremental investment and closure of uncompetitive lines. Between 1999 and 2007, the median age of paper machine lines decreased by 23 percent. During the same time, the average maximum speed of paper machine lines increased by 33 percent, the average width by 35 percent, and the average capacity by 20 percent (McNutt, 2009). However, it was suggested that some industries, such as containerboard producers, had been successful enough at matching supply with demand that investment in new capital became an attractive option in 2010 (Waghorne, 2010). Indeed, during 2010, capital expenditures increased by more than 41 percent for Paperboard Mills, after a loss of 38 percent in the previous year as a result of the economic downturn. Pulp Mills and Paper Mills also saw increases in capital expenditures, following significant declines in 2009, of 38 percent and 45 percent, respectively.

Table D-7: Capital Expenditures for Profiled Paper and Allied Products Segments (millions, $2011)

Year[a]	Pulp Mills		Paper Mills		Paperboard Mills	
	Capital Expenditures	Percent Change	Capital Expenditures	Percent Change	Capital Expenditures	Percent Change
1987	$404	NA	$5,239	NA	$1,351	NA
1988	$523	29.3%	$6,008	14.7%	$2,566	89.9%
1989	$1,135	117.2%	$9,074	51.0%	$2,694	5.0%
1990	$1,653	45.6%	$7,149	-21.2%	$4,669	73.4%
1991	$1,501	-9.2%	$5,892	-17.6%	$3,261	-30.2%
1992	$1,143	-23.9%	$4,653	-21.0%	$3,020	-7.4%
1993	$617	-46.0%	$4,641	-0.3%	$2,379	-21.2%
1994	$447	-27.5%	$4,917	5.9%	$2,476	4.1%
1995	$642	43.5%	$4,345	-11.6%	$2,906	17.3%
1996	$952	48.2%	$4,779	10.0%	$3,217	10.7%
1997	$462	-51.5%	$5,048	5.6%	$2,162	-32.8%
1998	$551	19.3%	$5,274	4.5%	$1,846	-14.6%
1999	$244	-55.8%	$3,985	-24.4%	$1,661	-10.0%
2000	$303	24.2%	$4,220	5.9%	$1,516	-8.8%
2001	$241	-20.3%	$3,936	-6.7%	$1,286	-15.1%
2002	$230	-4.6%	$3,433	-12.8%	$1,006	-21.8%
2003	$219	-4.7%	$3,303	-3.8%	$921	-8.4%
2004	$220	0.2%	$2,380	-27.9%	$1,086	17.9%
2005	$136	-38.0%	$2,572	8.1%	$1,143	5.2%
2006	$399	193.0%	$2,456	-4.5%	$1,091	-4.5%
2007	$294	-26.2%	$2,417	-1.6%	$1,205	10.5%
2008	$358	21.5%	$2,013	-16.7%	$1,449	20.2%
2009	$288	-19.4%	$1,320	-34.4%	$899	-38.0%
2010	$397	37.8%	$1,911	44.7%	$1,273	41.6%
Total Percent Change 1987- 2010	**-1.7%**		**-63.5%**		**-5.8%**	
Total Percent Change 2000- 2010	**31.4%**		**-54.7%**		**-16.0%**	
Average Annual Growth Rate 1987 - 2010	**-0.1%**		**-4.3%**		**-0.3%**	

a. Before 1997, data were compiled in the SIC system; since 1997, these data have been compiled in the North American Industry Classification System (NAICS). For this analysis, EPA converted the SIC classification data to the NAICS code classifications using the 1997 Economic Census *Bridge Between SIC and NAICS*.

Source: U.S. DOC, 1988-1991, 1993-1996, 1998-2001, 2003-2006, and 2008-2010 ASM; U.S. DOC, 1987, 1992, 1997, 2002, and 2007 EC.

D.3.6 Capacity Utilization

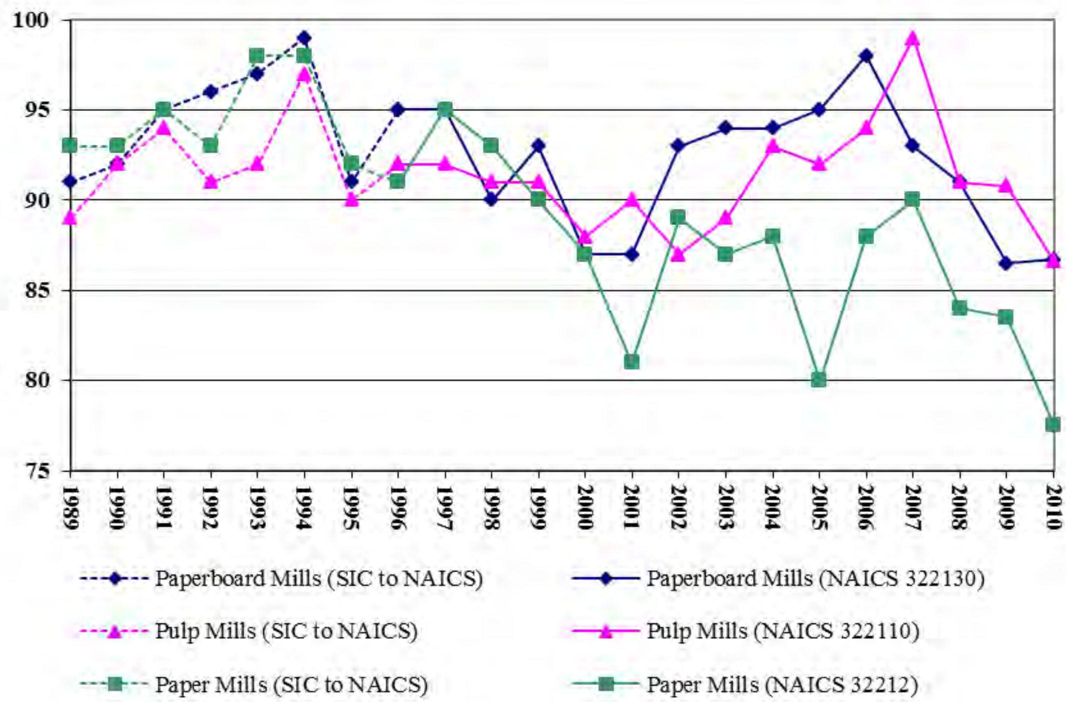
Capacity utilization measures actual output as a percentage of total potential output given the available capacity. Capacity utilization provides insight into the extent of excess or insufficient capacity in an industry, and into the likelihood of investment in new capacity.

As shown in *Figure D-4*, capacity utilization fluctuated sharply in all three profiled segments over the analysis period. Capacity utilization increased between 1989 and 1994, and then fell sharply in 1995. This sharp drop resulted from an effort to reduce inventories, which began rising in 1995 in response to low demand and oversupply (McGraw-Hill, 2000). As inventories were sold off and global economic activity strengthened, capacity utilization began to rise again in 1996, peaked in 1997, and again declined in 1998 due to reduced demand from the Asian market (S&P, 2001c). With the global economic slowdown starting in 2000, paper producers were forced to implement production cutbacks and downtime to prevent oversupply from further depressing prices. As a result, utilization rates fell farther in 2000 and 2001 to values below those observed in the prior decade. At the same time, overall capacity contracted as companies permanently closed less efficient facilities. By 2004, capacity utilization in the Paperboard Mills and Pulp Mills industry segments had returned to its 1990 level, while capacity utilization in the Pulp Mills industry segment increased between 2001 and 2002 and remained relatively constant over 2003 to 2004.

In the second half of the 2000s decade, capacity utilization rose substantially for Paperboard and Pulp Mills previous to the economy collapse in 2008. During this same period, capacity utilization for Paper Mills fluctuated, but remained fairly low. Producers of many grades curtailed production and capacity in those categories suffering from overcapacity in an effort to improve the balance between supply and demand (S&P, 2010b). U.S. paper and paperboard capacity edged down 0.8 percent in 2008 to 96.3 million tons, and declined 7.3 percent cumulatively since its 2000 peak level (AF&PA, 2009).

During 2008 through 2010, capacity utilization declined almost steadily. Boxboard and containerboard producers experienced increasing excess capacity, but still below 2001 to 2003 levels. The market pulp and printing and writing papers sectors also experienced relatively high levels of excess capacity/low capacity utilization, but this was expected to be remedied by recovery from the economic recession. For the struggling newsprint industry, supply and demand were kept in balance through capacity rationalization, but further cutbacks were expected (McNutt, 2009). Overall, total capacity for Paper and Paperboard Mills was slated to expand by 0.3 percent in both 2010 and 2011, with uncoated mechanical paper, tissue paper, linerboard, corrugating medium, and market pulp being forecast as the most successful product grades (AF&PA, 2009). However, despite the signs of economic recovery during 2010, the profiled Paper and Allied Products industry still suffered from excess capacity; the Pulp Mills and Paper Mills segments each saw a decline in capacity utilization (approximately 5 percent and 7 percent, respectively), while capacity utilization in the Paperboard Mills segment remained constant. The fact that capacity utilization either declined or remained unchanged coupled with increases in production and capital expenditures across all three profiled segments, signals that in 2010, capacity expansion as the result of economic recovery outpaced demand for Paper and Allied Products.

Figure D-4: Capacity Utilization Rate (Fourth Quarter) for Pulp and Paper Industry[a,b]



a. Before 1997, the Department of Commerce compiled data in the SIC system; since 1997, these data have been compiled in the North American Industry Classification System (NAICS). For this analysis, EPA converted the SIC classification data to the NAICS code classifications using the 1997 Economic Census Bridge Between SIC and NAICS.
b. Before 2007, U.S. Census sampled every industry in a specific NAICS6. Beginning in 2007, U.S. Census only sampled certain industries within any NAICS6, and therefore, the data collected before 2007 cannot be directly compared to the data collected in 2007 and beyond.
Source: U.S. DOC, 1989-2006 SPC;U.S. DOC, 2007-2010 SPC data was obtained from the Census Bureau, however the data do not meet the criteria outlined in the Census Bureau's Statistical Quality Standard: Releasing Information Products. Data is included here for completeness as it is the only data available for Capacity Utilization for these years.

D.4 Structure and Competitiveness

The Paper and Allied Products industry companies range in size from large corporations with billions of dollars of sales, to small producers with revenue a fraction of the size of the large producers. Because all Paper and Allied Products companies use the same base materials in their production, most manufacture more than one product. To escape the extreme price volatility of commodity markets, many smaller manufacturers have differentiated their products by offering value-added grades. The smaller markets for value-added products make this avenue less available to the larger firms (S&P, 2001c).

The Paper and Allied Products industry consolidated through mergers and acquisitions and has closed older mills during the last two decades as a way to improve profits in a mature industry. About six percent of North American containerboard capacity was shut down (most were on a permanent basis) in late 1998 and early 1999. Companies were reluctant to invest in any major new capacity, which might result in excess capacity (S&P, 2001c). In 1999, new capacity additions in the Paper and Allied Products industry were at their lowest level of the past ten years (Pponline.com, 2000); this caution in adding to capacity has continued through the 2000 to 2010 decade. Another problem for the industry has been the increasing capacity being brought online in foreign countries (S&P, 2004a). U.S. mills responded to the increased foreign competition by cutting capacity and retiring obsolete equipment and, with help from private equity investors, had succeeded in constraining supply and improving average product quality, hoping to improve long-term returns. Moreover, the devaluation of the dollar towards the end of the last decade made domestic paper products more affordable than foreign goods (Great American Group, 2009).

Major mergers in the most recent decade include International Paper‟s acquisition of Champion International in 2000 and Union Camp in 1999, Georgia-Pacific‟s takeover of Fort James Corp. (itself a 1997 combination of James River and Fort Howard), Weyerhaeuser‟s acquisition of Willamette Industries Inc., the merger of Mead and Westvaco, and Temple-Inland‟s takeover of Gaylord Container (S&P, 2001c, 2004b).

D.4.1 Firm Size

For this industry, the Small Business Administration defines a small firm as having fewer than 750 employees. The size categories reported in the Statistics of U.S. Businesses (SUSB) do not correspond with the SBA size criteria, therefore preventing precise use of the SBA size threshold in conjunction with SUSB data. The SUSB data presented in *Table D-8* show the following size distribution in 2009:

- 21 of 31 (68 percent) firms in the Pulp Mills segment had less than 500 employees. Therefore, at least 68 percent of firms were classified as small. These small firms owned 22 facilities, or 55 percent of all facilities in the segment.
- 128 of 174 (74 percent) firms in the Paper Mills segment had less than 500 employees. These small firms owned 131, or 48 percent of all Paper Mills.
- 49 of 83 (59 percent) firms in the Paperboard Mills segment had less than 500 employees. Therefore, at least 59 percent of paperboard mills were classified as small. These firms owned 53, or 29 percent of all Paperboard Mills.

An unknown number of the firms with more than 500 employees have less than 750 employees, and would therefore also be classified as small firms. *Table D-8* below shows the distribution of firms and facilities for each profiled segment by employment size of the parent firm.

Table D-8: Number of Firms and Facilities by Size Category for Profiled Paper and Allied Products Segments in 2009

Employment Size Category	Pulp Mills		Paper Mills		Paperboard Mills	
	No. of Firms	No. of Facilities	No. of Firms	No. of Facilities	No. of Firms	No. of Facilities
0-19	11	11	65	65	20	20
20-99	7	7	28	28	12	13
100-499	3	4	35	38	17	20
500+	10	18	46	140	34	128
Total	**31**	**40**	**174**	**271**	**83**	**181**

Source: U.S. DOC, 2009 SUSB.

D.4.2 Concentration Ratios

Concentration is the degree to which industry output is concentrated in a few large firms. Concentration is closely related to entry barriers, with more concentrated industries generally having higher barriers.

The ***four-firm concentration ratio (CR4)*** and the ***Herfindahl-Hirschman Index (HHI)*** are common measures of industry concentration. The CR4 indicates the market share of the four largest firms. For example, a CR4 of 72 percent means that the four largest firms in the industry account for 72 percent of the industry‟s total value of shipments. The higher the concentration ratio, the less competition there is in the industry, other things being equal.[3] An industry with a CR4 of more than 50 percent is generally considered concentrated. The HHI indicates

[3] Note that the measured concentration ratio and the HHI are very sensitive to how the industry is defined. An industry with a high concentration in domestic production may nonetheless be subject to significant competitive pressures if it competes with foreign producers or if it competes with products produced by other industries (e.g., plastics vs. aluminum in beverage containers). Concentration ratios based on share of domestic production are therefore only one indicator of the extent of competition in an industry.

concentration based on the largest 50 firms in the industry. It is equal to the sum of the squares of the market shares for the largest 50 firms in the industry. For example, if an industry consists of only three firms with market shares of 60, 30, and 10 percent, respectively, the HHI of this industry would be equal to 4,600 ($60^2 + 30^2 + 10^2$). The higher the index, the fewer the number of firms supplying the industry and the more concentrated the industry. Based on the U.S. Department of Justice‟s guidelines for evaluating mergers, markets in which the HHI is under 1000 are considered unconcentrated, markets in which the HHI is between 1,000 and 1,800 are considered to be moderately concentrated, and those in which the HHI is in excess of 1,800 are considered to be concentrated.

Table D-9 shows that in 2007, the latest year for which concentration data is available, Pulp Mills had the highest concentration with HHI of 1,024, followed by the Paperboard Mills segment with HHI of 713, and the Paper Mills segment with HHI of 673. The Pulp Mills segment also had the highest CR4 ratio of 54 percent. At these HHI levels, the Paper Mills and Paperboard Mills segments are *unconcentrated* while the Pulp Mills segment is at the lower end of the *moderately concentrated* range. With the majority of the firms in this industry having relatively small market shares, this suggests limited potential for passing through to customers any increase in production costs resulting from regulatory compliance.

The concentration ratios for the three profiled segments remained relatively stable between 1987 and 2007, with an overall increase through 2002 and a slight decline in 2007. During late 1990s, the top five U.S. firms controlled 38 percent of production capacity, with higher concentrations in individual product lines due to targeted consolidation and specialization (Ince, 1999). As described previously, the period of consolidation in the Paper and Allied Products industry on average continued throughout the second half of the decade. Ccontainerboard producers in particular went through a period of extensive restructuring resulting in a higher concentration of top producers (McNutt, 2009). However, an overall decline in concentration indicators in 2007 together with an increase in the number of firms during 2008/2009 in all three segments, potentially suggests that going forward, the profiled Paper and Allied Products industry may become even less concentrated.

Table D-9: Selected Ratios for Profiled Paper and Allied Products Segments, 1987, 1992, 1997, 2002, and 2007

SIC (S) or NAICS (N) Code	Year	Total Number of Firms	Concentration Ratios				
			4 Firm (CR4)	8 Firm (CR8)	20 Firm (CR20)	50 Firm (CR50)	Herfindahl-Hirschman Index
S 2611	1987	26	44%	69%	99%	100%	743
	1992	29	48%	75%	98%	100%	858
N 322110	1997	24	59%	86%	100%	100%	1,106
	2002	21	61%	88%	100%	100%	1,175
	2007	30	54%	82%	100%	100%	1,024
S 2621	1987	122	33%	50%	78%	94%	432
	1992	127	29%	49%	77%	94%	392
N 32212	1997	139	34%	55%	80%	94%	467
	2002	187	50%	66%	81%	97%	721
	2007	151	46%	62%	83%	96%	673
S 2631	1987	91	32%	51%	77%	97%	431
	1992	89	31%	52%	80%	97%	438
N 322130	1997	81	34%	53%	82%	98%	485
	2002	80	49%	68%	88%	99%	749
	2007	77	46%	68%	89%	99%	713

Source: U.S. DOC, 1987, 1992, 1997, 2002, and 2007 EC.

D.4.3 Foreign Trade

This profile uses two measures of foreign competition: ***export dependence*** and ***import penetration***.

Import penetration measures the extent to which domestic firms are exposed to foreign competition in domestic markets. Import penetration is calculated as total imports divided by total value of domestic consumption in that industry: where domestic consumption equals domestic production plus imports minus exports. Theory suggests that higher import penetration levels will reduce market power and pricing discretion because foreign competition limits domestic firms‟ ability to exercise such power. Firms belonging to segments in which imports account for a relatively large share of domestic sales would therefore be at a relative disadvantage in their ability to pass-through costs because foreign producers would not incur costs as a result of the Existing Facilities regulation. The estimated import penetration ratio for the entire U.S. manufacturing sector (NAICS 31-33) for 2010 is 28 percent. For characterizing the ability of industries to absorb compliance cost burdens, EPA judges that industries with import ratios close to or above 28 percent would more likely face stiff competition from foreign firms and thus be less likely to succeed in passing compliance costs through to customers.

Export dependence, calculated as exports divided by value of shipments, measures the share of a segment‟s sales that is presumed subject to strong foreign competition in export markets. The final rule would not increase the production costs of foreign producers with whom domestic firms must compete in export markets. As a result, firms in industries that rely to a greater extent on export sales would have less latitude in increasing prices to recover cost increases resulting from regulation-induced increases in production costs. The estimated export dependence ratio for the entire U.S. manufacturing sector for 2010 is 22 percent. For characterizing the ability of industries to absorb compliance cost burdens, EPA judges that industries with export ratios close to or above 22 percent are at a relatively greater disadvantage in potentially recovering compliance costs through price increases since export sales are presumed subject to substantial competition from foreign producers.

Table D-10 presents trade statistics for the Pulp Mills and Paper and Paperboard Mills segments. Imports and exports play a much larger role in the Pulp Mills segment than for the other two segments. Import penetration and export dependence levels for the Pulp Mills segment were an estimated 143 and 128 percent, respectively, in 2010, while for the Paper and Paperboard Mills segments, import penetration and export dependence ratios were 13 and 11 percent, respectively. While there have been some fluctuations in import penetration and export dependence during the last two decades, overall, the Pulp Mills segment remained significantly more reliant on foreign trade compared to the other two segments. For Pulp Mills, the large share of domestic production that is exported and domestic consumption served by imports implies the industry faces significant foreign competition, limiting the industry‟s ability to pass through to customers any increase in production costs resulting from regulatory compliance. For Paper and Paperboard Mills, both measures of foreign competition are well below the U.S. manufacturing averages estimated for 2010. Given just these measures, it would be reasonable to assume that these two segments do not face significant foreign competitive pressures, and would have more latitude in passing through to customers any increase in production costs resulting from regulatory compliance. However, foreign pressure is likely to increase as capacity in foreign countries, particularly China, continues to grow and exert pressure on the domestic market (McNutt, Cenatempo & Kinstrey, 2004). In addition, as noted above, the HHI of the Paper Mills and Paperboard Mills segments is 673 and 713, respectively, suggesting firms in these segments have small market shares, which would curtail their ability to pass through any increase in production costs.

Table D-10: Trade Statistics for Profiled Paper and Allied Products Segments (Millions, $2010)						
Year[a]	Value of Imports	Value of Exports	Value of Shipments	Implied Domestic Consumption[b]	Import Penetration[c]	Export Dependence[d]
Pulp Mills						
1989	$5,110	$5,935	$10,453	$9,628	53%	57%
1990	$4,689	$5,157	$9,787	$9,319	50%	53%
1991	$3,452	$4,424	$8,074	$7,103	49%	55%
1992	$3,300	$4,789	$8,089	$6,600	50%	59%
1993	$2,895	$3,594	$6,200	$5,501	53%	58%
1994	$3,433	$4,189	$6,845	$6,088	56%	61%
1995	$5,414	$6,526	$9,618	$8,506	64%	68%
1996	$3,736	$4,578	$7,508	$6,666	56%	61%
1997	$3,623	$4,357	$4,372	$3,637	100%	100%
1998	$3,344	$3,674	$4,146	$3,816	88%	89%
1999	$3,494	$3,672	$4,064	$3,887	90%	90%
2000	$4,383	$4,544	$4,729	$4,568	96%	96%
2001	$3,419	$3,559	$4,047	$3,907	88%	88%
2002	$3,015	$3,428	$4,342	$3,930	77%	79%
2003	$3,236	$3,316	$4,685	$4,604	70%	71%
2004	$3,548	$3,538	$4,797	$4,807	74%	74%
2005	$3,583	$3,832	$4,584	$4,335	83%	84%
2006	$3,640	$4,047	$4,675	$4,268	85%	87%
2007	$4,089	$4,449	$5,365	$5,004	82%	83%
2008	$4,282	$5,053	$5,501	$4,731	91%	92%
2009	$2,622	$4,301	$4,474	$2,795	94%	96%
2010	$4,020	$5,536	$4,328	$2,812	143%	128%
Total Percent Change 1989 - 2010	**-21.3%**	**-6.7%**	**-58.6%**	**-70.8%**		
Total Percent Change 2000 - 2010	**-8.3%**	**21.8%**	**-8.5%**	**-38.4%**		
Average Annual Growth Rate 1989 - 2010	**-1.1%**	**-0.3%**	**-4.1%**	**-5.7%**		
Paper and Paperboard Mills						
1989	$12,800	$5,164	$96,828	$104,464	12%	5%
1990	$12,399	$5,756	$92,854	$99,497	12%	6%
1991	$11,160	$6,612	$86,067	$90,615	12%	8%
1992	$10,643	$6,779	$85,002	$88,866	12%	8%
1993	$11,211	$6,581	$82,172	$86,801	13%	8%
1994	$11,301	$7,419	$88,140	$92,022	12%	8%
1995	$15,145	$9,564	$109,945	$115,525	13%	9%
1996	$13,371	$9,337	$94,441	$98,474	14%	10%
1997	$12,671	$8,573	$91,455	$95,553	13%	9%
1998	$13,656	$8,054	$91,191	$96,793	14%	9%
1999	$13,817	$7,678	$91,966	$98,105	14%	8%
2000	$14,986	$8,340	$94,715	$101,361	15%	9%
2001	$14,038	$7,258	$85,898	$92,678	15%	8%
2002	$13,025	$5,952	$82,321	$89,394	15%	7%
2003	$13,026	$5,923	$77,583	$84,685	15%	8%
2004	$14,625	$6,211	$79,092	$87,506	17%	8%
2005	$14,790	$6,790	$80,921	$88,921	17%	8%
2006	$14,761	$7,061	$81,994	$89,695	16%	9%
2007	$13,087	$7,757	$80,594	$85,924	15%	10%
2008	$12,919	$8,431	$81,523	$86,011	15%	10%
2009	$9,686	$7,072	$72,625	$75,239	13%	10%
2010	$9,787	$8,355	$76,687	$78,119	13%	11%
Total Percent Change 1989 - 2010	**-23.5%**	**61.8%**	**-20.8%**	**-25.2%**		
Total Percent Change 2000 - 2010	**-34.7%**	**0.2%**	**-19.0%**	**-22.9%**		

Table D-10: Trade Statistics for Profiled Paper and Allied Products Segments (Millions, $2010)

Year[a]	Value of Imports	Value of Exports	Value of Shipments	Implied Domestic Consumption[b]	Import Penetration[c]	Export Dependence[d]
Average Annual Growth Rate 1989 - 2010	**-1.3%**	**2.3%**	**-1.1%**	**-1.4%**		

a. Before 1997, data were compiled in the SIC system; since 1997, these data have been compiled in the North American Industry Classification System (NAICS). For this analysis, EPA converted the SIC classification data to the NAICS code classifications using the 1997 Economic Census Bridge Between SIC and NAICS.
b. Calculated by EPA as shipments + imports - exports.
c. Calculated by EPA as imports divided by implied domestic consumption.
d. Calculated by EPA as exports divided by shipments.
Source: U.S. ITC, 1989-2010.

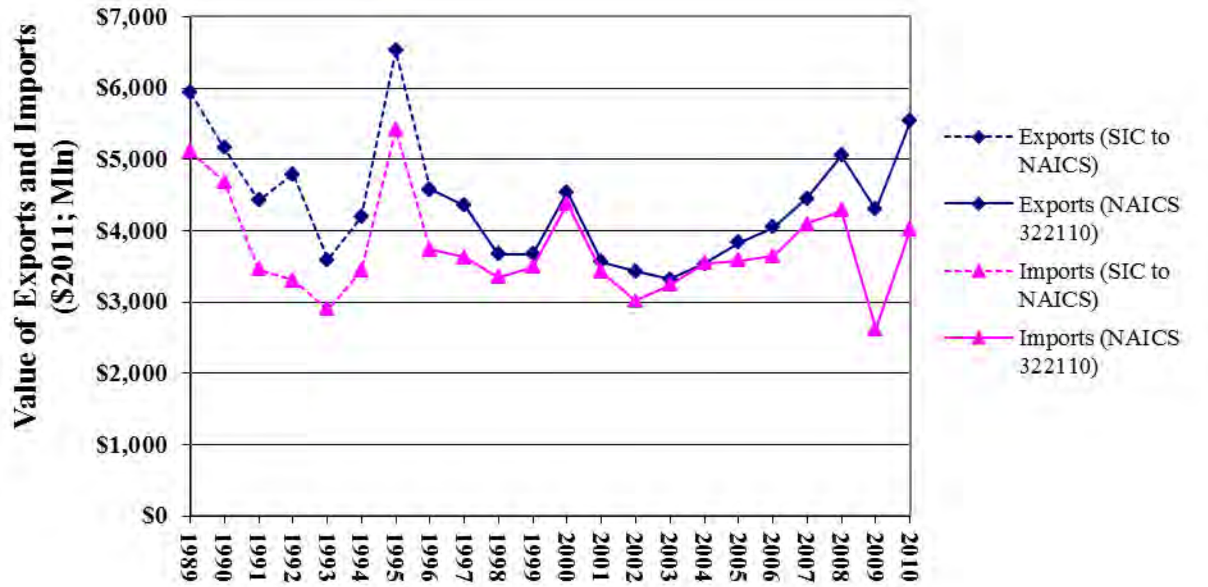
Overall, during the last two decades, the value of imports in the Pulp Mills segment declined at an average annual rate of more than1 percent resulting in an overall decline of approximately 21 percent. While the value of exports in this segment declined, it did so at an average annual rate of less than 1 percent resulting in a lower overall decline of about 7 percent. During the same time, the value of imports in the Paper and Paperboard Mills declined by approximately 24 percent while the value of exports increased by nearly 62 percent.

As shown in *Figure D-5*, the value of imports and exports peaked in the mid-1990s, before dropping and rebounding in 2000. As expected, values of both dropped again in 2001 and 2002, as the global economy fell into recession. In the Pulp Mills segment, the value of imports and exports grew steadily from 2003 to 2008, while the Paper and Paperboard industry segments turned increasingly towards exporting product and showed a slight overall decrease in imports. The five largest importers of U.S. paper and paperboard articles from 2004 through 2009 were Canada, Mexico, Japan, China, and the United Kingdom (U.S. DOC, 2009).

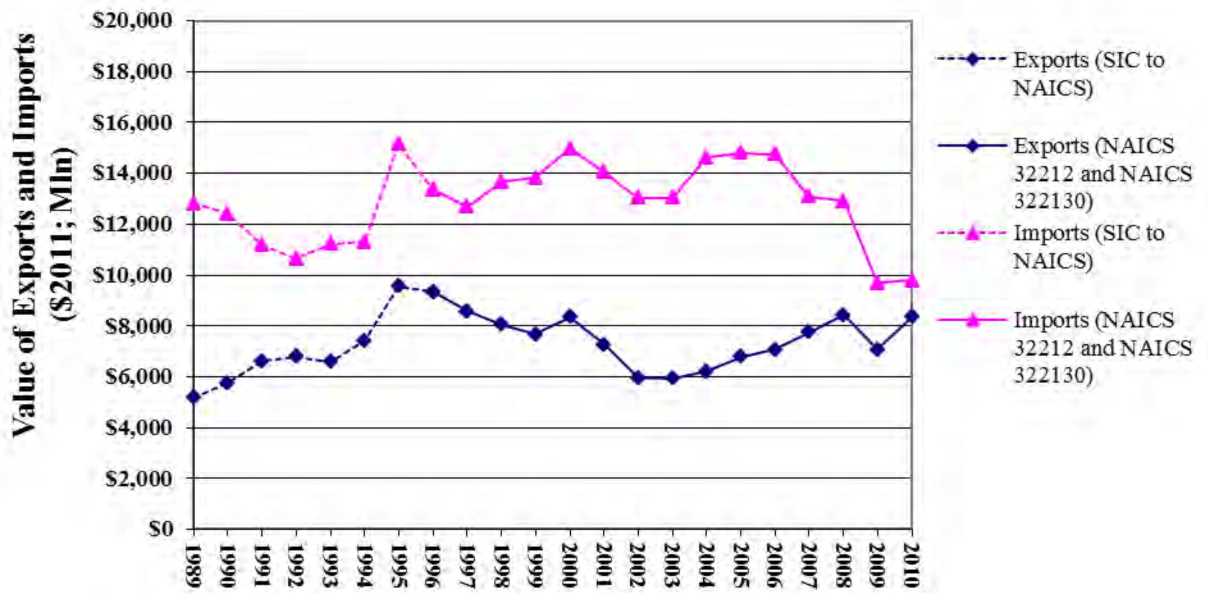
During 2009, the value of imports and exports within the Pulp Mills segment declined significantly by 39 percent and 15 percent, respectively; however, both rebounded rapidly in 2010 increasing by 54 percent and 29 percent, respectively, as the world economy began to recover. The Paperboard and Paper Mills segments also saw declines in trade during 2009, although less significant than those observed in the Pulp Mills segment (at 25 percent and 16 percent, respectively); during 2010, while exports increased significantly by 18 percent, imports remained relatively constant. As the world economy continues to recover, the biggest growth in paper consumption is likely to take place in Asia (excluding Japan). This growth, driven largely by India and China‟s rapidly increasing populations and developing markets, is expected to rise dramatically in the next decade (Environmental Paper Network, 2007). In particular, China‟s overall paper demand is projected to grow from approximately 60 million tons in 2005 to 143 million in 2021 (RISI, 2007).

Figure D-5: Value of Imports and Exports for Profiled Paper and Allied Products Segments (millions, $2011)[a]

Pulp Mills



Paper and Paperboard Mills



a. Before 1997, the Department of Commerce compiled data in the SIC system; since 1997, these data have been compiled in the North American Industry Classification System (NAICS). For this analysis, EPA converted the SIC classification data to the NAICS code classifications using the 1997 Economic Census Bridge Between SIC and NAICS.

Source: U.S. ITC, 1989-2010.

D.5 Financial Condition and Performance

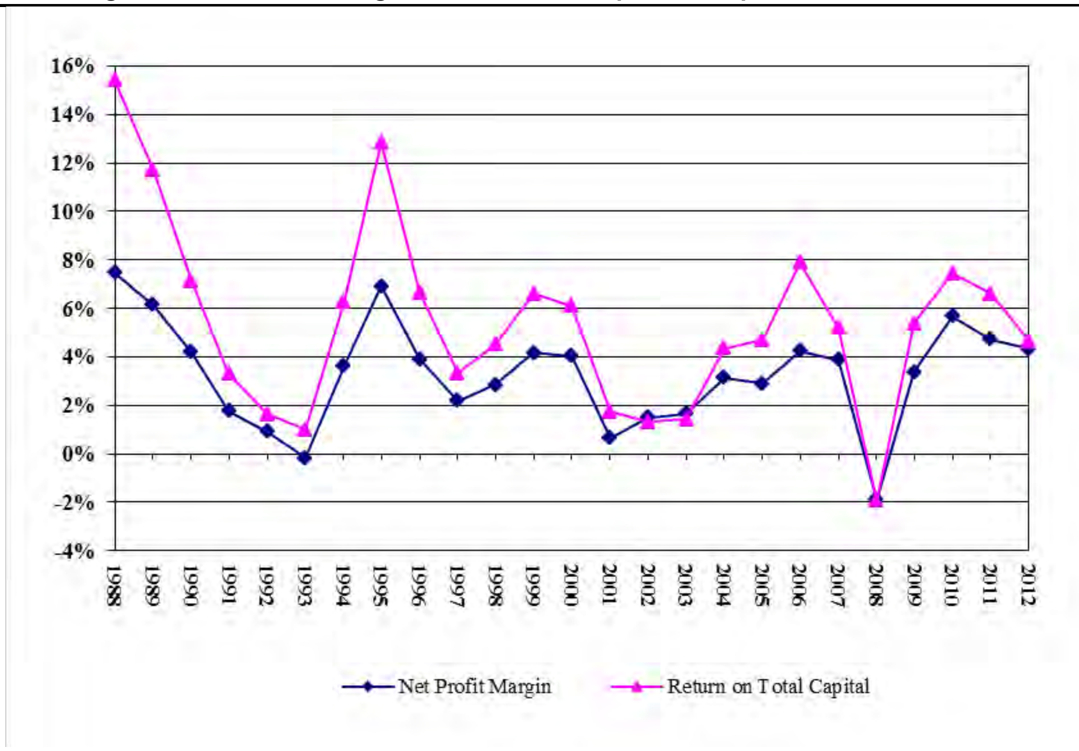
Financial performance in the Paper and Allied Products industry is closely linked to macroeconomic cycles, both in the domestic market and those of key foreign trade partners, and the resulting levels of demand. Many pulp producers, for example, were not very profitable during most of the 1990s as chronic oversupply, cyclical demand, rapidly fluctuating operating rates, sharp inventory swings, and uneven world demand plagued the global pulp market for more than a decade (Stanley, 2000). The ability of Paper and Allied Products industry manufacturers to withstand recession and react to changing global economic conditions will be critical in the coming years.

Net Profit Margin is calculated as after-tax income before nonrecurring gains and losses as a percentage of sales or revenue, and measures profitability, as reflected in the conventional accounting concept of net income. Over time, the firms in an industry, and the industry collectively, must generate a sufficient positive profit margin if the industry is to remain economically viable and attract capital. Year-to-year fluctuations in profit margin stem from several factors, including: variations in aggregate economic conditions (including international and U.S. conditions), variations in industry-specific market conditions (e.g., short-term capacity expansion resulting in overcapacity), or changes in the pricing and availability of inputs to the industry"s production processes (e.g., the cost of energy to the pulp and paper process). The extent to which these fluctuations affect an industry"s profitability, in turn, depends heavily on the fixed vs. variable cost structure of the industry"s operations. In a capital intensive industry such as the Paper and Allied Products industry, the relatively high fixed capital costs as well as other fixed overhead outlays, can cause even small fluctuations in output or prices to have a large positive or negative affect on profit margin.

Return on Total Capital is calculated as annual pre-tax income divided by the sum of the current portion of long-term debt due in 1 year or less, long-term debt due in more than 1 year, all other noncurrent liabilities and total stockholders" equity (total capital). This concept measures the total productivity of the capital deployed by a firm or industry, regardless of the financial source of the capital (i.e., equity, debt, or liability element). As such, the return on total capital provides insight into the profitability of a business" assets independent of financial structure and is thus a "purer" indicator of asset profitability than return on equity. In the same way as described for *net profit margin*, the firms in an industry, and the industry collectively, must generate over time a sufficient return on capital if the industry is to remain economically viable and attract capital. The factors causing short-term variation in *net profit margin* will also be the primary sources of short-term variation in *return on total capital*.

Figure D-6 shows trends in net profit margins and return on total capital for the Paper and Allied Products industry between 1989 and 2012. The figure shows considerable volatility in both metrics. Profitability and return on capital declined steadily between 1988 and 1993, reflecting oversupply in world markets and decreasing shipments from U.S. producers (McGraw-Hill, 2000). By the mid-1990s, financial performance peaked as demand rebounded, but weakened again in 1997 and 2001, reflecting slower growth in both the U.S. and the world economy. Coupled with overproduction in the U.S. and global markets, these factors led to deteriorating financial performance during these years. However, both net profit margins and return on capital improved gradually from 2004 to early 2007. During 2008, however, the industry"s financial performance declined significantly owing to the current recession. During the entire decade, total shareholder returns for the Paper and Allied Products industry, indexed to year 2001, performed at a higher level than the S&P 500 index. However, at the start of the recession in 2008, total shareholder returns began falling quickly back to S&P 500 levels. Ten of the largest public US-based forest and paper companies posted earnings of US $1.2 billion in the third quarter of 2008. All but two companies posted positive or improved earnings, reflecting an estimated US $1.1 billion of tax credits for the use of black liquor as a biofuel to generate energy (Pricewaterhouse Coopers, 2009).By 2009, as the world economy began to show some signs of recovery, both net profit margin and return on total capital had risen to pre-recession levels and continued to rise into 2010. In 2011 and 2012, net profit margin and return on total capital declined, moving towards the long-term averages for each of the respective indicators.

Figure D-6: Net Profit Margin and Return on Capital for Paper and Allied Products



Source: U.S. DOC, 1988-2010 QFR.

D.6 Facilities Operating Cooling Water Intake Structures

Point source facilities that use or propose to use a cooling water intake structure that withdraws cooling water directly from a surface waterbody of the United States are potentially subject to Section 316(b) of the Clean Water Act. In 1982, the paper and allied products industry withdrew 534 billion gallons of cooling water, accounting for approximately 0.7 percent of total industrial cooling water intake in the United States. The industry ranked 5th in industrial cooling water use, behind the electric power generation industry, and the chemical, primary metals, and petroleum industries (1982 Census of Manufactures).

This section provides information for facilities in the profiled paper and allied products segments potentially subject to the regulatory options. Existing facilities that meet all of the following conditions are potentially subject to regulation:

- Use a cooling water intake structure or structures, or obtain cooling water by any sort of contract or arrangement with an independent supplier who has a cooling water intake structure; or their cooling water intake structure(s) withdraw(s) cooling water from waters of the United States, and at least twenty-five (25) percent of the water withdrawn is used for contact or non-contact cooling purposes;
- Have a National Pollutant Discharge Elimination System (NPDES) permit or are required to obtain one; and
- Meet the applicability criteria for regulatory analysis options in terms of design intake flow (i.e., 2 MGD).

The regulatory analysis options also cover substantial additions or modifications to operations undertaken at such facilities. EPA identified the set of facilities that were estimated to be potentially subject to the Final 316(b)

Existing Facilities regulation based on a minimum applicability threshold of 2 MGD; this section focuses on these facilities in the profiled paper and allied products segments.[5]

D.6.1 Waterbody and Cooling System Type

Table D-11 reports the distribution of facilities in the profiled paper and allied products segments that are potentially subject to the existing facilities regulation by type of waterbody and cooling water intake system. The tables show that most of the facilities have either a once-through system or employ a combination of a once-through and closed system.

Table D-11: Number of Facilities Estimated Subject to the 316(b) Existing Facilities Regulation by Waterbody Type and Cooling Water Intake System for the Profiled Paper and Allied Products Segments

Waterbody Type	Recirculating		Combination		Once-Through		Other		Total
	No.	% of Total	No.	% of Total	No.	% of Total	No.	% of Total	
Estuary/Tidal River	0	0%	0	0%	6	5%	0	0%	6
Ocean	0	0%	0	0%	0	0%	0	0%	0
Lake/Reservoir	0	0%	6	14%	6	5%	11	34%	23
Freshwater River/ Stream	29	100%	35	86%	105	85%	19	58%	188
Great Lake	0	0%	0	0%	6	5%	3	8%	9
Total[a]	**29**	**13%**	**41**	**18%**	**122**	**54%**	**33**	**14%**	**225**

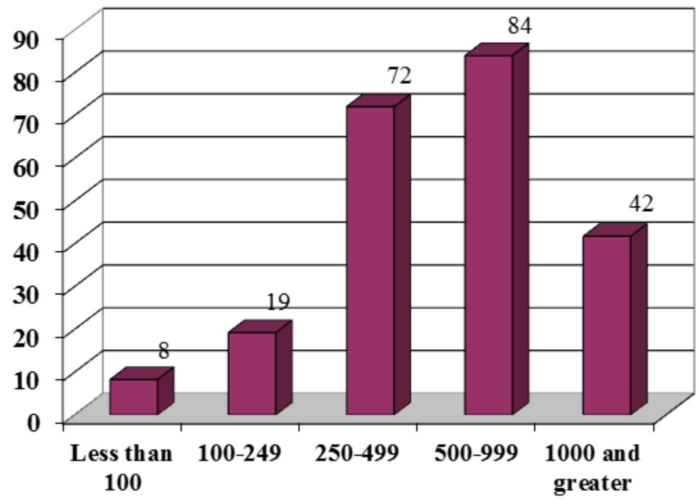
a. Individual numbers may not add up to total due to independent rounding.
Source: U.S. EPA, 2000; U.S. EPA analysis, 2013.

D.6.2 Facility Size

All of the pulp and paper facilities analyzed are relatively large, with no facilities employing fewer than 100 people. *Figure D-7*, shows the number of facilities in the profiled pulp and paper segments potentially subject to the regulation by employment size category for each primary analysis option.

5 EPA applied sample weights to the sampled facilities to account for non-sampled facilities and facilities that did not respond to the survey. For more information on EPA‟s 2000 Section 316(b) Industry Survey, please refer to the Information Collection Request (U.S. EPA, 2000).

Figure D-7: Number of Facilities Estimated to be Subject to the 316(b) Existing Facilities Regulation by Employment Size for Profiled Paper and Allied Products Segments



Source: U.S. EPA, 2000; U.S. EPA analysis, 2013.

D.6.3 Firm Size

EPA used the Small Business Administration (SBA) small entity size standards to determine the number of facilities in the three profiled paper segments that are owned by small firms. Firms in this industry are considered small if they employ fewer than 750 people. EPA estimates that 31 small entity-owned facilities and 194 large entity-owned facilities in the Paper and Allied Products Segment are potentially subject to the Final 316(b) Existing Facilities regulation.

Appendix E Profile of the Petroleum Refining Industry

E.1 Introduction

EPA‟s *Detailed Industry Questionnaire*, hereafter referred to as the DQ, identified the Petroleum Refining Industry (SIC 2911 or NAICS 324110) with at least one existing facility that operates a CWIS, holds a NPDES permit, withdraws at least two million gallons per day (MGD) from a water of the United States, and uses at least 25 percent of its intake flow for cooling purposes (facilities with these characteristics are hereafter referred to as "facilities potentially subject to the 316(b) Existing Facilities regulation" or "regulated facilities").

Table E-1, below, provides a description of the industry segment, a list of primary products manufactured, the total number of the DQ respondents (weighted to represent a national total of facilities that hold a NPDES permit and operate cooling water intake structures), and the number of facilities estimated to be potentially subject to the final rule based on the minimum withdrawal threshold of 2 MGD (see *Chapter 1: Introduction* for more details on the final rule applicability criteria).

Table E-1: Existing Facilities in the Petroleum Refining Industry (NAICS 324110)

NAICS	NAICS Description	Important Products Manufactured	Number of Regulated Facilities[a]
324110	Petroleum Refineries	Gasoline, including finished base stocks and blending agents; jet fuel; kerosene; light fuel oils; heavy fuel oils, including grades no. 5, 6, heavy diesel-type, heavy gas-enrichment oils; lubricating oils and greases; unfinished oils and lubricating oil base stock; asphalt; liquefied refinery gases, including other aliphatics (feed stock and other uses); and other finished petroleum products, including waxes.	39

a. Number of weighted detailed questionnaire survey respondents.
Source: Executive Office of the President, 1987; U.S. EPA, 2000; U.S. EPA analysis, 2013.

As shown in *Table E-1*, EPA estimates that, out of an estimated total of 163[194] facilities with a NPDES permit and operating cooling water intake structures in the Petroleum Refining industry (NAICS 324110), 39 (or 24 percent) would be subject to regulation under the 316(b) Final Existing Facilities Regulation. EPA also estimated the percentage of total production that occurs at facilities estimated to be subject to regulation under each analysis option. Total value of shipments for the Petroleum Refining Industry (NAICS 32411) from the 2010 Annual Survey of Manufactures is $601.2 billion ($2011). Value of shipments, a measure of the dollar value of production, was selected for the basis of this estimate. Because the DQ did not collect value of shipments data, these data were not available for existing facilities. Total revenue, as reported on the DQ, was used as a close approximation for value of shipments for these facilities. EPA estimated the total revenue of facilities expected to be subject to regulation under the 316(b) Existing Facilities Regulation to be $229.5 billion ($2011).[195] Therefore, EPA estimates that the percentage of total production in the petroleum refining industry that occurs at facilities estimated to be subject to the regulation is 38 percent.

Table E-2 provides the crosswalk between NAICS codes and SIC codes for the profiled petroleum NAICS codes. For the Petroleum Refineries segment, the translation of SIC-reported data to the NAICS framework is straightforward as these frameworks have a simple one-to-one match for Petroleum Refining: NAICS code 324110 and SIC code 2911.

194 This estimate of the number of facilities holding a NPDES permit and operating a cooling water intake structure is based on the responses from facilities that received the 1999 screener questionnaire.

195 To compare revenue values of regulated facilities with the industry value of shipments, EPA brought revenue values for regulated facilities forward to 2010 using industry-specific Producer Price Index (PPI) values published by the Bureau of Labor Statistics (BLS) and stated in 2011 dollars using GDP deflator published by the Bureau of Economic Analysis (BEA).

Table E-2: Relationship between NAICS and SIC Codes for the Petroleum Refineries Industry (2010)

NAICS Code	NAICS Description	SIC Code	SIC Description	Number of Establishments (2009)[a]	Value of Shipments (2010; Millions; $2011)	Employment (2010)
324110	Petroleum Refineries	2911	Petroleum Refining	303	$601,212	63,263

a. The data on number of establishments is based on data from the 2009 Statistics of U.S. Businesses. Value of Shipments and Employment reflect 2010 data.
Sources: U.S. DOC, 2010 ASM; U.S. DOC, 2009 SUSB.

E.2 Summary Insights from this Profile

A key purpose of this profile is to provide insight into the ability of Petroleum Refining firms to absorb compliance costs under the final rule without material, adverse economic/financial effects. The industry‟s ability to absorb compliance costs is primarily influenced by the following two factors: (1) the extent to which the industry may be expected to shift compliance costs to its customers through price increases and (2) the financial health of the industry and its general business outlook.

E.2.1 Likely Ability to Pass Compliance Costs Through to Customers

As reported in the following sections of this profile, the Petroleum Refining industry is relatively unconcentrated, which suggests that firms in this industry would have less power to pass a significant portion of their compliance-related costs through to customers. As discussed above, given the relatively small proportion of total value of shipments in the industry estimated to be subject to regulation under each option (less than 50 percent), EPA judges that regulated refineries subject to the 316(b) Existing Facilities Regulation are not likely to be able to recover compliance costs through price increases to customers. Even though the Petroleum Refining industry is not characterized by high competitive pressure from foreign markets, the low market concentration leads EPA to judge that the market power held by individual firms is likely to be quite small. For these reasons, in its analysis of regulatory impacts for the Petroleum Refining segment, EPA assumed that regulated facilities would be unable to pass compliance costs through to customers: i.e., they must absorb all compliance costs within their operating finances (see following sections and *Appendix K: Cost Pass-Through Analysis*, for further information).

E.2.2 Financial Health and General Business Outlook

Over the past two decades, Petroleum Refining, like other U.S. manufacturing industries, has experienced a range of economic/financial conditions, including substantial challenges. In the early 1990s, the domestic Petroleum Refining industry was affected by reduced U.S. demand as the economy entered a recessionary period. Although domestic market conditions improved by mid-decade, oversupply of crude oil, weakness in Asian markets, along with other domestic factors, materially weakened refiners‟‟ financial performance in 1998. As petroleum producing countries reduced crude oil supply and refiners cut production, prices rebounded in the late 1990‟s and into 2000, before another U.S. recession, the attacks of 9/11, and global economic downturn again had a negative effect on petroleum refiners. As the U.S. economy began recovery from its economic weakness caused by the 2001 recession, the domestic petroleum refining industry also recovered, with continuous improvements in demand levels and financial performance during 2003 to 2007. Between July and December of 2008, however, at the outset of the recent economic recession, the price of crude oil dropped more than $100 a barrel. Economists predict that this slide in oil demand will rebound as the economy recovers in the coming years (Protec Fuel Management, 2009). In fact, the 2009 Annual Energy Outlook, published by the U.S. Energy Information Administration (EIA) of the U.S. Department of Energy (DOE), projects that petroleum production will increase from 13.08 quadrillion Btu in 2008 to 15.51 in 2020, 15.68 in 2030, and 15.87 in 2035, showing gradual expansion in domestic petroleum production (U.S. DOE, 2009a). In addition, according to the 2010 Annual Energy Outlook, total liquid fuels consumption, including petroleum products, will grow by roughly 1 percent annually until 2035, owing a majority of this increase to the transportation sector‟s growing demand (U.S. DOE, 2010). Although the Petroleum Refining industry has weathered difficult periods over the last two decades, experts report a positive outlook for the industry in 2013 (S&P, 2013g). The recent strengthening of the industry‟s financial condition and general business outlook, as the world and U.S. economy recover from the recent recession, point to the ability of the regulated facilities in the Petroleum Refining industry to absorb additional regulatory compliance costs without imposing significant financial impacts.

E.3 Domestic Production

The Petroleum Refining industry accounted for about 11 percent of the value of shipments of the entire U.S. manufacturing sector and employed approximately 0.5 percent of the manufacturing sector‟s workers in the late 2000s (U.S. Census Bureau, 2009a). According to the Annual Survey of Manufactures, in 2010, Petroleum Refineries achieved shipments of approximately $601 billion dollars ($2011) and employed 63,263 people. At the end of the last decade, petroleum products constituted approximately 37 percent of the total energy used in the United States, including virtually all of the energy consumed in transportation (U.S. DOE, 2009b).

According to EIA, 150 Petroleum Refineries operated in the United States in 2008 (U.S. DOE, 2009b).[196] Some data reported in this profile are taken from EIA publications. Readers should note that the Census data reported for NAICS 324110 cover a somewhat broader range of facilities than do the U.S. DOE/EIA data, and the two data sources are therefore not entirely comparable.[197]

The petroleum industry includes exploration and production of crude oil, refining, transportation, and marketing. Petroleum refining is a capital-intensive process that converts crude oil into a variety of refined products. Refineries range in complexity, depending on the types of products produced. Nearly half of all U.S. refinery output is motor gasoline.

The number of U.S. refineries has declined by almost half since the early 1980s. The remaining refineries have improved their efficiency and flexibility to process heavier crude oils by adding “downstream” capacity.[198] While the number of refineries has declined, the average refinery capacity and utilization has increased, resulting in an increase in domestic refinery production overall.

E.3.1 Output

Table E-3 shows trends in production of petroleum refinery products from 1990 through 2010. In general, output of refined products grew over this period, reflecting growth in transportation demand and other end-uses. Output fell in 1991 due to the domestic economic recession, and the early years of the 2000s experienced little or negative growth because of the downturn of the U.S. economy and events of 9/11 (API, 2003). At the beginning of 2002, petroleum products were in excess supply in the world market, and the focus was on the elimination of excess supplies and stabilization of prices (U.S. DOE, 2004). In 2003, the industry rebounded, with refinery processing increasing 2 percent, producing record or near record levels of gasoline and distillate (API, 2004). Petroleum production continued to increase until the global recession hit in 2008. U.S. demand for oil and gas refined products fell by more than three million b/d from the peak in February 2008 to the trough in June 2009 during the global economic slowdown; as a result, refining margins narrowed and refiners responded by reducing throughput rates, idling and closing less efficient facilities, and cutting capital expenditures (S&P, 2010c). In

[196] In addition, one operating and one idle refinery were located in Puerto Rico and one operating refinery in the Virgin Islands.

[197] For comparison, preliminary 1997 Census data included 244 establishments for NAICS 3241/SIC 2911, whereas U.S. DOE/EIA reported 164 operable refineries as of January 1997.

[198] The first step in refining is atmospheric distillation, which uses heat to separate various hydrocarbon components in crude oil. Beyond this basic step are more complex operations (generally referred to as “downstream” from the initial distillation) that increase the refinery‟s capacity to process a wide range of crude oils and increase the yield of lighter (low-boiling point) products such as gasoline. These downstream operations include vacuum distillation, cracking units, reforming units, and other processes (U.S. DOE, 1999a).

2009, overall U.S. production fell by 1.5 percent, but by 2010 production had already rebounded with an increase in total output of 3.1 percent the greatest increase in total output throughout the entire period. As the U.S. and global economies continue to improve, Petroleum Refining firms are also likely to see improvements in their markets and earnings. This should place companies in a better position to incur any costs associated with regulatory compliance.

Table E-3: U.S. Petroleum Refinery Product Production (million barrels per day)

Year	Motor Gasoline	Distillate Fuel Oil	Jet Fuel	Residual Fuel Oil	Other Products[a]	Total Output	Percent Change in Total Output
1990	6.96	2.93	1.49	0.95	0.78	15.272	NA
1991	6.98	2.96	1.44	0.93	0.76	15.256	-0.1%
1992	7.06	2.97	1.40	0.89	0.80	15.398	0.9%
1993	7.30	3.13	1.42	0.84	0.78	15.787	2.5%
1994	7.18	3.21	1.45	0.83	0.79	15.791	0.0%
1995	7.46	3.16	1.42	0.79	0.78	15.994	1.3%
1996	7.57	3.32	1.52	0.73	0.76	16.324	2.1%
1997	7.74	3.39	1.55	0.71	0.84	16.759	2.7%
1998	7.89	3.42	1.53	0.76	0.89	17.03	1.6%
1999	7.93	3.40	1.57	0.70	0.84	16.989	-0.2%
2000	7.95	3.58	1.61	0.70	0.79	17.243	1.5%
2001	8.02	3.70	1.53	0.72	0.73	17.285	0.2%
2002	8.18	3.59	1.51	0.60	0.77	17.273	-0.1%
2003	8.19	3.71	1.49	0.66	0.78	17.487	1.2%
2004	8.27	3.81	1.55	0.66	0.84	17.814	1.9%
2005	8.32	3.95	1.55	0.63	0.75	17.8	-0.1%
2006	8.36	4.04	1.48	0.64	0.76	17.975	1.0%
2007	8.36	4.13	1.45	0.67	0.75	17.994	0.1%
2008	8.55	4.29	1.49	0.62	0.66	18.146	0.8%
2009	8.79	4.05	1.40	0.60	0.61	17.882	-1.5%
2010	9.05	4.23	1.42	0.58	0.65	18.428	3.1%
Total Percent Change 1990-2010	**30.0%**	**44.5%**	**-4.7%**	**-38.7%**	**-16.8%**	**20.7%**	
Total Percent Change 2000-2010	**13.8%**	**18.0%**	**-11.7%**	**-16.4%**	**-18.4%**	**6.9%**	
Average Annual Growth Rate[199]	**1.3%**	**1.9%**	**-0.2%**	**-2.4%**	**-0.9%**	**0.9%**	

a. Kerosene, lubricants, petrochemical feedstocks, waxes, and miscellaneous products.
Source: U.S. DOE, 2010c

Value of shipments and ***value added*** are two common measures of manufacturing output.[200] They provide insight into the overall economic health and outlook for an industry. Value of shipments is the sum of the receipts a manufacturer earns from the sale of its outputs; it indicates the overall size of a market or the size of a firm in relation to its market or competitors. Value added measures the value of production activity in a particular industry. It is the difference between the value of shipments and the value of inputs (from other industries) used to make the products that are sold.

Figure E-1 shows value of shipments and value added for petroleum products from 1987 to 2010. Value of shipments rose through 1990; however, during and following the recession of 1991, value of shipments fell through 1994. This was followed by some volatility over the next few years until experiencing a sharp drop in 1998, when a range of factors led to a dramatic decrease in petroleum prices. Increased production quotas by OPEC, increased production from Iraq through the "oil-for-food" program, weak demand in Asia due to their financial crisis, and a warm winter in the U.S. all increased the supply of petroleum products (U.S. DOE, 1999c).

199 In this appendix, average annual growth rate refers to a year-to-year, constant percentage growth mean, which is calculated as the compound annual growth rate between the first and last values. This is the same concept as the geometric mean, if all of the individual year-to-year

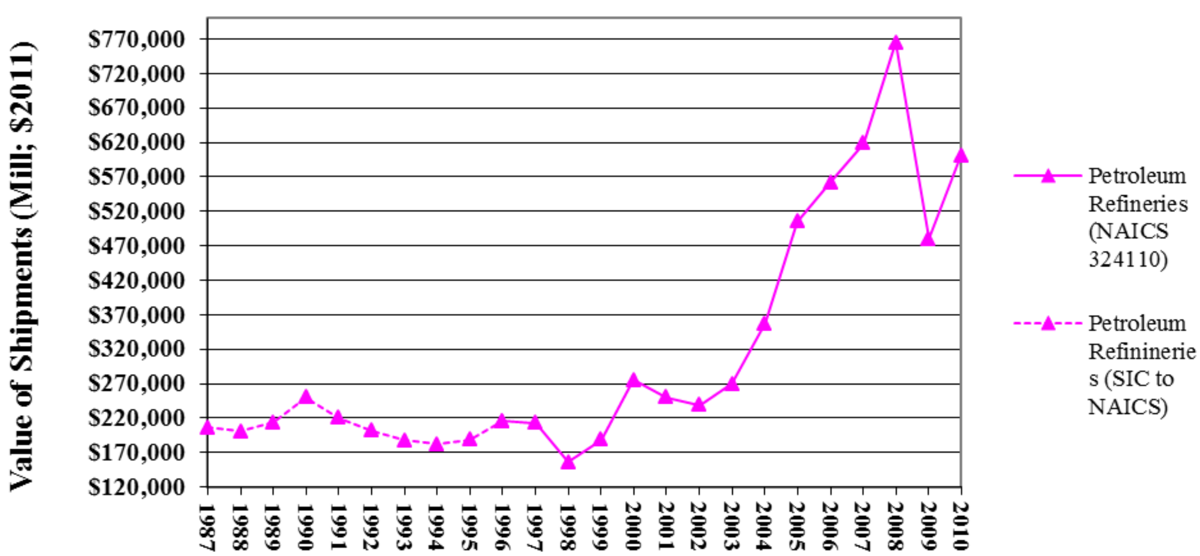
200 Terms highlighted in bold and italic font are further explained in the glossary.

Estimates of worldwide petroleum supply exceeding demand during 1998 range from 1.47 million barrels per day to 2.4 million barrels per day (World Oil, 1999).

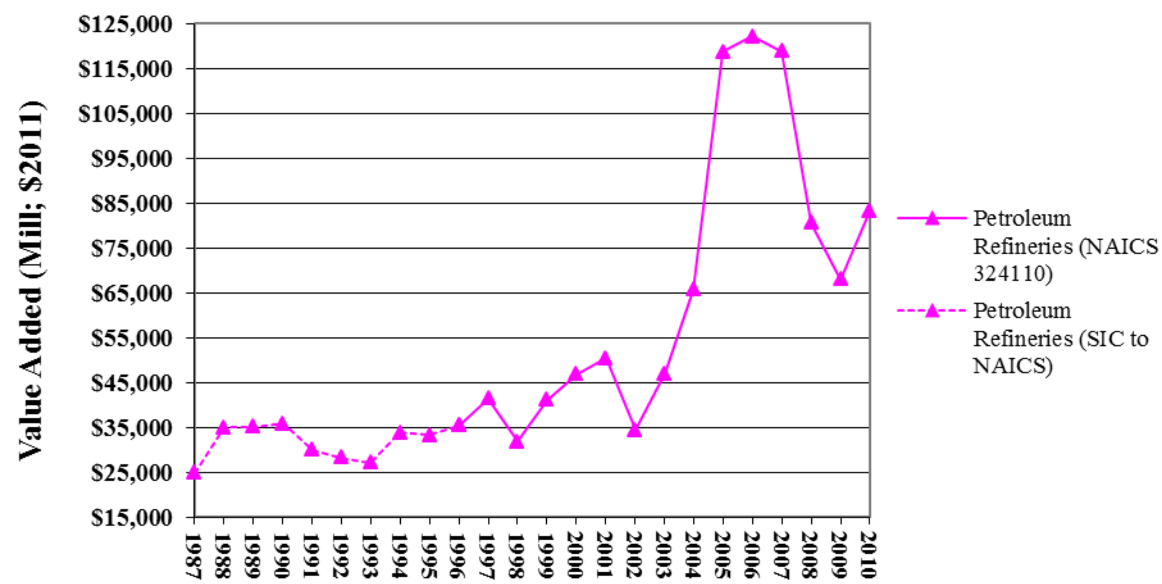
As crude oil producers and refiners cut back on production, the industry was restored with significant improvements in 1999 and 2000, before the global economic slowdown and weakening demand decreased the value of shipments in 2001. From 2003 through 2008, however, value of shipments increased significantly, peaking at nearly $765 billion in 2008. In 2009, value so shipments saw a drastic decline, followed by an increase the value of shipments in 2010. Value added generally followed the path of value of shipments over the last two decades, with the main difference being that value added peaked in 2006 and then began its decline in 2007.

Figure E-1: Value of Shipments and Value Added for Petroleum Refineries (millions, $2011)[a]

Value of Shipments



Value Added



a. Before 1997, the Department of Commerce compiled data in the SIC system; since 1997, these data have been compiled in the North American Industry Classification System (NAICS). For this analysis, EPA converted the NAICS classification data to the SIC code classifications using the 1997 Economic Census *Bridge Between NAICS and SIC.*

Source: U.S. DOC, 1988-1991, 1993-1996, 1998-2001, 2003-2006, and 2008-2010 ASM; U.S. DOC, 1987, 1992, 1997, 2002, and 2007 EC.

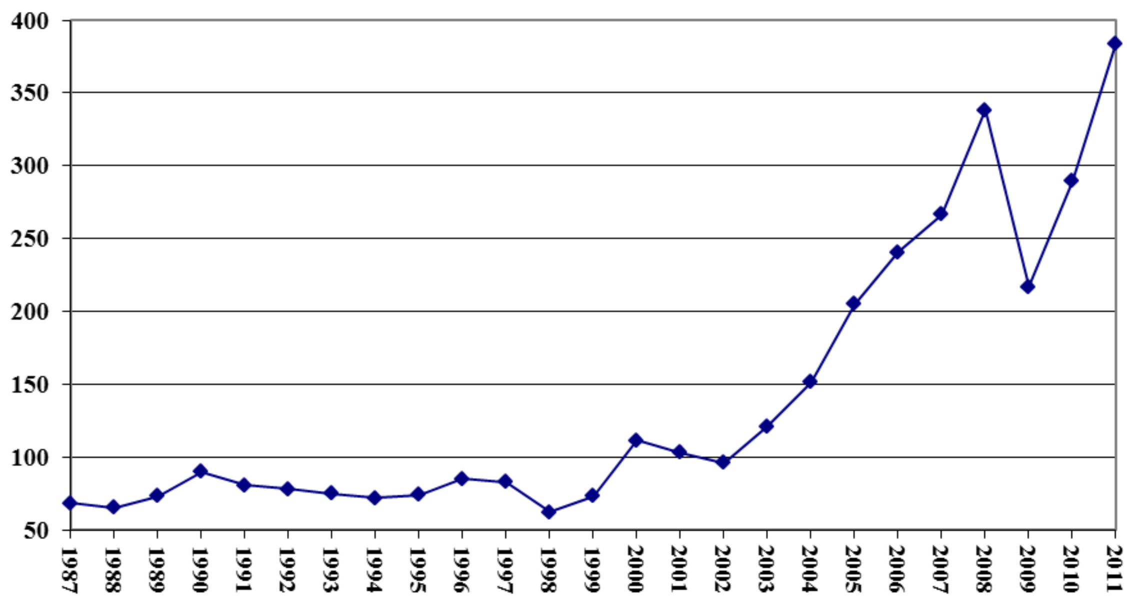
E.3.2 Prices

The producer price index (PPI) measures price changes from the perspective of the seller, and indicates the overall trend of product pricing, and thus provides insight into supply-demand conditions, within a given industry.

Figure E-2 shows substantial fluctuations in petroleum product prices between 1987 and 2011. Through the early 1990s, refiners faced declining prices due to the effects of the 1991 recession and weak demand before rebounding somewhat in the mid-1990s. Prices fell in 1998 as a massive oversupply of petroleum products coupled with decreased demand led to significant drops in petroleum prices. As the subsequent production cutbacks took hold and the glut of supply dwindled, prices recovered in 1999 and 2000, as shown in *Figure E-2*. The higher prices reflect low refinery product inventories and higher crude oil input prices (Value Line, 2010). Excess supply, the global recession, impacts from 9/11, and the relatively warm winter of 2001-2002 led to decreases in prices in subsequent years (U.S. DOE, 2004). During 2003 to 2008, however, prices rose dramatically. By 2008, the price of petroleum products was over double the price seen in 2000, the previous peak year during the 1987 to 2002 time period.

During the second half of 2008, petroleum industry prices began to decline as the result of economic recession and continued to do so through the middle of 2009. Oil prices fell during 2008 due to a broad-based financial de-leveraging occurring across all markets and investment asset classes. The drop in oil prices nearly exactly corresponded to price movements in the collapsing stock market (Protec Fuel Management, 2008). Prices rebounded in 2010 and 2011 as the world economy began to recover. In 2035, the average real price of crude oil is expected to be $133 per barrel ($2008) (U.S. DOE, 2009a).

Figure E-2: Producer Price Index for Petroleum Refineries



Source: BLS, 2011d.

E.3.3 Number of Facilities and Firms

The number of operable refineries fell substantially during the 1980s, with fluctuations in the number of refinery firms and facilities through the 1990s and 2000s. The earlier decrease resulted in part from the elimination of the Crude Oil Entitlements Program in the early 1980s. The Entitlements Program encouraged smaller refineries to add capacity throughout the 1970s. After the program was eliminated, surplus capacity and falling profit margins led to the closure of less efficient capacity (U.S. DOE, 1999a). The decrease in the number of refineries continued, as the industry consolidated to improve margins. After peaking in the early 1980s, refining capacity decreased throughout the rest of the decade. Refining capacity has remained relatively stable since the decrease in the 1980s, with a slight upward trend occurring in the latter part of the 1990s into the 2000s.

Table E-4 presents the numbers of refinery facilities and firms from 1990 to 2009 based on Statistics of U.S. Businesses for NAICS 324110. As shown in the table, despite some significant losses in 1997 and 2003, both the number of refinery facilities and the number of firms reporting Petroleum Refining as their primary business grew between 1990 and 2007. In 2008, both the number of firms and number of refinery facilities decreased significantly, followed by lesser declines in 2009. In spite of the declines at the end of the period, the number of petroleum refinery firms grew 24 percent from 2000 to 2009, while the number of facilities correspondingly grew by 2 percent.

Table E-4: Number of Firms and Facilities for Petroleum Refineries

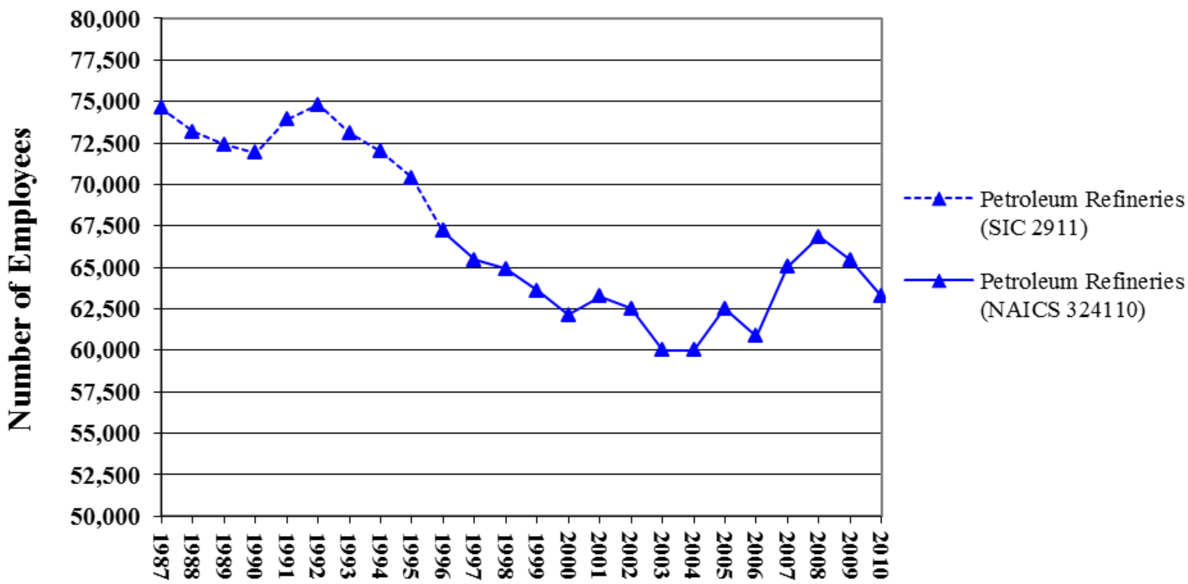
Year[a]	Firms		Facilities	
	Number	Percent Change	Number	Percent Change
1990	215	NA	340	NA
1991	215	0.0%	346	1.8%
1992	185	-14.0%	303	-12.4%
1993	148	-20.0%	251	-17.2%
1994	161	8.8%	265	5.6%
1995	150	-6.8%	251	-5.3%
1996	173	15.3%	275	9.6%
1997	128	-26.0%	248	-9.8%
1998	155	21.1%	304	22.6%
1999	145	-6.5%	292	-3.9%
2000	162	11.7%	298	2.1%
2001	165	1.9%	302	1.3%
2002	202	22.4%	349	15.6%
2003	142	-29.7%	274	-21.5%
2004	155	9.2%	364	32.8%
2005	177	14.2%	301	-17.3%
2006	228	28.8%	352	16.9%
2007	258	13.2%	374	6.3%
2008	201	-22.1%	311	-16.8%
2009	200	-0.5%	303	-2.6%
Total Percent Change 1990-2009	**-7.0%**		**-10.9%**	
Total Percent Change 2000-2009	**23.5%**		**1.7%**	
Average Annual Growth Rate	**-0.4%**		**-0.6%**	

a. Before 1998, these data were compiled in the Standard Industrial Classification (SIC) system; since 1998, these data have been compiled in the North American Industry Classification System (NAICS). For this analysis, EPA converted the NAICS classification data to the SIC code classifications using the 1997 Economic Census Bridge Between NAICS and SIC.
Source: U.S. DOC, 1990-1997 SBA; U.S. DOC, 1998-2009 SUSB.

E.3.4 Employment and Productivity

Between 1987 and 2010, employment in the Petroleum Refining segment declined by 15 percent, from 74,600 to 63,263 employees, as shown in *Figure E-3*. After increasing in the early 1990s, employment at Petroleum Refineries declined almost continuously through 2003, reflecting overall industry consolidation, before showing slight recovery up until 2008. In the latter part of the decade, employment in the Petroleum Refining segment yet again followed a downward trend. The declining level of employment is not so much an indicator of financial success for the industry, but rather an indicator of the increasing mechanization of petroleum refineries. The industry has become highly automated, with the average annual revenue per worker currently at over $3 million (First Research, 2009).

Figure E-3: Employment for Petroleum Refineries[a]



a. Before 1997, the Department of Commerce compiled data in the SIC system; since 1997 these data have been compiled in the North American Industry Classification System (NAICS). For this analysis, EPA converted the NAICS classification data to the SIC code classifications using the 1997 Economic Census *Bridge Between NAICS and SIC.*

Source: U.S. DOC, 1988-1991, 1993-1996, 1998-2001, 2003-2006, and 2008-2010 ASM; U.S. DOC, 1987, 1992, 1997, 2002, and 2007 EC.

Table E-5 shows substantial year-to-year changes in labor productivity, measured by value added per production hour. These fluctuations largely reflect volatility in value added, which in turn indicates variation in the relationship between input prices (primarily crude oil) and refinery product prices. Changes in production hours from year to year were less volatile, with a net reduction over the period 1987 to 2010. Value added was not negatively affected, as it more than tripled over the same period.

Table E-5: Productivity Trends for Petroleum Refineries ($2010)[a]

Year	Value Added (millions)	Production Hours (millions)	Value Added/Hour	
			($/hr)	% Change in Value Added/ Hour
1987	$24,867	103	$241	NA
1988	$34,978	103	$340	41.2%
1989	$35,159	105	$336	-1.1%
1990	$35,801	106	$338	0.7%
1991	$29,991	107	$282	-16.8%
1992	$28,267	109	$259	-8.2%
1993	$27,091	107	$254	-1.6%
1994	$33,758	110	$307	20.6%
1995	$33,308	107	$312	1.7%
1996	$35,450	103	$346	10.7%
1997	$41,362	100	$414	19.9%
1998	$31,820	98	$325	-21.5%
1999	$41,140	94	$437	34.3%
2000	$46,806	92	$507	16.0%
2001	$50,383	94	$539	6.3%
2002	$34,372	84	$408	-24.3%
2003	$47,010	83	$568	39.3%
2004	$65,627	83	$794	39.8%
2005	$118,700	89	$1,336	68.2%
2006	$122,097	88	$1,392	4.2%
2007	$118,881	92	$1,293	-7.1%
2008	$80,536	95	$851	-34.2%
2009	$67,918	94	$719	-15.5%
2010	$83,267	89	$931	29.5%
Total Percent Change 1987-2010	**234.9%**	**-13.4%**	**286.8%**	
Total Percent Change 2000-2010	**77.9%**	**-3.1%**	**83.7%**	
Average Annual Growth Rate 1987-2010	**5.4%**	**-0.6%**	**6.1%**	

a. Before 1997, these data were compiled in the Standard Industrial Classification (SIC) system; since 1997, these data have been compiled in the North American Industry Classification System (NAICS). For this analysis, EPA converted the NAICS classification data to the SIC code classifications using the 1997 Economic Census *Bridge Between NAICS and SIC.*

Source: U.S. DOC, 1988-1991, 1993-1996, 1998-2001, 2003-2006, and 2008-2010 ASM; U.S. DOC, 1987, 1992, 1997, 2002, and 2007 EC.

E.3.5 Capital Expenditures

Petroleum industry capital expenditures increased substantially between 1987 and 1993, generally decreased through the rest of the decade, then increased significantly in 2001, as shown in *Table E-6*. During 2001 through 2004, capital expenditures fluctuated somewhat, peaking at nearly $9 billion in 2002 before declining in both 2003 and 2004. The second half of the last decade showed a great increase in capital expenditures, reaching just over $18 billion in 2008 – a 418 percent change from 1987 expenditures and 208 percent change since 2000. Much recent investment in petroleum refineries has been to expand and de-bottleneck units downstream from distillation, partially in response to environmental requirements. Changes in refinery configurations have included adding catalytic cracking units, installing additional sulfur removal hydrotreaters, and using manufacturing additives such as oxygenates. These process changes have resulted from two factors:

- processing of heavier crudes with higher levels of sulfur and metals; and
- regulations requiring gasoline reformulation to reduce volatiles in gasoline and production of diesel fuels with reduced sulfur content (U.S. EPA, 1996b).

Environmentally related investments have also accounted for a substantial part of capital expenditures. Significant expenditures for gasoline quality improvements occurred in the early 1990s and in 2002, and capital expenditure activity is expected to continue to rise as oil and gas discoveries are being made worldwide. In 2009 alone, over 350 discoveries were announced (NPC, 2004; Global Data, 2010). However, in 2009 and 2010 capital expenditures declined, likely due to adverse effects of the slowdown in the U.S. economy.

Table E-6: Capital Expenditures for Petroleum Refineries ($2011)[a]

Year	Capital Expenditures (millions)	% Change
1987	$3,559	NA
1988	$3,934	10.5%
1989	$4,866	23.7%
1990	$5,990	23.1%
1991	$8,485	41.6%
1992	$9,086	7.1%
1993	$8,667	-4.6%
1994	$7,834	-9.6%
1995	$8,149	4.0%
1996	$7,084	-13.1%
1997	$5,685	-19.7%
1998	$5,522	-2.9%
1999	$5,147	-6.8%
2000	$5,986	16.3%
2001	$8,518	42.3%
2002	$9,060	6.4%
2003	$8,222	-9.2%
2004	$7,731	-6.0%
2005	$11,929	54.3%
2006	$12,229	2.5%
2007	$18,322	49.8%
2008	$18,437	0.6%
2009	$17,413	-5.6%
2010	$11,948	-31.4%
Percent Change 1987- 2010	**235.7%**	
Percent Change 2000- 2010	**99.6%**	
Average Annual Growth Rate 1987- 2010	**5.4%**	

a. Before 1997, these data were compiled in the Standard Industrial Classification (SIC) system; since 1997, these data have been compiled in the North American Industry Classification System (NAICS). For this analysis, EPA converted the NAICS classification data to the SIC code classifications using the 1997 Economic Census *Bridge Between NAICS and SIC.*

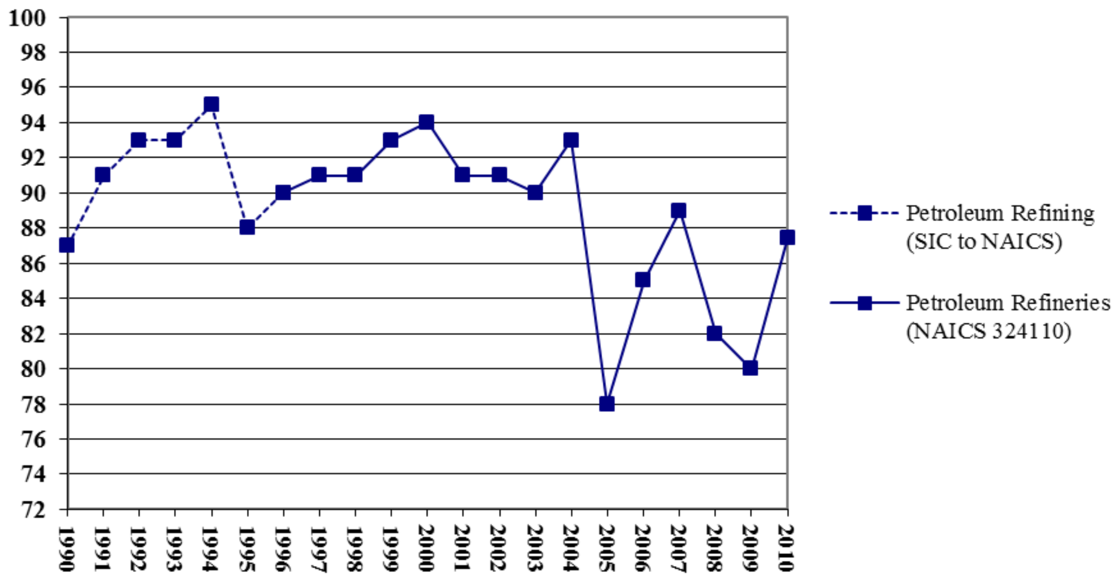
Source: U.S. DOC, 1988-1991, 1993-1996, 1998-2001, 2003-2006, and 2008-2010 ASM; U.S. DOC, 1987, 1992, 1997, 2002, and 2007 EC.

E.3.6 Capacity Utilization

Refinery capacity is frequently measured in terms of crude oil distillation capacity. EIA defines refinery capacity utilization as input divided by calendar day capacity, which is the maximum amount of crude oil input that can be processed during a 24-hour period with certain limitations. Some downstream refinery capacities are measured in terms of "stream days," which is the amount a unit can process when running full capacity under optimal crude and product mix conditions for 24 hours (U.S. DOE, 1999a). Downstream capacities are reported only for specific units or products, and are not summed across products, since not all products could be produced at the reported levels simultaneously.

Figure E-4 below shows the fluctuation in capacity utilization rates over the period 1990-2010, based on U.S. Census Bureau data. Overall, capacity utilization fluctuated over a relatively low range over the last two decades. Between 1990 and 1994, capacity utilization steadily increased, followed by a sharp drop in 1995. It remained relatively stable until 2004 when excess supply, recession, and other factors led to decreases in rates during the early part of this decade hitting particularly hard in 2005. The industry recovered very quickly, however, as capacity utilization increased during the following two years before dropping in 2008 and 2009 as a result of the economic downturn. Capacity utilization then rebounded in 2010 to end the two-decade period with no overall change. Overall, refinery utilization remained relative high during the last two decades. Capacity utilization for production of specific products may vary, however, as the industry adjusts to changes in the desired product mix and characteristics.

Figure E-4: Capacity Utilization Rates (Fourth Quarter) for Petroleum Refineries[a,b]



a. Before 1997, the Department of Commerce compiled data in the SIC system; since 1997, these data have been compiled in the North American Industry Classification System (NAICS). For this analysis, EPA converted the NAICS classification data to the SIC code classifications using the *1997 Economic Census Bridge Between NAICS and SIC*.

b. Prior to 2007, U.S. Census sampled every industry in a specific NAICS6. Beginning in 2007, U.S. Census only sampled certain industries within any NAICS6, and therefore, the data collected before 2007 cannot be directly compared to the data collected in 2007 and beyond.

Source: U.S. DOC, 1989-2010 SPC.

E.4 Structure and Competitiveness

The U.S. Petroleum Refining industry is made up of integrated international oil companies, integrated domestic oil companies, and independent domestic refining/marketing companies. In general, the petroleum industry is highly integrated, with many firms involved in more than one stage of petroleum industry operations. Large companies, referred to as the "majors," are fully integrated across crude oil exploration and production, refining, and marketing. Smaller, nonintegrated companies, referred to as the "independents," generally specialize in one segment of the industry.

Like the oil business in general, refining was dominated in the 1990s by integrated internationals, specifically a few large companies such as Exxon Corporation, Mobil Corporation, and Chevron Corporation. These three ranked in the top ten of Fortune 500 sales during this time period. Substantial diversification by major petroleum companies into other energy and non-energy segments was financed by high oil prices in the 1970s and 1980s. With lower profitability in the 1990s, the major producers began to exit unconventional energy operations (e.g., oil shale) as well as coal and non-energy operations in the 1990s. Some have recently ceased chemical production.

During the 1990s and into the early 2000s, several mergers, acquisitions, and joint ventures occurred in the Petroleum Refining segment in an effort to cut cost and increase profitability. This consolidation took place among the largest firms (as illustrated by the acquisition of Amoco Corporation by British Petroleum in 1999, the merger of Chevron and Texaco in 2001, the merger of Conoco and Phillips in 2002, and the mega-merger of Exxon and Mobil Corporation in 1998) as well as among independent refiners and marketers (e.g., the independent refiner/marketer Ultramar Diamond Shamrock (UDS) acquired Total Petroleum North America in

1997) (U.S. DOE, 1999b, 2004). Merger activity slowed during the earlier part of the decade, possibly because companies were trying to address financial issues after the 2001 recession and/or wanted to make sure that economy was indeed recovering (U.S. DOE, 2004).

At the end of the last decade, the oil industry became less vertically integrated. The share of U.S. refining capacity owned by independent refiners with no production operations was eight percent in 1990 while by 2007, this share exceeded 21 percent. Important mergers and acquisitions in the later part of the decade included: ChevronTexaco and Unocal in 2005; Valero and Premcor in 2005; ConocoPhillips and Burlington Resources in 2006; Anadarko, Kerr-McGee, and Western Gas Resources in 2006; and Occidental and Vintage Petroleum in 2006 (API, 2008).

E.4.1 Firm Size

For NAICS 324110, the Small Business Administration defines a small firm as having 1,500 or fewer employees. The size categories reported in the Statistics of U.S. Businesses (SUSB) do not correspond with the SBA size classifications, therefore preventing precise use of the SBA size threshold in conjunction with SUSB data. *Table E-7* below shows the distribution of firms and establishments in NAICS 324110 by the employment size of the parent firm. The SUSB data show that 137 of the 303 NAICS 324110 establishments reported for 2009 (45 percent) are owned by larger firms (those with 500 employees or more), some of which may still be defined as small under the SBA definition, and 166 (55 percent) are owned by small firms (those with fewer than 500 employees).

Table E-7: Number of Firms and Establishments for Petroleum Refineries by Firm Employment Size Category, 2009[a]

Employment Size Category	Number of Firms	Number of Establishments
0-19	126	126
20-99	18	20
100-499	19	20
500+	37	137
Total	**200**	**303**

a Based on NAICS 324110
Source: U.S.DOC, 2009 SUSB.

E.4.2 Concentration Ratios

Concentration is the degree to which industry output is concentrated in a few large firms. Concentration is closely related to entry barriers, with more concentrated industries generally having higher barriers.

The four-firm concentration ratio (CR4) and the Herfindahl-Hirschman Index (HHI) are common measures of industry concentration. The CR4 indicates the market share of the four largest firms. For example, a CR4 of 72 percent means that the four largest firms in the industry account for 72 percent of the industry‟s total value of shipments. The higher the concentration ratio, the less competition there is in the industry, other things being equal.[201] An industry with a CR4 of more than 50 percent is generally considered concentrated. The HHI indicates concentration based on the largest 50 firms in the industry. It is equal to the sum of the squares of the market shares for the largest 50 firms in the industry. For example, if an industry consists of only three firms with market shares of 60, 30, and 10 percent, respectively, the HHI of this industry would be equal to 4,600 ($60^2 + 30^2 + 10^2$). The higher the index, the fewer the number of firms supplying the industry and the more concentrated the industry. Based on the U.S. Department of Justice‟s guidelines for evaluating mergers, markets in which the HHI

201 Note that the measured concentration ratio and the HHF are very sensitive to how the industry is defined. An industry with a high concentration in domestic production may nonetheless be subject to significant competitive pressures if it competes with foreign producers or if it competes with products produced by other industries (e.g., plastics vs. aluminum in beverage containers). Concentration ratios based on share of domestic production are therefore only one indicator of the extent of competition in an industry.

is under 1,000 are considered unconcentrated, markets in which the HHI is between 1,000 and 1,800 are considered to be moderately concentrated, and those in which the HHI is in excess of 1,800 are considered to be concentrated.

As shown in *Table E-8*, the CR4 and the HHI for NAICS 324110 are both below the benchmarks of 50 percent and 1,000, respectively. For the Petroleum Refining segment, the HHI is 807, suggesting that as of 2007, the sector was still fairly unconcentrated, although the trend has been toward becoming a more concentrated industry. With the majority of the firms in this industry having small market shares, this suggests limited potential for passing through to customers any increase in production costs resulting from regulatory compliance.

Table E-8: Selected Ratios for Petroleum Refineries

SIC (S) or NAICS (N) Code	Year	Total Number of Firms	Concentration Ratios				
			4 Firm (CR4)	8 Firm (CR8)	20 Firm (CR20)	50 Firm (CR50)	Herfindahl-Hirschman Index
S 2911	1987	200	32%	52%	78%	95%	435
	1992	132	30%	49%	78%	97%	414
N 324110	1997	122	29%	49%	82%	98%	422
	2002	88	41%	64%	89%	99%	640
	2007	98	48%	73%	92%	100%	807

Source: U.S. DOC, 1987, 1992, 1997, 2002, and 2007 EC.

E.4.3 Foreign Trade

This profile uses two measures of foreign competition: ***export dependence*** and ***import penetration***.

Import penetration measures the extent to which domestic firms are exposed to foreign competition in domestic markets. Import penetration is calculated as total imports divided by total value of domestic consumption in that industry: where domestic consumption equals domestic production plus imports minus exports. Theory suggests that higher import penetration levels will reduce market power and pricing discretion because foreign competition limits domestic firms‟ ability to exercise such power. Firms belonging to segments in which imports account for a relatively large share of domestic sales would therefore be at a relative disadvantage in their ability to pass-through costs because foreign producers would not incur costs as a result of the Final Existing Facilities Regulation. The estimated import penetration ratio for the entire U.S. manufacturing sector (NAICS 31-33) for 2010 is 28 percent. For characterizing the ability of industries to absorb compliance cost burdens, EPA judges that industries with import ratios close to or above 28 percent would more likely face stiff competition from foreign firms and thus be less likely to succeed in passing compliance costs through to customers.

Export dependence, calculated as exports divided by value of shipments, measures the share of a segment‟s sales that is presumed subject to strong foreign competition in export markets. The Final Existing Facilities Regulation would not increase the production costs of foreign producers with whom domestic firms must compete in export markets. As a result, firms in industries that rely to a greater extent on export sales would have less latitude in increasing prices to recover cost increases resulting from regulation-induced increases in production costs. The estimated export dependence ratio for the entire U.S. manufacturing sector for 2010 is 22 percent. For characterizing the ability of industries to absorb compliance cost burdens, EPA judges that industries with export ratios close to or above 22 percent are at a relatively greater disadvantage in potentially recovering compliance costs through price increases since export sales are presumed subject to substantial competition from foreign producers.

Table E-9 presents trade statistics for the profiled Petroleum Refining segment from 1990 to 2010. The table shows that while export dependence has been relatively stable up until the mid-2000s, import penetration decreased during the national economic weakness of the early 1990s, before leveling off through the mid-1990s. Import penetration increased steadily through 2000 and then dropped slightly in 2001 and 2002. Since then, the industry resumed a gradual increase in import penetration through 2006, followed by slight fluctuations between

2006 and 2010. On the other hand, export penetration increased from 5 percent in 2007 to 10 percent in 2010. This cycle closely follows the periods of growth, stability, and decline of the U.S. economy during the volatile two decades. Mexico received the largest amount of U.S. exported petroleum and coal products in 2008, followed by Netherlands and Canada (U.S. Census Bureau, 2009b). Imports of refined petroleum products increased 40.9 percent from 1989 to 2008, with 46.3 percent of total imports coming from OPEC countries (U.S. DOE, 2009b).

The import penetration ratio for facilities in the Petroleum Refining segment in 2010 was only 17 percent, well below the U.S. manufacturing segment average of 28 percent. The export dependence ratio for petroleum refiners in 2010 was only 10 percent compared to the U.S. manufacturing average of 22 percent. Thus, based on the lack of competitive pressures from foreign markets/firms, the petroleum industry appears to be in a position to pass-through to consumers a significant portion of compliance-related costs associated with the Final Existing Facilities Regulation. However, given the low HHI for this industry, EPA believes that existing market competition among domestic firms most likely nullifies any favorable influence the lack of foreign competitors would have on increasing the market power of firms in this industry.

Table E-9: Foreign Trade Statistics for Petroleum Refining ($2010)

Year	Value of Imports (millions)	Value of Exports (millions)	Value of Shipments (millions)	Implied Domestic Consumption[a]	Import Penetration[b]	Export Dependence[c]
1990	$24,055	$9,394	$250,072	$264,733	9%	4%
1991	$17,884	$9,630	$220,269	$228,523	8%	4%
1992	$16,162	$8,523	$201,623	$209,262	8%	4%
1993	$15,263	$8,168	$188,176	$195,271	8%	4%
1994	$14,338	$7,031	$182,484	$189,790	8%	4%
1995	$13,232	$7,408	$189,159	$194,983	7%	4%
1996	$26,870	$8,588	$215,472	$233,754	11%	4%
1997	$29,142	$9,219	$212,535	$232,458	13%	4%
1998	$24,431	$6,870	$156,502	$174,062	14%	4%
1999	$30,443	$7,523	$188,351	$211,271	14%	4%
2000	$53,714	$11,151	$275,421	$317,984	17%	4%
2001	$46,638	$10,088	$249,777	$286,328	16%	4%
2002	$41,239	$9,510	$239,468	$271,198	15%	4%
2003	$49,900	$11,034	$269,383	$308,250	16%	4%
2004	$67,686	$14,450	$357,614	$410,850	16%	4%
2005	$96,926	$19,845	$505,479	$582,561	17%	4%
2006	$106,298	$28,144	$562,389	$640,543	17%	5%
2007	$113,137	$32,531	$618,962	$699,568	16%	5%
2008	$141,309	$60,304	$764,795	$845,800	17%	8%
2009	$80,789	$42,623	$479,793	$517,959	16%	9%
2010	$107,148	$61,618	$601,212	$646,742	17%	10%
Total Percent Change 1990 - 2010	**345.4%**	**555.9%**	**140.4%**	**144.3%**		
Total Percent Change 1990 - 2010	**99.5%**	**452.6%**	**118.3%**	**103.4%**		
Average Annual Growth Rate	**8%**	**10%**	**4%**	**5%**		

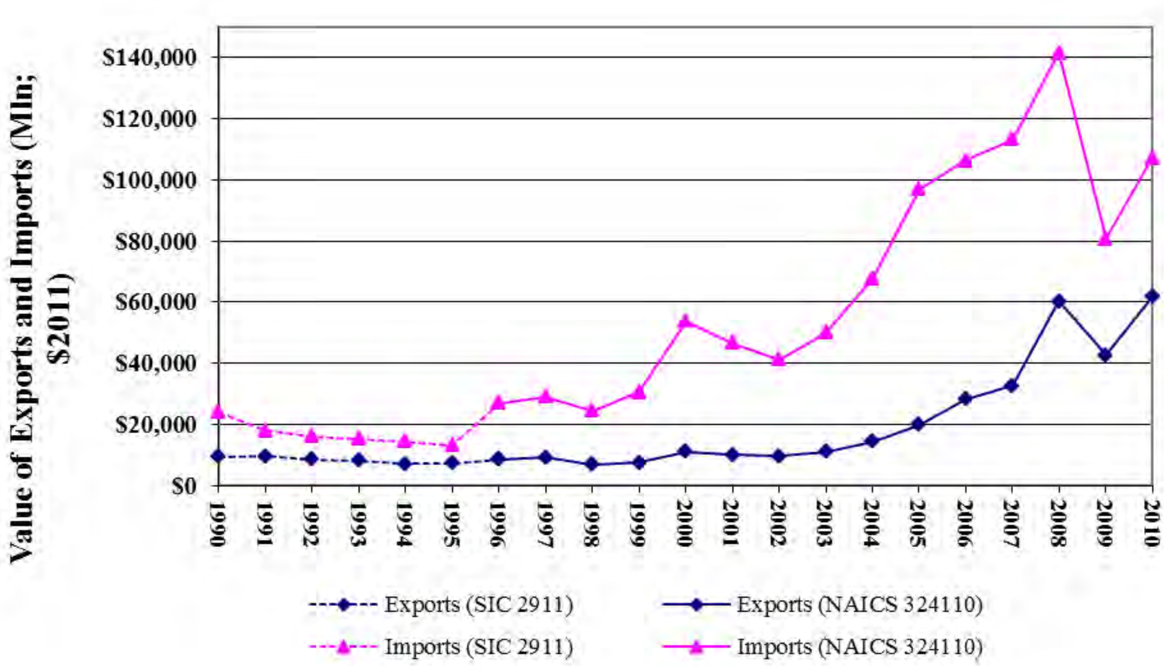
a. Calculated by EPA as shipments + imports - exports.
b. Calculated by EPA as imports divided by implied domestic consumption.
c. Calculated by EPA as exports divided by shipments.
Note: Before 1997, these data were compiled in the Standard Industrial Classification (SIC) system; since 1997, these data have been compiled in the North American Industry Classification System (NAICS). For this analysis, EPA converted the NAICS classification data to the SIC code classifications using the 1997 Economic Census Bridge Between NAICS and SIC.
Source: U.S. ITC, 1989-2010.

The United States consumes more petroleum than it produces, requiring net imports of both crude oil and refined products to meet domestic demand. In 2008, the United States imported 9.76 million barrels per day (MBD) of crude oil and 3.12 MBD of refined products. These refined product imports represented roughly 16 percent of the

19.42 MBD of refined products supplied to U.S. consumers. The U.S. exported 1.80 MBD of refined products in 2008 (U.S. DOE, 2009b).

Imports of refined petroleum products have fluctuated since 1985. Imports rose to 2.3 MB in the early 1980s, due to rapid growth in oil consumption, especially consumption of light products, which exceeded the growth in U.S. refining capacity. Imports then declined as a result of the 1990-91 recession and increased upgrading of refinery capacity resulting primarily from the 1990 Clean Air Act Amendments and other environmental requirements (U.S. DOE, 1997). Since the 1995 low point, imports steadily increased through 2000 with the exception of 1998, before dropping again, due to general economic weakness, in 2001 and 2002 (see *Figure E-5*). Up until 2008, both imports and exports showed rapid growth, with value of imports surpassing 100 billion dollars, and the value of exports reaching nearly 60 billion dollars. In 2009, both imports and exports declined significantly. In 2010, exports rebounded to a level higher than that of 2008 while the rise in imports was relatively smaller.

Figure E-5: Value of Imports and Exports for Petroleum Refining (millions, $2011)[a]



a Before 1997, the Department of Commerce compiled data in the SIC system; since 1997, these data have been compiled in the North American Industry Classification System (NAICS). For this analysis, EPA converted the NAICS classification data to the SIC code classifications using the 1997 Economic *Census Bridge Between NAICS and SIC.*
Source: U.S. ITC, 1989-2010.

Petroleum exports include heavy products such as residual fuel oil and petroleum coke, which are produced as co-products with motor gasoline and other light products. Production of these heavier products often exceeds U.S. demand, and foreign demand absorbs the excess. Distillate fuel oil is the leading petroleum export product, accounting for 29 percent of petroleum exports in 2008, followed by petroleum coke (almost 22 percent of exports) and residual fuel oil (almost 20 percent) (U.S. DOE, 2009b). Exports generally reflect foreign demand, but other factors influence exports as well. For example, exports of motor gasoline increased due to high prices in Europe at the time of the 1990 Persian Gulf War (U.S. DOE, 1997). U.S. refiners and marketers have gained experience in marketing to diverse world markets, and U.S. products are now sold widely abroad. As reported by the International Trade Administration and shown in *Figure E-5*, the real value of petroleum exports fluctuated between $6 and $10 billion during the years 1990 and 2002, and then increased over six-fold by the end of the decade.

E.5 Financial Condition and Performance

The financial performance and condition of the Petroleum Refining segment are important determinants of its ability to absorb the costs of regulatory compliance without material adverse economic/financial impact. To provide insight into the industry‟s financial performance and condition, EPA reviewed two key measures of financial performance over the period 1992 to 2012: net profit margin and return on total capital. EPA calculated these measures using data from the Quarterly Financial Report (QFR). Financial performance in the most recent financial reporting period (2008) is obviously not a perfect indicator of conditions at the time of regulatory compliance. However, examining the trend, and deviation from the trend, through the most recent reporting period gives insight into where the industry *may be*, in terms of financial performance and condition, at the time of compliance. In addition, the volatility of performance against the trend, in itself, provides a measure of the *potential* risk faced by the industry in a future period in which compliance requirements are faced: all else equal, the more volatile the historical performance, the more likely the industry *may* be in a period of relatively weak financial conditions at the time of compliance.

Net profit margin is calculated as after-tax income before nonrecurring gains and losses as a percentage of sales or revenue, and measures profitability, as reflected in the conventional accounting concept of net income. Over time, the firms in an industry, and the industry collectively, must generate a sufficient positive profit margin if the industry is to remain economically viable and attract capital. Year-to-year fluctuations in profit margin stem from several factors, including: variations in aggregate economic conditions (including international and U.S. conditions), variations in industry-specific market conditions (e.g., short-term capacity expansion resulting in overcapacity), or changes in the pricing and availability of inputs to the industry‟s production processes (e.g., the cost of energy to the petroleum refining process). The extent to which these fluctuations affect an industry‟s profitability, in turn, depends heavily on the fixed vs. variable cost structure of the industry‟s operations. In a capital intensive industry such as Petroleum Refining, the relatively high fixed capital costs as well as other fixed overhead outlays, can cause even small fluctuations in output or prices to have a large positive or negative affect on profit margin.

Return on total capital is calculated as annual pre-tax income divided by the sum of: current portion of long-term debt due in 1 year or less, long-term debt due in more than 1 year, all other noncurrent liabilities and total stockholders‟ equity (total capital). This concept measures the total productivity of the capital deployed by a firm or industry, regardless of the financial source of the capital (i.e., equity, debt, or other liability element). As such, the return on total capital provides insight into the profitability of a business‟ assets independent of financial structure and is thus a “purer” indicator of asset profitability than return on equity. In the same way as described for *net profit margin*, the firms in an industry, and the industry collectively, must generate, over time, a sufficient return on capital if the industry is to remain economically viable and attract capital. The factors causing short-term variation in *net profit margin* will also be important sources of short-term variation in *return on total capital*.

Figure E-6 below shows trends in net profit margins and return on total capital for the Petroleum Refining segment between 1988 and 2012. Through the first half of the 1990s, unusually low product margins, low profitability, and substantial restructuring characterized the petroleum industry. These low profit margins resulted from three supply-side factors – (1) increases in operating costs as a result of governmental regulations; (2) expensive upgrading of processing units to accommodate lower-quality crude oils;[202] and (3) upgrading of operations to adapt to changes in demand for refinery products[203] – coupled with lower product prices, resulting

[202] Crude oils processed by U.S. refineries have become heavier and more contaminated with materials such as sulfur. This trend reflects reduced U.S. dependence on the more expensive high gravity (“light”) and low sulfur (“sweet”) crude oils produced in the Middle East, and greater reliance on crude oil from Latin America (especially Mexico and Venezuela), which is relatively heavy and contains higher sulfur (“sour”) (U.S. DOE, 1999a).

[203] Demand for lighter products such as gasoline and diesel fuel has increased, and demand for heavier products has decreased.

from competitive pressures (API, 1999). In the late 1990s, the petroleum industry pursued cost-cutting measures throughout their operations (Rodekohr, 1999).[204] These cost-cutting measures, along with increases in the prices of petroleum refining products, resulted in significantly improved financial performance in the Petroleum Refining industry. Refinery profits remained high in 2000 and the first half of 2001, due to low product inventories and high operating rates. The latter half of 2001 and 2002 saw the effects of the global recession, the attacks of 9/11, and a mild winter. These factors, coupled with world supply in excess of demand, led to decreases in refiner margins, as crude oil prices increased and petroleum product prices decreased. In 2003, as the U.S. economy began recovery from its economic hardship, the domestic Petroleum Refining segment returned to relatively strong financial performance.

During the last decade, Petroleum Refining industry‟s performance continued to improve from 2004 through 2006, reaching the highest return on total capital and net profit margin observed over the time period. The industry showed a decrease in both net profit margin and return on total capital in 2007 and 2008, trending along with the beginning of the U.S. and global economy decline. At the end of the last decade, the oil and gas refining and marketing sub-was facing a challenging environment due to imbalance between supply and demand. This imbalance stemmed from a fall in U.S. demand for refined products by more than 3 million b/d from February 2008 to June 2009, at the same time that a minimum of 2 million b/d per year of new refining capacity worldwide was expected between 2009 and 2014 (S&P, 2010c; U.S. DOE, 2009a). In 2009, net profit margin and return on capital continued to decrease while in 2010 net profit margin decreased less severely and return on total capital increased. In 2011, both indicators saw significant rises, followed by declines in 2012.

[204] Reductions in costs resulted from:

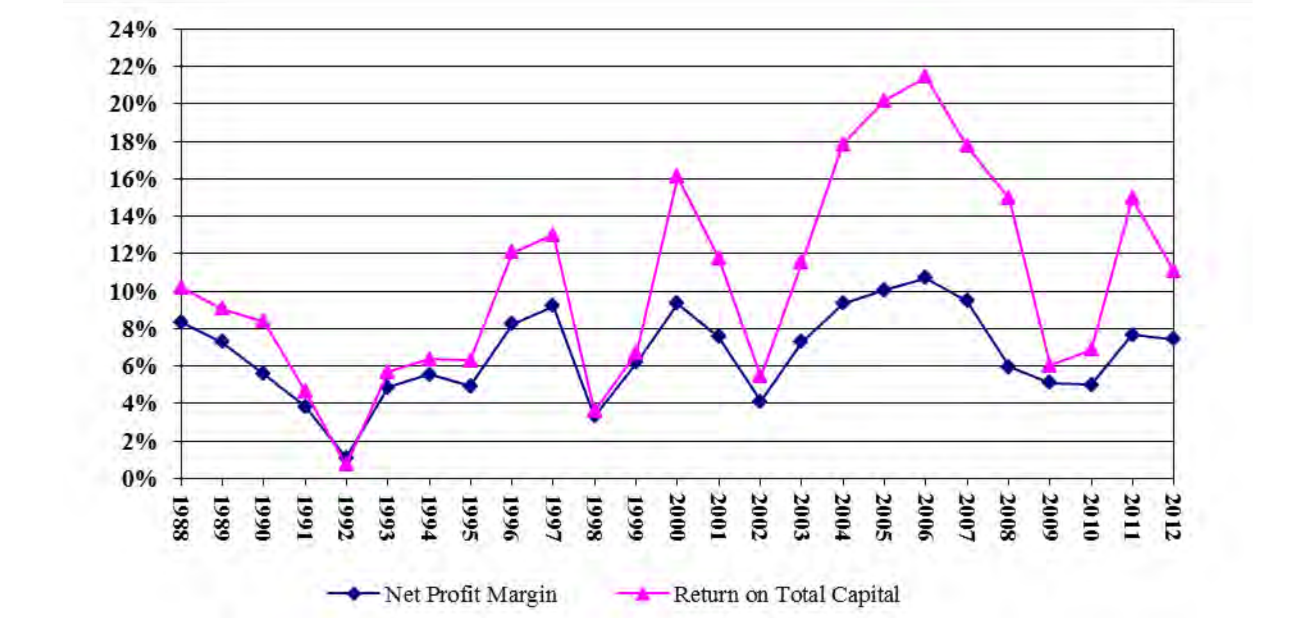
> divesting marginal refineries and gasoline outlets;

> divesting less profitable activities (e.g., gasoline credit cards);

> reducing corporate overhead costs, including eliminating redundancies through restructuring;

> outsourcing some administrative activities; and use of new technologies requiring less labor.

Figure E-6: Net Profit Margin and Return on Total Capital for Petroleum Refining



Source: U.S. DOC, 1988-2010 QFR.

E.6 Facilities Operating Cooling Water Intake Structures

Section 316(b) of the Clean Water Act applies to point source facilities that use, or propose to use, a cooling water intake structure that withdraws cooling water directly from a surface waterbody of the United States. In 1982, the Petroleum and Coal Products industry (SIC 29) withdrew 590 billion gallons of cooling water, accounting for approximately 0.8 percent of total industrial cooling water intake in the United States.[205] The industry ranked 4th in industrial cooling water use, behind the electric power generation industry and the chemical and primary metals industries (1982 Census of Manufactures).

This section provides information for facilities in the petroleum segment estimated to be subject to regulation for the regulatory analysis options. Existing facilities that meet all of the following conditions are expected to be subject to regulation:

Use a cooling water intake structure or structures, or obtain cooling water by any sort of contract or arrangement with an independent supplier who has a cooling water intake structure; or their cooling water intake structure(s) withdraw(s) cooling water from waters of the United States, and at least twenty-five (25) percent of the water withdrawn is used for contact or non-contact cooling purposes;

- Have a National Pollutant Discharge Elimination System (NPDES) permit or are required to obtain one; and
- Meet the coverage criteria for the final regulation in terms of design intake flow – i.e., 2 MGD.

205 Data on cooling water use are from the 1982 Census of Manufactures. 1982 was the last year in which the Census of Manufactures reported cooling water use.

EPA initially identified the set of facilities that were estimated to be *potentially* subject to the 316(b) Existing Facilities Regulation based on a minimum applicability threshold of 2 MGD; this section focuses on these facilities for the petroleum segment.[206]

E.6.1 Waterbody and Cooling Water Intake System Type

Table E-10, shows the distribution of facilities by type of water body and cooling water intake system for each option.

Table E-10: Number of Facilities Estimated Subject to the 316(b) Existing Facilities Regulation by Waterbody Type and Cooling Water Intake System for the Petroleum Refining Segment

Water Body Type	Cooling Water Intake System						Total
	Recirculating		Combination		Once-Through		
	Number	% of Total	Number	% of Total	Number	% of Total	
Estuary/ Tidal River	0	0%	3	30%	2	40%	5
Ocean	0	0%	0	0%	1	20%	1
Lake/Reservoir	1	5%	0	0%	0	0%	1
Freshwater River/ Stream	22	95%	5	50%	2	40%	29
Great Lake	0	0%	2	20%	0	0%	2
Total[a]	**23**	**58%**	**11**	**28%**	**5**	**14%**	**39**

a. Individual numbers may not add up to total due to independent rounding.
Source: U.S. EPA, 2000; U.S. EPA analysis, 2013.

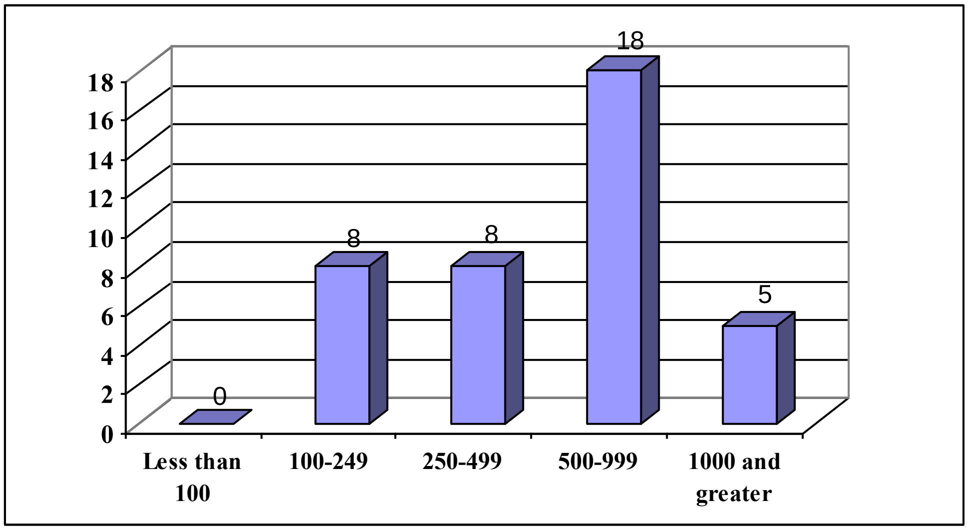
According to the American Petroleum Institute and EPA, water use at Petroleum Refineries has been declining because facilities are increasing their reuse of water (U.S. EPA, 1996a).

E.6.2 Facility Size

All petroleum refinery facilities that are estimated to be subject to regulation under the regulatory analysis options are relatively large. *Figure E-7*, shows the number of potentially regulated facilities by employment size category.

206 EPA applied sample weights to the sampled facilities to account for non-sampled facilities and facilities that did not respond to the survey. For more information on EPA‟s 2000 Section 316(b) Industry Survey, please refer to the Information Collection Request (U.S. EPA, 2000).

Figure E-7: Number of Facilities Estimated Subject to the 316(b) Existing Facilities Regulation by Employment Size for the Petroleum Refinery Segment



Source: U.S. EPA, 2000; U.S. EPA analysis, 2013.

E.6.3 Firm Size

EPA used the Small Business Administration (SBA) small entity thresholds to determine the number of facilities in the petroleum-refining segment that are owned by small firms. Firms in this industry are considered small if they employ fewer than 1,500 people. EPA estimates that four small entity-owned facilities and 35 large entity-owned facilities in the Petroleum Refining segment will be subject to the final regulation.

Appendix F Profile of the Steel Industry

F.1 Introduction

EPA‟s *Detailed Industry Questionnaire*, hereafter referred to as the DQ, identified five 4-digit SIC codes in the Steel Works, Blast Furnaces, and Rolling and Finishing Mills Industries (SIC 331) with at least one existing facility that operates a CWIS, holds a NPDES permit, withdraws at least two million gallons per day (MGD) from a water of the United States, and uses at least 25 percent of its intake flow for cooling purposes (facilities with these characteristics are hereafter referred to as "facilities potentially subject to the 316(b) Final Existing Facilities regulation", "existing facilities", or "regulated facilities"). For the purpose of this analysis, EPA identified a six-digit NAICS code for each of these potential facilities using the information from DQ and public sources (see *Appendix J: Mapping Manufacturers Standard Industrial Classification (SIC) Codes to North American Industry Classification System (NAICS) Codes*). As the result of this mapping, EPA identified five 6-digit NAICS codes in the Steel and Allied Products manufacturing industry (NAICS 3311/2).

For each of the five NAICS codes, *Table F-1*, below, provides a description of the industry segment, a list of primary products manufactured, the total number of detailed questionnaire respondents (weighted to represent a national total of facilities that hold a NPDES permit and operate cooling water intake structures), and the number of facilities estimated to be potentially subject to the 316(b) Existing Facilities Regulation based on the minimum withdrawal threshold of 2 MGD.

Table F-1: Existing Facilities in the Steel Industry (NAICS 3311/2)

NAICS	NAICS Description	Important Products Manufactured	Number of Regulated Facilities[a]
Steel Mills (NAICS 3311)			
331111	Iron and Steel Mills	Hot metal, pig iron, and silvery pig iron from iron ore and iron and steel scrap; converting pig iron, scrap iron, and scrap steel into steel; hot-rolling iron and steel into basic shapes, such as plates, sheets, strips, rods, bars, and tubing; merchant blast furnaces and byproduct or beehive coke ovens	42
331112	Electrometallurgical ferroalloy products manufacturing	Iron-rich alloys and more pure forms of elements added during the steel manufacturing process. Ferroalloys add critical elements for low and high metal alloys.	2
Steel Products (NAICS 3312)			
331210	Iron and steel pipe and tubes manufacturing from purchased steel	Production of welded or seamless steel pipe and tubes and heavy riveted steel pipe from purchased materials	9
331221	Rolled steel shape manufacturing	Cold-rolling steel sheets and strip from purchased hot-rolled sheets; cold-drawing steel bars and steel shapes from hot-rolled steel bars; producing other cold finished steel	13
331222	Steel wire drawing	Drawing wire from purchased iron or steel rods, bars, or wire; further manufacture of products made from wire; steel nails and spikes from purchased materials	3
Total Steel Products [b]			**24**
Total Steel (NAICS 3311/2)			
Total NAICS Code 3311/2 [b]			68

a. Number of weighted detailed questionnaire survey respondents.
b. Individual numbers may not add up due to independent rounding.
Source: Executive Office of the President, 1987; U.S. EPA, 2000; U.S. EPA analysis, 2013.

As shown in *Table F-1*, EPA estimates that, out of an estimated total of 476 facilities[207] with a NPDES permit and operating cooling water intake structures in the Steel Industry (NAICS 3311/2), 68 (14 percent) are expected to be subject to the Final 316(b) Existing Facilities regulation. EPA also estimated the percentage of total production that occurs at facilities estimated to be subject to the regulatory analysis options. Total value of shipments for the Steel industry (NAICS 3311/2) from the 2010 Annual Survey of Manufactures is $118.1 billion ($2011). Value of shipments, a measure of the dollar value of production, was selected for the basis of this estimate. Because the DQ did not collect value of shipments data, these data were not available for existing facilities. Total revenue, as reported on the DQ, was used as a close approximation for value of shipments for these facilities. EPA estimated the total revenue of facilities expected to be subject to the 316(b) Existing Facilities Regulation is $57.2 billion ($2011). Therefore, EPA estimates that 48 percent of total production in the steel industry occurs at facilities estimated to be subject to regulation.

The responses to the Detailed Questionnaire indicate that two main steel segments account for all of the potential regulated facilities: (1) Steel Mills (NAICS codes 331111 and 331112) and (2) Steel Products (NAICS codes 331210, 331221, and 331222).

Table F-2 provides the crosswalk between the new NAICS codes and the SIC codes for the profiled steel NAICS codes. The table shows that electrometallurgical ferroalloy product manufacturing (NAICS 331112), rolled steel shape manufacturing (NAICS 331221), steel wire drawing (NAICS 331222), and Iron and steel pipes and tubes manufacturing from purchased steel (NAICS 331210) have a one-to-one relationship to SIC codes. The remaining NAICS code – iron and steel mills (NAICS 331111) – corresponds to two SIC codes.

Table F-2: Relationships between NAICS and SIC Codes for the Steel Industries (2010)

NAICS Code	NAICS Description	SIC Code	SIC Description	Number of Establishments (2009)[a]	Value of Shipments (2010; Millions; $2011)	Employment (2010)
331111	Iron and steel mills	3312	Blast furnaces and steel mills	566	$94,823	95,129
		3399	Blast furnaces and steel mills			
331112	Electrometallurgical ferroalloy product manufacturing	3313	Electrometallurgical products	22	$1,224	1,784
331221	Rolled steel shape manufacturing	3316	Cold finishing of steel shapes	168	$7,056	9,174
331222	Steel wire drawing	3315	Steel wire and related products	276	$5,616	13,382
331210	Iron and steel pipes and tubes manufacturing from purchased steel	3317	Steel pipe and tubes	201	$9,369	16,790

a. The most recent data on number of establishments is available for 2009 from Statistics of U.S. Businesses. Value of Shipments and Employment reflect 2010 data.
Sources: U.S. DOC, 2010 ASM; U.S. DOC, 2009 SUSB.

F.2 Summary Insights from this Profile

The key purpose of this profile is to provide insight into the ability of steel industry firms to absorb compliance costs under the final rule without material adverse economic/financial effects. The industry"s ability to absorb compliance costs is primarily influenced by two factors: (1) the extent to which the industry may be expected to

207 This estimate of the number of facilities holding a NPDES permit and operating a cooling water intake structure is based on the responses from facilities that received the 1999 screener questionnaire.

shift compliance costs to its customers through price increases and (2) the financial health of the industry and its general business outlook.

F.2.1 Likely Ability to Pass Compliance Costs Through to Customers

As reported in the following sections of this profile, the Steel Mill segment is moderately concentrated while the Steel Products segment is unconcentrated, which suggests that firms in the profiled Steel industry would have difficulty in passing a significant portion of their compliance-related costs through to customers. The domestic Steel industry does not appear to face significant competition from foreign trade. Despite, the relatively high proportion of total value of shipments in the industry estimated subject to regulation under the primary analysis options (nearly 50 percent), based on the overall lack of market power in the industry EPA judges that regulated facilities subject to the 316(b) Existing Facilities Regulation are not likely to be able to recover compliance costs through price increases to customers and would have to absorb all compliance costs within their operating finances (see following sections and *Appendix K: Cost Pass-Through Analysis*, for further information).

F.2.2 Financial Health and General Business Outlook

Over the past two decades, the U.S. Steel industry, like other U.S. manufacturing industries, experienced a range of economic/financial conditions, including substantial challenges. The U.S. Steel industry went through a difficult restructuring process in the 1980s and early 1990s, including the closing of a number of inefficient mills, substantial investment in new technologies, and reductions in the labor force. Although U.S. demand for steel was strong in the late 1990s, low-priced imports increased substantially in 1998 because of the Asian financial crisis, with the associated decline in Asian demand for steel and currency devaluations, thereby causing a number of bankruptcies of U.S. Steel firms and steelworker layoffs. In addition to being affected by the increased inflow of low-priced imported steel, the U.S. Steel industry was also negatively affected by economic recession in 2000 and 2001. Tariffs provided temporary relief through 2002, but were removed by the end of 2003. By 2003, the U.S. steel industry‟s financial performance improved significantly, particularly for the Steel Mills industry segment, and value of shipments and value added increased substantially. During this time, demand grew considerably, the industry became more concentrated with high levels of productivity, and trade activity increased. The 2008 recession slowed growth of the U.S. Steel industry, with a substantial decrease in production in 2008. Moving out of the recession, experts expect an increase in the volume of steel shipped in 2013. Experts also project a seven percent increase in consumption, following a nine percent rise in 2012. However, remaining excess steel capacity offsets this expected increases in volume of steel shipments leaving experts to project a neutral outlook for 2013 (S&P, 2013h). Overall, the current condition of the steel industry suggests that, financial performance may be improving since the recent recession, indicating an average ability to absorb additional regulatory compliance costs.

F.3 Domestic Production

Steel is one of the most important products of the U.S. industrial metals industry. For most of the twentieth century, the U.S. steel industry consisted of a few large companies utilizing an integrated steelmaking process to produce raw steel. The integrated process requires a large capital investment to process coal, iron ore, limestone, and other raw materials into molten iron, which is then transformed into finished steel products. In recent decades, the integrated steel industry has undergone a dramatic downsizing as a result of increased steel imports, decreased consumption by the auto industry, and the advent of “minimills” (S&P, 2001b). While the traditional integrated facilities using basic oxygen furnaces (BOF) still account for a substantial share of U.S. steel mill product production, the share of electric arc furnace (EAF) facilities using scrap steel as an input has grown steadily.[208] By

[208] Production from open hearth furnaces, which dominated production until the early 1950s, ended in 1991. BOF facilities have traditionally been referred to as integrated producers, because they combined iron-making from coke, production of pig iron in a blast

2007, about 47 companies operating about 98 steelmaking plants, used the EAF steelmaking process; these non-integrated, minimill facilities produced 57 million metric tons of steel, an increase of about 1.7 percent compared with that of 2006, and accounted for 41.8 percent of total U.S. steelmaking (USGS, 2007f). The range of products produced by EAFs has also expanded over time. Initially, EAFs produced primarily lower-quality structural materials. Starting in the 1990s, EAFs began producing higher quality sheet products as well. A majority of recent capacity additions have been at EAF facilities.

Basic steel mill products include carbon steel, steel alloys, and stainless steel. Steel forming and finishing operations may take place at facilities co-located with steelmaking or at separate facilities. These operations use steel (in the form of blooms, billets, and slabs) in combination with heating, rolling or drawing, pickling, cleaning, galvanizing, and electroplating processes in various combinations to produce finished bars, wire, sheets, and coils (semifinished steel products). Establishments that produce hot rolled products, along with basic BOF and EAF steelmaking facilities, are included in NAICS 331111 while establishments that primarily engaged in manufacturing of electrometallurgical ferroalloys are included in NAICS 331112. NAICS codes 331222, 331221, and 331212 perform additional processing of steel bars, wires, sheets, and coils (including cold-rolling of sheets) to produce steel products for a variety of end-uses (U.S. EPA, 2000).

The steel industry represents about 3 percent of total U.S. energy demand, and the total cost of energy accounts for approximately 15-20 percent of the total manufacturing cost (NEED, 2010). Steelmakers use coal, oil, electricity, and natural gas to fire furnaces and run process equipment. Minimill producers require large quantities of electricity to operate the electric arc furnaces used to melt and refine scrap metal, while integrated steelmakers depend on coal-fired plants‟ coal and electricity for up to 60 percent of their total energy requirements (NEED, 2010). Because of its high energy intensity, the steel industry has invested over $60 billion in new technologies since 1975 in an effort to improve energy efficiency and productivity. As a result of this effort as well as increased use of recycled steel and older plant closures, the industry has been able to reduce its energy consumption by 45 percent per ton of steel since 1973 (NEED, 2010).

F.3.1 Output

Steel mill products are sold to service centers (which buy finished steel, often process it further, and sell to a variety of fabricators, manufacturers, and construction industry clients), to vehicle producers, and to the construction industry. The rapid growth in sales of heavy sport utility vehicles contributed to increased U.S. steel consumption in the 1990s. However, recent efforts to increase the fuel efficiency of vehicles have eroded steel‟s position in the automotive market as a whole, as aluminum and plastic have replaced steel in many automotive applications. Other end-uses for steel include a wide range of agricultural, industrial, appliance, transportation, and container applications. Use of steel in beverage cans has been largely replaced by aluminum.

Table F-3 shows trends in production from the two major groups of steel producers: BOF and EAF facilities.

furnace, and production of steel in the BOF. In recent years, some facilities have closed their coke ovens. These BOF facilities are no longer fully integrated.

Table F-3: U.S. Steel Production by Type of Producer

Year	Steel Production		Percent from BOF[c]	Percent from EAF[d]
	Million MT	% Change		
1990[a]	89.7	NA	59.1%	37.3%
1991[b]	79.7	-11.1%	60.0%	38.4%
1992	84.3	5.8%	62.0%	38.0%
1993	88.8	5.3%	60.6%	39.4%
1994	91.2	2.7%	60.7%	39.3%
1995	95.2	4.4%	59.6%	40.4%
1996	95.5	0.3%	57.4%	42.6%
1997	98.5	3.1%	56.2%	43.8%
1998	98.6	0.1%	54.9%	45.1%
1999	97.4	-1.2%	53.7%	46.3%
2000	102	4.7%	53.0%	47.0%
2001	90.1	-11.7%	52.6%	47.4%
2002	91.6	1.7%	49.6%	50.4%
2003	93.7	2.3%	49.0%	51.0%
2004	99.7	6.4%	47.8%	52.2%
2005	94.9	-4.8%	45.0%	55.0%
2006	98.2	3.5%	42.9%	57.1%
2007	98.1	-0.1%	41.8%	58.2%
2008	91.9	-6.3%	42.6%	57.4%
2009	59.4	-35.4%	38.2%	61.8%
2010[e]	90.0	51.5%	39.0%	61.0%
Percent Change 1990-2010	**0.33%**			
Percent Change 2000-2010	**-11.76%**			
Average Annual Growth Rate[209]	**0.02%**			

a. 3.5 percent of 1990 production was from open hearth furnaces.
b. 1.6 percent of 1991 production was from open hearth furnaces.
c. Basic oxygen furnaces
d. Electric arc furnaces
e. Data provided for 2010 are estimated values.
Source: USGS, 1995b, 1999b, 2002b, 2006b, 2010b, and 2011b

This table shows the cyclical nature of the U.S. steel industry, with variations in growth from year to year reflecting general domestic and world economic conditions, persistent excess production capacity worldwide, the competitive strength of imports, and trends in steel‟s share of the automotive and other end-use markets for steel. The U.S. steel industry went through a difficult restructuring process in the 1980s and early 1990s, including the closing of a number of inefficient mills, substantial investment in new technologies, and reductions in the labor force. Following this difficult transition, the United States became a world leader in low-cost production, led by the minimill producers. Although U.S. demand for steel was strong in the late 1990s, low-priced imports increased substantially in 1998, which led to a number of U.S. steel bankruptcies and steelworker layoffs. The increased imports resulted from the Asian financial crisis, with the associated decline in Asian demand for steel and currency devaluations. The U.S. government initiated the Steel Action Program in response to the crisis, focusing on strong enforcement of trade laws through the World Trade Organization and bilateral efforts to address market-distorting practices abroad.[210] The industry began to show signs of recovery in the second half of 1999, and by early 2000, capacity utilization recovered to above 90 percent and earnings were up for most major steel companies (U.S. DOC, 2000).

209 In this appendix, average annual growth rate refers to a year-to-year, constant percentage growth mean, which is calculated as the compound annual growth rate between the first and last values. This is the same concept as the geometric mean, if all of the individual year-to-year

210 World steel trade is characterized by noncompetitive practices in a number of countries, which have resulted in substantial friction over trade issues since the late 1960s. Since 1980, almost 40 percent of the unfair trade practice cases investigated in the U.S. have been related to steel products (U.S. DOC, 2000).

However, beginning in 2000, the weakening of the U.S. economy significantly reduced steel demand and total U.S. steel production fell by nearly 12 percent in 2001. In March 2002, the U.S. steel industry received temporary relief under Section 201 of the 1974 Trade Act with three years of tariffs ranging up to 30 percent on certain steel imports. Relief from imports was nullified to some extent when the U.S. Department of Commerce exempted 727 imported steel products from the tariff in June 2002. By year-end, 2002 was the fourth highest steel import year in U.S. history (USGS, 2002f). Removal of all tariffs occurred on December 4, 2003 (S&P, 2004c). The steel industry recovered, but slowly, from the import penetration in the late 1990s followed by the economic recession in 2001. In 2003, the integrated steel industry had poor operating results, as high raw material costs outweighed increased sales and higher volumes. As a result, most domestic steel producers instituted a raw material surcharge to offset sharply rising costs for raw materials such as scrap, iron ore and coke.

Between 2000 and 2005, world steel demand increased by 6 percent, and China surpassed Japan, Russia, and the United States to become the number one steel producer (British Geological Survey, 2005). During this period the two different methods for producing steel – integrated (ore-based) and electric arc furnace (scrap-based) – began converging in response to the changing cost balance of raw materials, scrap and energy (AISI, 2001a). Despite the increase in demand in the first half of the decade, steel production declined substantially between 2000 and 2010, as shown in *Table F-3*. This was largely due to significant declines that occurred in 2001, 2008 and 2009, coinciding with the recent economic downturns.

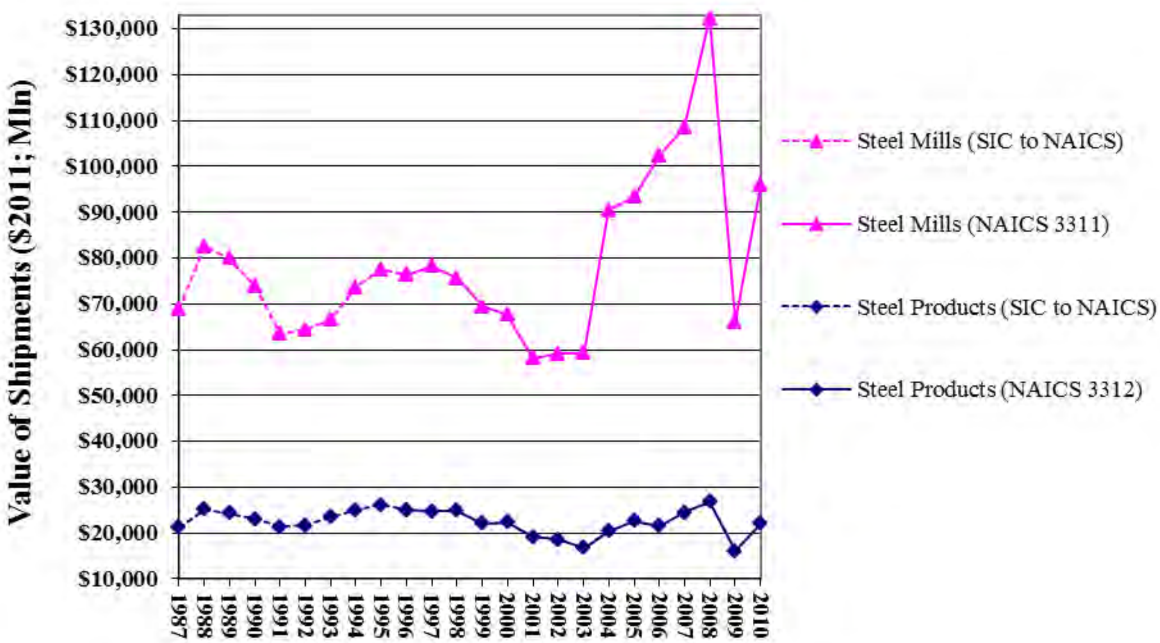
Value of shipments and ***value added*** are two common measures of manufacturing output.[211] Change in these values over time provides insight into the overall economic health and outlook for an industry. Value of shipments is the sum of receipts earned from the sale of outputs; it indicates the overall size of a market or the size of a firm in relation to its market or competitors. Value added, defined as the difference between the value of shipments and the value of inputs used to make the products sold, measures the value of production activity in a particular industry.

Figure F-1 presents trends in constant-dollar value of shipments and value added for the profiled Steel Mills and Steel Products segments. Value of shipments and value added from Steel Mills declined in the early 1990s, and recovered through 1997, prior to the 1998 import crisis and the later U.S. economic recession. The segment‟s value of shipments began to decline after 1997 and continued to do so through 2001. However, from 2002 through 2008, the Steel Mills segment experienced continuous growth, with value of shipments peaking at over $132 billion at the end of that period. Steel Mills value added also continued to decline until 2001 and then increased drastically in 2004. Between 2004 and 2006, value added for the Steel Mills segment remained relatively constant. This stagnation was followed by more substantial growth up until 2008. In 2009, both value added and value of shipments for the Steel Mills segment fell drastically (by over 50 percent). These large declines were followed by significant increases in 2010. Value of shipments and value added for Steel Products were less volatile, increasing gradually during 1990 through 1995 and 1996, respectively, when both value of shipments and value added began to decline, bottoming in 2003. From 2004 to 2008, both value of shipments and value added for the profiled Steel Products segment experienced overall moderate growth. Like the Steel Mills segment, value added and value of shipments in the Steep Products segment declined in 2009 and then rebounded in 2010.

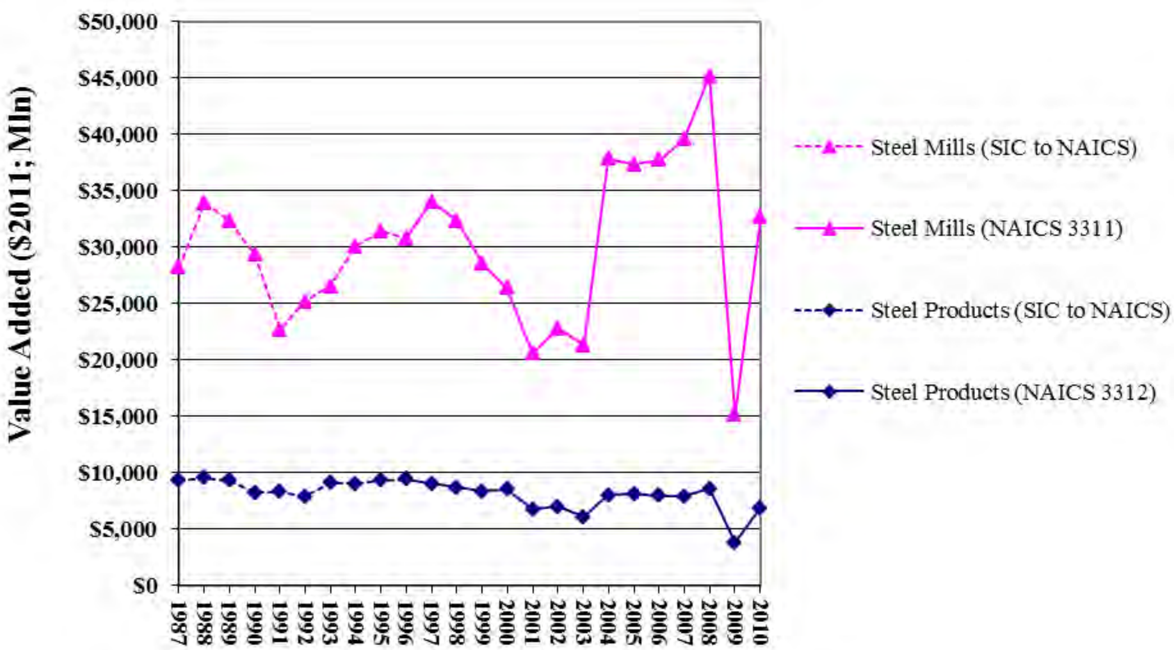
211 Terms highlighted in bold and italic font are further explained in the glossary.

Figure F-1:Value of Shipments and Value Added for Profiled Steel Industry Segments (millions, $2011)[a]

Value of Shipments



Value Added



a. Before 1997, the Department of Commerce compiled data in the SIC system; since 1997, these data have been compiled in the North American Industry Classification System (NAICS). For this analysis, EPA converted the NAICS classification data to the SIC code classifications using the *1997 Economic Census* Bridge *Between NAICS and SIC.*

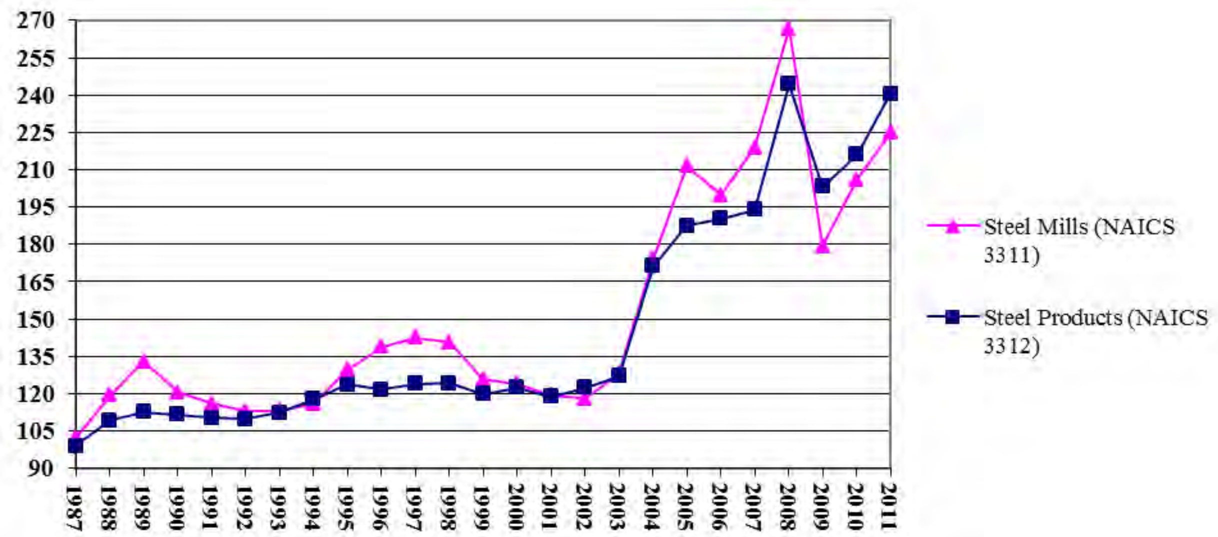
Source: U.S. DOC, 1988-1991, 1993-1996, 1998-2001, 2003-2006, and 2008-2010 ASM; U.S. DOC, 1987, 1992, 1997, 2002, and 2007 EC.

F.3.2 Prices

The ***producer price index (PPI)*** measures price changes, by segment, from the perspective of the seller, and indicates the overall trend of product pricing, and thus supply-demand conditions, within a segment.

As shown in *Figure F-2*, below, prices increased from 1987 to 1989 and then dropped slightly in the early 1990s, due to depressed domestic economy and the resulting decline in demand for steel. During the 1990s, prices in both profiled segments remained on average unchanged, with prices in the Steel Mills segments rising temporarily in the middle of the decade. As the U.S. and world economies began to recover in 2002, so did steel prices, which began to rise and continued to do so through 2008. Prices declined in 2009 and then rose for the remainder of the period of analysis. Despite some fluctuation, prices at the end of the last decade were significantly higher than at the beginning of the analysis period. Overall, during the last two decades, prices in the profiled Steel Mills segment showed a slightly higher degree of volatility compared to those in the profiled Steel Products segment.

Figure F-2: Producer Price Index for Profiled Steel Industry Segments



Source: BLS, 2011.

F.3.3 Number of Facilities and Firms

The number of operating Steel Mills fluctuated significantly between 1990 and 2009, as the U.S. industry underwent a substantial restructuring. *Table F-4* shows substantial decreases in the number of facilities in the profiled Steel Mills segment in 1992 and 1993 due to a significant decrease in global demand and resulting overcapacity. This decrease was followed by a significant recovery in 1995 and 1996, and another significant drop in 1997. The number of facilities continued to rise through 2001, with the largest increase around 1999. This increase may have resulted in part from the advent of minimills, as discussed above. The import crisis during 1997-1998 ultimately led to bankruptcy for a number of U.S. producers, including LTV and Bethlehem Steel (S&P, 2001b). Additionally, seven major bankruptcies occurred over 2002 and early 2003, including Bayou Steel Corp, Kentucky Electric Steel Inc, Slater Steel Inc, and Weirton Steel Corp (USGS, 2004b). Between 2000 and 2009, the number of facilities in the Steel Mills and Steel Products segments dropped by 41 percent and 40 percent, respectively. Largely due to declines at the end of the period, the Steel Mills segment saw an overall increase of just under 2 percent in the number of facilities between 1990 and 2009 with an average annual growth rate of less than 1 percent. Also mainly due to a decline in 2009, the Steel Products segment saw a decline in firms of 2 percent at an average annual rate of less than 1 percent over the period.

Table F-4: Number of Facilities in the Profiled Steel Industry Segments[a]

Year	Steel Mills		Steel Products	
	Number of Facilities	Percent Change	Number of Facilities	Percent Change
1990	579	NA	659	NA
1991	609	5.3%	782	18.7%
1992	499	-18.1%	807	3.1%
1993	436	-12.7%	808	0.1%
1994	431	-1.1%	779	-3.5%
1995	477	10.7%	766	-1.6%
1996	555	16.4%	748	-2.4%
1997	377	-32.1%	705	-5.8%
1998	410	8.7%	769	9.1%
1999	702	71.2%	824	7.2%
2000	1,003	42.9%	933	13.2%
2001	1,374	37.0%	939	0.6%
2002	1,259	-8.4%	870	-7.3%
2003	876	-30.4%	828	-4.8%
2004	799	-8.8%	734	-11.4%
2005	839	5.0%	716	-2.5%
2006	827	-1.4%	698	-2.5%
2007	901	8.9%	699	0.1%
2008	698	-22.5%	724	3.6%
2009	588	-15.8%	645	-10.9%
Total Percent Change 1990-2009	**1.6%**		**-2.1%**	
Total Percent Change 2000-2009	**-41.4%**		**-30.9%**	
Average Annual Growth Rate	**0.1%**		**-0.1%**	

a. Before 1998, data were compiled in the SIC system; since 1998, these data have been compiled in the North American Industry Classification System (NAICS). For this analysis, EPA converted the NAICS classification data to the SIC code classifications using the *1997 Economic Census Bridge Between NAICS and SIC*.
Source: U.S. DOC, 1990-1997 SBA; U.S. DOC, 1998-2009 SUSB.

Table F-5 shows the number of firms in the two profiled steel segments between 1990 and 2009. The trend in the number of firms over the period between 1990 and 2009 is similar to the trend in the number of facilities in the profiled Steel Mills industry segment. The number of firms in this segment decreased to a period-low of 288 in 1997, before increasing significantly during 1998 through 2001, to 1,269 firms. This rise in the number of Steel Mill firms was followed by declines during 2002 through 2004, and then a slight recovery in 2005. Between 2000 and 2009, the number of firms in the Steel Mills segment fell by nearly 50 percent. Overall, between 1990 and 2009, the number of Steel Mill firms declined by 6 percent at an average annual rate of less than 1 percent. The number of firms in the Steel Products segment also decreased between 1992 and 1997, before rising steadily through 2001, and then declining between 2002 and 2009. Like the Steel Mills segment, the number of firms in the Steel Products segment experienced a decline not only in the last decade – 29 percent – but an overall decline of 11 percent between 1990 and 2009.

Table F-5: Number of Firms in the Profiled Steel Industry Segments[a]

Year	Steel Mills		Steel Products	
	Number of Firms	Percent Change	Number of Firms	Percent Change
1990	482	NA	578	NA
1991	505	4.7%	615	6.4%
1992	401	-20.6%	642	4.3%
1993	345	-14.0%	622	-3.1%
1994	342	-0.9%	599	-3.7%
1995	388	13.6%	588	-1.8%
1996	462	19.1%	567	-3.5%
1997	288	-37.7%	528	-6.9%
1998	320	11.0%	577	9.3%
1999	603	88.4%	628	8.8%
2000	900	49.3%	725	15.4%
2001	1,269	41.0%	729	0.6%
2002	1,149	-9.5%	681	-6.6%
2003	758	-34.0%	684	0.4%
2004	684	-9.8%	598	-12.6%
2005	718	5.0%	580	-3.0%
2006	708	-1.4%	568	-2.1%
2007	776	9.6%	564	-0.7%
2008	566	-27.1%	599	6.2%
2009	454	-19.8%	517	-13.7%
Total Percent Change 1990-2009	**-5.8%**		**-10.6%**	
Total Percent Change 2000-2009	**-49.6%**		**-28.7%**	
Average Annual Growth Rate	**-0.3%**		**-0.6%**	

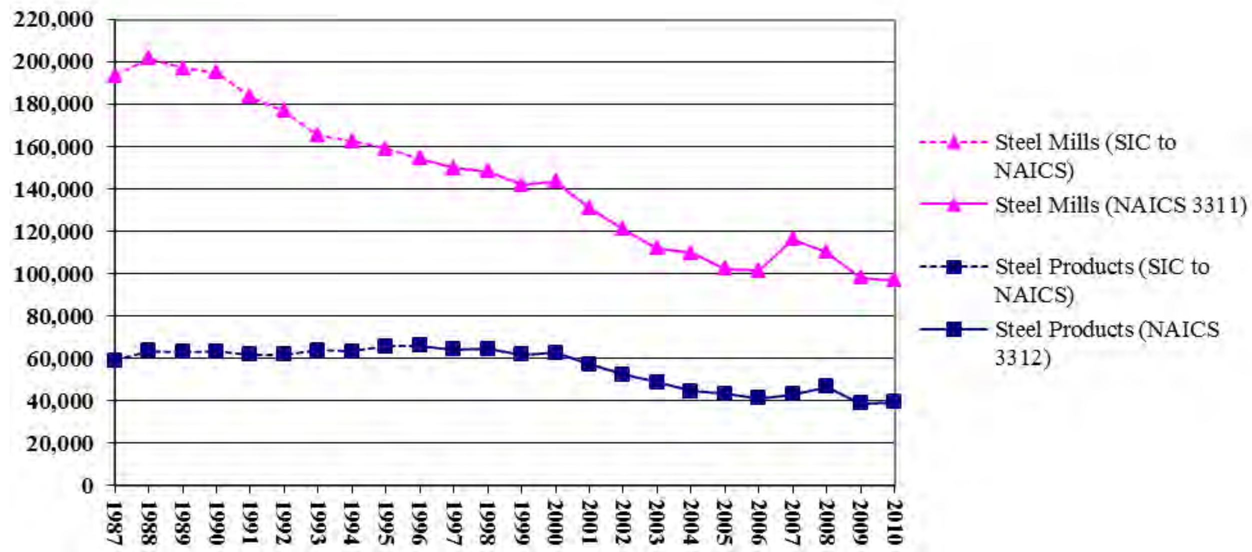
a Before 1998, data were compiled in the SIC system; since 1998, these data have been compiled in the North American Industry Classification System (NAICS). For this analysis, EPA converted the NAICS classification data to the SIC code classifications using the *1997 Economic Census Bridge Between NAICS and SIC.*

Source: U.S. DOC, 1990-1997 SBA; U.S. DOC, 1998-2009 SUSB.

F.3.4 Employment and Productivity

Figure F-3, following page, provides information on ***employment*** from the Annual Survey of Manufactures and the Economic Census for the profiled Steel Mills and Steel Products segments. As shown in the figure, between 1987 and 2010, employment levels in the Steel Mills segment decreased by a total of nearly 50 percent at an average annual rate of 3 percent. Employment is a significant cost component for steelmakers. Labor cost reductions enabled Steel Mills to improve profitability and competitiveness in the face of limited opportunities for price increase in the highly competitive market of Steel Products. A steady decline in employment in the 1990s reflects a smaller number of Steel Mill facilities and firms, in conjunction with aggressive efforts to improve worker productivity in order to cut labor costs and improve profits (McGraw-Hill, 1998). Employment declined further as a result of the 1997-1998 import crisis, with almost 26,000 U.S. steelworkers reportedly losing their jobs (AISI, 2001b). During the 2000s decade, employment in the Steel Mills segment declined until 2006 when the industry had a sudden rise in number of employees in 2007 and 2008, followed by declines. Employment in the Steel Products segment also declined, except for an increase between 2006 and 2008, at an average annual rate of nearly 2 percent resulting in a total decline of approximately 33 percent over the period 1987-2010 (approximately 37 percent between 2000 and 2010).

Figure F-3: Employment for Profiled Steel Industry Segments[a]



a. Before 1997, the Department of Commerce compiled data in the SIC system; since 1997, these data have been compiled in the North American Industry Classification System (NAICS). For this analysis, EPA converted the NAICS classification data to the SIC code classifications using the 1997 Economic Census Bridge Between NAICS and SIC.

Source: U.S. DOC, 1988-1991, 1993-1996, 1998-2001, 2003-2006, and 2008-2010 ASM; U.S. DOC, 1987, 1992, 1997, 2002, and 2007 EC.

Table F-6 presents the change in value added per labor hour, a measure of ***labor productivity***, for the Steel Mills and Steel Products segments between 1987 and 2010. Labor productivity at Steel Mills increased significantly over this period, despite a decline of nearly 60 percent in 2009. Between 1987 and 2010, value added per labor hour increased approximately 120 percent, with most growth – 86 percent – taking place since 2000. Much of this increase in labor productivity can be attributed to the restructuring of the U.S. steel industry and the increased role of minimills in production. Minimills are capable of producing rolled steel from scrap with substantially lower labor needs than integrated mills (McGraw-Hill, 1998). Labor productivity in the Steel Products segment has also experienced an overall growth between 1987 and 2010, although less so compared to that in the Steel Mills segment; labor productivity grew by about 24 percent between 1987 and 2010, with most of this growth – approximately 35 percent – taking place between 2000 and 2010.

Table F-6: Productivity Trends for the Profiled Steel Industry Segments ($2011)[a]

Year	Steel Mills				Steel Products			
	Value Added (millions)	Production Hours (millions)	Value Added/Hour		Value Added (millions)	Production Hours (millions)	Value Added/Hour	
			$/hr	Percent Change			$/hr	Percent Change
1987	$28,210	313	$90	NA	$9,333	105	$89	NA
1988	$33,942	333	$102	12.9%	$9,575	91	$106	18.7%
1989	$32,359	357	$91	-11.0%	$9,336	109	$86	-19.0%
1990	$29,416	323	$91	0.4%	$8,247	89	$92	7.6%
1991	$22,682	287	$79	-13.1%	$8,303	104	$80	-13.0%
1992	$25,207	285	$88	11.8%	$7,940	84	$95	17.9%
1993	$26,573	276	$96	8.9%	$9,140	106	$86	-8.8%
1994	$30,085	275	$109	13.7%	$9,084	88	$103	20.0%
1995	$31,461	271	$116	6.1%	$9,350	110	$85	-18.0%
1996	$30,772	268	$115	-1.2%	$9,482	130	$73	-14.2%
1997	$34,066	259	$132	14.9%	$9,058	106	$86	18.0%
1998	$32,340	252	$128	-2.8%	$8,706	108	$81	-5.9%
1999	$28,535	243	$118	-8.2%	$8,377	103	$82	1.2%
2000	$26,357	248	$106	-9.5%	$8,534	104	$82	0.3%
2001	$20,574	289	$71	-33.1%	$6,800	92	$74	-10.2%
2002	$22,827	200	$114	60.5%	$6,998	86	$81	10.6%
2003	$21,349	185	$116	1.2%	$6,095	80	$76	-6.9%
2004	$37,867	191	$198	71.5%	$8,058	73	$111	46.0%
2005	$37,332	183	$204	2.7%	$8,143	73	$112	1.1%
2006	$37,739	178	$212	3.9%	$7,962	71	$112	0.0%
2007	$39,586	189	$209	-1.2%	$7,918	78	$101	-9.3%
2008	$45,165	188	$240	14.5%	$8,618	76	$114	12.4%
2009	$15,123	150	$101	-58.0%	$3,827	55	$69	-39.2%
2010	$32,631	164	$199	97.4%	$6,892	62	$110	59.3%
Total Percent Change 1987-2010	**15.7%**	**-47.5%**	**120.2%**		**-26.2%**	**-40.4%**	**23.9%**	
Total Percent Change 2000-2010	**23.8%**	**-33.6%**	**86.6%**		**-19.2%**	**-40.1%**	**34.8%**	
Average Annual Growth Rate	**0.6%**	**-2.8%**	**3.5%**		**-1.3%**	**-2.2%**	**0.9%**	

a Before 1997, the Department of Commerce compiled data in the SIC system; since 1997, these data have been compiled in the North American Industry Classification System (NAICS). For this analysis, EPA converted the NAICS classification data to the SIC code classifications using the *1997 Economic Census Bridge Between NAICS and SIC.*

Source: U.S. DOC, 1988-1991, 1993-1996, 1998-2001, 2003-2006, and 2008-2010 ASM; U.S. DOC, 1987, 1992, 1997, 2002, and 2007 EC.

F.3.5 Capital Expenditures

New capital expenditures are needed to modernize, expand, and replace existing capacity to meet growing demand. Capital expenditures in the profiled Steel Mills and the Steel Products segments between 1987 and 2010 are presented in *Table F-7*, following page. As shown in the table, capital expenditures in both the Steel Mills and the Steel Products segments fluctuated significantly during this analysis period. Steel Mills‟ capital outlays increased in the late 1980s and early 1990s, rising by a total of 109 percent between 1987 and 1991. This substantial increase coincides with the advent of thin slab casting, a technology that allowed minimills to compete in the market for flat rolled sheet steel. The significant decreases in capital expenditures by Steel Mills that followed this expansion reflect the bottoming out of the demand for Steel Products in the early 1990s. The recovery in capital expenditures in the mid-1990s reflected increased demand and higher utilization rates (McGraw-Hill, 1998). The import crisis of the late 1990s and later weakening of the U.S. economy put pressure on the domestic steel industry, and expenditures for new capacity began to decline in 1997 in both segments (McGraw-Hill, 2000). However, capital expenditures in the Steel Mills segment recovered during the 2000s, increasing by approximately 25 percent, while the Steel Products segments saw a decline of approximately 21 percent. Overall, between 1987 and 2010, capital expenditures increased by about 54 percent in the Steel Mills segment and dropped by approximately 50 percent in the Steel Products segment.

Table F-7: Capital Expenditures for the Profiled Steel Industry Segments (millions, $2011)[a]

Year	Steel Mills		Steel Products	
	Capital Expenditures	Percent Change	Capital Expenditures	Percent Change
1987	$2,182	NA	$940	NA
1988	$3,281	50.4%	$711	-24.3%
1989	$4,133	26.0%	$797	12.1%
1990	$4,055	-1.9%	$797	0.0%
1991	$4,553	12.3%	$572	-28.3%
1992	$3,325	-27.0%	$588	2.8%
1993	$2,612	-21.4%	$644	9.6%
1994	$3,737	43.1%	$741	15.0%
1995	$3,843	2.8%	$721	-2.7%
1996	$3,880	1.0%	$773	7.2%
1997	$3,581	-7.7%	$715	-7.6%
1998	$3,486	-2.7%	$685	-4.1%
1999	$2,957	-15.2%	$574	-16.2%
2000	$2,688	-9.1%	$599	4.2%
2001	$1,937	-27.9%	$458	-23.6%
2002	$1,679	-13.3%	$497	8.6%
2003	$1,154	-31.3%	$506	1.9%
2004	$1,745	51.3%	$525	3.7%
2005	$2,043	17.1%	$409	-22.2%
2006	$2,012	-1.5%	$432	5.7%
2007	$3,438	70.9%	$518	19.9%
2008	$4,704	36.8%	$518	0.0%
2009	$3,096	-34.2%	$473	-8.6%
2010	$3,366	8.7%	$475	0.3%
Total Percent Change 1987-2010	**54.3%**		**-49.5%**	
Total Percent Change 2000-2010	**25.2%**		**-20.7%**	
Average Annual Growth Rate	**1.9%**		**-2.9%**	

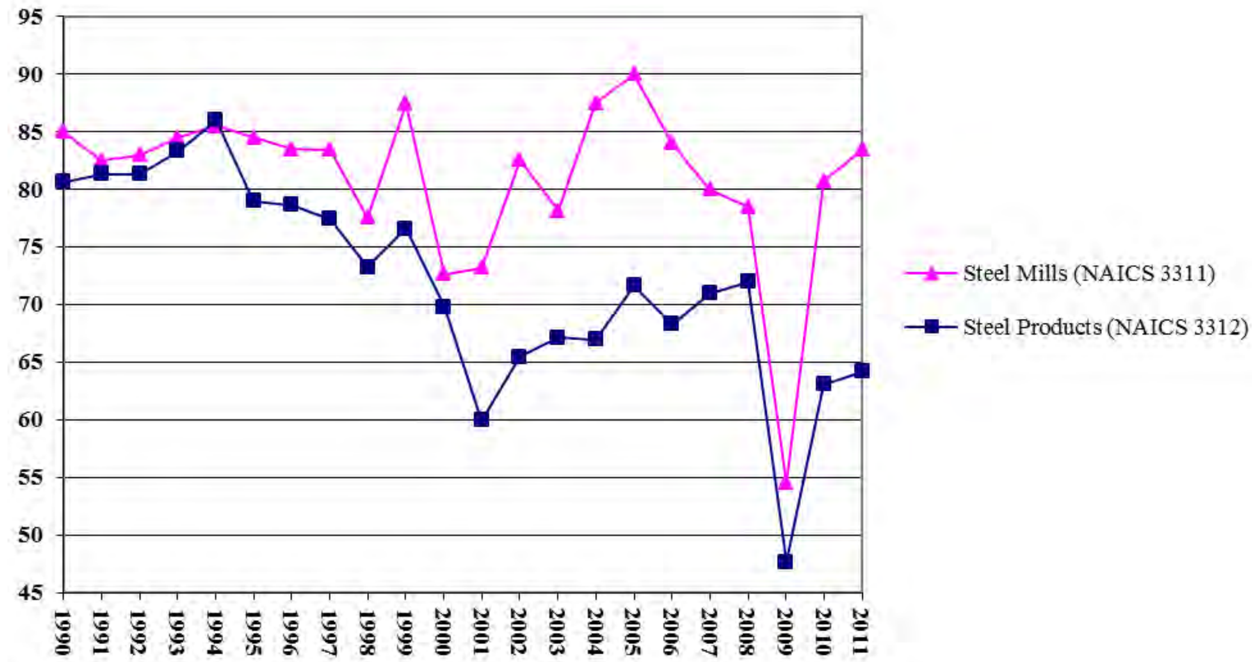
a. Before 1997, the Department of Commerce compiled data in the SIC system; since 1997, these data have been compiled in the North American Industry Classification System (NAICS). For this analysis, EPA converted the NAICS classification data to the SIC code classifications using the *1997 Economic Census Bridge Between NAICS and SIC.*

Source: U.S. DOC, 1988-1991, 1993-1996, 1998-2001, 2003-2006, and 2008-2010 ASM; U.S. DOC, 1987, 1992, 1997, 2002, and 2007 EC.

F.3.6 Capacity Utilization

Capacity utilization measures actual output as a percentage of total potential output given the available capacity. Capacity utilization provides insight into the extent of excess or insufficient capacity in an industry, and into the likelihood of investment in new capacity. *Figure F-4* presents capacity utilization index for 1990 through 2011 for the profiled Steel Mill and Steel Products segments. Capacity utilization followed a similar trend for both industry segments. Capacity utilization in the Steel Products segment declined by 22 percent over the last two decades and by 8 percent during the last decade. The Steel Mills segment saw a decline of less than 1 percent over the entire period, and increased by 15 percent between 2000 and 2011. The most dramatic drops in capacity utilization took place around the 2001 and the 2008 economic recessions; in fact, the 2009 drop in capacity utilization marked the most drastic drop in capacity utilization in the last two decades. For the Steel Mills segment, capacity utilization dropped by 31 percent in 2009 while for the Steel Products segment it fell by 34 percent. In 2010, capacity utilization for both Steel Mills and Steel Products increased drastically and continued to rise in 2011.

Figure F-4: Capacity Utilization Rates (Fourth Quarter) for Profiled Steel Industry Segments[a,b]



a. Before 1997, the Department of Commerce compiled data in the SIC system; since 1997, these data have been compiled in the North American Industry Classification System (NAICS). For this analysis, EPA converted the NAICS classification data to the SIC code classifications using the *1997 Economic Census Bridge Between NAICS and SIC.*
b. Prior to 2007, U.S. Census sampled every industry in a specific NAICS6. Beginning in 2007, U.S. Census only sampled certain industries within any NAICS6, and therefore, the data collected before 2007 cannot be directly compared to the data collected in 2007 and beyond.
Source: U.S. DOC, 1989-2010 SPC.

F.4 Structure and Competitiveness

The Steel Mill segment is comprised of two different kinds of facilities, integrated mills and minimills. The integrated steelmaking process requires expensive plant and equipment purchases that will support production capacities ranging from two million to four million tons per year. Until the early 1960s, integrated steelmaking was the dominant method of U.S. steel manufacturing. Since then, the integrated steel business underwent dramatic downsizing due to competition from minimills and imports. These trends reduced the number of integrated steelmakers (S&P, 2001b). Minimills vary in size, from capacities of 150,000 tons at small facilities to larger facilities with annual capacities of between 400,000 tons and two million tons. Integrated companies have significant capital costs of approximately $2,000 per ton of capacity compared with minimills" $500 per ton. Because minimills do not require as much investment in capital equipment as integrated steelmakers, minimills have been able to lower prices during periods of weak demand, driving integrated companies out of many of the commodity steel markets (S&P, 2001b). The advent of minimills, with their lower initial capital investments, has made it easier for new producers to enter the market.

F.4.1 Firm Size

For both the Steel Mills and Steel Products segments, the Small Business Administration defines a small firm as having 1,000 or fewer employees (750 or fewer employees for NAICS 331112). The size categories reported in the Statistics of U.S. Businesses (SUSB) do not correspond with the SBA size classifications, therefore preventing precise use of the SBA size threshold in conjunction with SUSB data. *Table F-8* below shows the distribution of firms, facilities, and receipts by the employment size of the parent firm.

The SUSB data presented in *Table F-8* show that in 2009, 388 of 454 firms in the Steel Mills segment had less than 500 employees. Therefore, at least 85 percent of firms in this segment were classified as small. These small firms owned 400 facilities, or 68 percent of all facilities in the segment. Of the 645 firms with facilities that manufacture Steel Products, 480, or 74 percent, employ fewer than 500 employees, and are therefore considered small businesses. Small firms own 74 percent of facilities in the industry.

Table F-8: Number of Firms and Facilities by Employment Size Category in the Profiled Steel Industry Segments, 2009

Employment Size Category	Steel Mills		Steel Products	
	Number of Firms	Number of Facilities	Number of Firms	Number of Facilities
0-19	255	255	223	223
20-99	71	73	142	142
100-499	62	72	115	115
500+	66	188	165	165
Total	**454**	**588**	**645**	**645**

Source: U.S.DOC, 2009 SUSB.

F.4.2 Concentration Ratios

Concentration is the degree to which industry output is concentrated in a few large firms. Concentration is closely related to entry barriers with more concentrated industries generally having higher barriers.

The four-firm ***concentration ratio*** (CR4) and the ***Herfindahl-Hirschman Index*** (HHI) are common measures of industry concentration. The CR4 indicates the market share of the four largest firms. For example, a CR4 of 72 percent means that the four largest firms in the industry account for 72 percent of the industry‟s total value of shipments. The higher the concentration ratio, the less competition there is in the industry, other things being equal.[212] An industry with a CR4 of more than 50 percent is generally considered concentrated. The HHI indicates concentration based on the largest 50 firms in the industry. It is equal to the sum of the squares of the market shares for the largest 50 firms in the industry. For example, if an industry consists of only three firms with market shares of 60, 30, and 10 percent, respectively, the HHI of this industry would be equal to 4,600 ($60^2 + 30^2 + 10^2$). The higher the index, the fewer the number of firms supplying the industry and the more concentrated the industry. Based on the U.S. Department of Justice‟s guidelines for evaluating mergers, markets in which the HHI is under 1000 are considered unconcentrated, markets in which the HHI is between 1,000 and 1,800 are considered to be moderately concentrated, and those in which the HHI is in excess of 1,800 are considered to be concentrated.

Table F-9 presents concentration ratios for the profiled segments. The Steel Mills segment is comprised of NAICS 331111 and 331112. The HHI for NAICS 331111 was 786 in 2007. The HHI for NAICS 331112 is not reported in 2007, but was 2,196 in 2002. In 2007, Steel Products, comprised of NAICS 331222, 331221, and 331210, had HHIs of 297, 402, and 436, respectively. Consequently, the Steel Products segment is considered competitive, based on standard measures of concentration. Because the Steel Mills segment is mostly comprised of firms in the NAICS 331111 industry sector, this segment is also mostly competitive. For the Steel Products segment, the CR4 and the HHI for all relevant NAICS codes are below the benchmarks of 50 percent and 1,000, respectively. The relatively low concentration values suggest low overall ability of the industry to pass through

212 Note that the measured concentration ratio and the HHF are very sensitive to how the industry is defined. An industry with a high concentration in domestic production may nonetheless be subject to significant competitive pressures if it competes with foreign producers or if it competes with products produced by other industries (e.g., plastics vs. aluminum in beverage containers). Concentration ratios based on share of production are therefore only one indicator of the extent of competition in an industry.

compliance costs as price increases to customers. However, in the Steel Mills segment, only NAICS code 331111 is below the HHI benchmark and neither segment is below the CR4 benchmark of 50 percent.

Table F-9: Selected Ratios for the Profiled Steel Industry Segments

SIC (S) or NAICS (N) Code	Year	Total Number of Firms	Concentration Ratios				
			4 Firm (CR4)	8 Firm (CR8)	20 Firm (CR20)	50 Firm (CR50)	Herfindahl-Hirschman Index
Steel Mills							
S 3312[a]	1987	271	44%	63%	81%	94%	607
	1992	135	37%	58%	81%	96%	551
N 331111	1997	191	33%	53%	75%	94%	445
	2002	285	44%	59%	78%	93%	657
	2007	235	52%	67%	84%	95%	786
S 3313	1987	25	55%	78%	99%	100%	1,208
	1992	31	56%	77%	98%	100%	1,103
N 331112	1997	19	61%	82%	100%	100%	1,123
	2002	19	75%	92%	100%	100%	2,196
	2007	20	56%	83%	100%	NA	NA
Steel Products							
S 3315	1987	274	21%	34%	54%	78%	212
	1992	271	19%	32%	54%	80%	201
N 331222	1997	199	21%	36%	56%	80%	223
	2002	270	30%	42%	61%	85%	326
	2007	237	25%	42%	62%	85%	297
S 3316	1987	156	45%	62%	82%	95%	654
	1992	158	43%	60%	81%	96%	604
N 331221	1997	153	44%	60%	81%	96%	631
	2002	121	34%	51%	73%	93%	491
	2007	120	31%	49%	71%	92%	402
S 3317	1987	155	23%	34%	58%	85%	242
	1992	166	19%	31%	53%	80%	194
N 331210	1997	166	20%	30%	52%	82%	200
	2002	133	26%	39%	61%	86%	279
	2007	134	34%	49%	70%	91%	436

a. SIC code represents largest percentage of facilities and value of shipments within this NAICS based on the 1997 Bridge Between SIC and NAICS
Source: U.S. DOC, 1987, 1992, 1997, 2002, and 2007 EC.

F.4.3 Foreign Trade

This profile uses two measures of foreign competition: ***export dependence*** and ***import penetration***.

Import penetration measures the extent to which domestic firms are exposed to foreign competition in domestic markets. Import penetration is calculated as total imports divided by total value of domestic consumption in that industry: where domestic consumption equals domestic production plus imports minus exports. Theory suggests that higher import penetration levels will reduce market power and pricing discretion because foreign competition limits domestic firms‟ ability to exercise such power. Firms belonging to segments in which imports account for a relatively large share of domestic sales would therefore be at a relative disadvantage in their ability to pass-through costs because foreign producers would not incur costs as a result of the final rule. The estimated import penetration ratio for the entire U.S. manufacturing sector (NAICS 31-33) for 2010 is 28 percent. For characterizing the ability of industries to absorb compliance cost burdens, EPA judges that industries with import ratios close to or above 28 percent would more likely face stiff competition from foreign firms and thus be less likely to succeed in passing compliance costs through to customers.

Export dependence, calculated as exports divided by value of shipments, measures the share of a segment‟s sales that is presumed subject to strong foreign competition in export markets. The Final Existing Facilities regulation would not increase the production costs of foreign producers with whom domestic firms must compete in export markets. As a result, firms in industries that rely to a greater extent on export sales would have less latitude in increasing prices to recover cost increases resulting from regulation-induced increases in production costs. The estimated export dependence ratio for the entire U.S. manufacturing sector for 2010 is 22 percent. For characterizing the ability of industries to absorb compliance cost burdens, EPA judges that industries with export ratios close to or above 22 percent are at a relatively greater disadvantage in potentially recovering compliance costs through price increases since export sales are presumed subject to substantial competition from foreign producers.

The global market for steel continues to be extremely competitive. From 1945 until 1960, the U.S. steel industry enjoyed a period of prosperity and was a net exporter until 1959. However, by the early 1960s, foreign steel industries had thoroughly recovered from World War II and had begun construction of new plants that were more advanced and efficient than the U.S. integrated steel mills. Foreign producers also enjoyed lower labor costs, allowing them to take substantial market share from U.S. producers. This increased competition from foreign producers, combined with decreased consumption in some key end use markets, served as a catalyst for the restructuring and downsizing of the U.S. steel industry. The industry emerged from this restructuring considerably smaller, more technologically advanced and internationally competitive (S&P, 2001b). Global steel trade fell during the economic recession of 2008, trade imbalances narrowed, and governments responded with an increase in trade policy measures to support the steel industry such as tariff increases, non-tariff barriers in emerging Asia, export-facilitating measures, and trade remedy measures (OECD, 2009).

Table F-10 presents trade statistics for the profiled steel industry segments from 1990 to 2010. As shown in the table, export dependence experienced slight fluctuations throughout the period, as did import penetration. Both export dependence and import penetration rose by 8 percentage points between 1990 and 2010. Historically, the U.S. steel industry has exported a relatively small share of shipments compared to the steel industries of other developed nations (McGraw-Hill, 2000). U.S. steel exports rose in 1995 to the highest level since 1941, and dropped slightly until 2003. From 2003 to 2010, the value of exports rose steadily, except for slight declines in 2009. Import penetration rose to 19 percent in 1994, 1996, and 2000 and reached another peak of 27 percent in 2008, after hovering around 15 percent in the early 1990s. This increase in imports reflected excess steel capacity worldwide and the competitiveness of foreign steel producers, as described previously. Canada received the largest amount of U.S. exported steel in 2007, followed by Mexico. Brazil, China, the EU, Germany, Japan, the Republic of Korea, Mexico, Russia, and Ukraine were major sources of steel mill product imports (USGS, 2008f).

The steel industry‟s import penetration ratio in 2010 was 23 percent (compared to the 28 percent penetration for the entire U.S. manufacturing industry), implying that domestic steel producers likely do not face highly significant competition from foreign firms in setting prices on the domestic market. The steel industry‟s export dependence ratio in 2010 was 13 percent (compared to the 22 percent export dependence for the entire U.S. manufacturing industry), suggesting that this industry‟s overall cost pass-through potential is not significantly affected by its foreign market sales.

The combination of moderate import penetration and relatively low export dependence suggest that international trade considerations are not a strong factor in determining the cost pass-through potential of firms facing compliance requirements under the final rule. However, potential changes in tariffs and other international trade policies that were implemented during the recent recession, as well as the global recession, itself, may have altered the overall balance of international competitiveness factors affecting the U.S. steel industry.

Table F-10: Import Penetration and Export Dependence: Profiled Steel Mills and Steel Products Segments ($2011)a

Year	Value of Imports (millions)	Value of Exports (millions)	Value of Shipments (millions)	Implied Domestic Consumption[b]	Import Penetration[c]	Export Dependence[d]
1990	$16,500	$4,799	$96,993	$108,695	15%	5%
1991	$14,894	$6,005	$84,916	$93,804	16%	7%
1992	$14,744	$4,886	$86,095	$95,953	15%	6%
1993	$15,645	$4,474	$89,999	$101,170	15%	5%
1994	$21,789	$4,682	$98,723	$115,830	19%	5%
1995	$21,218	$6,978	$103,695	$117,935	18%	7%
1996	$22,022	$6,114	$101,269	$117,177	19%	6%
1997	$23,214	$7,195	$103,007	$119,026	20%	7%
1998	$27,585	$6,714	$100,494	$121,365	23%	7%
1999	$21,606	$6,104	$91,488	$106,990	20%	7%
2000	$24,693	$6,849	$90,038	$107,882	23%	8%
2001	$18,595	$6,387	$77,207	$89,415	21%	8%
2002	$19,302	$5,947	$77,682	$91,036	21%	8%
2003	$17,048	$7,011	$76,006	$86,042	20%	9%
2004	$34,606	$8,661	$110,833	$136,778	25%	8%
2005	$35,363	$11,179	$116,067	$140,251	25%	10%
2006	$43,707	$12,016	$124,001	$155,692	28%	10%
2007	$40,353	$13,963	$132,914	$159,304	25%	11%
2008	$52,430	$18,098	$159,164	$193,496	27%	11%
2009	$21,706	$11,468	$82,157	$92,395	23%	14%
2010	$31,161	$15,079	$118,089	$134,171	23%	13%
Total Percent Change 1990 - 2010	**88.9%**	**214.2%**	**21.7%**	**23.4%**		
Total Percent Change 1990 - 2010	**26.2%**	**120.2%**	**31.2%**	**24.4%**		
Average Annual Growth Rate	**3.2%**	**5.9%**	**1.0%**	**1.1%**		

a. Before 1997, data were compiled in the SIC system; since 1998, these data have been compiled in the North American Industry Classification System (NAICS). For this analysis, EPA converted the NAICS classification data to the SIC code classifications using the *1997 Economic Census Bridge Between NAICS and SIC.*
b Calculated by EPA as shipments + imports - exports.
c. Calculated by EPA as imports divided by implied domestic consumption.
d. Calculated by EPA as exports divided by shipments.
Source: U.S. ITC, 1989-2010.

F.5 Financial Condition and Performance

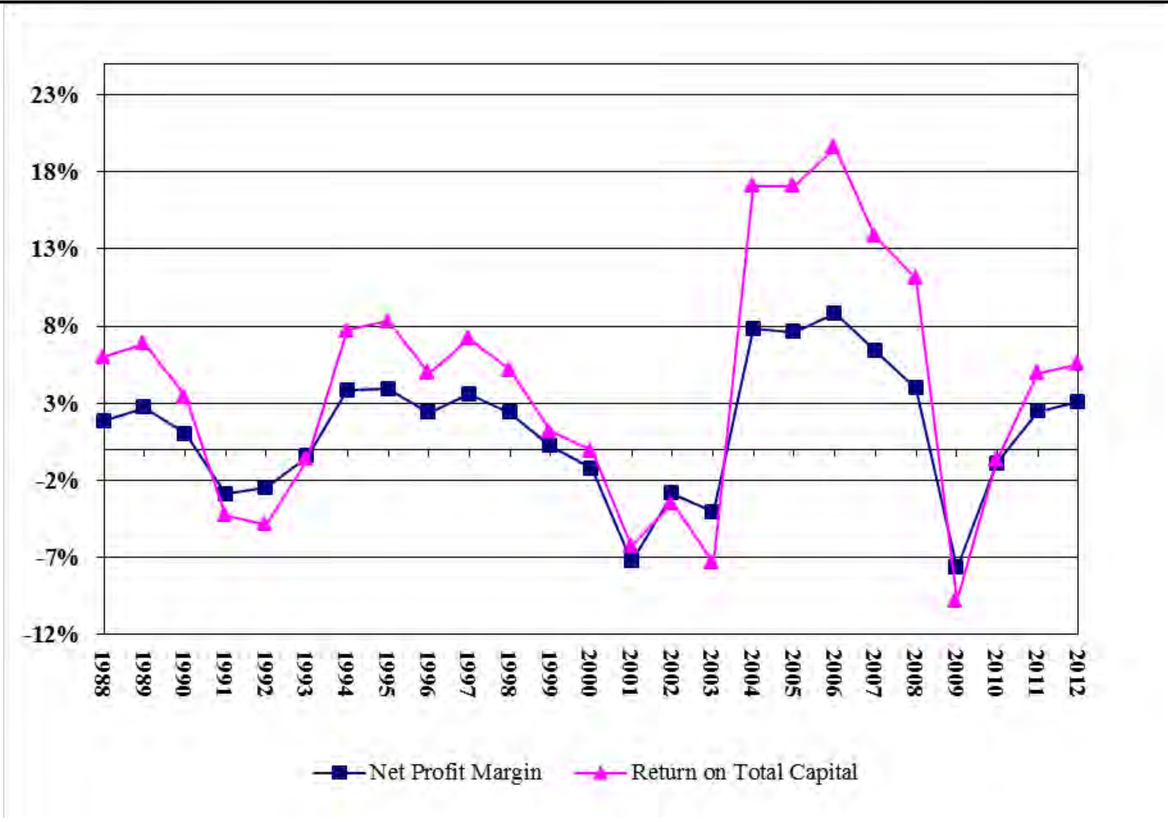
The financial performance and condition of the U.S. steel industry are important determinants of its ability to absorb the costs of regulatory compliance without material, adverse economic/financial impact. To provide insight into the industry‟s financial performance and condition, EPA reviewed two key measures of financial performance over the period 1988 to 2012: net profit margin and return on total capital. EPA calculated these using data from the Quarterly Financial Report (QFR) (*see Appendix L: Adjusting Baseline Facility Cash Flow*). Financial performance in the most recent financial reporting period (2008) is obviously not a perfect indicator of conditions at the time of regulatory compliance. However, examining the trend, and deviation from the trend, through the most recent reporting period gives insight into where the industry *may be*, in terms of financial performance and condition, at the time of compliance. In addition, the volatility of performance against the trend, in itself, provides a measure of the *potential* risk faced by the industry in a future period in which compliance requirements are faced: all else equal, the more volatile the historical performance, the more likely the industry *may* be in a period of relatively weak financial conditions at the time of compliance.

Net profit margin is calculated as after-tax income before nonrecurring gains and losses as a percentage of sales or revenue, and measures profitability, as reflected in the conventional accounting concept of net income. Over time, the firms in an industry, and the industry collectively, must generate a sufficient positive profit margin if the industry is to remain economically viable and attract capital. Year-to-year fluctuations in profit margin stem from several factors, including: variations in aggregate economic conditions (including international and U.S. conditions), variations in industry-specific market conditions (e.g., short-term capacity expansion resulting in overcapacity), or changes in the pricing and availability of inputs to the industry‟s production processes (e.g., the cost of energy to the steel production process). The extent to which these fluctuations affect an industry‟s profitability, in turn, depends heavily on the fixed vs. variable cost structure of the industry‟s operations. In a capital intensive industry such as the steel industry, the relatively high fixed capital costs as well as other fixed overhead outlays, can cause even small fluctuations in output or prices to have a large positive or negative affect on profit margin.

Return on total capital is calculated as annual pre-tax income divided by the sum of current portion of long-term debt due in 1 year or less, long-term debt due in more than one year, all other noncurrent liabilities and total stockholders‟ equity (total capital). This concept measures the total productivity of the capital deployed by a firm or industry, regardless of the financial source of the capital (i.e., equity, debt, or liability element). As such, the return on total capital provides insight into the profitability of a business‟ assets independent of financial structure and is thus a "purer" indicator of asset profitability than return on equity. In the same way as described for *net profit margin*, the firms in an industry, and the industry collectively, must generate over time a sufficient return on capital if the industry is to remain economically viable and attract capital. The factors causing short-term variation in *net profit margin* will also be the primary sources of short-term variation in *return on total capital*.

Figure F-5, following page, presents trends in net profit margins and return on total capital for the steel industry between 1988 and 2012. The graph shows considerable volatility in the trend over this analysis period. After registering improvement in financial performance in the first half of the 1990s, steel industry financial performance declined markedly between 1995 and 2002/2003, due first to increasing imports resulting from Asian financial crisis with the associated decline in Asian demand for steel and currency devaluations, and later, general economic weakness. Financial performance improved in 2002 slightly when the U.S. steel industry received temporary relief with tariffs ranging up to 30 percent on certain steel imports. However, in 2003 the integrated steel industry again saw poor operating results, as high raw material costs outweighed increased sales and higher volumes. In 2004, the steel industry‟s financial performance improved strongly, with returns on total capital and net profit margins peaking in 2006. In 2007, at the beginning of the recent economic recession, financial performance of the steel industry began to deteriorate. That deterioration accelerated into 2009, followed by an increase in both net profit margin and return on total capital in 2010. In 2011, net profit margin and return on total capital increased steeply and continued to increase in 2012, bringing values for both indicators towards long-term averages.

Figure F-5: Net Profit Margin and Return on Total Capital for the Iron and Steel Industry



Source: *Quarterly Financial Report, 1988-2010; U.S. Census Bureau.*

F.6 Facilities Operating Cooling Water Intake Structures

Section 316(b) of the Clean Water Act applies to point source facilities that use or propose to use a cooling water intake structure that withdraws cooling water directly from a surface waterbody of the United States. In 1982, the Primary Metals industries as a whole (including Nonferrous and Steel producers) withdrew 1,312 billion gallons of cooling water, accounting for approximately 1.7 percent of total industrial cooling water intake in the United States.[213] The industry ranked third in industrial cooling water use, behind the electric power generation industry, and the chemical industry (1982 Census of Manufactures).

This section provides information for facilities in the profiled steel segments estimated to be subject to regulation under the primary analysis options. Existing facilities that meet all of the following conditions would have been subject to regulation under the three regulatory analysis options:

- Use a cooling water intake structure or structures, or obtain cooling water by any sort of contract or arrangement with an independent supplier who has a cooling water intake structure; or their cooling water intake structure(s) withdraw(s) cooling water from waters of the U.S., and at least twenty-five (25) percent of the water withdrawn is used for contact or non-contact cooling purposes;
- Have an National Pollutant Discharge Elimination System (NPDES) permit or are required to obtain one; and
- Meet the applicability coverage criteria for the final regulation specific regulatory analysis option in terms of design intake flow (i.e., 2 MGD).

213 Data on cooling water use are from the *1982 Census of Manufactures*. 1982 was the last year in which the Census of Manufactures reported cooling water use.

EPA initially identified the set of facilities that were estimated to be *potentially* subject to the 316(b) Existing Facilities Regulation based on a minimum applicability threshold of 2 MGD; this section focuses on these facilities for the petroleum segment.[214]

F.6.1 Waterbody and Cooling Water Intake System Type

Minimills use electric-arc-furnaces (EAF) to make steel from ferrous scrap. The electric-arc-furnace is extensively cooled by water, which is in turn recycled through cooling towers (U.S. EPA, 1995). This is important to note since most new steel facilities are minimills.

Table F-11, shows the distribution of regulated facilities in the profiled Steel industry by type of water body and cooling water intake system. As reported in the table, most regulated facilities employ a combination of a once-through and recirculating system. In addition, most regulated facilities in the Steel industry draw water from a freshwater stream or river.

Table F-11: Number of Facilities Estimated Subject to the 316(b) Existing Facilities Regulation by Waterbody Type and Cooling Water Intake System for the Profiled Steel Industry Segments

Water Body Type	Cooling Water Intake Systems								Total
	Recirculating		Combination		Once-Through		Other		
	Number	% of Total	Number	% of Total	Number	% of Total	Number	% of Total	
Lake/Reservoir	0	0%	0	0%	1	5%	0	0%	1
Freshwater River/ Stream	13	100%	18	67%	20	89%	7	100%	57
Great Lake	0	0%	9	33%	1	5%	0	0%	10
Total[a]	**13**	**18%**	**26**	**39%**	**21**	**32%**	**7**	**11%**	**68**

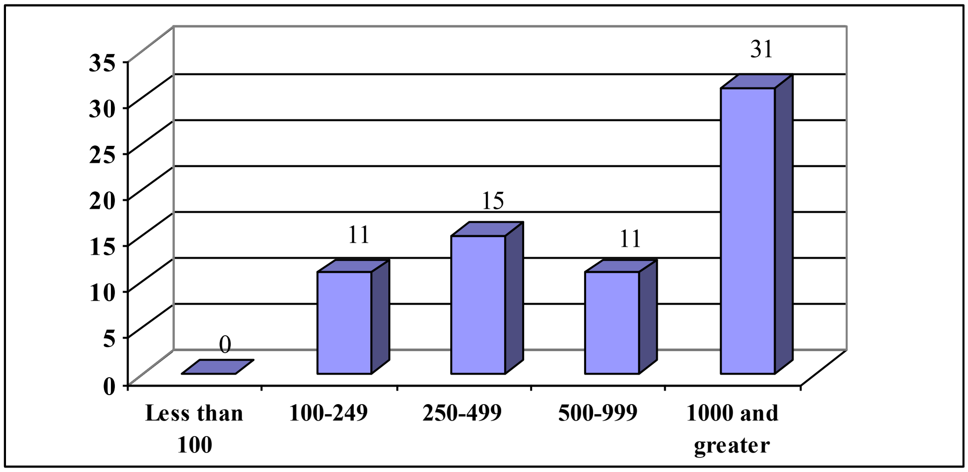
a. Individual numbers may not add up to total due to independent rounding.
Source: U.S. EPA, 2000; U.S. EPA analysis, 2013.

F.6.2 Facility Size

Figure F-6, shows the number of regulated facilities by employment size category. The regulated facilities in the Steel Mills and Steel Products segments are on-average relatively large.

214 EPA applied sample weights to the sampled facilities to account for non-sampled facilities and facilities that did not respond to the survey. For more information on EPA‟s 2000 Section 316(b) Industry Survey, please refer to the Information Collection Request (U.S. EPA, 2000).

Figure F-6: Number of Facilities Estimated Subject to the 316(b) Existing Facilities Regulation by Employment Size for Profiled Steel Industry Segments



Source: U.S. EPA, 2000; U.S. EPA analysis, 2013.

F.6.3 Firm Size

EPA used the Small Business Administration (SBA) small entity size standards to determine the number of Section 316(b) profiled steel industry facilities owned by small firms. Firms in the Steel Mills and Steel Products segments are defined as small if they have 1000 or fewer employees (except for facilities with NAICS code 331112 which are defined as small if they have 750 or fewer employees). EPA estimates that eight small entity-owned facilities and 60 large entity-owned facilities in the Steel industry segment will be subject to the final regulation. In addition, the ownership size of three facilities was unable to be classified due to insufficient survey data.

Appendix G Profile of Facilities in Other Industries

The preceding profile appendices focus on the six Primary Manufacturing Industries – Paper and Allied Products, Chemicals and Allied Products, Petroleum Refining, Steel, Aluminum, and Food and Kindred Products – identified, after electric power generators, as using the largest amount of cooling water in their operations and whose facilities are most likely, after electric power generators, to be subject to the final rule. However, facilities in other industries use cooling water and will therefore be subject to the final rule if they meet the regulation‟s specifications. This section of the profile provides information on a sample of facilities in these Other Industries.

EPA targeted its *Detailed Industry Questionnaire* at the electric power industry and manufacturing industries that use large amounts of cooling water. However, the Agency received 13 questionnaire responses from facilities with business operations in industries other than these major cooling water-intensive industries. EPA originally judged these facilities to be non-utility Electric Generators; however, inspection of their responses indicated that the facilities were better understood as cooling water-dependent facilities whose principal operations lie in businesses other than Electric Generators or the Primary Manufacturing Industries. Unlike the sample facility observations for the six Primary Manufacturing Industries, the sample of observations from Other Industries is not based on a scientifically framed sample and the information from this sample of observations may not be reliably extrapolated beyond these facilities. As a result, EPA‟s profile of information for the Other Industries facilities is restricted to these 13 sample facilities and is not presented as national estimates.

All of the 13 Other Industries facilities withdraw at least 2 million gallons of water a day and meet other regulated facility criteria, and thus would be subject to regulation under the final rule and other options EPA considered for existing facilities. These facilities fall in a wide range of businesses, as defined by three-digit NAICS industry group. *Table G-1* presents the number of responses received from facilities in the Other Industries by industry group. The information summarized in the following sections focuses on these Other Industries facilities, which EPA estimates will be subject to the final rule.

Table G-1: Facilities in Other Industries by 2-digit SIC code Estimated Subject to Regulation Under the Final Rule and Other Options Considered

No. of Facilities	NAICS Code	SIC Description	Important Operations
1	111	Crop production	Establishments, such as farms, orchards, groves, greenhouses, and nurseries, primarily engaged in growing crops, plants, vines, or trees and their seeds. Including biological and physiological characteristics and economic requirements, the length of growing season, degree of crop rotation, extent of input specialization, labor requirements, and capital demands production activities.
4	212	Mining (except oil and gas)	Mining, mine site development, and beneficiating (i.e., preparing) metallic minerals and nonmetallic minerals, including coal. Also includes ore extraction, quarrying, and beneficiating (e.g., crushing, screening, washing, sizing, concentrating, and flotation), customarily done at the mine site.
1	313	Textile mills	Transforming a basic fiber (natural or synthetic) into a product, such as yarn or fabric, that is further manufactured into usable items, such as apparel, sheets towels, and textile bags for individual or industrial consumption.
2	321	Wood product mfg.	Wood products, such as lumber, plywood, veneers, wood containers, wood flooring, wood trusses, manufactured homes (i.e., mobile home), and prefabricated wood buildings. Includes sawing, planing, shaping, laminating, and assembling of wood products starting from logs that are cut into bolts, or lumber that then may be further cut, or shaped by lathes or other shaping tools.
1	331	Primary metal mfg	Making (i.e., the primary production) nonferrous metals by smelting ore and/or the primary refining of nonferrous metals by electrolytic methods or other processes (except copper and aluminum).
2	332	Fabricated metal product mfg	Produce intermediate or end products from metal. Does not include computers, machinery, electronics, metal furniture, treat metals and other products fabricated elsewhere.
1	336	Transportation equipment mfg.	Equipment for transporting people and goods for each mode of transport - road, rail, air and water. Land use motor vehicle equipment not designed for highway operation (e.g., agricultural equipment, construction equipment, and materials handling equipment).
1	339	Miscellaneous mfg.	A wide range of products that cannot readily be classified in specific NAICS subsectors in manufacturing. Processes used by these establishments vary significantly, both among and within industries.

Source: Executive Office of the President, 1987; U.S. EPA, 2000; U.S. EPA analysis, 2013.

G.1 Facilities Operating Cooling Water Intake Structures

Section 316(b) of the Clean Water Act applies to point source facilities that use or propose to use a cooling water intake structure and that withdraw cooling water directly from a surface waterbody of the United States. This section provides information for facilities in Other Industries subject to the final rule and other options considered. The final rule and other options apply to existing facilities that meet the following criteria:

- Use a cooling water intake structure or structures, or obtain cooling water by any sort of contract or arrangement with an independent supplier who has a cooling water intake structure; or their cooling water intake structure(s) withdraw(s) cooling water from waters of the U.S., and at least twenty-five (25) percent of the water withdrawn is used for contact or non-contact cooling purposes;
- Have a National Pollutant Discharge Elimination System (NPDES) permit or are required to obtain one; and
- Meet the applicability criteria for regulatory coverage in terms of design intake flow (i.e., 2 MGD).

The final rule and other options considered also cover substantial additions or modifications to operations undertaken at such facilities.

G.1.1 Waterbody and Cooling System Types

Table G-2 summarizes information on the Other Industries facilities by type of water body and cooling system for the final rule and other options considered.

Table G-2: Other Industries Facilities Estimated Subject to the 316(b) Existing Facilities Regulation by Water Body and Cooling Water Intake System Type

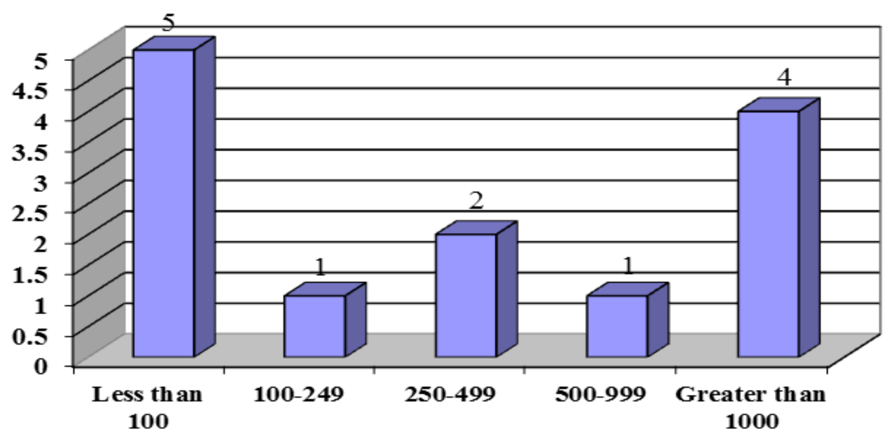
Waterbody Type	Recirculating		Once-Through		Other		Total
	Number	% of Total	Number	% of Total	Number	% of Total	
Estuary/ Tidal River	1	33%	1	11%	0	0%	2
Freshwater Stream/River	2	67%	4	45%	1	100%	7
Great Lake	0	0%	2	22%	0	0%	2
Lake/Reservoir	0	0%	1	11%	0	0%	1
Ocean	0	0%	1	11%	0	0%	1
Total[a]	**3**	**23%**	**9**	**69%**	**1**	**8%**	**13**

a. Individual numbers may not sum to total due to independent rounding.
Source: U.S. EPA, 2000; U.S. EPA Analysis, 2013.

G.1.2 Facility Size

Figure G-1 shows the employment size category for the Other Industries facilities that EPA estimates will be subject to the final rule and other options considered.

Figure G-1: Other Industries Facilities Estimated Subject to the Existing Facilities Regulation by Employment Size



Source: U.S. EPA, 2000; U.S. EPA Analysis, 2013.

G.1.3 Entity Size

EPA used the Small Business Administration (SBA) small entity-size standards to determine whether small or large entities own the Other Industries facilities. The SBA entity-size criteria define firms as small based on either revenue or number of employees, depending on their NAICS code. EPA estimates that five small entity-owned facilities and eight large entity-owned facilities in the Other Industries facility group will be subject to the 316(b) Existing Facilities regulation.[1]

1 EPA did not have sufficient survey data to determine the size of the entity owning one facility. EPA assumed this facility to be a small entity-owned facility in order to not understate the effect of this rule on small entities.

Appendix H Use of Sample Weights in the Final rule Analyses

EPA used facility-level sample weights to estimate costs and impacts on facilities subject to the final rule (regulated facilities, or, Electric Generators and Manufacturers). For the 316(b) Phase II and Phase III regulations, EPA developed and used facility-level survey sample weights (*original survey weights*) for Electric Generators and Manufacturers based on responses to the 2000 Detailed Industry Questionnaire (DQ), the 2000 Section 316(b) Industry Short Technical Questionnaire (STQ), and the 1999 Industry Screener Questionnaire (ISQ) (316(b) survey), and used these weights in the earlier analyses.[216] For Manufacturers, EPA continued to use these *original survey weights* for the analyses of the proposed and final rules. However, for Electric Generators, because of changes to cost and economic impact methodology, the Agency had to develop a different set of weights (*new facility-level weights*). Specifically, while for some Electric Generators the EPA was able to use the *original survey weights*, for others, the Agency developed new weights to account for different approaches used to analyze facilities that received the DQ and the STQ (*new DQ weights*). Thus, the *new facility-level weights* used for Electric Generators are a combination of the *original survey weights* and the *new DQ weights*. Different weighting approaches used to analyze Electric Generators and Manufacturers provided the basis for development and use of entity-level weights.

For Electric Generators, EPA knows with relative certainty the identity and location of all facilities that will be within the scope of the final rule based on the survey information described above. However, the level of available information varies depending on whether Electric Generators responded to the STQ or the DQ. While EPA had sufficient information to estimate likely compliance response and technology costs for Electric Generators that responded to the DQ, the Agency lacked needed information for Electric Generators that responded to the STQ. For this reason, EPA estimated compliance technology costs for Electric Generators that responded to DQ and used sample weights to extrapolate the costs and other information to the population of all Electric Generators estimated to be within the scope of the final rule. For Manufacturers, the use of sample weights is required because the cost and economic impact analyses are based on a sample of facilities that were surveyed from the total population of facilities that could be within the scope of the regulation. EPA does not know the identity or location of the total population of facilities that would be within the scope of the final rule, but used the sample weights to estimate industry-level costs and impacts *based on the sample of facilities that are used in the regulatory analysis*.[217]

This appendix describes the development and use of sample weights in the cost and economic impact analyses EPA conducted for the final rule. *Section H.1* discusses EPA‟s development and use of facility-level weights and *Section H.2* discusses EPA‟s development of entity-level weights for Electric Generators and Manufacturers. *Section H.3* summarizes the various weighting concepts used in the current analyses and in the relevant chapters of this report.

[216] For more information on the 316(b) survey, refer to the Information Collection Request (U.S. EPA, 2000).

[217] For details on development of compliance costs for Electric Generators and Manufacturers, see *Technical Development Document (TDD)*.

H.1 Facility-Level Weights

H.1.1 Electric Generators

For the facility-level analysis EPA conducted for Electric Generators, EPA used a combination of weights from the earlier 316(b) Phase II and Phase III analyses and sample weights that the Agency developed specifically to support the final rule analyses.

Original survey weights

As described in the regulatory-analysis documents for the earlier 316(b) regulations, EPA collected technical and economic information from 656 electric power facilities expected to be in scope of those regulations through STQ (372 facilities) and DQ (284 facilities) (surveyed facilities). Based on these survey responses, EPA developed facility sample weights to account for 15 additional facilities that did not respond to the DQ or the STQ (survey non-respondents). In general, these *original survey weights* are numerically close to one, as EPA had either DQ or STQ information for 656 facilities out of the 671 facilities presumed to be in scope of the earlier 316(b) regulations.

For the final rule analyses, EPA excluded 73 facilities (76 on a weighted basis) that have retired all steam operations since the 316(b) survey was conducted and 51 facilities (51 on a weighted basis) that EPA expects will retire their steam capacity by 2021, according to the 2011 EIA-860 database published by the Energy Information Administration (EIA) of the U.S. Department of Energy (DOE) (***baseline closures***). For the 532 facilities estimated to have steam operations (544 on a weighted basis), EPA continued to use the *original survey weights* in all analyses *that do not rely on compliance cost information for facilities*, such as the industry profile (see *Chapter 2: Industry Profiles*). In addition, as noted in *Table H-10*, EPA also used these original sample weights for DQ and STQ facilities that are known to have a re-circulating system in their baseline (106 and 109 on unweighted and weighted bases, respectively), California facilities that use coastal and estuarine waters for power plant cooling (14 and 16 on unweighted and weighted bases, respectively), and New York facilities with average intake flow (AIF) of at least 20 million gallons per day (MGD) (26 and 28 on unweighted and weighted bases, respectively).[218,219] These facilities are within the scope of the final rule but are not expected to incur additional technology costs to meet requirements of the final rule. Assigning the *original survey weights* to these DQ and STQ facilities eliminates the need to extrapolate information for the STQ facilities in this facility group.

As described below, however, the Agency had to develop new sample weights for facilities expected to incur compliance technology costs.

New facility-level weights

As discussed above, the *original survey weights* were designed to account for 15 survey non-respondents because in the previous 316(b) rule analyses, EPA developed costs for STQ facilities. To assess cost and economic

218 The States of California and New York already require these facilities to comply with standards at least as stringent as the final rule; thus, EPA does not expect these facilities to install any compliance technology under any of the regulatory options considered in this economic analysis. For the cost and economic impact analyses, these facilities are treated as if they already have re-circulating systems in their baseline.

219 Although EPA does not expect these facilities to incur compliance technology costs, they are within the scope of the final rule and will be subject to various administrative requirements for permitting, monitoring, and compliance reporting. To assess what administrative activities regulated facilities would have to undertake and to develop costs associated with these activities, EPA did not need facility-level technical information as detailed as that required to develop facility-specific compliance technology costs. Therefore, the Agency was able to determine facility-specific administrative requirements and to develop costs associated with these requirements for both DQ and STQ facilities and did not need to develop new sample weights to extrapolate costs and other information from DQ facilities to the STQ facilities.

impacts for the final rule, EPA developed compliance technology costs only for DQ facilities; upon review of the 316(b) survey responses, the Agency concluded that information reported for STQ facilities was insufficient to estimate compliance technology costs. As a result, to extrapolate compliance technology costs from the DQ facilities to the STQ facilities that may need to undertake a specific compliance technology response considered for this rule, EPA had to develop a new set of sample weights – *new DQ weights*. Specifically, EPA used the *new DQ weights* to extrapolate compliance technology costs and other information (e.g., facility counts, generating capacity, DIF) from 167 DQ facilities to 391 DQ and STQ facilities (including 316(b) survey non-respondents represented by these DQ and STQ facilities).[220]

As mentioned above, when developing the *new DQ weights*, EPA set aside 146 DQ and STQ facilities (152 on a weighted basis) with a re-circulating system in their baseline, California facilities that use coastal and estuarine waters for power plant cooling, and New York facilities with AIF of at least 20 MGD. As described above, EPA did not need to develop new sample weights for these facilities; for these DQ and STQ facilities the Agency used *original survey weights*, regardless of whether these facilities responded to the DQ or STQ.[221]

Throughout this document, EPA refers to Electric Generators for which compliance costs – technology and administrative - *were* specifically estimated as the "explicitly analyzed" facilities. The facilities for which compliance costs *were not* specifically estimated are referred to as the "implicitly analyzed" facilities. Thus, *explicitly analyzed* facilities include (1) *all* DQ facilities (227 facilities), (2) STQ facilities with a re-circulating system in the baseline (60 facilities), (3) coastal and estuarine California STQ facilities (11 facilities), and (4) New York STQ facilities with AIF of at least 20 MGD (15 facilities). The implicitly analyzed facilities include all other non-retired STQ facilities (219 facilities) and 12 facilities that did not respond to the 316(b) survey. For the cost and economic impact analyses conducted in support of the final rule, EPA accounted for the implicitly analyzed facilities by applying the appropriate facility-level weights to the findings – e.g., costs, generating capacity, DIF, counts of impact finding – for the explicitly analyzed facilities.

Development of new DQ weights

In developing the *new DQ weights* for the current rule analyses, EPA considered several approaches in attempting to account simultaneously for:

Three Control Variables	*And*	Four Classification Variables
➢ Generating capacity		➢ North American Electric Reliability Corporation (NERC) region
➢ Number of facilities		➢ Capacity/fuel type (coal steam, combined cycle, etc.)
➢ Design intake capacity		➢ Ownership (investor-owned, nonutility, etc.)
		➢ Baseline cooling water intake structure specifications and related compliance requirements (Technology Group)

EPA was unable to develop a single set of weights that accurately accounted for all control variables according to each classification variable, and therefore chose to develop three sets of weights, one based on each of the three control variables. Even with this approach, EPA was unable to develop weights that accurately accounted for facilities in all four classification variables. EPA chose to focus on weights that represented the NERC region classification and compliance requirements as accurately as possible, which are the more important classifications for understanding the economic implications of this action.[222,223]

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220 For details on development of compliance technology costs, see the *TDD*.

221 Facility counts may not add up because of sample weighting.

222 For more details of the approaches considered by EPA see memorandum dated June 18, 2008.

To ensure proper representation of STQ facilities by DQ facilities in terms of compliance response considered under the final rule and other options considered (Compliance Requirements Groups), EPA grouped Electric Generators into three Technology Groups (*Table H-1*). Because of the large number of factors determining compliance response, EPA was unable to account for option-specific compliance response for all analyzed options, while maintaining adequate representation of STQ facilities in each NERC region. Specifically, the Agency did not account for compliance response under Proposal Option 4 and Proposal Option 2. Proposal Option 4 requires only facilities with DIF>50MGD to comply with impingement mortality standards, while Proposal Option 2 requires all facilities to comply with impingement mortality standards and only facilities with DIF>125MGD to comply with entrainment mortality standards. To the extent that the final rule requires all regulated facilities to meet the same set of standards – i.e., only impingement mortality– the outlined weights development framework accounts for option-specific compliance response.

For each control variable (i.e., number of facilities, total steam generating capacity, or total intake flow), EPA developed a weight set that accounts *only* for that control variable in each NERC region and Technology Group.[224] As an example, using facility count-based weights accurately represents the number of facilities in each region and Technology Group, but may misrepresent the region"s total capacity or intake flow. In contrast, using capacity-based weights will accurately represent the total capacity in a given NERC region and compliance group, but will not yield as accurate estimates of the number of facilities and total intake flow. Further, although the underlying set of DQ facilities and the set of STQ facilities on which these weights were developed are the same for each weight set, the weights for any DQ facility generally differ by weight set. Thus, as discussed in the following section, cost estimates and other facility characteristics were weighted based on the concept corresponding to the parameters underlying the cost or characteristic. *Table H-2* presents unweighted and weighted counts of regulated facilities by NERC region.

Table H-1: Technology Groups Used to Develop New DQ Weights

Technology Group		Compliance Requirements	
Has Baseline Recirculating System or Located in California or New York	Water Intake Velocity	Impingement Mortality	Entrainment Mortality Controls
Yes[a]	NA	No Technology	No Technology
No	<=0.5	No Technology	CT Assigned
No	>0.5	IM Assigned[b]	CT Assigned

a. Because these facilities are assumed to be in compliance with the requirements of the final rule and other options considered, EPA did not have to extrapolate compliance costs for these facilities. These facilities are *explicitly analyzed DQ and STQ facilities*.
b. Some facilities in this group already meet impingement mortality requirements and are therefore not assigned technology meant to reduce impingement mortality.
Source: U.S. EPA Analysis, 2013

Table H-2: Unweighted and Weighted Counts of Electric Generators by NERC Region[a]

NERC Region[b]	Counts of Sampled Electric Generators			Weighted Facility Counts Estimated Using[c]	
	DQ	STQ	All	Original Survey Weights	Facility-Count Based Weights
ASCC	0	1	1	1	0
FRCC	13	11	24	24	24
HICC	2	1	3	3	3
MRO	26	34	60	60	63

223 Accounting for NERC regions is particularly important for the electricity rate and household impact analyses (see *Chapter 4: Economic Impact Analysis – Electric Generators*).

224 Because 14 regulated STQ facilities did not have an adequate DQ representation in their respective Compliance Requirements Groups and NERC regions, EPA re-assigned these STQ facilities to the NERC regions with relatively more substantial DQ representation in their Compliance Requirements Groups.

NPCC	25	29	54	59	58
RFC	59	79	138	140	136
SERC	59	75	134	136	141
SPP	14	26	40	40	37
TRE	17	24	41	41	46
WECC	12	25	37	39	36
U.S.	**227**	**305**	**532**	**544**	**544**

a. Counts exclude Electric Generators that have either retired all steam operations are expected to do so by 2021 according to the 2011 EIA-860 database.
b. ASCC – Alaska Systems Coordinating Council; FRCC – Florida Reliability Coordinating Council; HICC – Hawaii Coordinating Council; MRO – Midwest Reliability Organization; NPCC – Northeast Power Coordinating Council; RFC – ReliabilityFirst Corporation; SERC – Southeastern Electric Reliability Council; SPP – Southwest Power Pool; TRE - Texas Reliability Entity, and WECC – Western Energy Coordinating Council.
c. Slight misalignment of facility counts estimated using the original survey weights and facility-count based weights are present because re-assigned 14 regulated STQ facilities did not have an adequate DQ representation in their respective Compliance Requirements Groups and NERC regions to the NERC regions with relatively more substantial DQ representation in their Compliance Requirements Groups.
Source: U.S. EPA Analysis, 2013

Use of new facility-level weights

EPA used different weight sets – *facility-count based*, *capacity-based*, or *DIF-based* – to estimate technology and other compliance-related costs or other regulated facility characteristics according to the primary driver of a given cost element or of a given facility characteristic. For example, facility‟s DIF is the primary driver of technology capital cost. Accordingly, EPA used the *DIF-based weights* for extrapolating technology capital costs from the DQ facility set to all DQ and STQ facilities that may need to undertake a specific compliance technology response. For estimating facility counts and cost elements that are facility count-dependent (e.g., administrative costs), EPA used the *facility count-based weights*.

For facilities for which EPA used the *original survey weights* (i.e., DQ and STQ facilities that are known to have a re-circulating system in place, California facilities that use coastal and estuarine waters for power plant cooling, and New York facilities with AIF of at least 20 MGD, the sample weights are the same regardless of the weight set; they are the *original survey weights*.

Table H-3 provides information on what weights set was used for each compliance cost component.

Table H-3: Weights Applied to Each Cost Component

Weight Set	Cost Component
Capacity-based	Downtime impact costs
	Energy penalty (auxiliary requirements and turbine backpressure)
DIF-based	Capital costs
	O&M costs
Facility count-based	Initial permitting costs
	Annually recurring administrative costs
	Non-Annually recurring administrative costs
	State and federal initial permitting costs
	State and federal annually recurring costs
	State and federal non-annually recurring administrative costs
Source: U.S. EPA Analysis, 2013	

H.1.2 Manufacturers

EPA continued to use the *original survey* weights for the cost and economic impact analyses presented in this document.[225] EPA applied these weights to the Manufacturers that responded to the 316(b) survey to account for

225 These are the same weights as those used in the cost and economic impact analyses conducted in support of the 2006 Final Section 316(b) Phase III Existing Facilities Rule (U.S. EPA, 2006x).

non-sampled facilities and survey non-respondents. The methodology EPA used to develop these weights differs by industry.

Facilities in the Primary Manufacturing Industries, except Food and Kindred Products

As discussed in the earlier 316(b) rule analyses, the *initial* set of Primary Manufacturing Industries – i.e., the set that EPA expected to analyze at the time the 316(b) survey was conducted – did not include Food and Kindred Product industry.[226] The *original survey weights* used to analyze Manufacturers in this initial set of Primary Manufacturing Industries consist of two parallel sets of weights. One set is used for all analyses except for the facility-level economic impact analysis; EPA developed these weights based on the engineering information obtained from the DQ and ISQ and refers to these sample weights as the "technical weights." EPA used the second set of weights - "economic weights" - only for facility-level economic impact analysis; EPA developed these weights based on the economic/financial information received in the DQ and ISQ.

EPA used the *technical weights* to estimate facility counts, total costs, and impacts on *entities* that own regulated facilities. In developing these weights, EPA determined that survey responses for 11 facilities in the *initial* set of Primary Manufacturing Industries lacked certain financial data needed for the facility-level impact analysis. Therefore, EPA developed a second set of weights, the *economic weights*, based on the smaller set of facilities for which the Agency obtained sufficient economic/financial data to support analysis of facility-level impacts. For facilities in those parts of the sample frame from which the 11facilities were removed, the *economic weights* are slightly larger numerically than the corresponding *technical weights*.[227] EPA used the *economic weights*, developed for the slightly smaller facility set (11 fewer sample facilities than in the technical weight set), for the facility-level impact analysis.

Facilities in the Food and Kindred Products industry

As discussed in the earlier 316(b) Phase III rule analyses, EPA received 12 DQ responses from facilities with business operations in the Food and Kindred Products industry, in contrast to the *initial* set of Primary Manufacturing Industries. For the analysis conducted in support of the 2006 Final Section 316(b) Phase III Existing Facilities Rule, EPA included the Food and Kindred Products industry in the set of Primary Manufacturing Industries and used the cooling water usage-based multiplier of 3.11 to estimate the industry-level costs and impacts of Phase III regulatory compliance for the Food and Kindred Products industry. Therefore, these 12 sampled facilities represent 37 facilities in the Food and Kindred Products Industry. For these facilities, *economic weights* are the same as *technical weights*.

For the current analysis, EPA kept the Food and Kindred Products industry in the set of Primary Manufacturing Industries. However, because EPA did not have sufficient survey data for one of these 12 sampled facilities, EPA adjusted both economic weights and technical weights to reflect the fact that only 11 of the 12 facilities provided sufficient information for completing cost and economic impact analyses.

Facilities in Other Industries

In addition to 12 DQ responses from facilities in the Food and Kindred Products industry, EPA received 13 DQ responses from facilities with business operations in industries other than the set of Primary Manufacturing Industries. EPA originally believed these facilities to be non-utility electric power generators; however, inspection

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226 As discussed in the earlier 316(b) analyses, these are the industries on which EPA based the DQ sample frame. These industries are: Aluminum, Chemicals and Allied Products, Food and Kindred Products, Paper and Allied Products, Petroleum Refining, and Steel.

227 Recalculation of sample weights in the affected sample frame cells does not fully offset the loss in the total sample-weighted estimate for *regulated* facilities because the affected sample frame cells include some facilities that EPA estimated would not be within the scope of a 316(b) regulation – e.g., because reported cooling water intake did not meet the minimum coverage requirement. As a result, some of the sample mass for the 11 excluded facilities is reassigned to sample facilities not within the scope of the 316(b) regulation.

of their survey responses indicated that these facilities should be classified as cooling water-dependent facilities whose principal operations lie in businesses other than the electric power industry or the Primary Manufacturing Industries. In the earlier Phase III rule analysis documents, EPA referred to these additional industries as "Other Industries" and their facilities as "Other Industries facilities." [228,229] However, for the purpose of cost and economic impact analysis and discussion of analysis results, EPA refers to any non-generators under the broad terminology of Manufacturers.

Because EPA did not receive the DQ responses for the Other Industries facilities through the structured sample framework, EPA did not apply sample weights to these facilities, and treated them as "additional known facility" observations with a sample weight of one.[230]

Similar to the 11 facilities in the Primary Manufacturing Industries with insufficient data for facility-level impact analysis, three of the 13 Other Industries facilities also did not provide sufficient data for facility-level impact analysis. Therefore, EPA excluded these three facilities from the facility-level economic impact analysis. However, unlike the treatment of the excluded facilities in the Primary Manufacturing Industries, EPA did not reassign the weights of these three facilities to the remaining Other Industries facilities. The reason for this difference is because facilities in the Other Industries are not from a single sector and are considered standalone facilities. Therefore, EPA assessed that it would be inappropriate to reassign the weight from these three facilities to the remaining 10 facilities. For the remaining 10 facilities, the *economic weights* are therefore the same as the *technical weights*.

Summary of Unweighted and Weighted Facility Counts of Manufacturers

Table H-4 presents unweighted counts of Manufacturers that responded to the 316(b) survey and counts of Manufacturers weighted according to the two weighting schemes. Using the *technical weights*, EPA estimated, that 588 facilities (575 facilities in the Primary Manufacturing Industries plus 13 facilities in the Other Industries) will be subject to the final rule. Using the *economic weights*, EPA estimates that 579 facilities (569 facilities in the Primary Manufacturing Industries plus 10 facilities in the Other Industries) will be subject to the final rule.

As described in the following section, EPA subsequently adjusted these counts to exclude baseline closures from the cost and economic impact analysis for Manufacturers subject to the final rule.

228 These industries are: Crop Production, Mining (Except Oil and Gas), Textile Mills, Wood Product Manufacturing, Primary Metal Manufacturing, Transportation Equipment Manufacturing, and Miscellaneous Manufacturing.

229 The 13 facilities in the Other Industries represent only the known, surveyed facilities. EPA did not estimate the total number of facilities in the Other Industries because EPA does not believe that this number can be reliably extrapolated from the sample of known facilities in this group. However, because the statistically valid survey group of industries (i.e., Electric Generators and Manufacturers in the six Primary Manufacturing Industries) reflects 99 percent of total estimated cooling water withdrawals, EPA believes that only a few additional facilities in the Other Industries group potentially may be subject to the final rule.

230 EPA also applied this convention in the earlier 316(b) analyses, including those conducted for the proposed rule.

Table H-4: Manufacturers that Responded to the 316(b) Survey and Sample-Weighted Estimates of Facility Counts

	Technical Weights		Economic Weights	
Sector	**Unweighted**	**Weighted[a]**	**Unweighted**	**Weighted[a]**
Primary Manufacturing Industries	***221***	***575***	***210***	***569***
Aluminum	9	26	9	27
Chemicals and Allied Products	49	179	44	171
Food and Kindred Products	11	37	11	37
Paper and Allied Products	94	225	90	230
Petroleum Refining	29	39	28	36
Steel	29	68	28	68
Other Industries	***13***	***13***	***10***	***10***
Total, All Industries[a]	**234**	**588**	**220**	**579**

a. Both sets of counts are valid statistical estimates of the same, but unknown, number of Manufacturers.
b. Values may not sum to reported totals due to independent rounding.
Source: U.S. EPA analysis, 2013

Development of the Set of Manufacturers for the Cost and Economic Impact Analysis – Excluding Manufacturers Assessed as Baseline Closures

Similar to the earlier 316(b) analyses, EPA removed Manufacturers showing materially inadequate financial performance in the baseline (***baseline closures***) from the cost and economic impact analyses conducted for the final rule. To determine whether Manufacturers in *Table H-4* are at material risk of business failure independent of regulatory requirements, EPA relied on financial information collected through the 316(b) survey.[231]

As discussed above, 14 Manufacturers (33 sample weighted using *technical weights*) did not provide sufficient information for the facility-level financial analysis. Because EPA did not have the information necessary to assess whether these facilities would be baseline closures, the Agency assumed that these 14 facilities (33 on a weighted basis) *would not be* baseline closures for the analyses that use *technical weights*.[232] This assumption has the potential to understate baseline closures and therefore overestimate the number of regulated facilities in each of the analyses that use *technical weights*. As a result, this assumption may lead to overstating costs and entity-level impacts.

Table H-5 reports the results of the baseline closure analysis. Using the *technical weights*, EPA assessed 67 facilities as baseline closures. Using the *economic weights*, EPA assessed 70 facilities as baseline closures. These facilities are removed from the subsequent cost and economic impact analyses of the final rule and other options considered.

Table H-6 presents weighted and unweighted counts of Manufacturers included in the cost and economic impact analyses conducted for the final rule and discussed in this report – i.e., after excluding the baseline closures reported in *Table H-5*. Using the *technical weights*, EPA estimates that 521 facilities (509 facilities in the Primary Manufacturing Industries plus 12 facilities in the Other Industries) are subject to the final rule. Using the *economic weights*, EPA estimates that 509 facilities (500 facilities in the Primary Manufacturing Industries plus nine facilities in the Other Industries).

231 For details of this analysis, see *Chapter 5: Economic Impact Analysis – Manufacturers*.

232 This assumption has the potential to understate baseline closures and therefore overestimate the number of regulated facilities in the analyses that use technical weights. As a result, this assumption may lead to overstating entity-level impacts (*Chapter 4* and *Chapter 10*).

Table H-5: Manufacturers Assessed to be Baseline Closures

Sector	Technical Weights		Economic Weights	
	Unweighted	Weighted	Unweighted	Weighted
Primary Manufacturing Industries	***27***	***66***	***27***	***69***
Aluminum	1	3	1	3
Chemicals and Allied Products	1	4	1	4
Food and Kindred Products	1	3	1	3
Paper and Allied Products	13	31	13	33
Petroleum Refining	4	4	4	4
Steel	7	20	7	21
Other Industries	***1***	***1***	***1***	***1***
Total, All Industries[a]	***28***	***67***	***28***	***70***

a. Values may not sum to reported totals due to independent rounding.

Source: U.S. EPA analysis, 2013

Table H-6: Manufacturers Included in Cost and Economic Impact Analyses – After Exclusion of Baseline Closures

Sector	Technical Weights		Economic Weights	
	Unweighted	Weighted	Unweighted	Weighted
Primary Manufacturing Industries	***194***	***509***	***183***	***500***
Aluminum	8	22	8	24
Chemicals and Allied Products	48	175	43	167
Food and Kindred Products	10	34	10	34
Paper and Allied Products	81	194	77	197
Petroleum Refining	25	35	24	31
Steel	22	48	21	47
Other Industries	***12***	***12***	***9***	***9***
Total, All Industries[a]	***206***	***521***	***192***	***509***

a. Values .may not sum to reported totals due to independent rounding.

Source: U.S. EPA analysis, 2013

H.2 Entity-Level Weights

In addition to developing and using facility sample weights for the facility-level analysis, EPA also needed to perform certain analyses at the level of the entity that owns regulated facilities. EPA performed these entity-level analyses to meet Regulatory Flexibility Act (RFA) requirements (*Chapter 10*), which apply to small entities that own regulated facilities, and for the entity-level cost-to-revenue analyses that were performed regardless of entity size classification (*Chapter 4* and *Chapter 5*). Because facility-level sample weights do not apply at the level of the entity and do not account for entity characteristics, such as the profile of entity ownership of regulated facilities, EPA needed to develop sample weighting approaches for estimating entity-level costs, impacts, and affected entity-level counts according to various classifications. These entity-level sample weighting approaches are generally not as precise in their estimation concepts as the facility-level sample weights. As described below, the entity-level weights generally provide ranges of results based on specific assumptions about the profile in which entities own regulated facilities – e.g., how many regulated facilities does an individual entity own? and what level of costs will the entity incur based on the number and profile of regulated facilities that the entity owns?

H.2.1 Electric Generators

In addition to facility-level weights (*Section H.1.1*), EPA also developed sample weights at the parent-entity level for estimating cost and economic impacts on parent entities that own Electric Generators. This allowed EPA to extend entity-level analyses from entities that own explicitly analyzed facilities, to the estimated population of parent entities that own explicitly *and* implicitly analyzed facilities. These entity-level weights are necessary because parent entities that own *only* implicitly analyzed facilities (implicitly analyzed entities) would not be accounted for by an analysis that focuses only on explicitly analyzed facilities and, as a result, only on their parent entities (explicitly analyzed entities). As the result, such analysis may understate the absolute number of parent entities affected by the final rule and other options considered. The use of entity-level weights allows EPA to estimate more precisely the impacts on entities owning only implicitly analyzed facilities by taking into account important entity characteristics (such as business size and type) in the development of the weights.

Development of entity-level weights

To develop entity-level weights, EPA first identified entities that currently own 532 analyzed surveyed DQ and STQ facilities. For each identified parent entity, the Agency then determined ownership type – such as privately owned, municipality, co-operative, etc. – and whether the owning parent entity would be classified as a small entity based on Small Business Administration (SBA) entity size criteria. EPA developed entity-level weights in accordance with this classification framework – by entity-ownership type and by entity size classification. *Table H-7* presents number of analyzed sampled DQ and STQ facilities and their parent entities by entity ownership type and size for entities that own at least one explicitly analyzed facility and for all entities.

Table H-7: Counts of Regulated Facilities and their Parent Entities by Entity Type and Size

Parent Entity Type	Small Entity Size Standard	Number of Parent Entities[a,b,c]			Number of Facilities		
		Large	Small	Total	Large	Small	Total
Parent Entities Owning at Least One Explicitly Analyzed Facility							
Rural Electric Cooperative	4,000,000 MWh output	12	1	13	14	1	15
Federal	assumed large	1	0	1	6	0	6
Investor-Owned Utilities	4,000,000 MWh output	49	8	57	196	9	205
Municipality	50,000 population served	8	7	15	8	7	15
Nonutility	4,000,000 MWh output	19	4	23	33	3	36
Other Political Subdivision	50,000 population served	4	0	4	5	0	5
State	assumed large	3	0	3	5	0	5
Total		**96**	**20**	**116**	**267**	**20**	**287**
All Known Parent Entities– i.e., Parent Entities Owning Only Implicitly Analyzed Facilities *or* at Least One Explicitly Analyzed Facility[d]							
Rural Electric Cooperative	4,000,000 MWh output	15	7	22	27	7	34
Federal	assumed large	1	0	1	12	0	12
Investor-Owned Utilities	4,000,000 MWh output	54	9	63	350	15	365
Municipality	50,000 population served	19	18	37	29	18	47
Nonutility	4,000,000 MWh output	22	5	27	52	5	57
Other Political Subdivision	50,000 population served	5	1	6	10	1	11
State	assumed large	3	0	3	6	0	6
Total		**119**	**40**	**159**	**486**	**46**	**532**

a. EPA was unable to find entity revenue values needed to determine the size of five entities; consequently, EPA used the total revenue for all regulated facilities owned by these entities to determine entity size.
b. EPA was unable to determine size of two parent entities and assumed that this entity was small.
c. Ten surveyed DQ and STQ facilities are owned by joint ventures of two entities.
d. These counts are unweighted estimates and reflect the known universe of facilities (i.e., facilities that responded to DQ and STQ) and their parent entities.
Source: U.S. EPA Analysis, 2013

EPA developed the entity-level weights for each combination category of *entity size* and *entity type* by dividing the number of parent entities at the total population level (i.e., parent entities owning at least one explicitly analyzed facility *and* parent entities owning only implicitly analyzed facilities) by the number of parent entities owning at least one explicitly analyzed facility (*Table H-8*). Applying these entity-level weights to the number of explicitly analyzed entities yields an estimate of the number of parent entities that includes implicitly-analyzed entities.

Table H-8: Entity-Level Weights and Weighted Entity Counts

Parent Entity Type	Entity Weights			Weighted Entity Counts		
	Small	Large	Total	Small	Large	Total
Rural Electric Cooperative	7.00	1.25	1.69	7	15	22
Federal	0	1.00	1.00	0	1	1
Investor-Owned Utilities	1.13	1.10	1.11	9	54	63
Municipality	2.57	2.38	2.47	18	19	37
Nonutility	1.25	1.16	1.17	5	22	27
Other Political Subdivision[a]	1.00	1.25	1.50	0	5	6
State	0	1.00	1.00	0	3	3
Total	**2.00**	**1.24**	**1.37**	**39**	**119**	**159**

a. One entity in the other political subdivision category owns only implicitly analyzed facilities (*Table H-78*); consequently, there is no explicitly analyzed entity to represent this implicitly analyzed entity and weighted entity counts do not include one small entity in the *other political subdivision* ownership category.
Source: U.S. EPA Analysis, 2013

Application of entity-level weights

EPA used entity-level weights to assess impacts on owning entities as part of the general cost and economic impact analysis (*Chapter 4*) and in the RFA analysis (*Chapter 10*). Thus, the findings of impacts to entities owning explicitly analyzed facilities (i.e., the number of parent entities in a given impact category) were extrapolated to entities owning implicitly analyzed facilities with the same characteristics by multiplying by the appropriate weight.

EPA conducted the entity-level impact analyses discussed in *Chapter 4* and *Chapter 10* using two weighting approaches: (1) using only *new facility-level weights* and (2) using only *entity-level weights*. The Agency notes that using only facility-level weights may *overstate* the impact on a given entity while *underestimating* the number of entities in each impact category, while using only entity-level weights may *understate* the impact on an individual entity while *accounting more accurately* for the total number of entities that own regulated facilities. For this reason, EPA conducted entity-level analyses using both of these weighting concepts. Using neither facility-level weights nor entity-level weights would likely *underestimate both* the number of facilities that may be owned by a parent entity and associated compliance costs *and* the number of parent entities that own regulated facilities. EPA chose not to combine the entity-level weights with the facility-level weights, because this has the potential to *overestimate both* the number of facilities owned by a parent entity and associate costs and the number of entities that own regulated facilities. The relevant chapters present more information on how EPA used entity-level weights in the analysis.

H.2.2 Manufacturers

Similar to Electric Generators, in addition to facility-level weights (*Section H.1.2*), EPA also developed sample weights at the parent-entity level for estimating cost and economic impacts on parent entities that own Manufacturers. This allowed EPA to extend entity-level analyses from entities that own surveyed facilities to the estimated population of parent entities that own all regulated facilities. As discussed in *Chapter 5*, the entity-level analysis goes beyond the facility-level analysis to assess whether entities that own regulated facilities may incur impacts at the level of the entity in a way that is not revealed by the facility impact analysis. EPA‟s sample-based facility analysis supports specific estimates of (1) the number of regulated facilities and (2) the total compliance costs expected to be incurred by these facilities. However, the sample-based analysis does not support specific estimates of the number of entities that own these facilities. In addition, the sample-based analysis does not support specific estimates of the number of regulated facilities that may be owned by a single entity, or the total of compliance costs across regulated facilities that may be owned by a single entity. The use of entity-level weights allows EPA to more precisely estimate the impacts on entities owning not only the surveyed Manufacturers, but the entire population of regulated facilities.

Development of Entity-Level Weights

As discussed in *Chapter 5*, for the entity-level analysis conducted for Manufacturers, EPA considered two weighting cases based on facility-level *technical weights* developed from the 316(b) survey.[233] These cases provide approximate upper and lower bound estimates on: (1) the number of entities that own Manufacturers and therefore, incur compliance costs and (2) the number of facilities owned and consequently, costs incurred by any parent entity.[234] These weighting cases are as follows:

Case 1: Lower bound estimate of number of entities that own regulated facilities; upper bound estimate of number of regulated facilities that an entity may own and of total compliance costs that an entity may incur.

For this case, EPA assumed that any entity that owns a regulated sample facility(ies), owns the known sample facility(ies) and all of the sample weight associated with the sample facility(ies). This case minimizes the number of affected entities, because the weight for each known affected entity is 1, while maximizing the number of facilities any single entity may own. This also maximizes the potential cost burden to that entity, because EPA assumed that entities own all facilities represented by the sample weights of the facility(ies) they are known to own.

Case 2: Upper bound estimate of number of entities owning facilities that face requirements under the regulation; lower bound estimate of total compliance costs that an entity may incur.

For this case, EPA inverted the prior assumption and assumed that (1) an entity owns only the regulated sample facility(ies) that it is known to own from the sample analysis and (2) this pattern of ownership, observed for sampled facilities and their parent entities, extends over the facility population represented by the sample facilities. In this case, the entities are weighted based on the weight(s) of the facility(ies) they own. This case minimizes the possibility of multi-facility ownership by a single entity and thus maximizes the count of affected entities. It also minimizes the number of facilities any single entity may own and consequently, the potential cost burden to that entity.

EPA assumed that none of the entities that own one sample facility own more than one facility. In this case, the analysis is straightforward: the entity owns one regulated facility. EPA assumed that this configuration exists as many times as the facility‟s sample weight and entity-level weight is the same as facility-level weight. However, EPA found that 29 percent of the entities identified as owning a sample facility, own more than one sample facility. Where the multiple facilities owned by the same entity have the same sample weight, the analysis is also straightforward. EPA assumed that the entity owns the sample facilities that it *is known* to own and that this configuration exists as many times as the uniform sample weight of the multiple facilities. Therefore, in this case, entity-level weight is the same as the uniform facility-level weight.

In some instances, however, the sample facilities that are owned by the same entity have different sample weights. These cases required a more complex analysis. EPA accounted for the ownership of multiple sample facilities by a single entity, but restricted the count of the multiple facilities and their configuration of ownership for the entity-level cost analysis based on the sample weights of the individual sample facilities. Specifically, EPA assumed that the *entity* exists on a sample-weighted basis as many times as the *highest* of the sample weights among the sample facilities known to be owned by the entity. However, sample facilities with a smaller sample weight, *and their compliance costs*, can be included in the total instances of ownership by the entity for only as many times as their

233 As summarized in *Table H-4,* 14 facilities did not provide sufficient data for the facility impact analysis; however 11 of these facilities provided sufficient data for estimating compliance cost, as needed for the entity-level analysis. Therefore, for the entity-level analysis, EPA used *technical weights* and excluded three facilities with insufficient data and facilities they represent through *technical weights*.

234 The application of sample weights in the entity-level analyses for Manufacturers is the same as that used in the earlier 316(b) Phase III rule analyses.

sample weights. Otherwise, the total facility count implied in the entity analysis would exceed the sample-based estimated total of facilities. For implementation, this concept means that *all* of the sample facilities known to be owned by the same entity can be included in the ownership configuration for only as many sample weighted instances as the smallest sample weight among the multiple facilities owned by the entity. Once the sample weight of the smallest sample weight facility is "used up," a new multiple facility ownership is configured. This configuration includes only facilities with weights greater than the weight of the smallest sample weight facility. EPA assumed that this configuration exists for as many sample weighted instances as the difference between the lowest sample weight and the next higher sample weight among the facilities owned by the entity. EPA repeated this process– with successive removal of the new lowest sample weight facility – as many times as necessary until only the highest sample weight facility remains in the ownership configuration. This process yields a set of configurations, with estimated sample occurrence, in which varying numbers of facilities are assigned to the same entity. These configurations are assumed to exist as many times as the assigned numbers of facilities; therefore, the assigned facility counts be become entity-level weights.

Table H-9 presents unweighted and weighted entity counts by industry. EPA estimates that between 120 and 337 entities own regulated facilities. Of these entities, between 110 and 327 entities own regulated facilities in the Primary Manufacturing Industries (including entities that own multiple facilities) and 10 entities own regulated facilities in the Other Industries.

Table H-9: Parent Entities of Manufacturers Included in Cost and Economic Impact Analyses

Sector	Unweighted	Weighted[a]
Primary Manufacturing Industries	***110***	***327***
Aluminum	4	11
Chemicals and Allied Products	30	121
Food and Kindred Products	6	20
Paper and Allied Products	37	104
Petroleum Refining	16	25
Steel	13	32
Multiple	4	14
Other Industries	***10***	***10***
Total, All Industries[a]	***120***	***337***

a. Counts developed based on facility-level *technical weights*.
b. Values may not sum to reported totals due to independent rounding.
Source: U.S. EPA analysis, 2013

Application of entity-level weights

EPA used entity-level weights to assess impacts on owning entities as part of the general cost and economic impact analysis (*Chapter 5*) and in the RFA analysis (*Chapter 10*). EPA conducted the entity-level impact analyses discussed in *Chapter 5* and *Chapter 7* using two weighting approaches – Case 1 and Case 2 – discussed above. The Agency notes that using the "Case 1" weighting approach may *overstate* the impact on a given entity while *underestimating* the number of entities in each impact category, while using "Case 2" weighting approach may *understate* the impact on an individual entity while potentially *accounting more accurately* for the total number of entities that own regulated facilities. For this reason, EPA conducted entity-level analyses using both of these weighting approaches and presented results for entity-level analyses as a range. The relevant chapters present more information on how entity-level weights were used in the analysis.

H.3 Summary

Table H-10 summarizes EPA‟s use of weights in each of the analyses the Agency conducted for Electric Generators and Manufacturers.

Table H-10: Use of Weights in the Cost and Economic Impact Analysis for the Final Rule		
Chapter	**Weights Used**	
	Electric Generators[a]	**Manufacturers**[b]
2: Industry Profile	➢ Original survey weights	➢ Original survey weights (T)
3: Compliance Cost Assessment	➢ New facility-level weights[c]	➢ Original survey weights (T)
4 and 5: Cost and Economic Impact Assessment ➢ Facility-Level Analysis	➢ New facility-level weights ➢ *Original survey weights* for short-term reliability assessment.	➢ Original survey weights (E)
➢ Entity-Level Analysis	➢ *New facility-level weights*, without using *entity-level weights* ➢ *Entity-level weights*, without using *new facility-level weights*	➢ Original survey weights (T)
7: Market Model Analysis	➢ No weights[d]	➢ Not included
8: Social Cost Assessment	➢ New facility-level weights	➢ Original survey weights (T)
9: Cost and Benefits	➢ *New facility-level weights* used in Social Cost Assessment	➢ Original survey weights (T)
10: Employment Effects	➢ *New facility-level weights* used in Social Cost Assessment	➢ Original survey weights (T)
11: Regulatory Flexibility Act (RFA) Analysis	➢ New facility-level weights ➢ *Entity-level weights*, without using *new facility-level weights*	➢ Original survey weights (T)
12: Unfunded Mandates Reform Act (UMRA) Analysis	➢ *New facility-level weights* for impacts to facilities owned by governments and small governments ➢ *No weights* when only entity and facility counts are presented without associated cost estimates	➢ Original survey weights (T)
13: Other Administrative Requirements	➢ New facility-level weights ➢ *No weights* for E.O. 13211: Energy Effects	➢ Original survey weights (T)

a. "DQ" refers to the Detailed Questionnaire.
b. Manufacturers survey sample weights consist of two sets, one used for economic impact analysis (denoted by an E), and another set used for all other analyses (denoted by a T). For details on these two weight sets, see *Section H.1.2*.
c. *New facility-level* weights are a combination of the *original survey weights* used for facilities with re-circulating systems in the baseline, coastal California facilities, and New York facilities with DIF of at least 20 MGD and the *new-DQ weights* used for all other facilities. For details on these weights, see *Section H.1.1*.
d. "No weights" means that the analyses in a chapter do not use weights.
Source: U.S. EPA Analysis, 2013

Appendix I Energy Requirements to Install and Operate Compliance Technology

As discussed in *Chapter 3: Compliance Costs*, in addition to accounting for capital costs, pilot study, and O&M costs, which were estimated as specific dollar values for each facility, EPA accounted for two technology-related operating effects that translate into a revenue and/or cost impact on facilities:

- *Energy penalty.* Energy penalty effects arise from two factors: (1) an increase in auxiliary power required to operate an assigned compliance technology and (2) a reduction in the energy conversion efficiency of the power generating system, which occurs with operation of retrofitted recirculating system compliance technologies. Depending on facility type and baseline operating circumstances, the combination of these effects (referred to as the "energy penalty") is assessed as (1) a reduction in the generated electricity that is available for sale or use or (2) an increase in the production cost of sold electricity. The energy penalty effect is discussed in *Section I.1*.
- *Installation downtime.* Installation of certain compliance technologies will require a one-time, temporary downtime period for the facility; costs associated with this connection outage are discussed in *Section I.2*.

The *Technical Development Document (TDD)* details the methodology EPA used to develop facility-level cost estimates for the final rule and other options EPA considered.

I.1 Energy Penalty

For regulatory options in which facilities could be assigned cooling towers, EPA assessed the energy penalty as a permanent reduction in the electricity generation efficiency of affected generating units: for a given level of energy input to the generating unit, the quantity of electricity that is available to be sold for revenue or otherwise used by the power generator for onsite services (e.g., electricity for onsite offices) is reduced. As described above, the energy penalty assessed in this analysis includes two effects:

- *Increased auxiliary power requirement*. Cooling towers require some of the facility‟s electricity output to operate the compliance technology (e.g., pumps and fans). This effect manifests itself as a reduction in produced power that is available for sale, given a baseline level of power generation. This effect is more substantial for entrainment control (cooling tower) technology than for IM technologies. For the analysis of cooling tower installations, EPA assessed the auxiliary power requirement as a percentage reduction in the generating capacity and electric generating output for any given level of energy input. For the analysis of IM technologies, the cost of the auxiliary power requirement was included in the estimated cost of technology O&M.
- *Reduction in unit generating efficiency.* Operation of retrofitted recirculating or dry cooling systems causes an increase in turbine back-pressure, which reduces the amount of electricity that is produced by the generating unit for the same energy input. For this analysis, the reduction in unit generating efficiency was also assessed as a percentage reduction in the generating capacity and electric generating output for any given level of energy input.

EPA accounted for energy penalty effects for Electric Generators and Manufacturers using two different methodologies.

I.1.1 Electric Generators

EPA assessed the impact of the energy penalty differently for Electric Generators depending on the type of generating unit affected and the unit‟s baseline operating circumstances in terms of capacity utilization:

- For generating units that operate at high capacity utilization (namely, nuclear units and base load fossil fuel units with capacity utilization exceeding 62 percent), EPA assumed that the energy penalty will manifest as a loss in generating capacity available for revenue generation. As a result, the financial effect of the energy penalty is to reduce the revenue otherwise received by the generating unit, but with no change in the cost of energy inputs to the generating unit.
- For units that operate at lower capacity utilization (i.e., less than or equal to capacity utilization rate of 62 percent), EPA assumed that the energy penalty effect can be offset by increasing the energy input to the unit, thereby avoiding a loss in revenue. In this case, although the generating unit does not lose revenue, the cost of generating electricity for sale from the unit will increase, and the financial effect is a reduction in the operating margin for electricity sales from the affected unit.

Regardless of the method for accounting for the energy penalty effect, EPA combined the separate operating effects to yield the total energy penalty effect as follows:

$$Energy\ Penalty = Aux.\ Requirement + Eff.\ Loss + \left(Aux.\ Requirement \times Eff.\ Loss\right) \qquad \text{(I-1)}$$

Where:

Energy Penalty	=	Total percentage loss in generating unit production capability for a given level of energy input to the generating unit
Aux. Requirement	=	Energy required for operation of the compliance technology, as a percentage of baseline generating unit capacity
Eff. Loss	=	Reduction in generating unit energy conversion efficiency, as a percentage of baseline generating unit capacity.

EPA estimated that for Electric Generators installing cooling towers under Proposal Option 2, *increased auxiliary power requirements* will vary by facility, ranging from 0.1 to 3.2 percent of baseline steam generating capacity. EPA estimated *unit generating efficiency loss* as 1.5 percent and 2.5 percent of baseline steam generating capacity for each non-nuclear and nuclear facility assigned a cooling tower, respectively. As described above, the Agency assumed that nuclear Electric Generators and non-nuclear Electric Generators with capacity utilization rate exceeding 62 percent will not to be able to increase their electricity generation to make up this efficiency loss on site.[235] EPA accounted for energy penalty at these regulated facilities, as revenue loss – i.e., revenue was reduced by the amount of the *energy penalty* percentage as follows:

$$Adjusted\ Revenue\ (\$) = Baseline\ Revenue\ (\$)\ x\ (1 - Energy\ Penalty\ (\%)) \qquad \text{(I-2)}$$

EPA assumed that all other Electric Generators would have sufficient excess generating capacity to be able to make up the potential loss in electricity generation on site. For these facilities, EPA accounted for the energy penalty effect as an increase in variable production costs, i.e., fuel and other variable O&M costs as follows:

235 To make up the reduction in electricity generation at these regulated facilities and ensure adequate electricity supply in the United States, other electric power facilities supplying to the grid would have to increase their electricity production.

$$Variable\ Production\ Costs\ (\$) = Fuel\ Costs\ (\$) + Variable\ O\&M\ Costs\ (\$) \qquad \text{(I-3)}$$

and

$$Adjusted\ Variable\ Production\ Costs = \frac{Variable\ Production\ Costs}{(1 - Energy\ Penalty\ (\%))} \qquad \text{(I-4)}$$

EPA estimated facility-specific annual average variable production costs and baseline revenue as follows:

- *Variable production costs:* To estimate average annual variable costs, EPA relied on data published by the U.S. Department of Energy (DOE), Energy Information Administration (EIA) and projections from the Integrated Planning Model (IPM). Using IPM data, the Agency first calculated average annual variable cost values – fuel and variable O&M – on a per-unit of generated electricity basis (MWh) by North American Electric Reliability Council (NERC) region and/or fuel type for each IPM data year – 2015, 2020, and 2030.[236] EPA then calculated facility-level steam generation as a 5-year average of steam net generation values reported in the EIA-906/920/923 database for 2007 through 2011.[237] Finally, the Agency estimated facility-specific average annual variable production costs as the product of (1) the 3-year average of variable unit costs (calculated for 2015, 2020, and 2030), in accordance with the NERC region of and/or fuel type used by a given facility, and (2) facility-level 2007-2011 average steam net generation.
- *Baseline revenue*: To estimate average annual revenues, EPA used prime mover-level data on net electricity generation from the EIA-906/920/923 database and utility-level electricity sales quantity and revenue data from the EIA-861 database. EPA used the utility-level revenue and sales quantity data to estimate electricity prices (revenue per MWh of sales) for each Electric Generator. As the measure of price, EPA used the 5-year average of total (retail and wholesale) prices (e.g., total revenue per MWh of total sales) for 2007 through 2011. For the measure of facility-specific generating output, EPA used the same 5-year average steam net generation values as used to estimate variable costs. To estimate the amount of generated electricity sold, EPA first estimated the share of total power disposition sold through both retail and wholesale operations for each facility using EIA-861 data as a 2007 to 2011 average. EPA then used these shares to adjust facility-specific steam generation. Finally, the Agency estimated facility-specific average annual baseline revenue as a product of (1) the adjusted steam generation and (2) prices.

EPA used the GDP Deflator series to restate the resulting variable cost and revenues in 2011 dollars.

I.1.2 Manufacturers

EPA used a different methodology to assess the impact of the *energy penalty* for Manufacturers than that used for Electric Generators because of data constraints and differences in the operating characteristics of these facilities. EPA estimated that for Manufacturers *increased auxiliary power requirements* range from 0 to 9.78 MW[238] and that *unit generating efficiency loss* is the same as for non-nuclear Electric Generators, i.e., 1.5 percent of baseline

[236] EPA used IPM to assess the impact of the final rule and other options considered in development of this rule on the electric power market as a whole. For details on this analysis see *Chapter 7: Electricity Market Analysis*. To estimate average annual variable production costs EPA used the version 4.10 MATS IPM platform.

[237] In using the year-by-year revenue values to develop an average over the data years, EPA set aside from the average calculation, generation values that are anomalously low. Such low generating output likely results from temporary disruptions in operation, such as a generating unit being out of service for maintenance.

[238] Of the 588 Manufacturers, only seven have increased auxiliary power requirements exceeding five MW.

steam generating capacity. [239,240] The capacity required to meet increased auxiliary power needs represents, on average, approximately 3.2 percent of baseline electric generating capacity at facilities, with a maximum of 48.5 percent of baseline generating capacity.

Because Manufacturers are not, by definition, *primarily* in the business of generating electricity for sale, the energy penalty can affect Manufacturers in ways that differ from Electric Generators. Depending on the specific operating circumstances of a given Manufacturer, the energy penalty effect on Manufacturers includes:

- Reduced production of electricity for sale to external consumers – i.e., via the power grid – with loss of revenue to the Manufacturer,
- Reduced production of electricity for consumption by the Manufacturer with a resulting requirement to purchase electricity to offset the lost production,
- Requirement to purchase electricity for meeting the auxiliary energy needs – even though the facility does not generate any of its own electricity.

To analyze the energy penalty effect for Manufacturers, EPA used the following information from the 316(b) survey: (1) whether the facility has generating capacity and generates electricity for its own consumption and/or external sale; (2) electric generating capacity; (3) total generation; (4) total sale of electricity (quantity and value) generated by the facility, if any; (5) total consumption of electricity generated by the facility; and (6) cost of electricity generation in terms of fuel consumption and other variable electric generation costs. When data were reported for more than one of the three survey years – 1996, 1997, and 1998 – EPA used the average of these values as facility-level values for this analysis.[241,242]

In reviewing the 316(b) survey responses, EPA found that some facilities reported information on the quantity of electricity generated but did not report electric generating capacity. EPA used a different methodology to estimate energy penalty effect for these facilities than that used for facilities that reported generating capacity, as described below.

Table I-1 presents five analysis cases for assessing the effect of the energy penalty on Manufacturers, based on the three impact cases described above and the availability of generating capacity information from the 316(b) survey.

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239 For five facilities assigned an energy efficiency loss, the survey did not provide total generation or capacity information and therefore EPA could not calculate the loss in generation or the cost associated with that loss in generation. EPA believes this cost to be relatively minor in significance.

240 For a detailed discussion of the development of these energy penalty values, see the *TDD*.

241 For 26 Manufacturers facilities, information received from the survey indicated that a facility‟s total generation was higher than would be feasible for the facility‟s reported generating capacity, even when operating at full output for all hours in a year. This indicates a reporting error. EPA was not able to assess whether firms erred in their reporting by overstating total generation or by understating capacity. For these facilities, EPA used the total generation value in assessing the energy penalty. EPA recognizes that this may lead to an overstatement of the energy penalty value, to the extent that facilities erred in their reporting of total generation.

242 Some facilities did not report generating capacity at the facility level but instead, reported the values by generating unit. In these instances, EPA used the sum of the reported unit-level capacity values.

Table I-1: Summary of Cases for Analyzing Impact of Energy Penalty on Manufacturers

Case	Electricity Generation/ Sales Status	Generating Capacity and Generation Data Provided	Analytic Treatment
1	Facility generates and sells electricity to grid	Generating capacity, and annual generation and sales quantities provided	1. Convert *auxiliary power requirement* (MW) to percentage capacity loss value (%) by dividing *auxiliary requirement* by baseline generating capacity 2. Combine *auxiliary requirement* (%) and *efficiency loss* (%) to calculate *energy penalty* (%) using Equation (I-1) 3. Multiply *energy penalty* (%) by total steam generation (MWh) to obtain *energy penalty* (MWh) 4. Calculate *revenue loss* component ($) of *energy penalty* as a loss in revenue from electricity sales ($) by multiplying *energy penalty* (MWh), but not to exceed the facilities" sales quantity (MWh), times the average unit price received for electricity sales ($/MWh) 5. Calculate *electricity purchase* value component ($) of *energy penalty* by multiplying the quantity of *energy penalty* (MWh) that exceeds electricity sales *by* electricity price ($/MWh). This value will $0 if the *energy penalty* is less than or equal to the total quantity of electricity sales 6. Sum *revenue loss* component ($) and *electricity purchase* value component ($) to yield *energy penalty* ($) (see equation (I-6))
2	Facility generates and sells electricity to grid	Generating capacity information not provided; annual generation and sales quantities provided	Same as Case 1, except that facility does not report electric generating capacity. 1. Convert *auxiliary power requirement* (MW) to *auxiliary energy requirement* (annual generation loss, in MWh), under assumption that the MW capacity requirement occurs for all hours of year (see equation (I-5)) 2. Multiply *efficiency loss* (%) times total steam generation to obtain associated generation loss (MWh) 3. Sum *auxiliary energy requirement* (MWh) and *efficiency loss* (MWh) to obtain total generation loss, or *energy penalty* (MWh) 4. Calculate *revenue loss* component ($) of *energy penalty* as a loss in electricity sales revenue ($) by multiplying *energy penalty* (MWh), up to the facilities" sales quantity (MWh), times the average unit price received for electricity sales ($/MWh) 5. Calculate *electricity purchase* value component ($) of *energy penalty* by multiplying the quantity of *energy penalty* (MWh) that exceeds electricity sales by electricity price ($/MWh) –this value will $0 if Total Penalty is less than or equal to total quantity of electricity sales 6. Sum *revenue loss* component ($) and *electricity purchase* value component ($) to yield *energy penalty* value ($) (see equation (I-6))
3	Facility generates electricity but does not sell electricity	Generating capacity, and annual generation and sales quantities provided	Same as Case 1 except that, since the facility does not sell electricity, the *revenue loss* component ($) of *energy penalty* will be equal to $0.
4	Facility generates electricity but does not sell electricity	Generating capacity information not provided; annual generation and sales quantities provided	Same as Case 2 except that, since the facility does not sell electricity, the *revenue loss* component ($) of *energy penalty* will be equal to $0.
5	Facility does not generate electricity	NA	Same as Case 4, in that the *energy penalty* is considered an electricity purchase value. 1. Calculate *energy penalty* (MWh) by converting *auxiliary requirement* (MW) to annual generation loss value due to *auxiliary requirement* (MWh), under assumption that the MW capacity requirement occurs for all hours of year (see equation (I-5)) 2. Calculate the *energy penalty* value ($) by multiplying the *energy penalty* (MWh) by electricity price ($/MWh) (see (I-6))

As mentioned above, for Cases 2, 4 and 5, EPA used a different method to calculate the *auxiliary energy requirement*:

$$Aux.\ Requirement\ (MWh) = Aux.\ Requirement\ \ (MW) \times 8{,}760 \qquad \text{(I-5)}$$

Where:

Aux. Requirement (MWh) = Annual energy requirement for operating the compliance system

Aux. Requirement (MW) = Capacity required for operation of the compliance system, measured in MW

Energy Conversion = EPA assumed that facilities experience constant electricity demand for compliance system operation for all hours of the year and therefore calculated the auxiliary energy requirement by multiplying the capacity requirement by 8,760 hours (365 days times 24 hours per day).

EPA applied the following equation to each of the facilities, regardless of case, to determine the *value* of the Total Penalty:

$$Energy\ Penalty\ (\$) = En.\ Pen._{\leq ES} \times Elec.\ Rev. + En.\ Pen._{>ES} \times Elec.\ Price \tag{I-6}$$

Where:

Energy Penalty ($) = The economic value of the energy penalty, reported in 2011 dollars

$En.\ Pen._{\leq ES}$ = The portion of the energy penalty that is less than or equal to the facility"s *Electricity Sales* (see below), for facilities that do not sell electricity this value is zero

Electricity Sales = Facility-level electricity sales; these values are a simple 3-year average of values reported in the 316(b) survey for 1996, 1997, and 1998.

Elec. Revenue = Facility-level revenue from electricity sales per MWh of electricity sales; these values are a simple 3-year average of values reported in the 316(b) survey for 1996, 1997, and 1998 and restated in 2011 dollars, divided by a simple 3-year average of electricity sales reported in the 316(b) survey

$En.\ Pen._{>ES}$ = The portion of the energy penalty that exceeds a facility"s electricity sales, for facilities that do not sell electricity this value is equivalent to *energy penalty*

Elec. Price = EIA-reported electricity prices for the industrial sector, by state, for the year 2011 measured in $/KWh.

Cost of Energy Penalty to Society

The primary cost of Manufacturers energy penalty – to facilities and society – results from the replacement of electricity otherwise generated by facilities. This *replacement electricity* serves two functions:

1. Replacement of electricity that Manufacturers facilities would generate and consume themselves
2. Replacement of electricity that Manufacturers facilities would generate and sell to the electric power grid.

To the extent that the cost for other sources to generate this electricity exceeds the cost otherwise incurred by Manufacturers facilities, this cost difference would be the cost to society from the energy penalty. For the social cost analysis (see *Chapter 8*), EPA approximated this value based on the unit price for purchasing replacement electricity. EPA multiplied this unit price *times* the total quantity of electricity lost by each facility through the energy penalty, to yield the social cost of energy penalty applicable to *each facility*. EPA summed these values over the regulated facilities achieving compliance in a given year, to yield the total social cost of Manufacturers facilities" energy penalty in the year. This approach assumes that the *price for purchasing* replacement energy reflects the *cost of generating electricity* from the alternative supply sources. The *price for purchasing electricity* reflects more closely the cost to society for generating replacement electricity than the price otherwise received by facilities in selling electricity to the electric power grid.

This approach relies on the same methodologies as those described for facilities in *Table I-1* to calculate the impact of the energy penalty. However, the cost of the energy penalty is calculated differently from what is shown in *Equation (I-6)* for facilities. The second half of the equation, for calculating the component of electricity that facilities would generate and consume themselves (the first of the two components of replacement electricity listed above) remains the same. However, the calculation differs for the first half of the equation, for calculating the second component of Manufacturers‟ electricity generation – electricity that Manufacturers facilities would generate and sell to the electric power grid (the second of the two components of replacement electricity listed above). In calculating the cost of the energy penalty to regulated facilities, EPA used the *foregone revenue* in electricity sales to calculate the cost of the second component of the replacement electricity. The social cost calculation for this component of electricity generation differs by substituting the price to purchase replacement electricity for the facilities‟ foregone price for selling electricity.

I.2 Technology Installation Downtime

Installation of certain compliance technologies will require facilities to shut down their business operations temporarily (installation downtime). This downtime will lead to a loss in facility revenue and net income, which constitutes an additional regulation-induced cost to regulated facilities. In addition, specifically for Electric Generators, depending on the extent and scheduling of installation downtime, the occurrence of these temporary reductions in electricity supply could create local electricity market imbalances, with reductions in system reliability reserve margins and/or short-term electricity price increases (see *Chapter 4: Economic Impact Analysis – Electric Generators* and *Chapter 7: Electricity Market Analysis*). EPA first estimated the duration of downtime (weeks) based on the type of compliance technology to be installed and the type of facility. EPA then assessed the effect of this temporary suspension in generation activity on regulated facilities, their parent-entities, and society as a whole.

I.2.1 Electric Generators

To assess the effect of temporary suspension in electricity generation necessary to install compliance technology for Electric Generators, EPA first estimated the length of time for technology installation, and then assessed the impact of this suspension on facility operations and financial standing, and as a cost to society as a whole.

Length of Time Required to Install Compliance Technology

For the cost and economic impact analyses, the Agency assumed that all Electric Generators installing IM technologies and *non-nuclear* Electric Generators installing entrainment control technology (cooling towers) would do so during customary annual maintenance, which typically requires facilities to shut down their electric power generating units for a minimum duration of four weeks. Therefore, for these facilities, EPA calculated the *net* downtime due to regulatory requirements as total downtime outage required for technology installation less the four weeks of customary annual maintenance.

EPA assumed that cooling tower installation at nuclear facilities would take place during either extended capacity upratings (ECUs) or during In-Service Inspections (ISIs). An ECU occurs no more than once during the life of a nuclear facility. It lasts several months and is undertaken subject to approval by the Nuclear Regulatory Commission (NRC). EPA assumed that nuclear facilities that have not applied to NRC for an ECU will do so in the future and will install cooling towers during their ECUs; EPA expects that the length of the ECU will be sufficient to install a cooling tower and did not assign additional downtime to these nuclear facilities. EPA assumed that nuclear facilities that have already completed or applied for an ECU from the NRC, would complete their ECU before cooling tower installation; thus, these facilities would need to complete cooling tower installation during an ICI. In this case, EPA calculated the net additional downtime required for cooling tower installation as (1) total estimated downtime outage less (2) an estimated eight weeks duration for the periodic ISIs. ISIs occur at 5-year intervals and typically last eight to 16 weeks; consequently, the Agency calculated the additional downtime for IM technology installation as total downtime outage less the eight weeks of periodic ISIs (i.e., the minimum ISI duration).[243] To the extent that an ISI would require longer than eight weeks (i.e., up to 16 weeks), EPA‟s estimate of net downtime duration and costs for the non-ECU facilities is an overestimate.

EPA also considered whether other factors could influence the need for net downtime to complete installation of compliance technology; in particular, the baseline operating level of a facility as determined by its capacity utilization rate (CUR). Based on this consideration, EPA decided to assign no net downtime to facilities with very low CUR – specifically less than 15 percent. The Agency judged that given the low level of utilization of these facilities, they very likely would be able to schedule downtime at a time when they do not need to generate electricity.[244,245,246]

Table I-2 presents the number of net downtime weeks by technology module assigned to Electric Generators.

Table I-2: Estimated Average Net Downtime for Technology Modules[a]

Module	Description	Estimated Net Downtime (Weeks)
CT	Cooling Tower	0 or 24 for nuclear, 4 for non-nuclear
1	Add Fish Handling and Return System (includes screen replacement)	0
3	Add New Larger Intake Structure with Fish Handling and Return	2-4
4	Relocate Intake to Submerged Near-shore (20 M) with passive wedgewire screen.	9
10.2	Module 3 plus Module 5: Add Fish Barrier Net	2,3
10.3	Module 1 plus Module 5	0
15	Variable Speed Cooling Water Pumps	0

a. For details on these technology modules and on how they were assigned to regulated facilities, see the *TDD*.
Source: U.S. EPA analysis, 2013

Cost of Technology-Installation Downtime

EPA calculated the financial loss to Electric Generators from installation downtime as lost revenue (from reduced electricity sales by the facilities) less the variable production costs that would not be incurred during the net installation downtime period. The Agency used average annual *variable production costs* and *baseline revenue* in the same way as described for calculating the effect of energy penalty on facility operations (*Section I.1.1*). EPA first calculated all revenue and cost effects on a per-week basis (i.e., annual values divided by the number of weeks a given facility is available for electricity generation in a given year, which assumes that all revenue and cost values occur uniformly over this period of availability).[247] Subtracting the variable cost reduction from revenue, on a per-week basis, yields the net income loss per week from installation downtime. The Agency multiplied these average weekly net revenue losses by the estimated number of net downtime weeks to yield the one-time net income loss from installation downtime.

To the extent that Electric Generators are able to install compliance technology during the spring and fall, when electricity demand is on average at its lowest, using *average annual* revenue and variable production costs may overstate the cost of downtime to regulated facilities.

243 For details see United States Nuclear Regulatory Commission. Generic Environmental Impact Statement for License Renewal of Nuclear Plants (NUREG-1437 Vol. 1). Available online at: http://www.nrc.gov/reading-rm/doc-collections/nuregs/staff/sr1437/v1/part02.html#_1_49

244 EPA calculated capacity utilization rates using nameplate capacity from the EIA databases and a five-year average net generation reported in the EIA-906/920/923 for 2005 through 2011.

245 Only steam operations were included in the calculation of capacity utilization rate.

246 In using the year-by-year revenue values to develop an average over the data years, EPA set aside from the average calculation, generation values that are anomalously low. Such low generating output likely results from temporary disruption in operation, such as a generating unit being out of service for maintenance.

247 For non-nuclear facilities, EPA assumed that generating units are available 48 weeks, i.e., total number of weeks in the entire year (52 weeks) less four weeks of assumed baseline customary maintenance downtime. For nuclear facilities, the Agency assumed 44 weeks, i.e., total number of weeks in a year less eight weeks of assumed ISI-related downtime.

Cost of Technology Installation Downtime to Society

As discussed above, EPA assessed impacts to Electric Generators by calculating the cost of downtime as the lost net income to facilities from suspension of operation to install compliance equipment. However, this approach does not accurately capture the cost to society of downtime at electric power generating facilities (see *Chapter 8*). When generating units are taken out of service to install compliance technology, other generating units compensate for the lost electricity generation In this case, the opportunity cost to society from installation downtime is the *increase* in energy production costs from using the alternative generating units to supply electricity compared to the cost that would have been incurred if regulated units remained in service – *and not the loss in net income to the individual generating units that are temporarily out of service*. Under the principles of economic dispatch (i.e., at any point of time, electricity is supplied by the combination of available electric power generating units, which in the aggregate, can provide electricity at the lowest total cost), the alternative generating units are presumed to provide the replacement electricity at a somewhat higher production cost than would otherwise be incurred.[248] This increase in short-term energy production cost is then the appropriate concept for social cost of downtime. The electricity market analysis, described in *Chapter 7*, provides an estimate of the increase in energy production costs resulting from installation downtime. EPA used this estimated increase in energy production costs as the social cost of installation downtime. Specifically, EPA calculated the aggregate increase, from baseline to post-compliance case, in the annual variable O&M and annual fuel costs from the electric market analysis conducted using IPM (see *Chapter 7*).[249,250]

I.2.2 Manufacturers

EPA focused its assessment of downtime impact for Manufacturers on the suspension of electricity generation, which would accompany installation downtime for Manufacturers that generate electricity. Inability to generate electricity could have several economic effects, including the need to purchase electricity to offset the lost electricity supply during downtime, lost revenue from forgone electricity sales, and avoidance of certain costs that would otherwise be incurred for electricity generation. EPA first estimated the length of time required for technology installation and then assessed the impact of this suspension on facility operations and financial standing, and the cost to society as a whole.

Length of Time Required to Install Compliance Technology

Similar to Electric Generators, EPA estimated the length of time required to install compliance technology in weeks. Unlike for Electric Generators, EPA did not account for any time when Manufacturers might suspend production for maintenance services. This assumption is appropriate because, unlike electric power generating facilities, manufacturing facilities do not customarily shut down operations for maintenance. The required downtime for IM technologies varies by module. *Table I-3* presents the number of net downtime weeks by technology module assigned to Manufacturers.

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248 This is a considerable simplification of the economic dispatch concept, in that it does not account for a range of factors – for example, "must run" requirements for certain generating units. However, overall, the least-cost-solution concept is the applicable governing concept in the management of electric power generation throughout the country.

249 EPA assumed that facilities will incur technology installation downtime during the spring or fall seasons so as not to coincide with either the winter or summer higher demand periods. The IPM modeling framework is built around winter and summer seasons, which last seven and five months, respectively. For the purpose of this analysis, EPA used variable costs reported for the modeled winter season. To the extent that these variable costs include changes in variable costs outside the actual spring and fall shoulder seasons, the downtime impact of the final rule may be overestimated.

250 Updated from 2007 to 2011 dollars using the GDP deflator.

Table I-3: Estimated Average Net Downtime by Technology Module[a]

Module	Description	Estimated Net Downtime (Weeks)
CT	Cooling Tower	4
1	Add Fish Handling and Return System (includes screen replacement)	0
3	Add New Larger Intake Structure with Fish Handling and Return	0, 1
4	Relocate Intake to Submerged Near-shore (20 M) with passive wedgewire screen.	3, 7
10.2	Module 3 plus Module 5: Add Fish Barrier Net	0
10.3	Module 1 plus Module 5	0
15	Variable Speed Cooling Water Pumps	0

a. For details on these technology modules and on how they were assigned to regulated facilities, see the *TDD*.
Source: U.S. EPA analysis, 2013

Cost of Technology Installation Downtime to Regulated Facilities

Installation downtime may affect business operations at a manufacturing facility in several ways:

- The facility may be unable to generate electricity or perform other business operations that depend on cooling water.
- The facility may lose revenue from sale of electricity (if the facility sells electricity to the power grid), or lose or defer revenue from the production and sale of other goods and services that are affected for curtailed operations during downtime.
- The facility may shed the variable cost of generating electricity or of producing the goods and services not produced during the downtime. However, the facility will continue to incur the fixed costs of production associated with the affected operations.
- If, as part of its cooling water dependent operations, the facility generates electricity for its own use, and some part of this self-generated electricity continues to be needed during downtime, the facility may need to purchase replacement electricity.

Together, these effects may lead to a loss in pre-tax income, which EPA calculated and used as the cost to Manufacturers for installation downtime in its analysis of facility impacts. EPA assumed that installation downtime will affect facilities only through suspension of their electricity-generation activities, with no effect on other facility processes. Specifically, EPA assumed that downtime requires Manufacturers to curtail electricity generation and purchase power from the grid in order to continue operation. EPA calculated the cost of this temporary suspension of power generation as the cost of purchasing replacement power plus the loss of any revenues received from selling power, minus the variable costs of generating electricity. If a Manufacturer does not sell power to the grid, then its cost of downtime is simply the cost of purchasing replacement power minus the variable cost of generation.

EPA used information from the 316(b) survey to calculate the income loss in electric power-related operations. The data sources and approach for the downtime loss calculation essentially are the same as described above for the energy penalty effect. The analyses differ only in that the downtime analysis reflects *full termination* of cooling water-dependent generation *but only for the downtime period*, while the energy penalty effect reflects a *partial reduction* in cooling water-dependent generation but on an *on-going basis* following technology installation. The data requirements include: (1) annual electric revenue reported as cooling water dependent, (2) the fuel cost of electricity generation, which is assumed to be shed during the period of curtailed operations, (3) the quantity of electricity consumed by the facility, (4) the quantity of electricity generated by the facility, and (5) the unit price of replacement electricity. EPA calculated the pre-tax income loss from installation downtime as follows:

1. Average annual electric revenue from cooling water-dependent generation is obtained from the facility questionnaire and adjusted for inflation to 2011. This value is assumed to be the annual revenue loss in electricity generation, from curtailment of cooling water-dependent operations.

2. Average annual fuel cost of electricity generation is obtained from the facility questionnaire and adjusted for inflation to 2011. EPA assumes that this value is shed during the period of curtailed operations.
3. Calculate the quantity of replacement electricity to be purchased by the facility as the quantity of self-generated electricity that is consumed by the facility. Calculate self-generated electricity consumed by the facility as the lesser of (a) the facility"s own electricity generation or (b) the electricity used within the facility.
4. Calculate the cost of electricity purchased to replace self-generated electricity used by the facility by multiplying the quantity of replacement electricity by the average electricity price, by state, for industrial customers.
5. Calculate *annual* loss in pre-tax income for electric power-related operations as estimated revenue loss from cooling water-dependent generation *less* estimated annual fuel cost of electricity generation *plus* cost of electricity purchased to replace own-generated electricity.
6. Calculate pre-tax income loss in electric power-related operations, from installation downtime, by multiplying the annual pre-tax income loss by the fraction of the year indicated as the net downtime required for installing compliance equipment.

In some cases, EPA estimated a cost for replacement electricity that is less than a facility"s fuel costs, resulting in a negative cost (i.e., a gain in pre-tax income) from downtime. To avoid potentially understating the burden of installation downtime, EPA set a floor of $0 for the cost of downtime.

Cost of Technology Installation Downtime to Society

EPA does not expect installation downtime to interrupt the production of goods at Manufacturers, but only to interrupt their ability to produce their own power, requiring them to purchase replacement energy from the grid. Thus, the primary cost of Manufacturers downtime – to facilities and society – results from the replacement of electricity otherwise generated by facilities. To assess society"s cost of downtime, EPA followed a similar method to that described for the cost of the energy penalty to society (see page *6*). The only difference is that for the social cost of downtime, EPA calculated the cost of replacement electricity that Manufacturers would normally generate and sell to the electric power grid as the price of purchasing replacement electricity (from *item 4* in the calculation steps above) *less the cost to produce electricity* (from *item 2* in the calculation steps above). EPA did not subtract facilities" cost of producing electricity for the energy penalty because it causes a net increase in electricity requirements, while downtime only requires replacement of electricity that Manufacturers would otherwise produce. Again, this approach assumes that the *price for purchasing* replacement energy reflects the *cost of generating electricity* from the alternative supply sources.

Appendix J Mapping Manufacturers' Standard Industrial Classification Codes to North American Industry Classification System Codes

At the time the 2000 Section 316(b) Detailed Industry Questionnaire (DQ) and the 1999 Section 316(b) Industry Screener Questionnaire (ISQ) and (316(b) survey) were designed and distributed, the United States used the Standard Industry Classification (SIC) framework for assembling and reporting data by economic sector. Consequently, the 316(b) survey respondents were asked to report their primary SIC codes. However, in 1997, the United States switched to the North American Industry Classification System (NAICS) framework for industrial classification. To report and assess historical industry trends in the earlier 316(b) rulemaking analyses, industry data for years after 1997 were mapped from the NAICS framework back onto the SIC framework. Now that more than a decade of historical data is available in the NAICS framework, EPA determined that it was appropriate to use the NAICS framework for the current analyses. To use the 316(b) survey-based facility information, the Agency mapped facility-level 4-digit SIC codes onto 6-digit NAICS codes to determine the industry to which to assign Manufacturers and for which to collect public industry data.

Because there is not always a one-to-one relationship between an SIC and a NAICS code, EPA first used a Manufacturer‟s NPDES permit identification number to obtain current information about the facility, including facility‟s primary NAICS code. In the event that these data were not available or are unclear in the NPDES database, EPA used the SIC code provided in the facilities‟ survey responses and SIC-to-NAICS crosswalk provided by the U.S. Census Bureau to determine the appropriate NAICS code. When the crosswalk was not one-to-one, EPA assigned the NAICS code with the largest share of value of shipments according to the *1997 Economic Census: Bridge Between NAICS and SIC* published by the U.S. Census.[251]

[251] This bridge is available online at http://www.census.gov/epcd/ec97brdg/.

Appendix K Cost Pass-Through Analysis

The impact of the final rule and other options EPA considered on Manufacturers will depend on the extent to which regulated facilities are able to pass on compliance costs to customers through increased prices (cost pass-through). This appendix presents the assessment of cost pass-through (CPT) potential for the six Primary Manufacturing Industries.

EPA closely followed the methodology, and relied largely on the same data sources, used in the CPT analysis for the previous 316(b) rule analyses (U.S. EPA, 2006x; U.S. EPA, 2010x). This appendix begins with a review of approaches for assessing CPT potential associated with market-wide cost increase scenarios; it then discusses the methodology and specific metrics used to assess CPT potential and provides the CPT assessment results for each Primary Manufacturing Industry.

As was the case with the analysis conducted for the previous 316(b) rules, an assumption of zero CPT is appropriate for analyzing the impact of the final rule and other options considered on facilities in the six Primary Manufacturing Industries. For the economic/financial impact analysis, this assumption means that facilities must absorb all compliance-related costs and operating effects (e.g., income loss from facility shutdown during equipment installation) within their baseline cash flow and financial condition. To the extent that facilities would be able to pass on some of the compliance costs to customers through price increases, the analysis using the zero CPT assumption likely overstates the potential impact on regulated facilities.

K.1 The Choice of Facility-Specific versus Industry-Specific CPT Coefficients

One method of examining the ability of a facility to pass-through compliance-related cost increases due to the final rule and other options considered is to review the facility‟s historical performance in passing on previous cost increases to consumers. For example, Ashenfelter *et al.* (1998) estimate the CPT rate facing an individual facility and distinguish that rate from the rate at which a facility passes through cost changes common to all facilities in an industry, by regressing the price charged by a facility on both its costs and the costs of another facility in the industry. The facility-specific CPT rate would relate a change in the prices charged by a specific facility to a change in its production costs, assuming no changes in the production cost for rival producers of that product. However, this analysis is extremely complex. For example, in order to estimate facility-specific CPT rates for every manufacturing facility included in the sample of 2000 Section 316(b) Detailed Industry Questionnaire (DQ) respondents, EPA would require, for each facility, detailed information on the products sold, the markets in which these products are sold, as well as information identifying major competitors in each market. The DQ did not obtain this information from surveyed facilities. And even if such information were available, the analysis would remain highly challenging and subject to significant analytic error. As such, it is neither possible nor practical to develop facility-specific CPT coefficients for Manufacturers.

Moreover, even if the Agency possessed the data necessary to estimate facility-specific CPT rates, these rates may not be the appropriate measure of CPT potential for compliance-related cost increases stemming from the final rule and other options considered. This regulation would force multiple facilities in each of Primary Manufacturing Industry to incur compliance-related cost increases, which implies that for most facilities, the cost increases would not apply only to them, but also to several of their competitors. Not surprisingly, previous studies have found that the CPT rate for changes to an individual facility‟s cost differs from the rate at which a facility would pass through cost changes that are common to all, or a substantial fraction of, facilities in an industry (Ashenfelter et al., 1998). In general, the higher the share of facilities incurring the cost increase, or more appropriately, the higher the share of total output produced by such facilities, the greater their ability will be to pass on a greater portion of those costs to the consumer.

When an industry-wide cost shock occurs, an industry-wide CPT rate would be an appropriate and practical way of assessing the potential of all facilities in that industry to pass through that cost increase to consumers (EPA, 2003). This rate provides an estimate of the change in each facility"s output prices as a function of the increase in its production costs, assuming that the same cost increase applies to all facilities in the industry. This rate is easier to estimate than facility-specific CPT rates, assuming that perfect competition exists in the industry. Among other things, perfect competition implies the existence of product homogeneity within the industry, homogeneity of production technology among firms in the industry, and homogeneity of production costs among firms (i.e., pricing is at marginal cost). Under these conditions, the price response to a general industry-wide change in production costs is likely to be industry-wide and similar across all firms. For example, in support of the Economic, Environmental, and Benefits Analysis of the Final Metal Products & Machinery Rule (MP&M), promulgated in 2003,[252] EPA estimated industry-specific CPT rates because a large fraction of establishments in these industries would be subject to the regulation. EPA regressed annual output price indices on annual input cost indices for the MP&M industry (U.S. EPA, 2003). EPA confirmed the estimated CPT coefficients by a market structure analysis that assessed, for each industry, the potential market power enjoyed by firms in the industry and the consequent implications it had on their ability to pass through compliance-related costs.

Industry-wide CPT rates can be estimated for the analyzed manufacturing sectors based on the methodology used for deriving industry-wide CPT rates for industries covered by the MP&M regulation, the 2006 Phase III final rule, and the Proposed Existing Facilities Rule. As was the case with the previous 316(b) rules, because the final rule and other options considered will affect only those facilities that operate a CWIS to withdraw cooling water from surface water bodies, only a subset of facilities in each industry sector would incur compliance-related cost increases. As the cost increase associated with final rule, and other options considered, is not industry-wide, it is questionable whether industry-wide CPT rates are appropriate for estimating the price response of regulated facilities. If a substantial portion of production in each industry occurs at facilities not subject to the regulation, then the use of industry-wide CPT rates may overstate the ability of facilities in these industries to pass-through compliance-related costs to consumers.

To assess the reasonableness of using industry-wide CPT rates in the analysis of impacts to Manufacturers, EPA estimated the share of total production in each of the six Primary Manufacturing Industries that occurs at regulated facilities, using value of shipments, a measure of the dollar value of production. Because value of shipments data were not collected using the DQ, these data were not available for the sample of Manufacturers; therefore, the Agency used total revenue reported in the DQ, as a close approximation to value of shipments for these facilities. EPA estimated the total revenue subject to the final rule by multiplying the revenue of surveyed facilities (in $2011) by their respective facility sample weights and summing across all surveyed facilities (for details on sample weights see *Appendix H*).[253] EPA obtained total value of shipments estimates from the 2010 Annual Survey of Manufactures (ASM) published by the U.S. Census Bureau.

As reported in *Table K-1*, the share of total value of shipments subject to the final rule varies by industry, ranging from 2 percent in the Food and Kindred Products Industry to 48 percent in the Steel Industry. For four of the six industries, significantly less than 50 percent of the total value of shipments would incur compliance costs; EPA assesses that for these industries, the theoretical threshold for justifying the use of industry-wide CPT rates in the economic/financial analysis has not been met. For the two industries – Steel and Aluminum – where the percentage of total value of shipments subject to the final rule is less than, but close to, 50 percent, EPA assesses that industry market structure in these industries must be taken into account.

[252] For details see *Economic, Environmental, and Benefits Analysis of the Final Metal Products & Machinery Rule* report available online at http://water.epa.gov/scitech/wastetech/guide/mpm/upload/2003_1_31_guide_mpm_eeba_part1.pdf

[253] For this calculation, EPA used technical weights and included facilities estimated to close in the baseline. For analysis of baseline closures see *Chapter 5: Economic Impact Analysis - Manufacturers*.

As was the case for the previous 316(b) rule analyses, the Agency assesses that using industry-wide CPT rates in the analysis of the final rule impacts would overestimate the CPT ability of regulated facilities, and thus underestimate regulatory impacts. However, an assumption of zero CPT would avoid the risk of understating impacts, as it would assume that all regulated facilities absorb one hundred percent of cost impacts.

Given the inability to estimate facility-specific CPT rates and the finding that the use of industry-wide CPT rates would not be appropriate, EPA conducted a market-structure analysis to investigate the extent to which facilities in the Primary Manufacturing Industries enjoy sufficient market power to pass compliance-related costs on to consumers in the form of higher prices.

Table K-1: Proportion of Value of Shipments Potentially Subject to Compliance-Related Costs Associated with the Final Rule (Millions; $2011)

NAICS	Industry	Revenue for Manufacturers Subject to Final Rule[a,b]	Total Value of Shipments	Proportion of Total Value of Shipments Subject to Regulation
3313	Aluminum	$15,131	$32,966	45.9%
325	Chemicals and Allied Products	$102,914	$716,178	14.4%
311/3121	Food and Kindred Products	$16,881	$755,071	2.2%
322	Paper and Allied Products	$66,845	$173,577	38.5%
32411	Petroleum Refining	$229,480	$601,212	38.2%
3311/2	Steel	$57,195	$118,089	48.4%

a. For this analysis, EPA used facility revenue as an appropriate surrogate in the absence of value of shipments for sample facilities. Revenue estimates are the sum of weighted facility-level revenues and exclude revenue for baseline closures.
b. To compare regulated revenues with the industry value of shipments, EPA adjusted regulated revenues to 2010 using industry-specific Producer Price Index (PPI) values published by the Bureau of Labor Statistics (BLS), and restated in 2011 dollars using GDP deflator published by the Bureau of Economic Analysis (BEA).
Source: U.S. DOC, 2010 ASM; U.S. EPA, 2000

K.2 Market Structure Analysis

Information on the competitive structure and market characteristics of an industry provide insight into the likely ranges of supply and demand elasticities and the sensitivity of output prices to input costs. For example, when input costs increase, the profit-maximizing firm attempts to maintain its profits by increasing output prices, to the extent permitted by market power. The amount of the cost increase the firm can pass on as higher prices depends on the relative market power of the firm and its customers. The market structure analysis described in this section attempts to measure the market power enjoyed by market players in each of the six industries. EPA combined this analysis with information from industry review documents such as *McGraw-Hill's U.S. Industry and Trade Outlook* to reach conclusions regarding the CPT ability of firms in each industry. The market structure analysis consists of a review of economic data for the following four indicators of market power: industry concentration; import competition; export competition; and long-term growth. Each of these indicators is discussed in detail below. EPA notes that the impact of each of these four indicators of market power varies from industry to industry. Furthermore, the results presented for each indicator must be interpreted with caution. Even though an indicator for a particular industry may predict high CPT potential, the specific features of the industry may result in the indicator having diminished significance in predicting market power.

K.2.1 Industry Concentration

The extent of concentration among a group of market participants is an important determinant of that group's market power. A group of many small firms typically has less market power than a group of a few large firms, because it is easier for a few large firms to collude with each other than many small firms. All else being equal, highly concentrated industries would be more likely to pass through a higher proportion of compliance costs that would result from the final rule.

This analysis uses the Herfindahl-Hirschman Index (HHI) as a measure of market concentration. The HHI is calculated by squaring the market share of each firm competing in the market and then summing the resulting numbers.[254] For example, for a market consisting of four firms with shares of thirty, thirty, twenty and twenty percent, the HHI is 2600 ($30^2 + 30^2 + 20^2 + 20^2 = 2600$). The HHI takes into account the relative size and distribution of the firms in a market and approaches zero when a market consists of a large number of firms of relatively equal size. The HHI increases both as the number of firms in the market decreases and as the disparity in size between those firms increases. Based on the U.S. Department of Justice (DOJ) guidelines for evaluating mergers, an HHI under 1,000 indicates an unconcentrated market, an HHI between 1,000 and 1,800 indicates moderate concentration, and an HHI in excess of 1,800 indicates concentrated markets.

The accuracy of any analysis of market power originating from industry concentration depends largely on properly defining the relevant market. A well-defined market requires the inclusion of all competitors and the exclusion of all non-competitors. Defining the relevant market too narrowly overstates market power, while defining the market too broadly would underestimate it. The 4-digit SIC category and 6-digit NAICS, while not a perfect delineation, are used most often by industrial organization economists in their studies because, among publicly available data sources, these industries appear to correspond most closely to economic markets (Waldman & Jensen, 1997). Therefore, *Table K-2* below, reports industry concentration data for each of the 6-digit NAICS codes that include at least one potentially regulated manufacturing facility for which DQ data are available.

As shown in *Table K-2*, based on their HHI, 15 of the 6-digit NAICS markets[255] would be unconcentrated, six would be moderately concentrated, and only six would be concentrated according to the DOJ guidelines. Notably, all sectors in the Steel Industry would be unconcentrated, which suggests that even though more than 50 percent of value of shipments in the Steel Industry would potentially be subject to the final rule, the likelihood of regulated facilities in this industry to pass compliance costs through to consumers is low.

Four of the six 6-digit NAICS sectors listed as being concentrated belong to the Chemicals and Allied Products Industry; the other two sectors are in the Aluminum Industry. From a market power perspective, this seems to suggest that at the 6-digit NAICS level, only these six NAICS sectors are sufficiently concentrated to argue that their regulated facilities may possess sufficient market power to pass through a portion of their compliance costs – assuming that competitor firms in the same industry do not incur similar cost increases.

[254] EPA chose the Herfindahl-Hirschman Index for this analysis because it provides a more complete picture of industry concentration compared to other measures such as the 4-firm and 8-firm concentration ratios. In contrast, the 4- and 8-firm concentration ratios do not use the market share of all firms in the industry, and nor do they provide information about the distribution of firm size. For example, if there were a significant change in the market shares among the firms included in the ratio, the value of the concentration ratio would not change.

[255] This includes 3-digit and 4-digit NAICS for Food and Beverage industries, respectively, because every 6-digit NAICS sector covered by these two industries are expected to be affected by the final rule.

Table K-2: Herfindahl-Hirschman Index for 6-Digit NAICS Sectors

NAICS	NAICS Description	Industry	HHI[ab]
Unconcentrated Markets (HHI < 1,000)			
311	Food Manufacturing	Food Manufacturing	102
325998	All Other Miscellaneous Chemical Product and Preparation Manufacturing	Chemicals	158
322299	All Other Converted Paper Product Manufacturing	Paper	188
325188	All Other Basic Inorganic Chemical Manufacturing	Chemicals	224
331222	Steel Wire Drawing	Steel	297
325199	All Other Basic Organic Chemical Manufacturing	Chemicals	361
325211	Plastics Material and Resin Manufacturing	Chemicals	400
331221	Rolled Steel Shape Manufacturing	Steel	402
331210	Iron and Steel Pipe and Tube Manufacturing from Purchased Steel	Steel	436
325412	Pharmaceutical Preparation Manufacturing	Chemicals	457
3121	Beverage Manufacturing	Food	483
322222	Coated and Laminated Paper Manufacturing	Paper	630
322130	Paperboard Mills	Paper	713
322121	Paper (except Newsprint) Mills	Paper	759
331111	Iron and Steel Mills	Steel	786
324110	Petroleum Refineries	Petroleum	807
331314	Secondary Smelting and Alloying of Aluminum	Aluminum	931
Moderately Concentrated Markets (1,000 < HHI < 1,800)			
322110	Pulp Mills	Paper	1,024
322224	Uncoated Paper and Multiwall Bag Manufacturing	Paper	1,043
325311	Nitrogenous Fertilizer Manufacturing	Chemicals	1,136
325131	Inorganic Dye and Pigment Manufacturing	Chemicals	1,265
325120	Industrial Gas Manufacturing	Chemicals	1,415
325411	Medicinal and Botanical Manufacturing	Chemicals	1,424
Concentrated Markets (1,800 < HHI)			
331315	Aluminum Sheet, Plate, and Foil Manufacturing	Aluminum	1,995
325611	Soap and Other Detergent Manufacturing	Chemicals	2,025
325222	Noncellulosic Organic Fiber Manufacturing	Chemicals	2,071
331312	Primary Aluminum Production	Aluminum	2,250
325181	Alkalies and Chlorine Manufacturing	Chemicals	2,392
325110	Petrochemical Manufacturing	Chemicals	2,535
Unknown			
325312	Phosphatic Fertilizer Manufacturing	Chemicals	NA
331112	Electrometallurgical Ferroalloy Product Manufacturing	Steel	NA
322122	Newsprint Mills	Paper	NA
325221	Cellulosic Organic Fiber Manufacturing	Chemicals	NA
331311	Alumina Refining	Aluminum	NA

a. The 2007 Economic Census is the most recent concentration data available.
b. 2007 Economic Census does not disclose HHI values for five of the analyzed 6-digit NAICS sectors: (1) NAICS 325312: Phosphatic Fertilizer Manufacturing (a total of fifty companies), (2) NAICS 331112: Electrometallurgical Ferroalloy Product Manufacturing (a total of twenty companies), (3) NAICS 322122: Newsprint Mills (a total of sixteen companies), (4) NAICS 325221: Cellulosic Organic Fiber Manufacturing (a total of fifteen companies), and (5) NAICS 331311: Alumina Refining (a total of twelve companies)
Source: U.S. DOC, 2007 EC

To further examine the level of concentration in each of the analyzed six industries, EPA analyzed HHI at the industry level as well. In general, while these estimates understate market power industry HHI should still provide meaningful insight into the market power of firms in the industry because firms in each industry still produce similar or related products (for example, paper products, chemicals, etc.).

Table K-3 shows that, at the industry level, the estimated HHI for five of the six Primary Manufacturing Industries are quite small. Low HHI values imply that these industries have unconcentrated markets and within these industries, individual firms do not enjoy much market power. Notably, the Chemicals and Allied Products Industry has a low HHI, which suggests that the four 6-digit NAICS sectors with concentrated markets comprise a small segment of the Chemicals and Allied Products Industry. Thus, it is reasonable to conclude that the majority of regulated facilities in this industry have low market power. In addition, EPA notes that only 14 percent of production in the Chemicals and Allied Products Industry would potentially be subject to compliance-related cost increases, which suggests that the CPT potential of regulated facilities in this sector incurring such expenses would be limited. As reported in *Table K-3*, the Aluminum Industry appears to be moderately concentrated. Thus, based solely on an analysis of industry concentration, it would appear that regulated facilities in the Aluminum Industry might enjoy moderate levels of market power, which may enable them to pass through costs at a more than negligible rate. However, as cautioned at the beginning of the market structure analysis, an accurate judgment of the market power enjoyed by firms in an industry must be reserved until all indicators have been analyzed.

Table K-3: Herfindahl-Hirschman Index by Industry

NAICS	Industry	HHI[a,b]
3313	Aluminum	1,045
325	Chemicals and Allied Products	114
311/3121	Food and Kindred Products	177
322	Paper and Allied Products	228
325	Chemicals and Allied Products	114
32411	Petroleum Refining	807
3311/2	Steel	679

a. The 2007 Economic Census is the most recent concentration data available.
b. HHI values are as reported in the 2007 Economic Census for the 3- and 4-digit NAICS codes and not value of shipments-weighted HHI values for the profiled 6- and 5-digit NAICS codes.
Source: U.S. DOC, 2007 EC; U.S. EPA Analysis, 2013

K.2.2 Import Competition

Theory suggests that imports as a percent of domestic sales, or import penetration, are negatively associated with market power because competition from foreign firms limits domestic firms‟ ability to exercise such power. Firms that belong to sectors in which imports make up a relatively large proportion of domestic sales would therefore be at a relative disadvantage in their ability to pass through costs compared to firms belonging to sectors with lower levels of import penetration, the measure of import competition used in this analysis. Import penetration is particularly relevant because foreign producers would not incur costs because of the final rule. In this market structure analysis, EPA assumes that higher import penetration will generally imply that firms are exposed to greater competition from foreign producers and would thus possess less market power to increase prices in response to regulation-induced increases in production costs. EPA estimated import penetration ratios for each industry as total imports in an industry divided by total value of domestic consumption in that industry; where domestic consumption equals domestic production plus imports minus exports. *Table K-4* reports import penetration ratios based on 2010 ASM data for the six Primary Manufacturing Industries.

The estimated 2010 import penetration ratios vary by industry, ranging from eight percent in the Food and Kindred Products Industry to 30 percent in the Aluminum Industry. The estimated 2010 import penetration ratio for the entire U.S. manufacturing sector (NAICS 31-33) is 28 percent. Considering that the United States is an open economy, in sectors with import penetration ratios close to or above 28 percent, domestic firms most likely face substantial competition from foreign firms. Such competition is likely to curtail the market power that domestic firms would otherwise appear to possess, based strictly on a domestic market analysis. Further, given the fact that foreign producers do not incur U.S. compliance cost increases, this finding would point to reduced ability of domestic firms to pass through such costs. Thus, based on the import penetration ratios presented in *Table K-4*, firms in all of the sectors except Aluminum appear to be in a position to pass through to consumers a significant portion of compliance costs. However, given the relatively low HHIs for these sectors (other than Aluminum), existing market competition among domestic firms most likely nullifies any favorable influence that the lack of foreign competitors would have on increasing the market power of firms in these industries. EPA also highlights the above average import penetration ratio for the Aluminum Industry, which suggests low market power for firms in this industry. With respect to the Aluminum Industry, this fact may offset – from a market power perspective – the finding of the industry being moderately concentrated. Thus, even though there are relatively few domestic producers in the U.S. Aluminum Industry, the notable presence of foreign producers in U.S. markets is likely to markedly reduce their market power.

Table K-4: Import Penetration by Industry, 2010

NAICS	Industry	Value of Imports (Millions; $2011)[a]	Implied Domestic Consumption (Millions ;$2011)[a,b]	Import Penetration[a,c]
3313	Aluminum	$11,241	$32,966	29.7%
325	Chemicals and Allied Products	$180,147	$716,178	25.3%
311/3121	Food and Kindred Products	$57,665	$755,071	7.6%
322	Paper and Allied Products	$21,490	$173,577	12.6%
32411	Petroleum Refining	$63,134	$601,212	9.8%
3311/2	Steel	$29,644	$118,089	22.5%

a. These revenues are the totals reported for the entire 3- and 4-digit NAICS codes and not just the sum of regulated 6-digit NAICS codes.
b. Implied Domestic Consumption = Value of Shipments + Value of Imports – Value of Exports.
c. Import Penetration = Value of Imports / Implied Domestic Consumption
Source: U.S. DOC, 2010 ASM; U.S. ITC, 2010; U.S. EPA Analysis, 2013

K.2.3 Export Competition

The final rule will not increase the production costs of foreign producers with which domestic firms must compete in export markets. As a result, firms in industries that rely to a greater extent on export sales would have less latitude to raise prices to recover compliance-related increases in production costs. They would therefore have a lower CPT potential, all else being equal. This analysis uses export dependence, defined as the percentage of shipments that an industry exports, to measure the degree to which a sector is exposed to competitive pressures abroad in export sales. All else equal, firms in industries with relatively high export dependence will have lower market power than those in industries with relatively low export dependence, due to their relatively larger reliance on sales in export markets. *Table K-5*, below, reports export dependence ratios for the six industry sectors.

The estimated 2010 export dependence ratios for the Primary Manufacturing Industries vary by industry, ranging from 3 percent in the Petroleum Refining Industry to 26 percent in the Chemicals and Allied Products Industry. The estimated export dependence ratio for the entire U.S. manufacturing sector for the same year is 22 percent. Thus, for all but one industry (Chemicals and Allied Products), the export dependence ratio is below the average for the U.S. manufacturing sector. This finding implies that none of these industries would face strong competitive pressures from foreign firms/markets in export market sales, and thus export dependence would not diminish market power and CPT potential. However, this effect may not work as strongly in the opposite direction, i.e., firms in an industry will have a comparatively high CPT potential simply because firms in that industry are not active in export markets. From the standpoint of firms gaining market power, the finding of low export dependence diminishes the importance of export competition as an indicator of market power. Thus, EPA must rely on the other three indicators to gauge the amount of market power that firms in each industry are expected to hold. For example, even though the Petroleum Refining and Food and Kindred Products Industries have low export dependence, the low market concentration in these industries makes it likely that market power held by individual firms is quite small.

Table K-5: Export Dependence by Industry, 2010

NAICS	Industry	Value of Export (Millions; $2011)[a]	Value of Shipments (Millions; $2011)[a]	Export Dependence[b]
3313	Aluminum	$6,182	$32,966	18.7%
325	Chemicals and Allied Products	$183,400	$716,178	25.6%
311/3121	Food and Kindred Products	$58,385	$755,071	7.7%
322	Paper and Allied Products	$24,156	$173,577	13.9%
3241	Petroleum Refining	$18,163	$601,212	3.0%
3311/2	Steel	$16,058	$118,089	13.6%

a. These values are the totals reported for the entire 3- and 4-digit NAICS codes and not just the sum of regulated 6-digit NAICS codes.
b. Export Dependence = Value of Exports / Value of Shipments.
Source: U.S. DOC, 2010 ASM; U.S. ITC, 2010; U.S. EPA Analysis, 2013

K.2.4 Long-Term Industry Growth

An industry‟s competitiveness and the ability of firms to engage in price competition are likely to differ between declining and growing industries. Most studies have found that recent growth in revenue positively correlates with profitability (Waldman & Jensen, 1997), which suggests a greater ability to recover costs fully. To examine trends in long-term growth for each of the six industry sectors considered in this analysis, EPA estimated the average annual growth rate in the constant dollar value of shipments between 1989 and 2010 as well as between 2000 and 2010 for each industry using data available from the U.S. Bureau of Census.[256] EPA also calculated the average annual growth rate for the economy as a whole, based on gross domestic product (GDP), as a threshold to compare with growth in the industries. EPA expects regulated facilities in sectors with growth rates higher than those experienced by the overall economy to be better positioned to pass through compliance costs rather than being forced to absorb such cost increases in order to retain market share and revenue. As reported in *Table K-6*, of the six Primary Manufacturing Industries, two industries – Paper and Allied Products and Aluminum – experienced negative growth over both periods. The Petroleum Refining Industry experienced the largest growth, displaying an annual growth rate of 5 percent between 1989 and 2010, and about 8 percent between 2000 and 2010. For the period 1989 to 2010, only the Petroleum Refining Industry grew at a rate greater than that of the overall economy. For the more recent period, 2000 to 2010, all but two of the industries grew at a faster rate than the overall economy. However, this comparison may be misleading, given the relatively weak performance of the U.S. economy over this period. In particular, the absolute growth of these industries remains low when compared with the total economy‟s growth over a longer period. From 1970 to 2010, the U.S. economy grew at an inflation-adjusted annual rate of 2.8 percent, while from 1980 to 2010 the total economy grew at a rate of 2.7 percent (EPA analysis; U.S. BEA, 2013). In comparison, only Steel‟s growth rate (2.7 percent) falls into the range of long-term annual growth for the economy; however, the Steel Industry‟s growth rate does not exceed the growth rate of the overall economy and therefore, would not indicate a relatively high rate of growth. In this light, for all of these industries except for the Petroleum Refining Industry, EPA finds it is unlikely that firms possess significant market power based on growing demand for their products. In effect, the long-term growth performance of these five industries does not support a conclusion that regulated facilities in these industries would be in a strong position to pass on a significant portion of their compliance costs. In contrast, the long-term growth in the Petroleum Refining Industry indicates that firms in this industry may be better able to pass through costs to consumers.

256 The period from 1989 to 2010 represents the two most recent decades that includes data consistent with the survey period for the 2000 Detailed Industry Questionnaire (1996-1998).

Table K-6: Average Annual Growth Rate by Industry[257]

NAICS	Industry	Average Annual Growth Rate in Value of Shipments 1989 to 2010	Average Annual Growth Rate in Value of Shipments 2000 to 2010
3313	Aluminum	-4.9%	-1.9%
325	Chemicals and Allied Products	2.2%	2.2%
311/3121	Food and Kindred Products	1.2%	1.8%
322	Paper and Allied Products	-1.0%	-1.9%
32411	Petroleum Refining	4.6%	8.1%
3311/2	Steel	0.6%	2.7%
NA	U.S. Economy[a]	2.4%	1.5%

a. The average annual growth rate for the U.S. economy is based on gross domestic product (GDP), not value of shipments.
Source: U.S. BEA, 2013; U.S. DOC, 1989, 2000 and 2010 ASM; U.S. EPA Analysis, 2013.

K.3 Conclusions

Given that EPA estimates that less than 50 percent of the total value of shipments in four of the six Primary Manufacturing Industries will be subject to the final rule and the likelihood that these percentages represent upper bound estimates, regulated facilities in these industries are not likely to be able to pass through to consumers a material portion of their compliance costs. In the other two industries – Steel and Aluminum – EPA estimates that 51 percent and 57 percent of the total value of shipments, respectively, will be subject to the final rule. This implies more potential for regulated facilities in these industries to pass through part of their compliance costs to consumers.

To validate these hypotheses, EPA undertook the market-structure analysis presented in the previous sections. In general, the weight of evidence from the market-structure analysis suggests that firms in all six Primary Manufacturing Industries are unlikely to possess significant levels of market power, thereby lending support to EPA‟s hypothesis that most regulated facilities would not be in a position to pass through a significant portion of compliance costs.

The analysis of individual indicators under the market structure analysis did reveal a few exceptions to the general finding of low market power in all industries. However, considering the combined impact of all four indicators of market power together with information on recent economic trends in these industries suggests that overall, firms in each of the six industries hold relatively low market power and CPT potential. For example, the HHI for the Aluminum Industry indicated that this sector is moderately concentrated, which would potentially allow regulated facilities in this industry to pass through a significant portion of their compliance-related costs. In contrast, however, the market structure analysis also found that the domestic Aluminum Industry witnessed a sustained decline in production during the 1990s and faces stiff competition from foreign producers in its U.S. markets. As discussed in the profile of this industry, in the early 1990s the domestic Aluminum Industry was affected by reduced U.S. demand and the dissolution of the Soviet Union, which led to substantial increases in Russian exports of aluminum. The recovery that followed was subsequently affected by the economic crises in Asian markets in the second half of the 1990s, which along with growing Russian exports, again caused oversupply. Demand for Aluminum Industry products declined again in 2000 through 2002, reflecting weakness in both the U.S. and world economies, and again resulted in oversupply and declining financial performance. In 2003, the U.S. economy began to recover, resulting in higher demand for aluminum and improving financial condition for the Aluminum Industry through 2007. However, the recession that began in 2008 resulted in lower demand for and production of aluminum, both in the United States and worldwide, and a consequent decline in the financial performance of the Aluminum Industry.

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[257] In this appendix, average annual growth rate refers to a year-to-year, constant percentage growth mean, which is calculated as the compound annual growth rate between the first and last values. This is the same concept as the geometric mean, if all of the individual year-to-year

Regulated facilities in the Aluminum Industry belong to either the Primary Aluminum Production segment (NAICS 331311: Alumina Refining and NAICS 331312: Primary Aluminum Production) or the Secondary Aluminum Production segment (NAICS 331314: Secondary Smelting and Alloying of Aluminum and NAICS 331315: Aluminum Sheet, Plate, and Foil Manufacturing) (for more information see *Appendix A*).The data reported in the Aluminum Industry Profile indicate the Secondary Aluminum Production segment is less import dependent and less concentrated than the Primary Aluminum Production segment. Further, while the Secondary Aluminum Production segment has grown over the last two decades and especially in the last decade, the Primary Aluminum Production segment has declined. Consequently, while domestic firms in the Secondary Aluminum Production segment may be in a better position to pass some compliance-related costs to consumers than firms in the Primary Aluminum Production segment, several factors combine to suggest that the Secondary Aluminum Production segment has relatively low CPT potential; specifically, the general economic condition of the U.S. Aluminum Industry as a whole throughout the last two decades. While there is moderate-to-high market concentration, there is also a rather high degree of import penetration and moderate export dependence. This suggests that overall domestic firms in this industry hold relatively low market power and are not likely to have the ability to pass through *significant* portions of their compliance-related cost increases.

Regulated facilities in the Steel Industry belong either to the Steel Mills segment (NAICS 331111 and NAICS 331112) or to the Steel Products segment (NAICS 331210, NAICS 331221, and NAICS 331222). The Steel Industry as a whole does not appear to be significantly subject to competition from foreign trade, implying some potential for regulated facilities to pass on compliance costs to consumers. The Steel Products segment is unconcentrated while the Steel Mills segment is moderately concentrated; however, the HHI Index for NAICS 331111, which contains the majority of regulated facilities, indicates that it is unconcentrated. The Steel Industry as a whole is also unconcentrated. Based on the relatively low growth rates in the Steel Industry and low market concentration, it is unlikely that domestic firms in this industry have the ability to pass through *significant* portions of their compliance-related cost increases.

From the findings of the market structure analysis, EPA concluded that an assumption of zero CPT rate is appropriate for all six Primary Manufacturing Industries for analyzing the final rule‟s economic impact. This assumption is reasonable given the results of the market structure analysis and is superior to using industry-wide CPT rates. In addition, EPA notes that by assuming a CPT rate of zero for all industries, the analysis of final rule impacts is less likely to underestimate facility impacts in that the analysis assumes that facilities would absorb one hundred percent of compliance costs. Thus, whereas an overstated CPT rate may erroneously underestimate impacts for facilities incurring compliance-related cost increases, the use of a CPT rate of zero errs on the side of caution, thus potentially overstating impacts to affected facilities.

Appendix L Adjusting Baseline Facility Cash Flow

This appendix documents EPA‟s development and analysis of cash-flow adjustment factors used in the facility-level baseline and post-compliance closure analyses. This analysis presents an updated version of the analysis conducted for the previous 316(b) regulations, including the proposed rule. As was done for the proposed rule, EPA used the Quarterly Financial Report (QFR) published by the U.S. Census Bureau as the primary data source.[258] The analysis for the final rule incorporates three additional years of data for 2009, 2010, and 2011, beyond that used for the proposed rule.

EPA collected economic/financial data for manufacturing facilities subject to the final rule (regulated facilities or Manufacturers) through the 2000 Section 316(b) Detailed Industry Questionnaire (DQ) and the 1999 Industry Screener Questionnaire (ISQ) (316(b) survey). The surveys collected these data for three years: 1996, 1997, and 1998. The sample survey of Manufacturers and their financial data serve as models for testing the financial impact of the final rule and options EPA considered. To provide valid insight into the ability of the six Primary Manufacturing Industries[259] to meet regulatory requirements without significant adverse financial impact, EPA sought to ensure that the sample facility data reasonably reflect business conditions that might occur at the time of compliance.

EPA assessed two concerns it had that the facility survey data might yield erroneous conclusions:

1. Given that U.S. business conditions during the latter half of the 1990s, when the 316(b) survey was conducted, were cyclically strong, EPA was concerned that business conditions might have been abnormally favorable for some of the Primary Manufacturing Industries. If so, the business-performance and valuation measures, which draw from survey data and support assessment of the burden of regulatory compliance costs, might overstate industry‟s ability to bear these costs during more typical business conditions. The resulting impact analysis might understate the potential impact of the regulatory analysis options considered for the 316(b) regulations.
2. EPA was also aware from its profile analyses that some of the affected industries might be experiencing a longer-term trend of deteriorating performance. Using sample facility data that do not reflect such possible trends would again potentially overstate industry‟s ability to bear compliance costs and therefore, understate the potential impact of the final rule and options EPA considered.

The Agency‟s assessment validated its concerns, so EPA developed a basis for adjusting survey financial data to account for the short-term deviation from trend and non-neutral long-term trend.

L.1 Background: Review of Overall Business Conditions

As background for its analysis, EPA reviewed general economic data over the past several years to assess whether business conditions during the 316(b) survey period (1996 - 1998) might be generally perceived as abnormally favorable for the U.S. economy as a whole. This review confirmed EPA‟s concern.

Figure L-1 - *Figure L-3* present annual and average values for the analysis period of 1985 through 2011 for three measures of general economic performance:

[258] To develop adjustment factors for the previous Phase III proposed and final rules, the Agency used the Value Line Investment Survey firm financial dataset published by the private independent financial research firm Value Line.

[259] The six Primary Manufacturing industries are the Aluminum, Chemicals and Allied Products, Food and Kindred Products, Paper and Allied Products, Petroleum Refining and Steel Industries.

Figure L-1 focuses on the growth trend of the broad economy, including all sectors. Growth stronger than the average trend would indicate a strongly expanding economy and generally would indicate strong business performance. This exhibit is based on data published by the Department of Commerce (DOC), Bureau of Economic Analysis (U.S. BEA, 2012).

Figure L-2 reports the rate of capital utilization for all manufacturing sectors. T, All else equal, when the rate of capital utilization is higher than the average trend, demand for manufacturing output is strong and manufacturing business performance would be generally strong. This exhibit is based on data published by the U.S. Federal Reserve Bank (Federal Reserve Board of Governors, 2013).

Figure L-3 reports the rate of growth in the Federal Reserve‟s Industrial Production Index, which is a measure of the real output of the manufacturing industries. Growth stronger than the average trend would indicate a strong expansion in the manufacturing industries and generally would indicate strong manufacturing business performance. Like the preceding exhibit, this exhibit is based on data published by the U.S. Federal Reserve Bank (Federal Reserve Board of Governors, 2013).

In each case, 1996 to 1998 annual values are above the average trend line, indicating stronger overall economic performance in the 316(b) survey data period than for the longer period presented in the charts. The data show a consistent pattern over this three-year period:

- 1996: The values for 1996 are above the longer-term average trend but are the lower than the values for 1997, indicating that the manufacturing economy was in an upswing from 1996 to 1997.
- 1997: The values for 1997 are the highest of the three years.
- 1998: The values for 1998 are all lower than the values for 1997 and generally appear to be the beginning of the downswing in economic performance that occurred in the latter part of the 1990s. In the case of *industrial production* and *capacity utilization in manufacturing industries*, 1997 is the peak performance year over the 1990s decade. This peak is followed by a decline in 1998 and subsequent years leading to the recession in 2001. In the case of *GDP growth*, the fall-off in 1998 from 1997 is followed by one more year of strong growth in 1999. During 2000 and 2001, GDP growth sharply falls. As the U.S. economy began to recover during the first half of the last decade following the recession of 2001, so did production in the Primary Manufacturing Sectors. The second half of the decade, however, once again experienced an economic slowdown leading to the current recession. Even though the U.S. manufacturing sector experienced some recovery after the recession of 2001, its performance never achieved the level of 1997.

Figure L-1: Growth in Real Domestic Product, 1985-2011

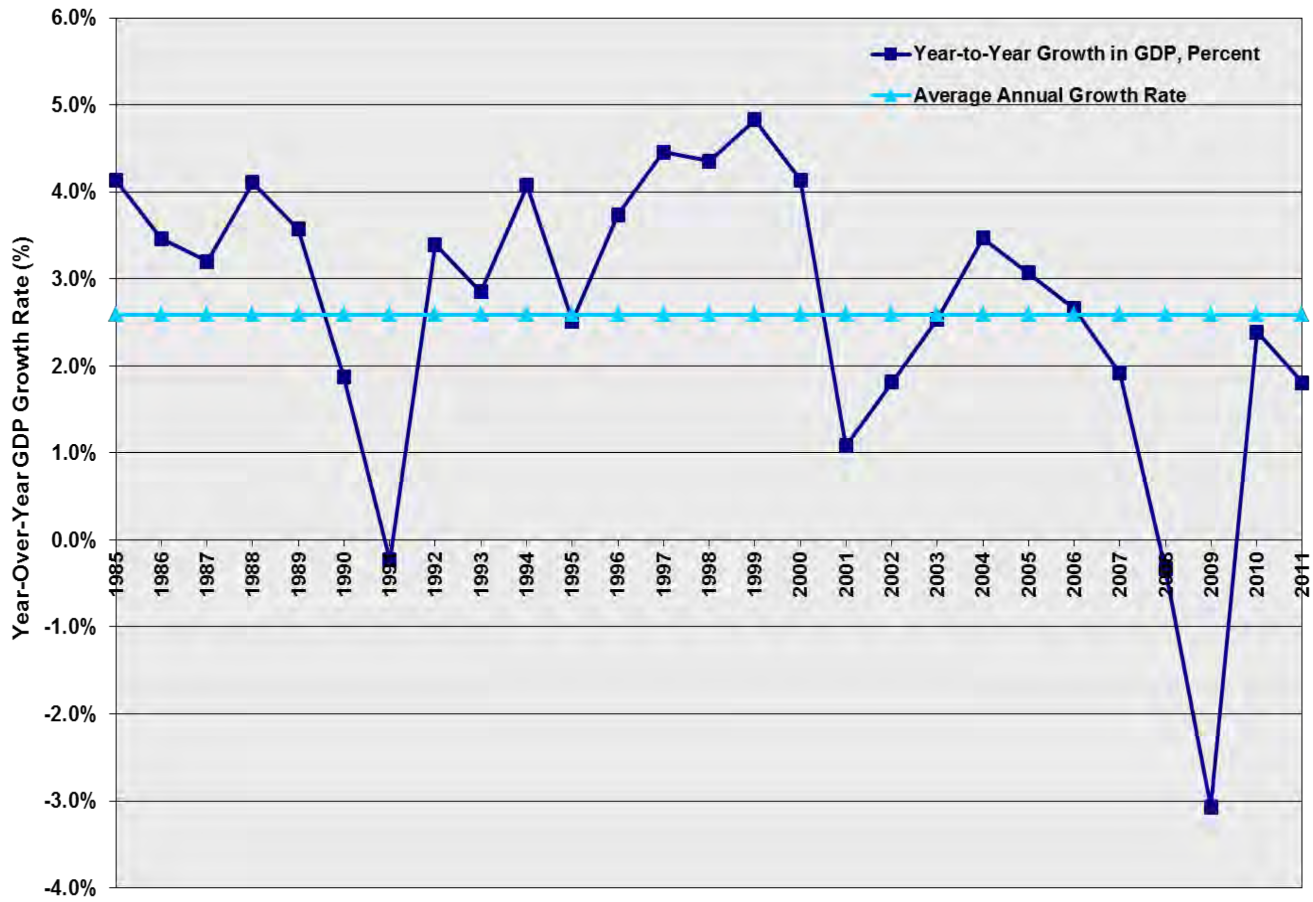


Figure L-2: Capacity Utilization in Manufacturing Industries, 1985-2011

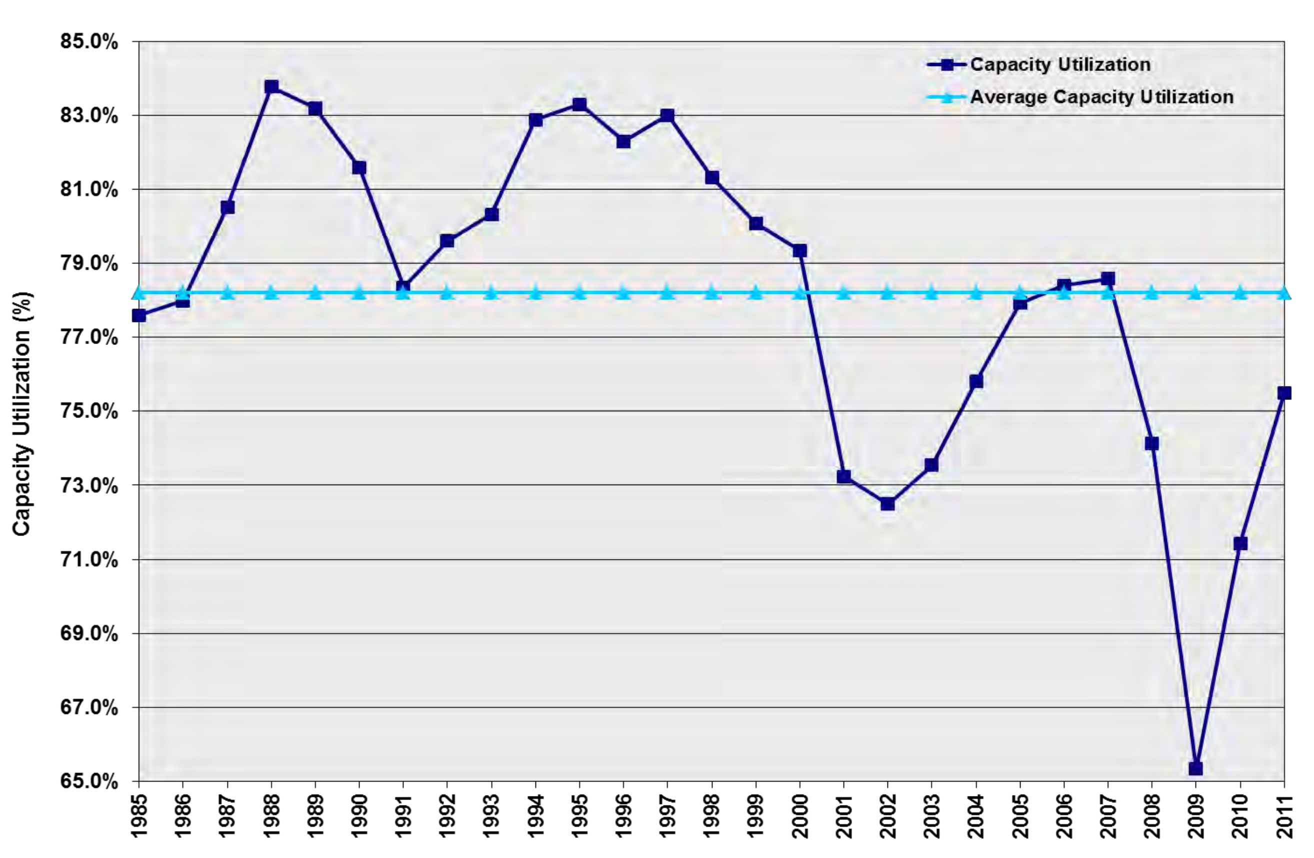
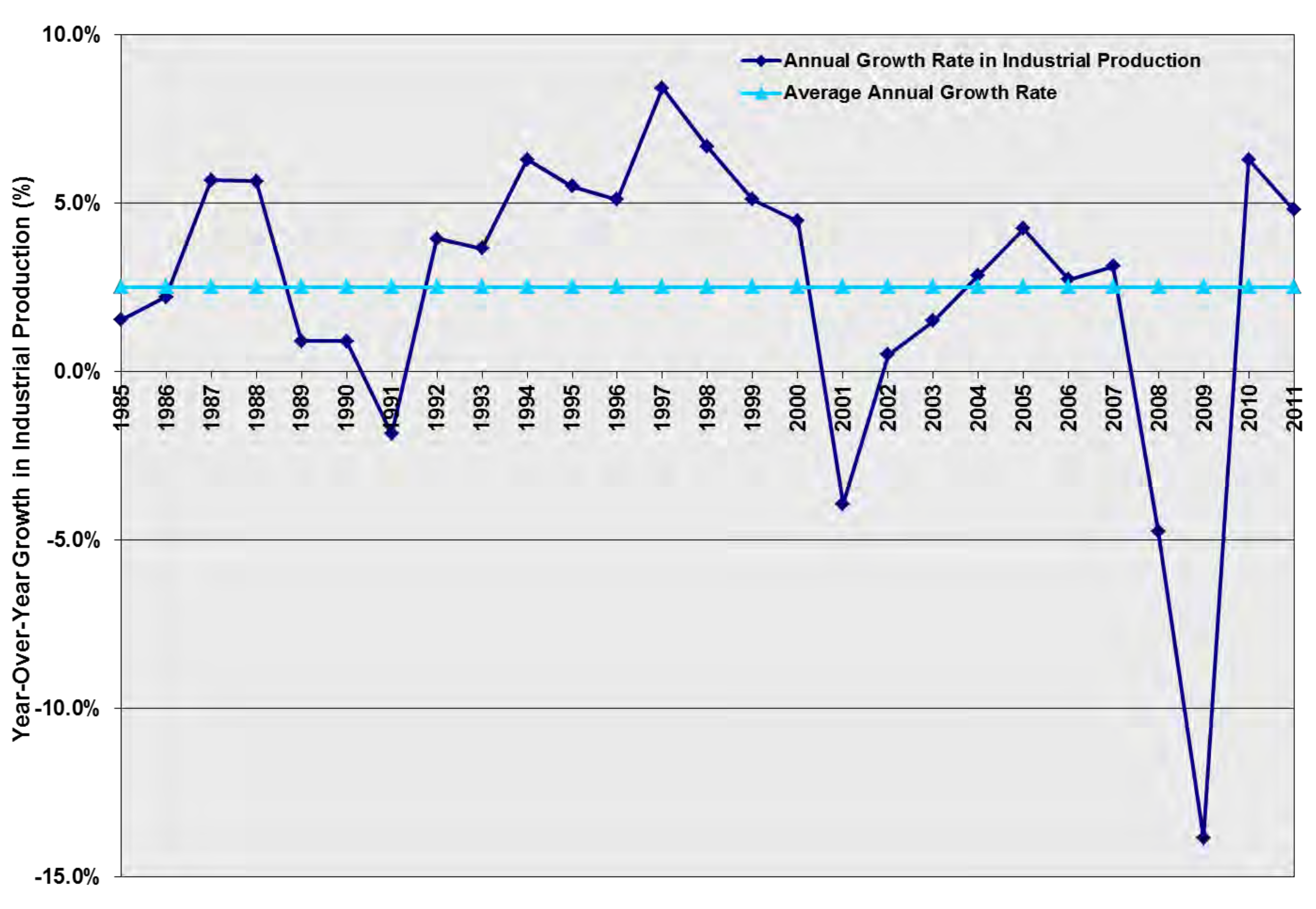


Figure L-3: Growth in Industrial Production, 1985-2011



L.2 Framing and Executing the Analysis

The objective of this analysis was to understand (1) the extent to which the business conditions and financial performance of the Primary Manufacturing Industries reflected cyclically favorable conditions during the 316(b) survey period and (2) whether these industries show a non-neutral longer term trend in economic/financial performance – e.g., deterioration in performance over time independent of cyclical variation. If either or both of these conditions were found, then the data used to test for these conditions would be used to adjust relevant survey data items to a level consistent with normal business conditions and/or the longer term of performance.

EPA used the same data source and analytical approach as those used for the proposed rule. Specifically, EPA used industry-level QFR data to infer the trend of performance in facility financial performance from industry-level performance and adjusted facility-level financial data from the 316(b) survey based on analysis of the industry-level performance. Although the industry-level information for adjusting facility data necessarily represents a limitation in this analysis, the effort is warranted, given: (1) the potential for the facility impact analysis to yield erroneous findings if it is based on data that reflect cyclically favorable conditions and (2) the absence of facility data to support a more precise analysis.[260] EPA was able to add three more years of QFR data – 2009, 2010, and 2011 – released since EPA conducted the analysis in support of the proposed rule.

[260] For details on QFR data and other data sources EPA considered for this analysis, see Economic and Benefits Analysis for Proposed Section 316(b) Existing Facilities Rule available online at http://water.epa.gov/lawsregs/lawsguidance/cwa/316b/upload/econandbenefits.pdf.

L.2.1 Methodology for Development of ATCF Adjustment Factors

Similar to the proposed rule, EPA‟s overall approach was to analyze, for each industry group, the trend of financial performance over a multi-year analysis period and to assess where the industry‟s financial performance lay relative to that trend during the 316(b) survey data years of 1996 to 1998. For the final rule, EPA looked at the 24-year analysis period – 1988 through 2011. For each industry group, EPA used as analysis observations an index of constant dollar-adjusted, after-tax cash flow for the relevant industry groups. EPA calculated a simple regression of the index values against time, which provides a direct measure of the real (i.e., inflation-adjusted) trend of financial performance over time for each industry group. EPA then compared the 1996 to 1998 average of index values for each industry group with the trend values predicted from the estimated regression coefficients – both for the 1996 to 1998 years and for 2011, which is the end of the analysis period. This allowed EPA to determine the extent to which it should adjust 1996 to 1998 survey values to reflect (1) the deviation from trend at 1996 to 1998 and (2) the trend from 1996 to 1998 to the end of the analysis period.

EPA followed these steps to calculate After-Tax Cash Flow (ATCF) adjustment factors using QFR:

- **Choose variables, period of analysis, and industry sectors**: EPA used quarterly *Income (or Loss) After Income Taxes* (ATI) and *Depreciation, Depletion, and Amortization of Property, Plant, and Equipment* (DDA) values, reported for either the Primary Manufacturing Industries or sectors within the industries, as the basis for calculating ATCF for 24 years – 1988 through 2011 – for all of the sectors in the following table, except for Pesticides and Fertilizers, and Resins and Synthetics. QFR data are available for the Pesticides and Fertilizers sector only starting 1992. Consequently, EPA developed ATCF adjustment factor for this sector using only 20 years of QFR data. QFR does not provide data specifically for the Resins and Synthetics sector. Instead, these data are a part of the Basic Chemicals, Resins and Synthetics sector. Therefore, EPA was unable to perform a separate QFR-based analysis for this sector and used ATCF adjustment factor calculated for the Basic Chemicals sector for the Resins and Synthetics sector (*Table L-1*).

Table L-1: Analysis Sectors and Corresponding Sectors Covered by QFR

Analysis Sector Name	QFR SIC Sector	SIC Description	QFR NAICS Sector	NAICS Description
	Available for 1998 Q1 through 2001 Q3		Available for 2000 Q4 through 2008 Q4	
Aluminum	333-336	Nonferrous Metals	3313, 3314	Nonferrous Metals
Basic Chemicals; Resins and Synthetics	281, 282, 286	Industrial Chemicals and Synthetics	3251, 3252	Basic Chemicals, Resins, and Synthetics
Pharmaceuticals	283	Drugs	3254	Pharmaceuticals & Medicines
Resins and Synthetics[b]	NA	NA	NA	NA
Pesticides and Fertilizers[a]	284, 285, 287, 289	Residual of Chemicals	3253, 3255, 3256, and 3259	Other Chemicals
Food and Kindred Products	22, 21	Food & Kindred Products (Incl. Tobacco)	311, 312	Food, Beverage, & Tobacco Products
Paper and Allied Products	26	Paper & Allied Products	322	Paper
Petroleum Refining	29	Petroleum & Coal Products	324	Petroleum & Coal Products
Steel	331, 332, 329	Iron & Steel	3311, 3312	Iron, Steel, & Ferroalloys

a. QFR does not provide data specifically for the Pesticides and Fertilizers sector. Instead, these data are a part of the Other Chemicals sector (SIC 284, 285, 287, and 289; NAICS 3253, 3255, 3256, and 3259)
b. QFR does not provide data specifically for the Resins and Synthetics sector. Instead, these data are a part of the Basic Chemicals, Resins and Synthetics sector.
Source: U.S. Census Bureau, 1998-2011 Quarterly Financial Report; U.S. EPA Analysis, 2013

- **Adjust ATI and DDA values to constant dollars in 2011**: EPA deflated all values to 2011 using the GDP Deflator series published by the Bureau of Economic Analysis (U.S. BEA, 20XX).

- **Calculate ATCF**: EPA calculated quarterly ATCF values as *quarterly* ATI *plus* DDA for each industry, and summed the resulting *quarterly* ATCF values to calculate *annual* ATCF values for 1988 through 2011.
- **Generate ATCF index series**:
  - EPA first adjusted the ATCF series to eliminate negative values for each industry by adding to each ATCF value in a given industry"s 24-year series, the absolute value of the most negative ATCF value for this industry, plus one. This adjustment has the effect of "vertically" shifting the ATCF values for a given industry so that all values are positive while retaining the mathematical "shape" of the series as needed for the trend analysis. This adjustment was necessary to prevent the undesirable inversion of the ATCF index trend – calculated in the next step below – that would occur if a negative index numerator is combined with a positive series in calculating the ATCF index series.
  - EPA calculated ATCF index values for each year and industry by dividing each adjusted ATCF value by the 24-year average of adjusted ATCF values.
- **Calculate the time trend of ATCF index series**: EPA regressed ATCF index values against year by industry, to calculate the time trend of constant dollar ATCF over the period 1988 to 2011 (1992 to 2011 for the Pesticides and Fertilizers sector).

L.1 Analysis Results

Table L-2 summarizes the analysis results together with potential adjustments under varying interpretations of the findings.

Table L-2: Statistical Significance of Regression Results and Potential Adjustments

Analysis Sector	P-Value	Statistically Significant?	Difference in Trend-Predicted ATCF Index and Actual Index Values – both at 1996-1998[a]	Difference in Trend-Predicted ATCF Index *at 2011* and Actual Index Value at 1996-1998[b]
Aluminum	0.6148	no	-6.5%	NA
Basic Chemicals; Resins and Synthetics	0.8225	no	-13.4%	NA
Pharmaceuticals	0.0000	yes	20.0%	144.4%
Resins and Synthetics[c]	NA	NA	NA	NA
Pesticides and Fertilizers	0.0005	yes	-25.7%	17.1%
Food and Kindred Products	0.0000	yes	1.8%	38.0%
Paper and Allied Products	0.0401	yes	-11.1%	-32.3%
Petroleum Refining	0.0011	yes	21.7%	93.0%
Steel	0.8483	no	-27.5%	NA

a. For sectors with statistically *significant* estimated trend factors, the "trend-predicted ATCF values" are the average of 1996-1998 predicted ATCF values using the estimated *non-zero* time-trend factor. For sectors for which the estimated trend factor is *not* statistically significant, the "trend-predicted ATCF values" are the simple 24-year average of ATCF index values – i.e., the time-trend factor is assumed to be zero.
A negative value indicates that the *actual* value exceeds the *trend-predicted ATCF value*; a positive value indicates that the *trend-predicted ATCF value* exceeds the *actual* value. In both instances, the reported percentage value is the adjustment that would be applied to bring the actual index value to the 1996-1998 trend-predicted value.
b. The "trend-predicted ATCF values" are at 2011 and are reported only for sectors for which the estimated time-trend factor is statistically significant. In four instances, the estimated time-trend factor is positive and the trend-predicted ATCF index values at 2011 are higher than the actual index values at 1996-1998. In the case of the Paper and Allied Products sector, the estimated time-trend factor is negative and the trend-predicted ATCF index value at 2011 is lower than the actual index value at 1996-1998.
c. QFR does not provide data specifically for the Resins and Synthetics sector. Instead, these data are a part of the Basic Chemicals, Resins and Synthetics sector.
Source: U.S. Census Bureau, 1998-2011 Quarterly Financial Report; U.S. EPA Analysis, 2013

Several observations are relevant:

- The estimated trend value is *not* statistically significant for three of the eight analyzed sectors: *Aluminum* (*Figure L-4*), *Basic Chemicals, Resins and Synthetics* (*Figure L-5*), and *Steel* (*Figure L-11*). For these sectors:
  - EPA decided *not* to use the estimated trend value in any adjustments, but to use simply the average ATCF index values over the 24 years – i.e., a trend line with zero slope – as the basis of any adjustment.
  - The indicated direction of adjustment to bring their ATCF values to the 1996 to 1998 trend value is negative – i.e., the ATCF adjustment would lower the estimated ATCF values for facilities in these sectors.
  - Consequently, EPA decided to adjust ATCF values for these sectors" facilities *only* to the 1996 to 1998 trend value. The downward adjustment of the ATCF values avoids *overstating* the ability of facilities in these industries to comply with rule requirements.
- The estimated trend value is statistically significant for the other five sectors of the eight: *Food and Kindred Products* (*Figure L-6*), *Paper and Allied Products* (*Figure L-7*), *Pesticides and Fertilizers* (*Figure L-8*), *Petroleum Refining* (*Figure L-9*), and *Pharmaceuticals* (*Figure L-10*).
  - Therefore, EPA could use the estimated trend line as the basis for adjustment either (1) to adjust the survey-based ATCF values to trend at 1996-1998 or (2) to adjust ATCF values for the trend over time since the survey.
  - For three of these sectors, Pharmaceuticals, Food and Kindred Products, and Petroleum Refining, the calculated ATCF index values for 1996 through 1998 are roughly at or below the estimated trend lines at 1996 to 1998 *and* the estimated trends show a steep increase in ATCF from 1996 through 1998 to 2011. On the other hand, the calculated ATCF index values for 1996 through 1998 for Pesticides and Fertilizers are *above* the estimated trend line at 1996 to 1998, *while* the estimated trend still shows a steep increase in ATCF from 1996 through 1998 to 2011. For Paper and Allied Products, the calculated ATCF index value for is also *above* the estimated trend line *but* the estimated trend shows a relatively steep decline in ATCF from 1996 through 1998 to 2011.
  - The change in ATCF implied by the estimated trend lines occurs over too long a period and is too large to reflect unchanging capital in an industry, in terms of number and/or size of facilities. Although the trend values are statistically significant, for these reasons for four of the five sectors – Food and Kindred Products, Pesticides and Fertilizers, Petroleum Refining, and Pharmaceuticals – EPA decided not to adjust the survey-based ATCF values *along the trend* – i.e., from 1996 through 1998 to 2011. The estimated trend is positive and moving the survey-based ATCF along the trend could have the effect of overstating the potential of facilities in these four sectors to comply with rule requirements. As a result, the Agency decided to bring survey-based ATCF values for these sectors *only* to the estimated trend at 1996 to 1998 and *not* adjust along the trend. On the other hand, for the Pulp and Paper sector, EPA decided to adjust the survey- based ATCF values along the trend. Here, the estimated trend is negative; *not* moving the survey-based ATCF along the trend could have the effect of overstating the potential of facilities in this industry to comply with rule requirements. Consequently, these adjustments from the original survey avoid overstating the potential of facilities in these industries to meet rule requirements.

Table L-3 presents the cash flow adjustment factors developed based on the preceding findings and judgments. The table also reports the adjustment factors used in the previous Phase III cost and economic impact analyses. For *Aluminum*, *Paper and Allied Products*, *Basic Chemicals, Resins and Synthetics*, *Pesticides and Fertilizers*, and *Steel*, the potential adjustment would *reduce* the survey-based ATCF values by the multiplicative factor. For *Food and Kindred Products*, *Petroleum Refining*, and *Pharmaceuticals* the potential adjustment would *increase* the survey-based ATCF values by the multiplicative factor. Because QFR does not provide information for the *Resins and Synthetics* sector, EPA substituted the adjustment factor calculated for the *Basic Chemicals, Resins and Synthetics* sector.

Table L-3: Potential ATCF Adjustment Factors

Analysis Sector	Adjustment Factors			
	Adjustments in Previous Analyses			
	To 2003 – P3P[a]	To 2005 – P3F[b]	To 1996-1998 Trend – P4P[c]	To 1996-1998 Trend or 2011 – Current
Aluminum	NA	NA	0.9044	0.9346
Basic Chemicals; Resins and Synthetics	0.9228	1.1543	0.8501	0.8660
Pharmaceuticals	1.3171	1.2526	**1.2004**	**1.2218**
Resins and Synthetics	1.1398	1.1948	0.8501	0.8660
Pesticides and Fertilizers	NA	NA	**0.7420**	**0.7426**
Food and Kindred Products	NA	NA	**1.0355**	**1.0181**
Food	NA	1.3835	NA	NA
Beverages	NA	1.3076	NA	NA
Paper and Allied Products	1.0397	1.0386	0.8737	**0.6700**
Petroleum Refining	1.2480	1.4914	**1.2304**	**1.2173**
Steel	0.8056	0.9096	0.7539	0.7249

a. For more information on the development of these adjustments factors, see the 2004 Economic Analysis for the Proposed Section 316(b) Rule for Phase III Facilities

b. For more information on the development of these adjustments factors, see the 2006 Economic and Benefits Analysis for the Final Section 316(b) Phase III Existing Facilities Rule.

c. For more information on the development of these adjustments factors, see the 2011 Environmental and Economic Benefits Analysis for Proposed Section 316(b) Existing Facilities Rule.

Source: U.S. Census Bureau, 1998-2011 Quarterly Financial Report; U.S. EPA Analysis, 2013

The following eight charts depict the calculated ATCF Index Series and Trend-Predicted ATCF Index series for the eight sectors representing the Primary Manufacturing Industries. The Trend-Predicted ATCF Index series is a *non-zero* slope line and is labeled "Calculated Trend" for sectors for which the estimated time-trend factor is statistically significant. For sectors for which the factor is *not* statistically significant, the Trend-Predicted Index series is a *zero* slope line and is labeled "24-Yr Ave ATCF Index."

Figure L-4: ATCF Index Series and Calculated Trend - Aluminum

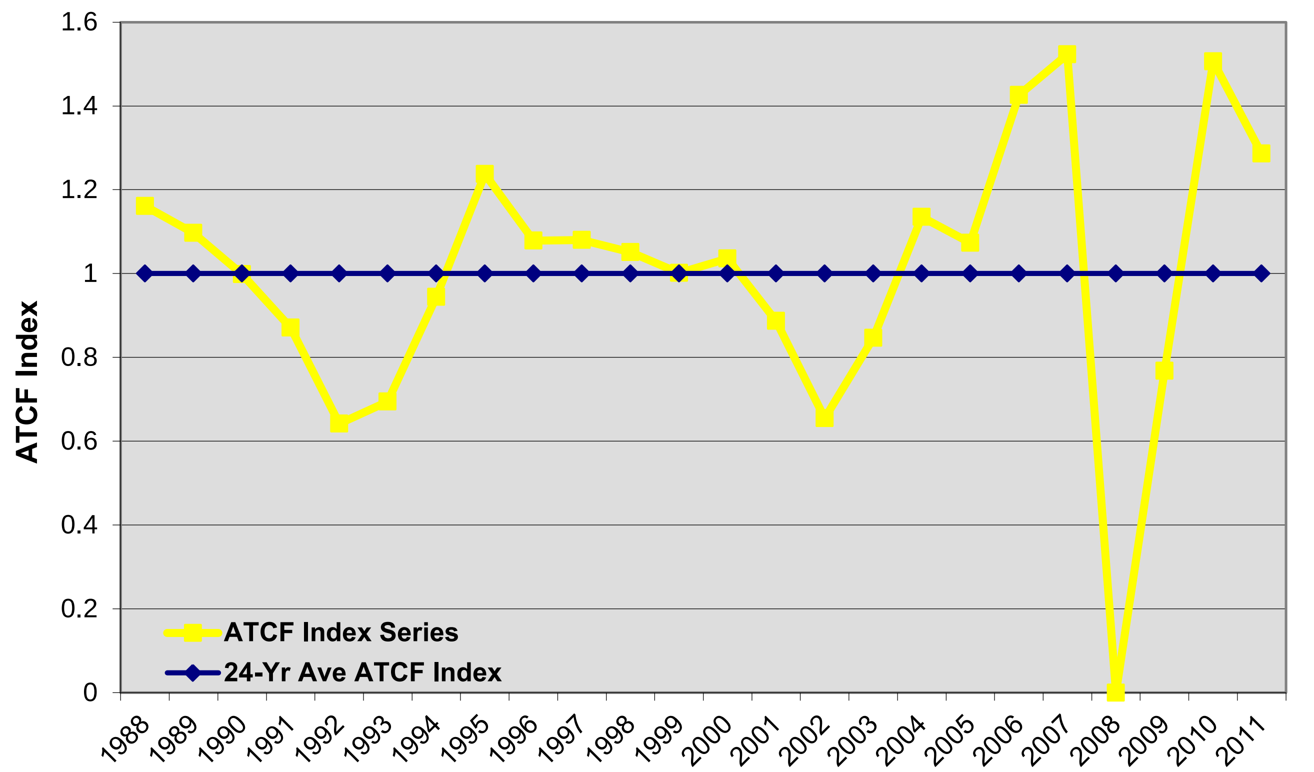


Figure L-5: ATCF Index Series and Calculated Trend – Basic Chemicals, Resins and Synthetics

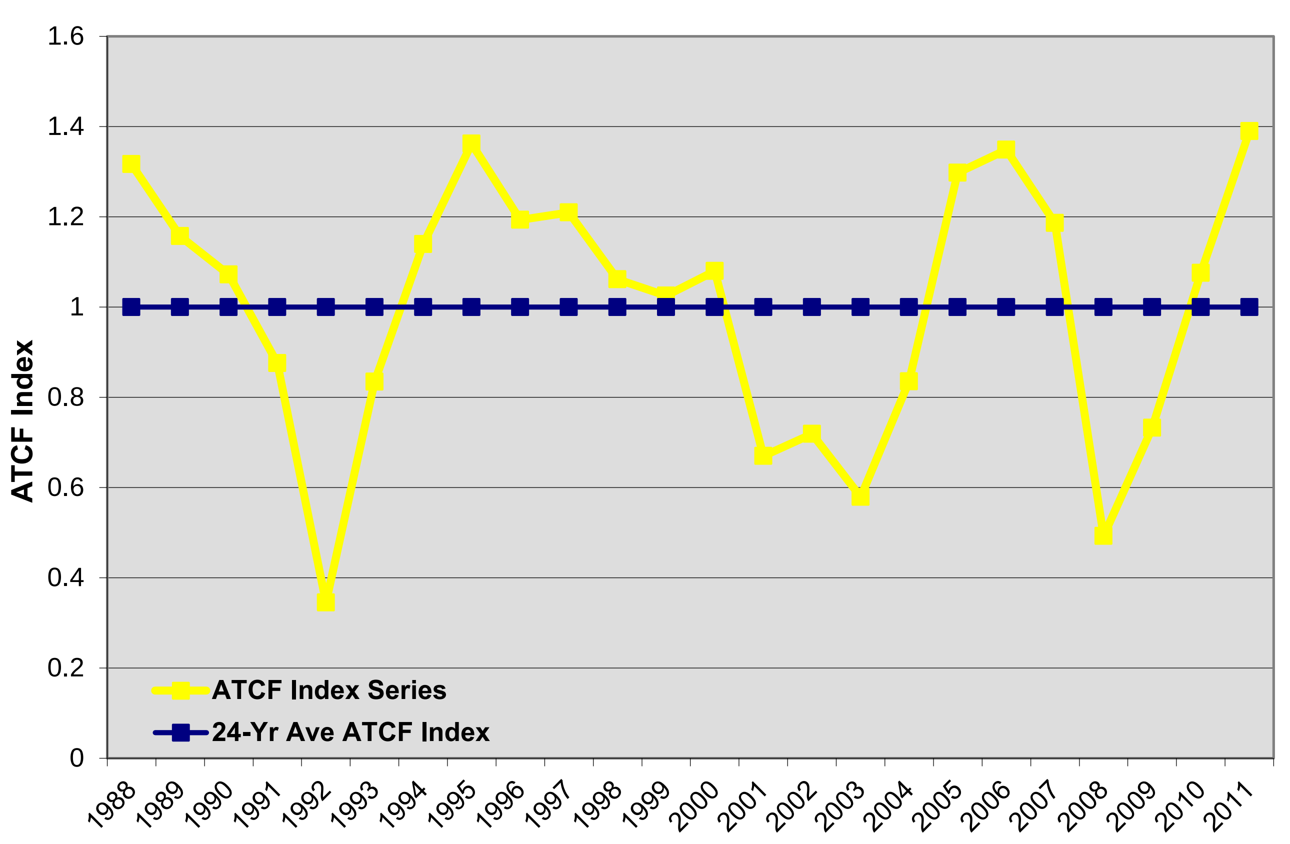


Figure L-6: ATCF Index Series and Calculated Trend – Food and Kindred Products

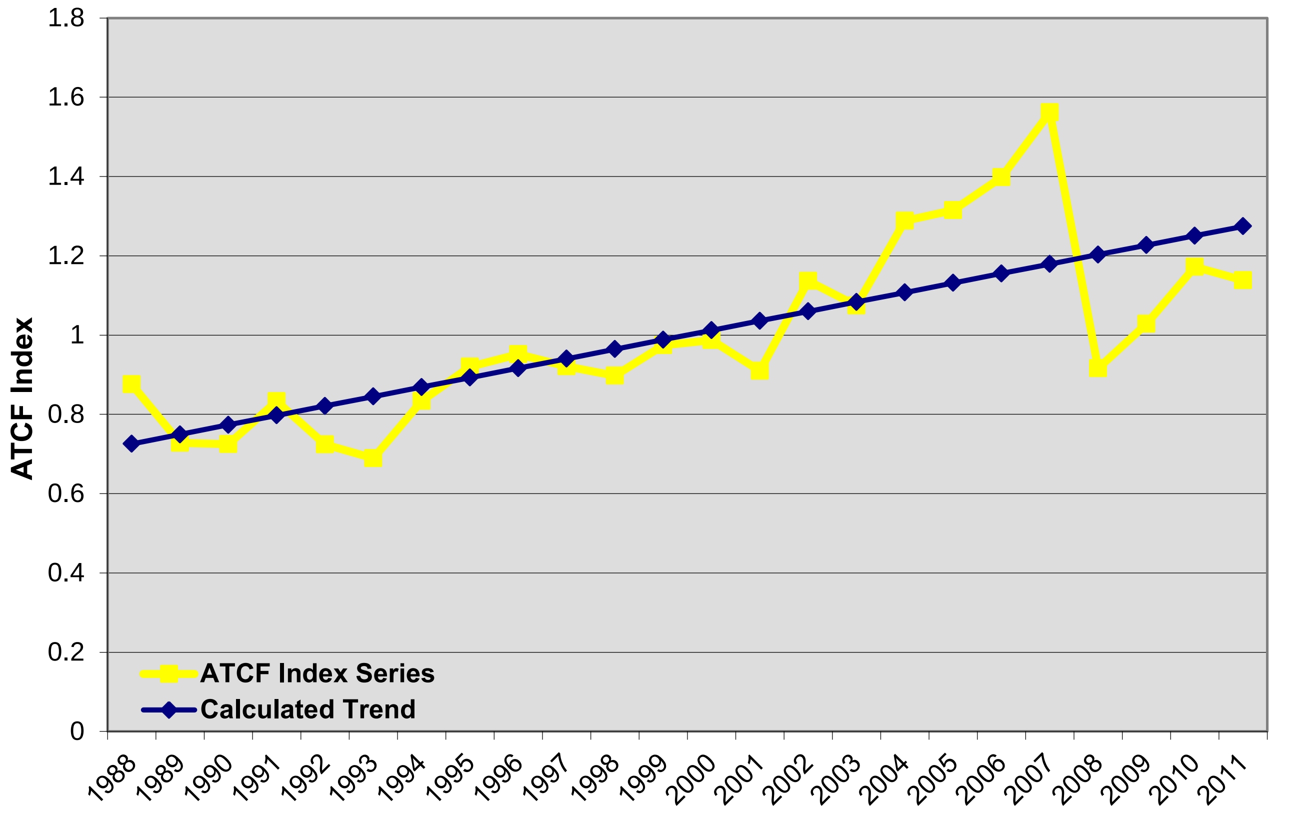


Figure L-7: ATCF Index Series and Calculated Trend – Paper and Allied Products

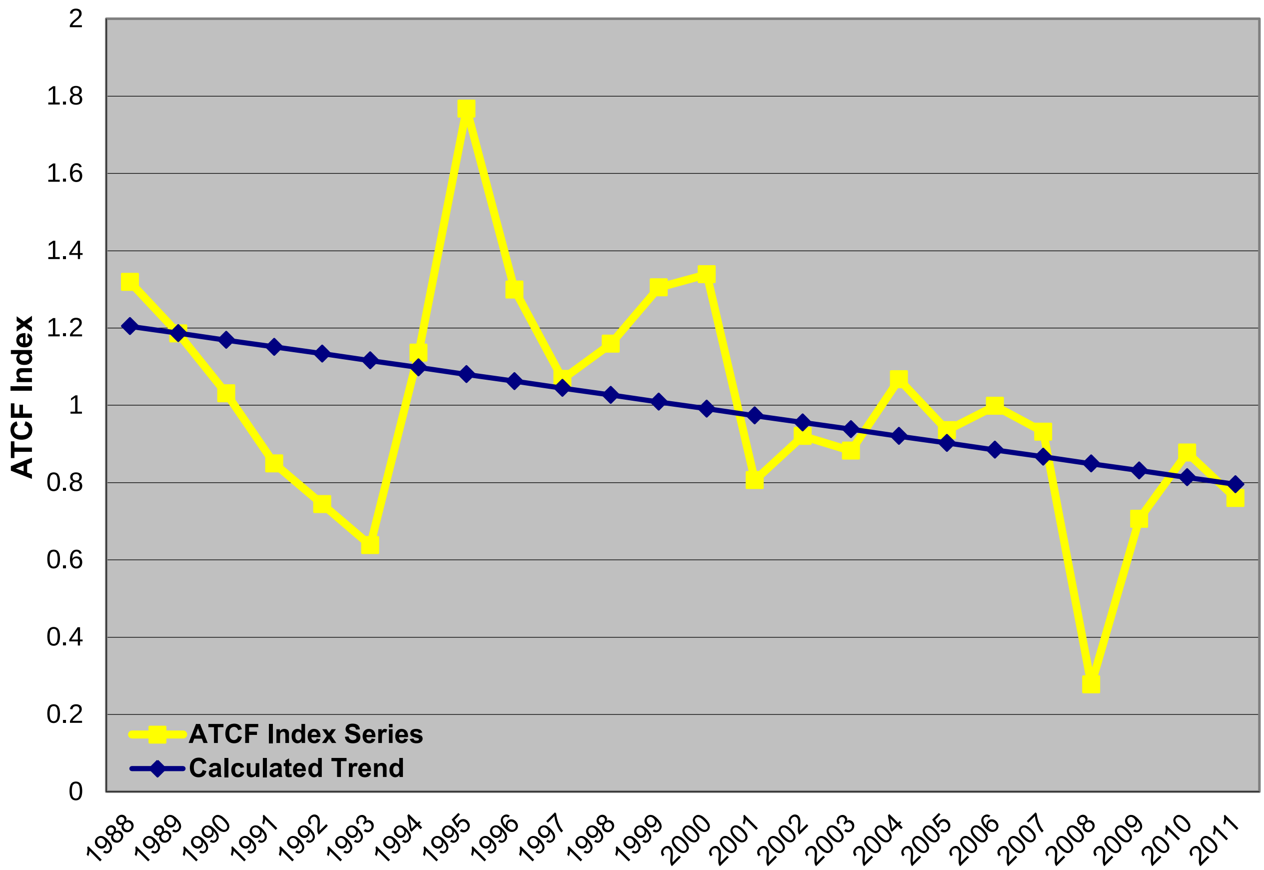


Figure L-8: ATCF Index Series and Calculated Trend – Pesticides and Fertilizers

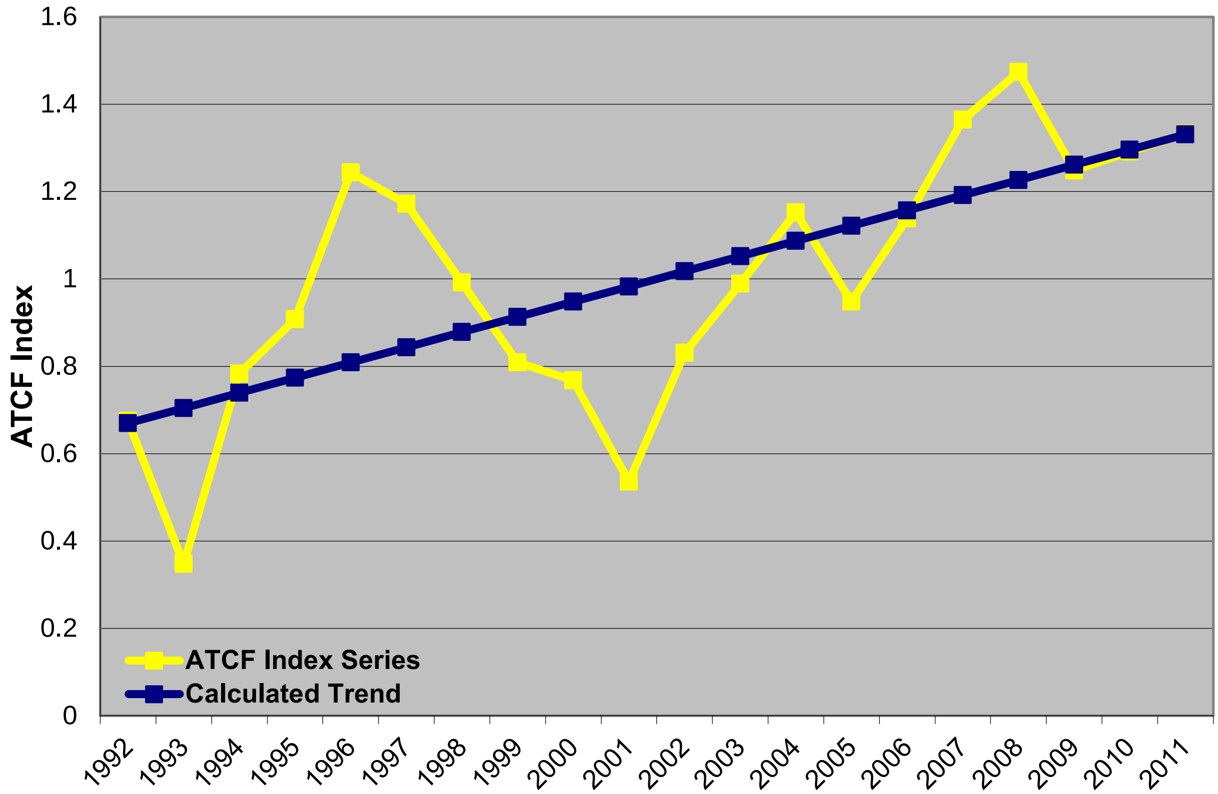


Figure L-9: ATCF Index Series and Calculated Trend – Petroleum Refining

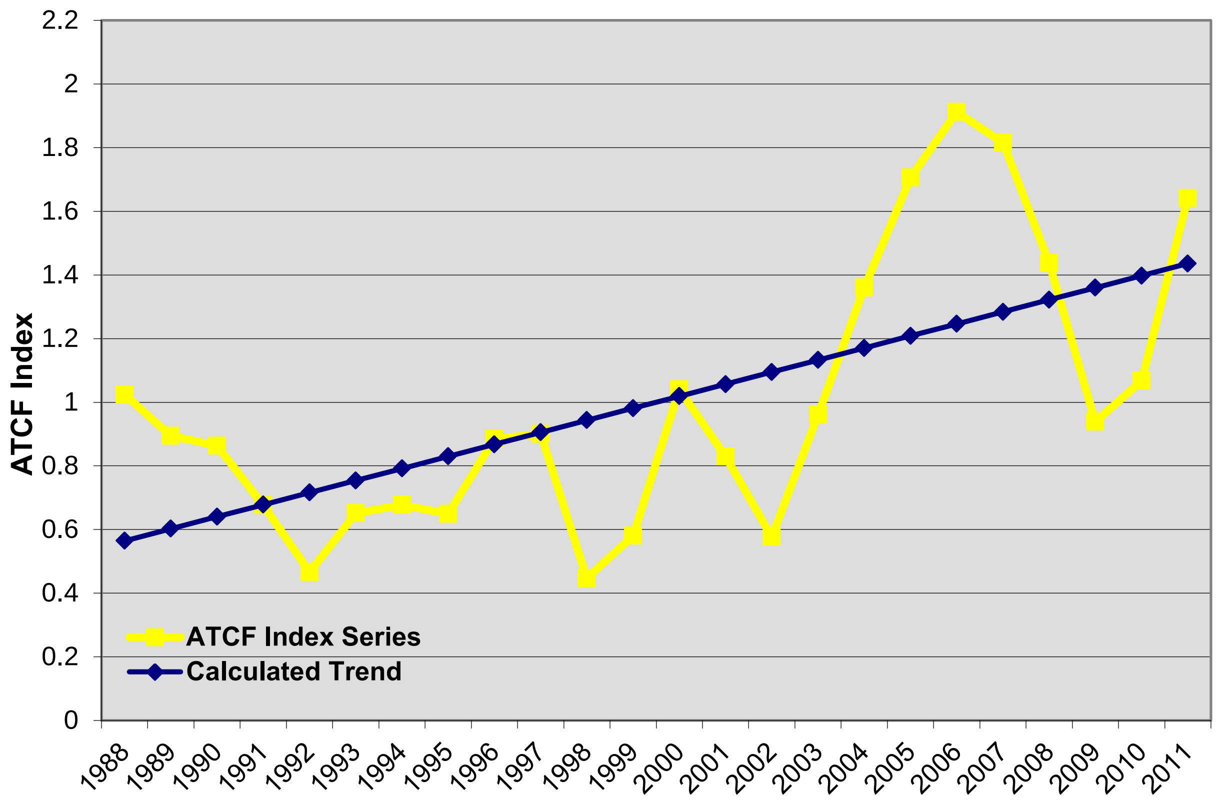


Figure L-10: ATCF Index Series and Calculated Trend – Pharmaceuticals

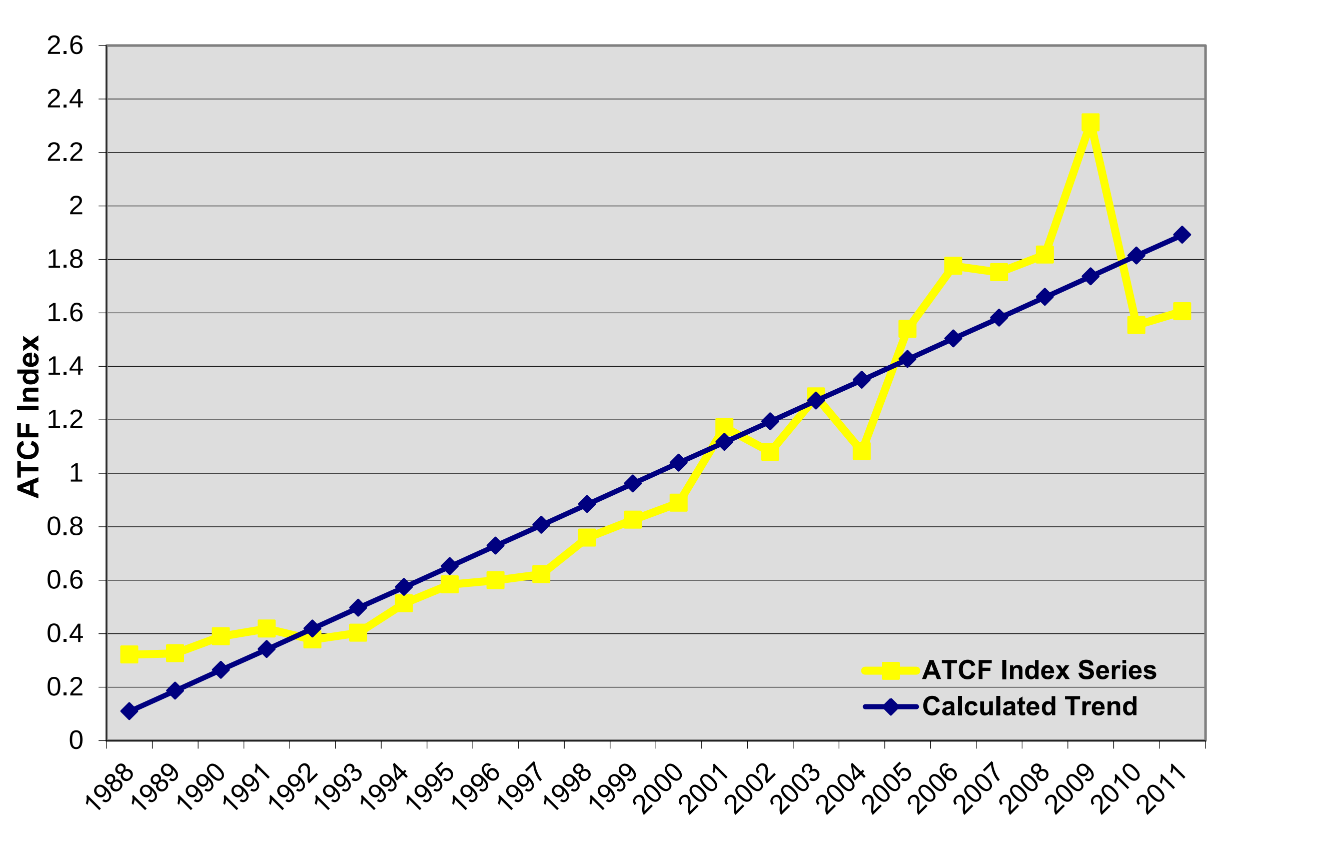
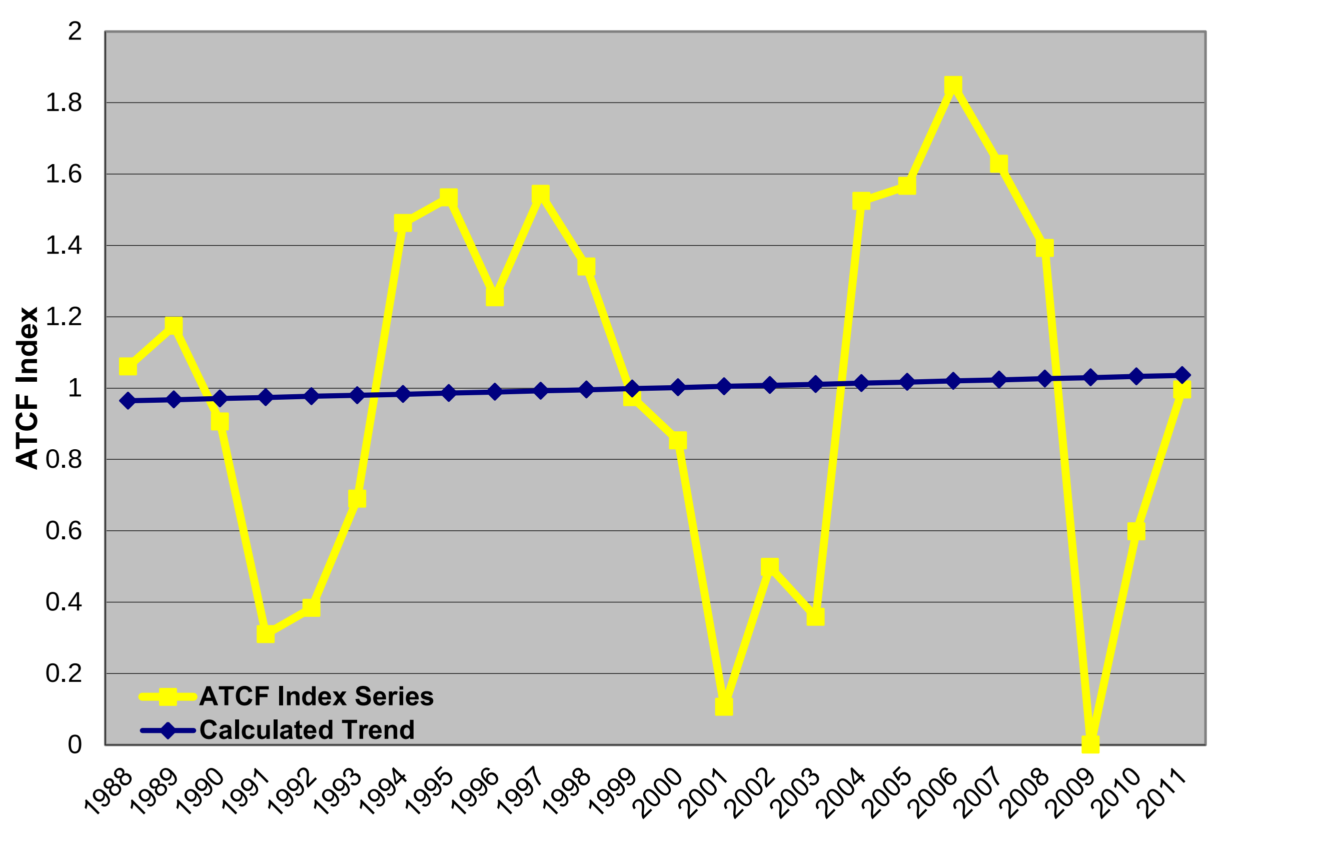


Figure L-11: ATCF Index Series and Calculated Trend – Steel



Appendix M Estimating Capital Outlays for Discounted Cash Flow Analyses - Manufacturers

The analysis of economic impacts to Manufacturers involves calculation of the business value of sample facilities on the basis of a discounted cash flow (DCF) analysis of operating cash flow as developed from the 316(b) survey data.[261] This appendix presents the details of the Capital Expenditure analysis, as performed and documented for the previous 316(b) analyses, including propose rule. EPA did not re-estimate the regression equation for the analysis of the final rule, but did update some of the input data that is used to estimate Capital Expenditure based on the regression analysis. These updates are described in *Section M.6.* While the estimation of capital outlays relies in part on data in the SIC framework and uses data from the Value Line dataset, which have been replaced respectively by the NAICS framework and Quarterly Financial Reports (QFR) published by the U.S. Census Bureau, EPA judges that the estimations of capital expenditures remain valid for the analysis of the current final rule.[262] As done for the proposed rule, this analysis was conducted for Manufacturers in the *original* set of Primary Manufacturing Industries and does not include information for the Food and Kindred Products industry, which was added as a primary industry for the 316(b) Phase III Final Rule analysis.[263]

Business value is calculated on a pre- and post-compliance basis and the change in this value serves as an important factor in estimating regulatory impacts in terms of potential facility closures. To be accurate in concept, the business-value calculation should recognize cash outlays for capital acquisition as a component of cash flow. However, the 316(b) survey did not request information from surveyed facilities on their cash outlays for capital acquisition. Absent this data, EPA developed an estimate of cash outlays for capital acquisition. This appendix describes the methodology EPA used to derive, for each sample facility, an estimate of cash outlays for capital acquisition.

EPA Office of Water (OW) previously identified that the omission of cash outlays for capital acquisition from DCF analyses may lead to overstatement of the business value of surveyed facilities and, as a consequence, understatement of regulatory impacts in terms of estimated facility closures (EPA, 2003). In response to this omission, the Office of Management and Budget suggested the adoption of depreciation expense as a surrogate for cash outlays for capital replacement and additions. However, for several reasons EPA believes depreciation is a poor surrogate. First, depreciation is meant to capture the consumption/use of previously acquired assets, *not* the cost of replacing, or adding to, the existing capital base. Therefore, depreciation is fundamentally the wrong concept to use as a surrogate for capital outlays associated with capital replacement and additions. Second, depreciation is estimated based on the historical asset cost, which may understate or overstate the real replacement cost of assets. Third, both book and tax depreciation schedules generally understate the assets‟ useful life. Thus, reported depreciation will overstate real depreciation value for recently acquired assets that are still in the depreciable asset base, and conversely, understate the real depreciation value of assets that have expired from the depreciable asset base but still remain in valuable use. Finally, depreciation does not capture the important variations in capital outlays that result from differences in revenue growth and financial performance among

261 This analysis is limited to potentially affected facilities in SIC codes 26, 28, 29, and 33.

262 The prior analysis, and therefore this appendix, relied on classification of businesses in the SIC framework. Although other analyses and presentations for the final rule have been updated to use the NAICS framework, this analysis continues to use the SIC framework as the basis for business classification.

263 Although the Food and Kindred Products sector was ultimately included in the set of the Primary Manufacturing Industries, EPA judged that it was not necessary to re-estimate the model with data for this additional industry because the model coefficients originally estimated at 316(b) Phase III proposal did not vary by industry in a statistically significant way. EPA continues to rely on this judgment as the basis for carrying forward the previously estimated regression relationship without inclusion of the Food and Kindred Products sector as an explicitly analyzed sector.

firms. Businesses with real growth in revenue will need to expand both their fixed and working capital assets to support business growth, and all else being equal, growing businesses will have higher ongoing outlays for fixed and working capital assets. Similarly, the ability of businesses to renew and expand their asset base depends on the financial productivity of the deployed capital as indicated by measures such as return on assets (ROA) or return on invested capital (ROIC). As a result, businesses with "strong" asset productivity will attract capital for renewal and expansion of their asset base, while businesses with "weak" asset productivity will have difficulty attracting the capital for renewal and expansion of the business‟ asset base. All else being equal, businesses with strong asset productivity will have higher and businesses with weak asset productivity will have lower ongoing outlays for capital.

As an approach to addressing the absence of data on cash outlays for capital acquisition to support the DCF analysis, EPA estimated a regression model of capital outlays using reported capital expenditures and relevant explanatory financial and business environment information for public-reporting firms in the *original* Primary Manufacturing Industries. The Agency used the resulting model to estimate capital outlays for in-scope facilities, which were then used in the DCF analyses to calculate business value of these facilities and estimate regulatory impacts in terms of facility closures.[264]

This appendix discussed the methodology and data sources used to estimated capital outlays for Manufacturers, and presents the findings from the regression analysis.[265]

M.1 Analytic Concepts Underlying Analysis of Capital Outlays

On the basis of general economic and financial concepts of investment behavior, EPA began its analysis by outlining a framework relating the level of a firm‟s capital outlays to explanatory factors that:

- Can be observed for public-reporting firms – either as firm-specific information or general business environment information – and thus be included in a regression analysis; and
- For firm-specific information, are also available for surveyed Manufacturers from the 316(b) survey.

EPA reviewed recent studies of the determinants of capital outlays to identify the explanatory concepts and variables that might be used in and to specify the models for analysis. EPA‟s review of this literature generally confirmed the overall approach to estimation of capital outlays and helped to identify additional specific variables that other analysts found to contribute important information in the analysis of capital outlays (e.g., the decision to test capacity utilization as an explanatory variable, see below, resulted from the literature review).

Table M-1 summarizes the conceptual relationships between a firm‟s capital outlays and explanatory factors that EPA sought to capture in this analysis. Specifically, this table outlines the concept of influence on capital outlays,

264 The approach and regression model described above are based largely on the approach and regression model developed in support of the analysis of economic impacts for the Metal Products and Machinery Regulation (MP&M). This analysis provides a recent example of the need to address the omission of capital acquisition cash outlay data from a DCF analysis. EPA notes that the Primary Manufacturing Industries are similar to the industries analyzed in the MP&M analysis in that both sets are in the manufacturing sector. In addition, the 316(b) survey and the MP&M survey instruments are similar in the information they ask; therefore, similar data are available for the 316(b) manufacturers and MP&M survey facilities. As such, EPA relied heavily on prior experience from the MP&M final regulation to estimate capital outlays for in-scope facilities.

265 Because the estimated regression model for Manufacturers is based on an earlier model developed for the MP&M final regulation, much of the underlying research involved in the analytic development of the model had been previously completed and was not required to be redone. Nonetheless, in order to present a lucid discussion of the analytic concepts underlying the model and the rationale behind specifying variables for the analysis and specification of the regression model, a complete discussion of how the regression model was developed is presented. During the course of the discussion, instances where prior experience gained during estimating the regression model for the MP&M final regulation had a significant influence in the development of the current model are clearly highlighted.

the general explanatory variable(s) that EPA identified to capture the concept in a regression analysis, and the hypothesized mathematical relationship (sign of estimated coefficients) between the concept and capital outlays.

Table M-1: Summary of Factors Influencing Capital Outlays

Explanatory Factor/Concept To Be Captured in Analysis	Translation of Concept to Explanatory Variable(s)	Expected Relationship
Availability of attractive opportunities for additional capital investment. A firm‟s owners, or management acting on behalf of owners, should expend cash for capital outlays only to the extent that the expected return on the capital outlays – whether for replacement of, or additions to, existing capital stock – are sufficient to compensate providers of capital for the expected return on alternative, competing investment opportunities, taking into account the risk of investment opportunities.	Historical ***Return On Assets*** of establishment as an indicator of investment opportunities and management effectiveness, and, hence, of desirability to expand capital stock and ability to attract capital investment. Use of a historical variable implicitly assumes past performance is indicative of future expectations.	Positive
Business growth and outlook as a determinant of need for capital expansion and attractiveness of investment opportunities. All else equal, a firm is more likely to have attractive investment opportunities and need to expand its capital base if the business is growing and the outlook for business performance is favorable.	***Revenue Growth***, from the prior time period(s) to the present, provides a *historical* measure of business growth and is a potential indicator of need for capital expansion. Use of a historical variable implicitly assumes past performance is indicative of future expectations.	Positive
	Clearly, the theoretical preference is for a forward-looking indicator of business growth and need for capital expansion. Options EPA identified include ***Index of Leading Indicators*** and current ***Capacity Utilization***, by industry. Higher current *Capacity Utilization* may presage need for capital expansion.	Positive
Importance of capital in business production. All else equal, the more capital intensive the production activities of a business, the greater will be the need for capital outlay to replenish, and add to, the existing capital stock. More capital intensive businesses will spend more in capital outlays to sustain a given level of revenue over time.	The ***Capital Intensity*** of production as measured by the production capital required to produce a dollar of revenue provides an indicator of the level of capital outlay needed to sustain and grow production. As an alternative to a firm-specific concept such as Capital Intensity of production, differences in business characteristics might be captured by an ***Industry Classification*** variable.	Positive
Life of capital equipment in the business. All else equal, the shorter the useful life of the capital equipment in a business, the greater will be the need for capital outlay to replenish, and add to, the existing capital stock.	No information is available on the actual useful life of capital equipment by business or industry classification. However, the ***Capital Turnover Rate***, as calculated by the ratio of book depreciation to net capital assets, provides an indicator of the rate at which capital is depleted, according to book accounting principles: the higher the turnover rate, the shorter the life of the capital equipment. However, the measure is imperfect for reasons of both the inaccuracies of book reporting as a measure of useful life, and as well the confounding effects of growth in the asset base due to business expansion – which will tend to lower the indicated turnover rate, all else equal, without a real reduction in life of capital equipment. As above, an alternative to a firm-specific concept, differences in business characteristics might be captured by an ***Industry Classification*** variable.	Positive, generally, but with recognition of the potential for counter-trend effects
The cost of financial capital. The cost at which capital – both debt and equity – is made available to a firm will determine which investment opportunities can be expected to generate sufficient return to warrant use of the financial capital for equipment purchases. All else equal, the higher the cost of financial capital, the fewer the investment/capital outlay opportunities that would be expected to be profitable and the lower the level of outlays for replacement of, or additions to, capital stock.	Preferably, measures of cost-of-capital would be developed separately for debt and equity. The ***Cost of Debt Capital***, as measured by an appropriate benchmark interest rate, provides an indication of the terms of debt availability and how those terms are changing over time. Preferably, the debt cost/terms would reflect the credit condition of the firm, which could be based on a credit safety rating (e.g., S&P Debt Rating).	Negative
	The cost of equity capital is more problematic than the cost of debt capital since it is not directly observable for either public-reporting firms or, in particular, private firms in the 316(b) manufacturers dataset. However, a readily available surrogate such as ***Market-to-Book Ratio*** provides insight into the terms at which capital markets are providing equity capital to *public-reporting firms*: the higher the Market-to-Book Ratio, the more favorable the terms of equity availability.	Negative

Table M-1: Summary of Factors Influencing Capital Outlays		
Explanatory Factor/Concept To Be Captured in Analysis	**Translation of Concept to Explanatory Variable(s)**	**Expected Relationship**
The price of capital equipment. The price of capital equipment – in particular, how capital equipment prices are changing over time – will influence the expected return from capital outlays. All else equal, when capital equipment prices are increasing, the expected return from incremental capital outlays will decline and vice versa. However, although the generally expected effect of higher capital equipment prices is to remove certain investment opportunities from consideration, the potential effect on *total capital outlay* may be mixed. If expected returns are such that the demand to invest in capital projects is relatively inelastic, the effect of higher prices for capital equipment may be to raise, instead of lower, the total capital outlay for a firm.	Index provides an indicator of the change in capital equipment prices.	Negative, generally, but with recognition of the potential for counter-trend effects
Source: U.S. EPA analysis, 2013		

M.2 Specifying Variables for the Analysis

Working from the general concepts of explanatory variables outlined above, EPA defined the specific explanatory variables to be included in the analysis. A key requirement of the regression analysis is that the firm-specific explanatory variables included in the regression analysis later be used as the basis for estimating capital expenditures for Manufacturers. As a result, in defining the firm-specific variables, it was necessary to ensure that the definition of variables selected for the regression analysis using data on public-reporting firms be consistent with the data items available for Manufacturers. EPA‟s selection of firm-specific variables was further constrained by the decision to use the Value Line Investment Survey (VL) as the source of firm-specific information for the regression analysis (see *Section M.3*).

Table M-2 reports the specific definitions of variables included in the analysis (both the dependent variable and explanatory variables) as well as any additional data manipulations, the data sources, the estimation analysis equivalent for Manufacturers (either the corresponding variable(s) in the 316(b) survey or other source outside the survey), and any issues in variable definition.

Table M-2: Variables Used in the Capital-Expenditure Modeling Analysis				
Variables for Regression Analysis			**Equivalent Used for Manufacturers**	**Comment / Issue**
Variable	**Source**	**Calculation**		
Dependent Variable				
Gross expenditures on fixed assets: CAPEX, includes outlays to replace, and add to, existing capital stock	Value Line	Obtained from VL as Capital Spending per Share. CAPEX calculated by multiplying by Average Shares Outstanding.	None: to be estimated based on estimated coefficients.	*This value and all other dollar values in the regression analysis were deflated to 2002 using 2-digit SIC PPI values.*
Explanatory Variables				
Firm-Specific Variables				

Table M-2: Variables Used in the Capital-Expenditure Modeling Analysis

Variables for Regression Analysis			Equivalent Used for Manufacturers	Comment / Issue
Variable	**Source**	**Calculation**		
Return On Assets: ROA	Value Line	ROA = Operating Income / Total Assets. Both Operating Income, defined as Revenue less Operating Expenses (CoGS+SG&A), and Total Assets were obtained directly from VL.	From 316(b) survey: Revenue *less* Total Operating Expenses (Material & Product Costs + Production Labor + Cost of Contract Work + Fixed Overhead + R&D + Other Costs & Expenses)	Would have preferred an after-tax concept in numerator *and* a deployed production capital concept in denominator. However, VL provides no tax value *per se* and would require calculation of tax using an estimated tax rate, which could introduce error. Also neither VL nor 316(b) survey data provide sufficient information to get at deployed production capital.
Revenue: REV	Value Line	REV = Revenues. Revenues directly available from VL.	From 316(b) survey: Revenue	In the log-linear formulation this variable captures percent change/growth in revenues. However, the use of the log-linear formulation, eliminates the potential to set the growth term to zero in estimating baseline capital outlays for Manufacturers. During the specification of the regression model for the MP&M final regulation, Total Assets was also tested as a scale variable. Since it provided a good, but not as strong, an explanation, as REV it was not included in the final specification. Based on this previous finding, Total Assets was not considered while specifying the regression model.
Capital Turnover Rate: CAPT	Value Line	CAPT = Depreciation / Total Assets. Depreciation and Total Assets directly available from VL.	From 316(b) survey: Depreciation / Total Assets	Would have preferred denominator of *net fixed assets* instead of *total assets*. However, VL provides detailed balance sheet information for only the four most recent years. Not possible to separate current assets and intangibles from total assets.
Capital Intensity: CAPI	Value Line	CAPI = Total Assets / Revenue. Total Assets and Revenue directly available from VL	From 316(b) survey: Total Assets / Revenue	As above, would have preferred *net fixed assets* instead of *total assets*, but needed data are not available from VL for the full analysis period.
Market-to-Book Ratio: MV/B	Value Line	MV/B = average market price of common equity (Price) divided by book value of common equity (Book Value per Share). Price and Book Value per Share directly available from VL.	N/A (see Comment/Issue)	During specification of the MP&M regression model, MV/B was found to highly correlated with other, more important explanatory variables, which makes sense, given that equity terms would be derived from more fundamental factors, such as ROA. Thus, MV/B was omitted from the MP&M regression model. As a result, MV/B was not considered during the specification of the 316(b) manufacturers regression model which eliminated the need to define an approach to use this variable with 316(b) survey data.
General Business Environment Variables				

Table M-2: Variables Used in the Capital-Expenditure Modeling Analysis

Variables for Regression Analysis			Equivalent Used for Manufacturers	Comment / Issue
Variable	Source	Calculation		
Interest on 10-year, A-rated industrial debt: DEBTCST	Moody"s Investor Services	DEBTCST = annual average of rates for each data year	Use average of DEBTCST rates at time of 316(b) survey.	10-year maturity, industry debt selected as reasonable benchmark for industry debt costs. 10 years became "standard" maturity for industrial debt during 1990s.
Index of Leading Indicators: ILI	Conference Board	Monthly index series available from Conference Board. ILI = geometric mean of current year values.	Use average of ILI values at time of 316(b) survey.	During specification of the MP&M regression model, EPA found that ILI and the CAPPRC (see below) are highly correlated. Thus, ILI was omitted from the MP&M regression model. As a result, ILI was not considered during the specification of the regression model.
Capacity Utilization by Industry: CAPUTIL	Federal Reserve Board (Dallas Federal Reserve)	Monthly index series available from Federal Reserve. CAPUTIL = current year average value.	Use average of CAPUTIL values at time of 316(b) survey.	
Producer Price Index series for capital equipment: CAPPRC	Bureau of Labor Statistics (BLS)	Annual average values available from BLS. CAPPRC = current year average value as reported by BLS.	Use average of CAPPRC values at time of 316(b) survey.	BLS reports PPI series for capital equipment based on "consumption bundles" defined for manufacturing and non-manufacturing industries. For this analysis, EPA used the PPI series based on the manufacturing industry bundle.

Source: U.S. EPA analysis, 2013

M.3 Selecting the Regression Analysis Dataset

In addition to specifying the variables to be used in the regression analysis, EPA also needed to select the public-firm dataset on which the analysis would be performed. As noted above, for this analysis EPA used VL data. The decision to use VL as the source of firm-specific data for the analysis was driven by several considerations:

- Reasonable breadth of public-reporting firm coverage. The VL dataset includes over 8,500 publicly traded firms and identifies principal business of these firms both by a broad industry classification (e.g., Paper/Forest) and by an SIC code assignment.
- Reasonable breadth of temporal coverage. VL provides data for 11 years – i.e., 1992-2002. Although ideally EPA would have preferred a longer time series to include more years not in the "boom" business investment period of the mid- to late-1990s.
- Reasonable coverage of concepts/data needed for analysis. The VL data includes a wide range of financial data that are applicable to the analysis (VL provides 37 data items over the 11 reporting years; see Attachment DB). However, because of the pre-packaged nature of the VL data, it was not possible to customize any data items to support more precise definition of variables in the analysis. In particular, EPA found that certain balance sheet items were not reported to the level of specificity preferred for the analysis. Overall, though, EPA expects the consequence of using more aggregate, less-refined concepts should be minor.

VL SIC-code definitions do not match the official SIC-code definitions generated by the U.S. Census Bureau; however, in most instances a VL"s SIC code can be reasonably matched to one or several Census-defined SIC codes. To build the public-firm dataset corresponding to the *original* Primary Manufacturing Industries (SIC 26: Paper and allied products, SIC 28: Chemicals and allied products, SIC 29: Petroleum and coal products, and SIC 33 Primary metal industries), EPA initially selected all firms included in the VL SIC-code families:

- 2600: Paper/forest products,
- 2640: Packaging and container,
- 2810: Chemical (basic),
- 2813: Chemical (diversified),
- 2820: Chemical (specialty),
- 2830: Biotechnology,
- 2834: Drug,
- 2840: Household products,
- 2844: Toiletries/cosmetics,
- 2900: Petroleum (integrated),
- 3311: Steel (general), and
- 3312: Steel (integrated)

This is the same dataset used for the previous 316(b) rules, including the proposed rule. In order to derive a dataset of firms whose business activities closely match the activities of Manufacturers, EPA made or attempted to make the following revisions to the initial dataset:

EPA found that the VL SIC code definition does not include categories that match SIC 331 and SIC 335 (combined together to form the aluminum sector in the original Phase III analysis). Since U.S. aluminum companies are generally vertically integrated (S&P, 2001), most aluminum companies own large bauxite reserves and mine bauxite ore. As such, these firms are classified in VL under SIC 1000: Metals and mining. EPA reviewed the business activities of firms listed in SIC 1000: Metals and mining, and included only those firms described as aluminum companies in the regression analysis dataset.

EPA reviewed the business activities of firms listed in SIC 3400: Metal fabricating and found no firms whose activities matched those described within the profiles of the original Primary Manufacturing Industries.[266]

EPA reviewed the business activities of firms listed in SIC 2840: Household products and SIC 2844: Toiletries/cosmetics, and retained only those firms in the dataset whose activities matched those described within the profiles of the original Primary Manufacturing Industries.

EPA deleted firms within SIC 2600: Paper/forest products whose business activities are solely limited to timber/lumber production. These facilities are unlikely to use cooling water intake structures and therefore fall outside the original Primary Manufacturing Industries.

EPA reviewed the business activities of firms listed in SIC 2830: Biotechnology and SIC 2834: Drug in order to exclude firms that are exclusively research and development (R&D) firms and are unlikely to use cooling water intake structures. However, based on the information provided by Value Line EPA was unable to segregate R&D firms from the rest of the firms listed in these SIC codes.

EPA only retained firms in the VL dataset if they are situated in the U.S. or Canada, and for whom financial information is available in U.S. dollars.

On inspection, EPA found that a substantial number of firms did not have data for the full 11 years of the analysis period. The general reason for the omission of some years of data is that the firms did not become publicly listed

[266] The profiles only focus on 4-digit SIC categories represented in the sample of facilities which received the Section 316(b) detailed industry questionnaire.

in their current operating structure – whether through an initial public offering, spin-off, divestiture of business assets, or other significant corporate restructuring that renders earlier year data inconsistent with more recent data – until after the beginning of the 11-year data period.[267] As a result, the omission of observation years for a firm always starts at the beginning of the data analysis period. This systematic front-end truncation of firm observations in the dataset could be expected to bias the analysis in favor of the capital expenditure behavior nearer the end of the 1990s decade. To avoid this problem, EPA removed all firm observations that have fewer than 11 years of data. As a result, the dataset used in the analysis has a total of 2,244 yearly data observations and represents 204 firms.

Table M-3 presents the number of firms by industry classifications.

Table M-3: Number of Firms by Industry Classifications

SIC Industry Classification	Number of Firms
26: Paper and allied products	24
28: Chemicals and allied products	136
29: Petroleum and coal products	20
33: Primary metal industries	24

U.S. EPA Analysis, 2012

M.4 Specification of Models to be Tested

On the basis of the variables listed above and their hypothesized relationship to capital outlays, EPA specified a time-series, cross sectional model to be tested in the regression analysis. EPA‟s dataset consisted of 204 cross sections observed over 11 years (1992 through 2002). The general structure of this model was as follows:

$$CAPEX_{i,t} = f(ROA_{i,t}, REV_{i,t}, CAPT_{i,t}, CAPI_{i,t}, DEBTCST_{i,t}, CAPPRC_{t}, CAPUTIL_{j,t}) \quad \text{(M-1)}$$

Where:

$CAPEX_{i,t}$ = capital expenditures of firm i, in time period t;[268]

t = year (year = 1992, . . . , 2002);

i = firm i (i = 1, . . . , 204);

j = industry classification j

$ROA_{i,t}$ = return on total assets for firm i in year t;

$REV_{i,t}$ = revenue ($ millions) for firm i in year t;

$CAPT_{i,t}$ = capital turnover rate for firm i in year t;

$CAPI_{i,t}$ = capital intensity for firm i in year t;

$DEBTCST_{t}$ = financial cost of capital in year t;

$CAPPRC_{t}$ = price of capital goods in year t;

$CAPUTIL_{j,t}$ = the Federal Reserve Board‟s Index of Capacity utilization for a given industry j in year t.

267 When VL adds a firm to its dataset, it fills in the public-reported data history for the firm for the lesser of 11 years or the length of time that the firm has been publicly listed and thus subject to SEC public reporting requirements.

268 All dollar values were deflated to 2002 using 2-digit PPI values.

EPA only tested log-linear model specifications for this analysis.[269] The main advantage of the log-linear model is that it incorporates directly the concept of percent change in the explanatory variables. Specifying the key regression variables as logarithms permitted EPA to estimate directly as the coefficients of the model, the elasticities of capital expenditures with respect to firm financial characteristics and general business environment factors. The following paragraphs briefly discuss testing of the log-linear forms of the model. Parameter estimates are presented for the final log-linear model only.

EPA specified a log-linear model, as follows:

$$\ln(CAPEX_{i,t}) = \alpha + \Sigma[\beta_x \ln(X_{i,t})] + \Sigma[\gamma_y \ln(Y_t)] + \varepsilon \quad \text{(M-2)}$$

Where:

$CAPEX_{i,t}$ = capital expenditures of firm i, year t;

β_x = elasticity of capital expenditures with respect to firm characteristic X;

$X_{i,t}$, = a vector of financial characteristics of firm i, year t;

γ_y = elasticity of capital expenditures with respect to economic indicator Y;

Y_t = a vector of economic indicators, year t; for CAPUTIL, Y is also differentiated by industry classification

ε = an error term; and

$\ln(x)$ = natural log of x

Based on this model, the elasticity of capital expenditures with respect to an explanatory variable, for example, return on assets is calculated as follows:

$$E(CAPEX) = \frac{d\ln(CAPEX)}{d\ln(ROA)} = \frac{d(CAPEX)/CAPEX}{d(ROA)/ROA} \quad \text{(M-3)}$$

Since logarithmic transformation is not feasible for negative and zero values, such values in the VL public firm dataset required linear transformation to be included in the analysis. The following variables in the sample required transformation:

CAPEX: Eighteen firms in the sample reported zero capital expenditures at least in one time period. EPA set these expenditures to $1.

REVENUE: Seven firms reported negative revenues in at least one time period. Because these are likely due to accounting adjustments from prior period reporting, EPA set negative revenues for these firms to $1.

ROA: the values for return on assets in the public firm sample range from -2.9 to 0.7. Approximately 34 percent of the firms in the dataset reported negative ROAs in at least one year. To address this issue while reducing

[269] While specifying the MP&M regression model, EPA tested both linear and log-linear model specifications. The pattern of coefficient significance was found to be better in the log-linear model. In addition, the log-linear model offered advantages in terms of retention of early time period observations (by eliminating the need to use percent change variables) and variable specifications, and helped to reduce outlier effects in the model. As a result, EPA selected a log-linear specification as the final regression model for the MP&M final regulation. Based on these reasons and the similarity of industry sectors analyzed for the two regulations, EPA decided to test only log-linear model specifications for the Phase III regression model.

potential effects of data transformation on the modeling results, EPA used the following data transformation approach:[270]

- EPA excluded 27 firms with *any* annual ROA values below the 95th percentile of the ROA distribution (i.e., ROA # - 0.51).
- EPA used an additive data transformation to ensure that remaining negative ROA values were positive in the logarithm transformation. The additive transformation was performed by adding 0.51 to all ROA values.

As a result of the data transformation procedures outlined above, the VL public firm dataset on which the regression model is based was reduced to 177 firms (204 - 27 firms) and 1,947 yearly data observations.

The analysis tested several specifications of a log-linear model, including models with the intercept and slope dummies for different industrial sectors and models with the intercept suppressed.[271] Slope dummies were used to test the influence of industry classification on the elasticity of capital expenditures with respect to an explanatory variable: e.g., using the product of an industry classification dummy variable and CAPPRC to test whether certain industries responded differently to change in price of capital equipment over time. Following review of the different models tested, EPA concluded that the estimated coefficients did not vary, significantly, by industry and thus selected the simple log-linear model, with the intercept and no slope dummies as the basis for the 316(b) manufacturers capital expenditures analysis. The results for this model are summarized below.

Cross-sectional, time-series datasets typically exhibit both autocorrelation and group-wise heteroscedasticity characteristics. Autocorrelation is frequently present in economic time series data as the data display a “memory” with the variation not being independent from one period to the next. Heteroscedasticity usually occurs in cross-sectional data where the scale of the dependent variable and the explanatory power of the model vary across observations. Not surprisingly, the dataset used in this analysis had both characteristics. Therefore, EPA estimated the specified model using the generalized least squares procedure. This procedure involves the following two steps:

First, EPA estimated the model using simple OLS, ignoring autocorrelation for the purpose of obtaining a consistent estimator of the autocorrelation coefficient (ρ);

Second, EPA used the generalized least squares procedure, where the analysis is applied to transformed data. The resulting autocorrelation adjustment is as follows:

$$Z_{i,t} = Z_{i,t} - \rho Z_{i,t-1} \quad \text{(M-4)}$$

where Z_{it} is either dependent or independent variables.

EPA was unable to correct the estimated model for group-wise heteroscedasticity due to computational difficulties. The statistical software used in the analysis (LIMDEP) failed to correct the covariance matrix due to

270 While specifying the MP&M regression model EPA conducted a sensitivity analysis to examine the degree to which the estimated model was affected by this data transformation. Results of this analysis showed that the data transformation produces results that are compatible with a model considering only positive ROA values and a model considering all ROA values. As a result, the Phase III regression model utilized the same data transformation procedure.

271 While specifying the MP&M regression model, EPA also tested specifications that included the following structural modifications: (1) testing contemporary vs. lagged specification of certain explanatory variables: e.g., using prior, instead of current period revenue, REV, as an explanatory variable; (2) testing scale-normalized specification of the dependent variable: e.g., using CAPEX/REV as the dependent variable instead of simple CAPEX; (3) testing flexible functional forms that included quadratic terms; and (4) testing additional explanatory variables including the index of 10 leading economic indicators (ILI) and market-to-book ratio (MV/B). Because EPA found that these structural modifications either did not improve the fit of the MP&M regression model or resulted in the introduction of multicollinearity among variables, these structural modifications were not tested while specifying the Phase III regression model.

the very large number of groups (i.e., 177 firms) included in the dataset. Application of other techniques to correct for group-wise heteroscedasticity was not feasible due to time constraints. The estimated coefficients remain unbiased; however, they are not minimum variance estimators. Regression results reveal strong systematic elements influencing capital expenditures: the analysis finds both statistically significant and intuitive patterns that influence firm's investment behavior. We find a strong systematic element of capital expenditures variation that allows forecasting of capital expenditures based on firm and business environment characteristics.

Table M-4 presents model results. The model has a fairly good fit, with adjusted R^2 of 0.81. All coefficients have the expected sign and all but one variable (cost of debt capital) are significantly different from zero at the 95th percentile.

Table M-4: Time Series, Cross-Sectional Model Results

Variable	Coefficient	t-Statistics
Constant	21.880	2.618
Ln(ROA)	0.526	3.964
Ln(REV)	1.129	58.450
Ln(CAPT)	0.687	11.085
Ln(CAPI)	1.078	18.491
Ln(DEBTCST)	-0.789	-1.605
Ln(CAPPRC)	-5.957	-4.369
Ln(CAPUTIL)	1.716	2.842
Autocorrelation Coefficient		
r	0.385	18.402

Source: U.S. EPA Analysis, 2013

The empirical results show that among the firm-specific variables, the output variable (REV) is a dominant determinant of firms‟ investment spending. A positive coefficient on this variable means that larger firms invest more, all else equal, which is clearly a simple expected result. In addition, as expected, firms with higher financial performance and better investment opportunities (ROA) invest more, all else equal: for each one percent increase in ROA, a firm is expected to increase its capital outlays by 0.53 percent. Other firm-specific characteristics were also found important and will aid in differentiating the expected capital outlay for 316(b) manufacturers facilities according to firm-specific characteristics. Firms that require more capital to produce a given level of business activity (i.e., firms that have high capital intensity, CAPI) tend to invest more: a one percent increase in capital intensity leads to a 1.08 percent increase in capital spending. Higher capital turnover/shorter capital life (CAPT) also has a positive effect on investment decisions: a one percent increase in capital turnover rate translates to a 0.69 percent increase in capital outlays.

The model also shows that current business environment conditions play an important role in firms‟ decision to invest. Negative signs on the capital price (CAPPRC) and debt cost (DEBTCST) variables match expectations, indicating that falling (either relatively or absolutely) capital equipment prices and less costly credit are likely to have a positive effect on firms‟ capital expenditures. The most influential factor is capital equipment prices for manufacturing facilities. A one percent increase in the capital price index (CAPPRC) leads to a 5.96 percent decrease in capital investment. Capacity utilization is also an influential factor: a one percent increase in the Federal Reserve Index of Capacity Utilization for the relevant industrial sector (CAPUTIL) leads to a 1.7 percent increase in capital investments. The fact that these systematic variables are significant in the regression analysis means that EPA will be able to control for economy- and industry-wide conditions in estimating capital outlays for Manufacturers.

M.5 Model Validation

To validate the results of the regression analysis, EPA used the estimated regression equation to calculate capital expenditures and then compared the resulting estimate of capital expenditures with actual data. EPA used two methods to validate its results:

- EPA used median values for explanatory variables from the VL data as inputs to estimate capital expenditures and then compared the estimated value to the median reported capital expenditures, and
- EPA used 316(b) survey data to estimate capital expenditures and then compared the estimated values to depreciation reported in the survey.

First, EPA estimated capital expenditures for a hypothetical firm based on the median values of the four dependent variables from the VL data and the relevant values of the three economic indicators. The estimated capital expenditures for this hypothetical firm are $43 million. EPA then compared this estimate to the median value of capital expenditures from the Value Line data. The median capital expenditure value in the dataset is $36 million, which provides a close match to the estimated value. This is not surprising since the same dataset was used to estimate the regression model and to calculate the median values used in this analysis.

EPA also used 316(b) survey data to confirm that the estimated capital expenditures seem reasonable. Because the 316(b) survey does not provide information on capital expenditures, EPA compared the capital expenditure estimates to the depreciation values reported in the survey. Depreciation had been proposed as a possible surrogate for cash outlays for capital replacements and additions. However, depreciation does not capture important variations in capital outlays that result from differences in firms‟ financial performance.

For this analysis, EPA chose a representative facility from each of the original Primary Manufacturing Industries for model validation. The selected facility for each sector corresponds as closely as possible to the hypothetical median facility in the sector based on the distribution of facility revenues and facility return on assets. For each of the facilities, EPA estimated capital expenditures using the estimated regression equation and facility financial data. *Table M-5* shows the estimated regression coefficients, financial averages for the original Primary Manufacturing Industries, estimated facility capital expenditures, reported facility depreciation, and the comparison of capital expenditures and depreciation.

As shown in *Table M-5*, the estimated model provides reasonable estimates of capital expenditures.

Table M-5: Estimation of Capital Outlays: Median Facilities Selected by Revenue and ROA Percentiles

Sectors	Pre-Tax Return on Assets (ROA)	Revenue ($2004, millions)	Capital Turnover Rate	Capital Intensity	Cost of Debt	Price of Capital Goods	Capacity Utilization	Estimated Capital Expenditures ($2004, millions)	Depreciation ($2004, millions)	Difference between Depreciation and Capital Expenditures ($2004, millions)
Coefficient Intercept (21.88)	0.53	1.13	0.69	1.08	-0.79	-5.96	1.72			
Paper and allied products	0.16	252.00	0.09	0.89	7.71	137.60	86.24	$19.54	$16.73	($2.80)
Chemicals and allied products	0.27	244.59	0.06	1.14	7.71	137.60	79.36	$15.73	$14.69	($1.04)
Petroleum and coal products	0.22	1516.01	0.05	0.59	7.71	137.60	91.88	$47.03	$66.95	$19.93
Primary metals industries	0.09	458.46	0.04	0.93	7.71	137.60	88.77	$16.07	$19.21	$3.14
Food and kindred products	0.37	292.56	0.06	0.29	7.71	137.60	80.46	$4.82	$4.52	($0.30)

Source: U.S. EPA analysis, 2013

One of the possible implications of the hypothesized relationships and estimated coefficient values from the prior analysis is that a facility"s predicted capital expenditures might be expected to increase relative to the facility"s actual depreciation as the facility"s ROA increases. An extension of this hypothesis is that, at lower ROA values, predicted capital expenditures would be less than the depreciation but that at higher ROA values, predicted capital expenditures exceed depreciation. These hypotheses are consistent with the expectation that businesses with higher financial performance will have relatively more attractive investment opportunities and are more likely to attract the capital to undertake those investments. EPA examined whether these relationships occur in the Manufacturers. Specifically, EPA calculated the predicted capital expenditure for each in-scope facility and compared these values to the facilities" reported depreciation values. To remove the scale effect of revenue, EPA normalized both the predicted capital expenditure and reported depreciation values by dividing by the three-year average of revenue for each facility. EPA then estimated the simple linear relationship of the resulting revenue-normalized capital expenditure and deprecation values against facility ROA. The five graphs on the following pages present, for each of the five primary two-digit SIC code sectors, the normalized capital expenditure and deprecation values, and the estimated trend lines for each sector"s depreciation and capital expenditures with respect to ROA.[272] The graphs indicate the following:

The Paper and Allied Products (SIC 26) graph shows depreciation exceeding predicted capital expenditure at low ROA values but this relationship reverses with predicted capital expenditure exceeding depreciation as ROA increases. Thus, the calculations for these facilities match the hypothesized relationship.

The Chemicals and Allied Products (SIC 28) graph also shows depreciation exceeding predicted capital expenditure at low ROA values, but again the relationship reverses with predicted capital expenditure exceeding depreciation as ROA increases. This predicted relationship is observed more strongly for facilities in the Chemicals and Allied Products industry than in the Paper and Allied Products industry.

The Petroleum and Coal Products (SIC 29) graph shows predicted capital expenditures exceeding depreciation over the ROA range analyzed. However, the extent of difference does not materially change as ROA increases.

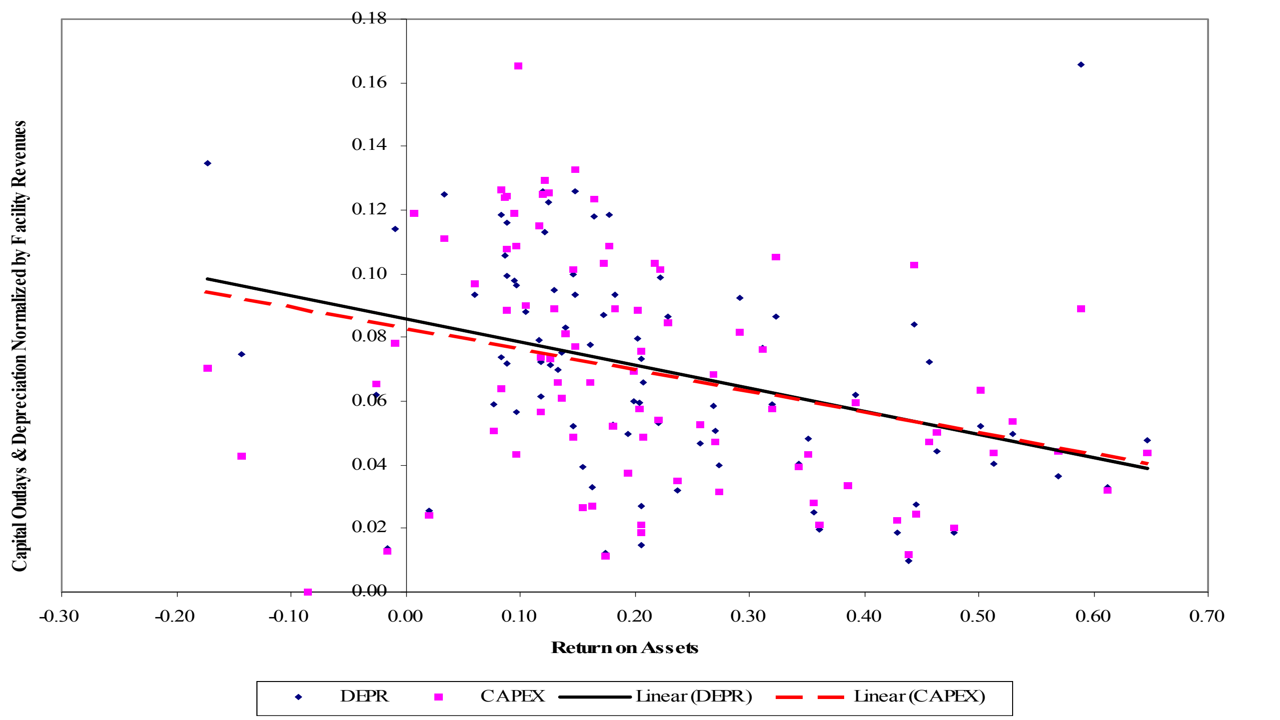
The Primary Metal Industries (SIC 33) graph also shows predicted capital expenditures exceeding depreciation over the ROA range analyzed. However, unlike for the Petroleum and Coal Products facilities, the amount by which predicted capital expenditures exceeds depreciation increases as ROA increases, thus matching the hypothesized relationship.

The Food and Kindred Products (SIC 20) graph also shows that calculations for these facilities match the hypothesized relationship, where predicted capital expenditures exceed depreciation over the ROA range analyzed. The consistency of this result, as well as the CAPEX estimation in *Table M-5* above, is notable to the extent that it demonstrates the model"s overall applicability across industries, as facility data from SIC 20 were not used for model specification.

In summary, with the exception of facilities in the Petroleum and Coal Products industry, the estimated model produces capital expenditure values that increase relative to reported depreciation with increasing ROA, which matches the hypothesized relationship.

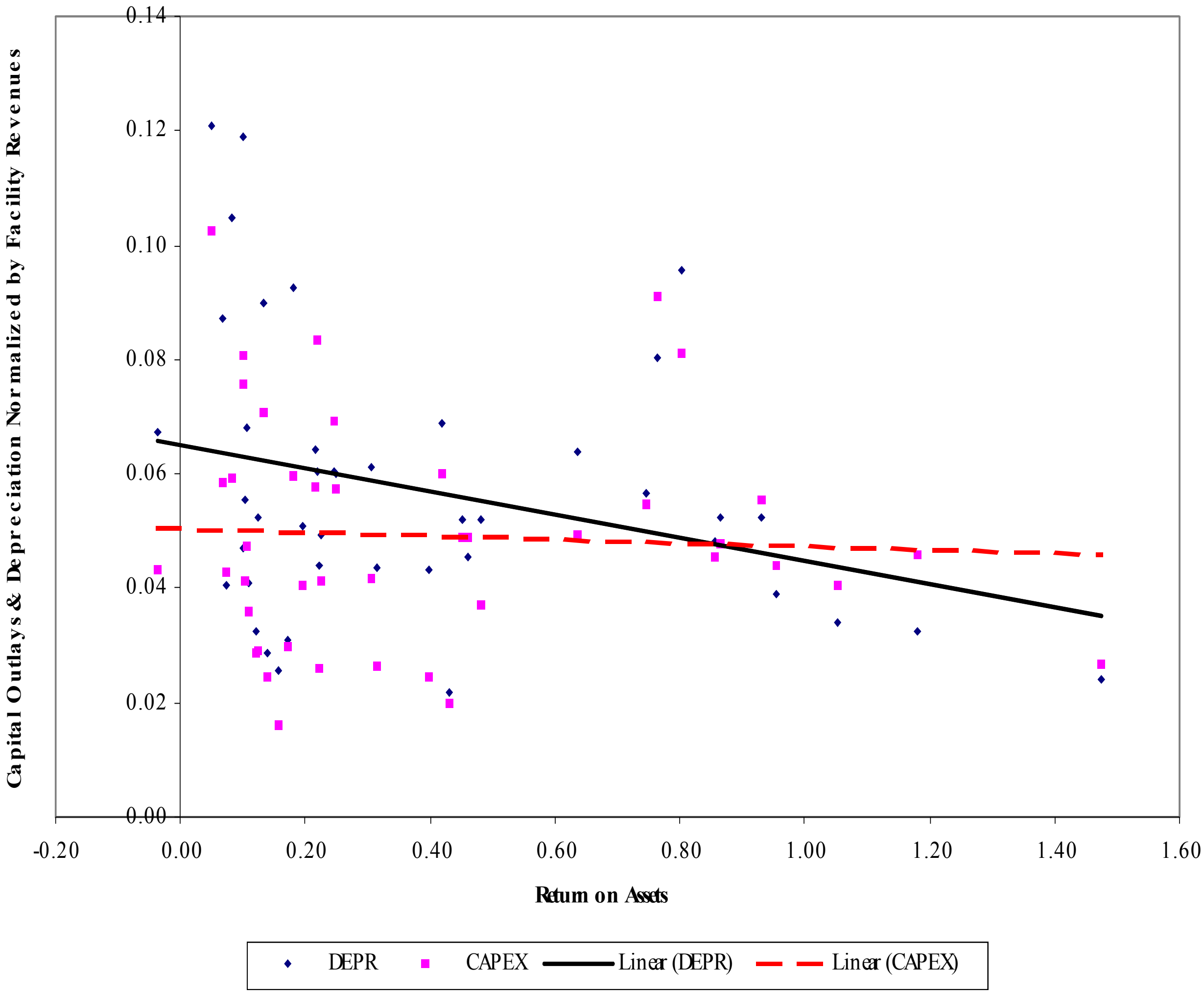
[272] For presentation purposes, two outlier facilities were excluded from the graph for SIC 28: Chemicals and allied products, and one outlier facility was excluded from the graph for SIC 26: Paper and allied products.

Figure M-1: Comparison of Estimated Capital Outlays to Reported Depreciation for 316(b) Manufacturers Survey Facilities in the Paper and Allied Products Sector



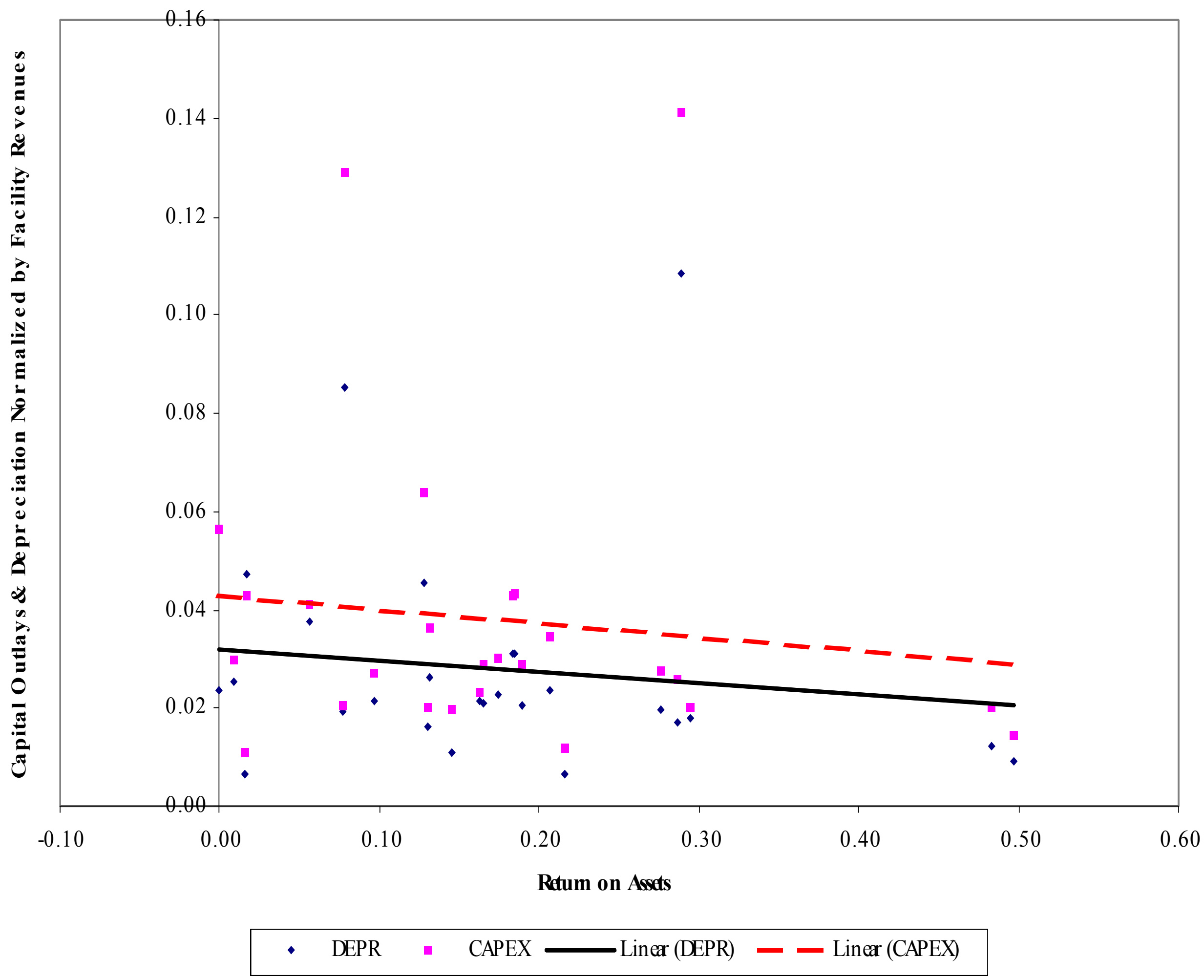
Source: U.S. EPA analysis, 2004

Figure M-2: Comparison of Estimated Capital Outlays to Reported Depreciation for 316(b) Manufacturers Survey Facilities in the Chemicals and Allied Products Sector



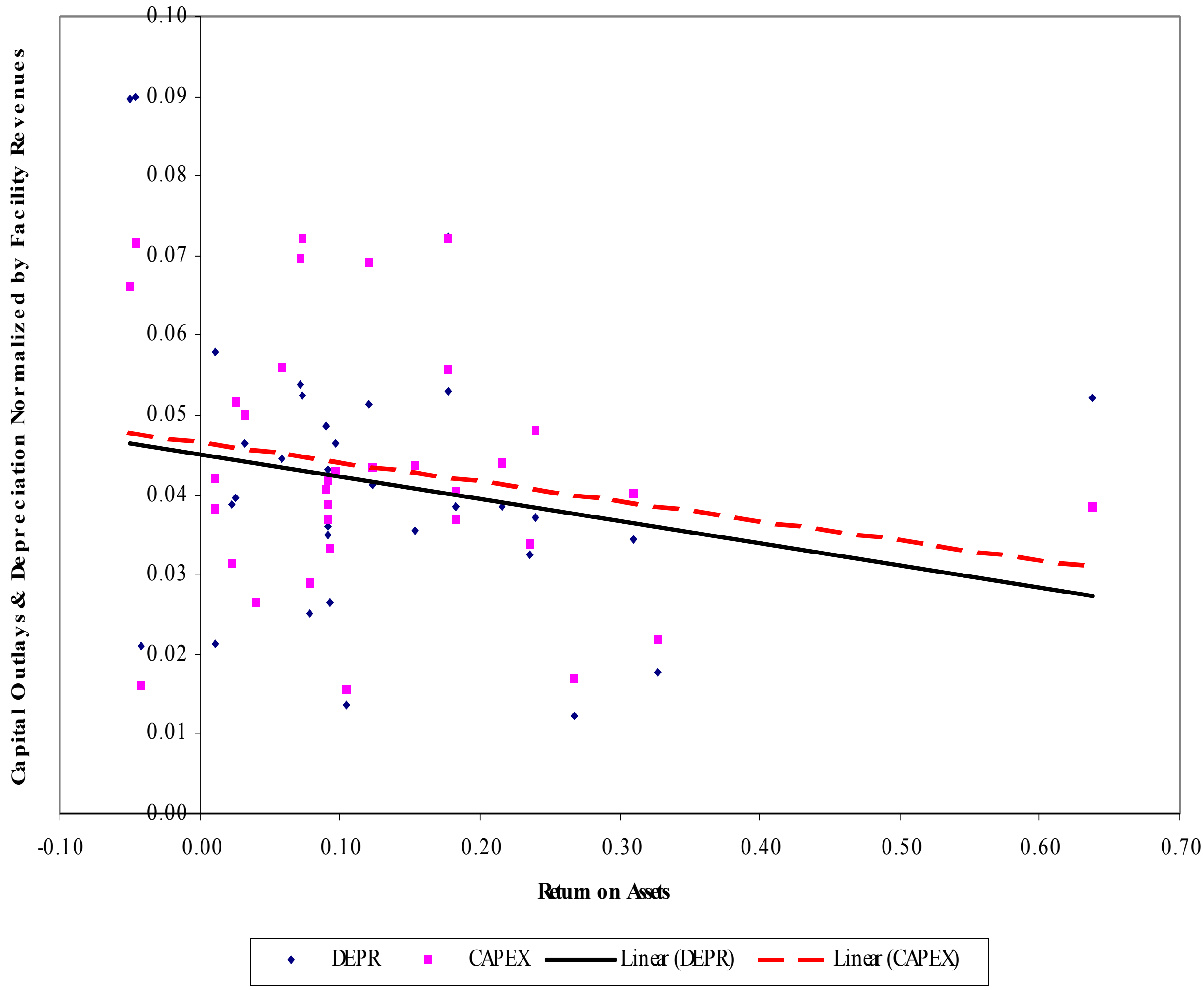
Source: U.S. EPA analysis, 2004

Figure M-3: Comparison of Estimated Capital Outlays to Reported Depreciation for 316(b) Manufacturers Survey Facilities in the Petroleum and Coal Products Sector



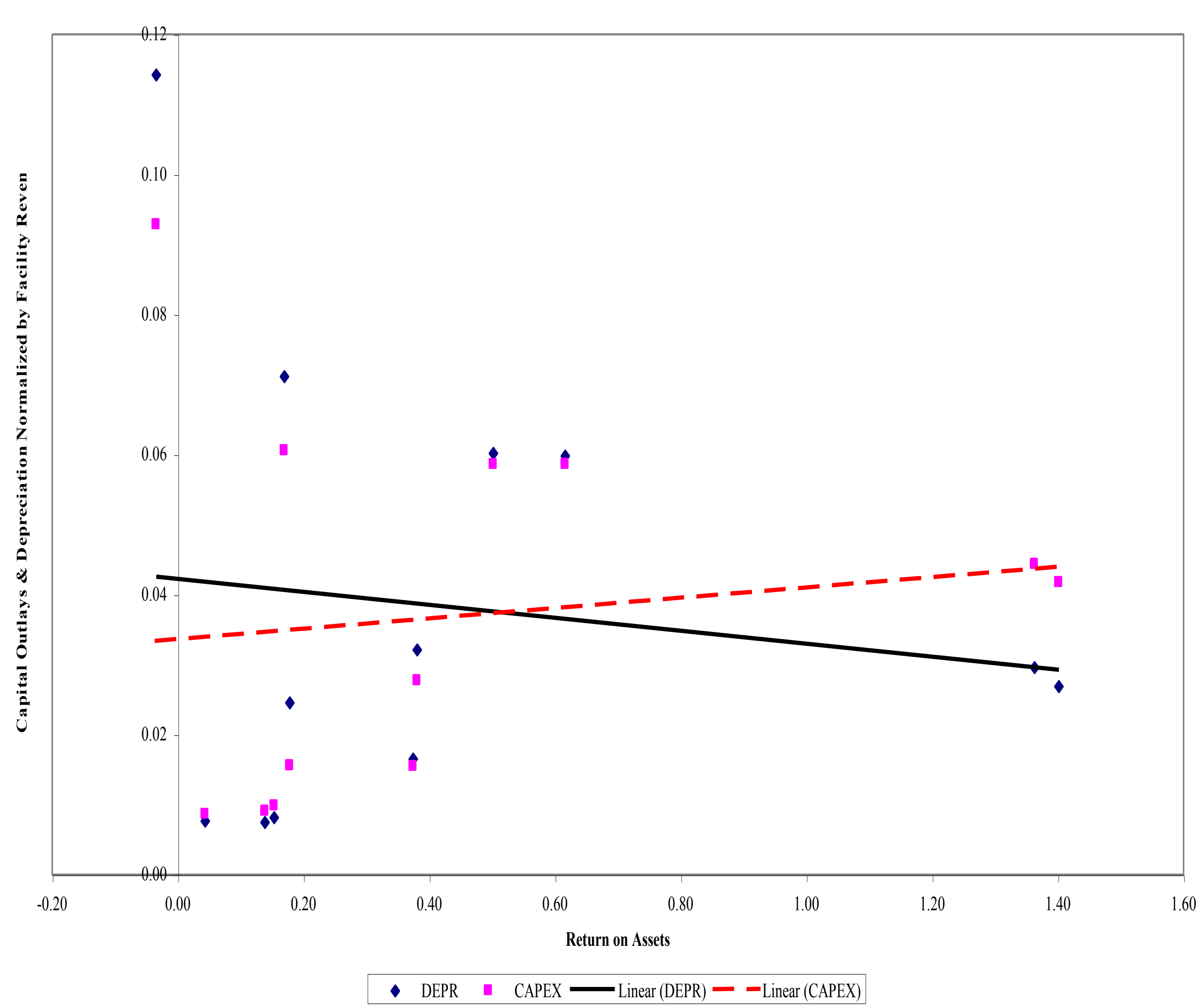
Source: U.S. EPA analysis, 2004

Figure M-4: Comparison of Estimated Capital Outlays to Reported Depreciation for 316(b) Manufacturers Survey Facilities in the Primary Metal Industries Sector



Source: U.S. EPA analysis, 2004

Figure M-5: Comparison of Estimated Capital Outlays to Reported Depreciation for 316(b) Manufacturers Survey Facilities in the Food and Kindred Products Sector



Source: U.S. EPA analysis, 2004

M.6 Updating Inputs to Estimate Capital Outlays for the Final Rule

For the analysis of the final rule and other options considered, EPA used the 316(b) survey data reported for 1996-1998; the Agency restated these values in 2011 dollars using GDP Deflator series published by the U.S. Bureau of Economic Analysis.

In the previous analyses, for the "General Business Environment" explanatory variables, EPA used a 3-year average of data reported for 1996-1998. For the current analysis, EPA updated these "General Business Environment" variables to the average of values over the period 1999-2010, the period between the end of the survey data and the time period of the final rule analyses. For DEBTCST, EPA took an average of the yield on 10-year BAA-rated bonds from 1999-2010 from the Federal Reserve; for CAPPRC, EPA averaged the PPI for capital goods from 1999-2010 from the Bureau of Labor Statistics; and for CAPUTIL, EPA averaged, by industry segment, annual average capacity utilization from the U.S. Census. Using this relatively long-term average for these three business environment variables is intended to account for changes in facilities" operating environment over this period.

Attachment A Historical Variables Contained in the Value Line Investment Survey Dataset

All variables are provided for 10 years (except where a firm has been publicly listed for less than 10 years):

- Price of Common Stock
- Revenues
- Operating Income
- Operating Margin
- Net Profit Margin
- Depreciation
- Working Capital
- Cash Flow per share
- Dividends Declared per share
- Capital Spending per share
- Revenues per share
- Average Annual Price-Earnings Ratio
- Relative Price-Earnings Ratio
- Average Annual Dividend
- Return Total Capital
- Return Shareholders Equity
- Retained To Common Equity
- All Dividends To Net Worth
- Employees
- Net Profit
- Income Tax Rate
- Earnings Before Extras
- Earnings per share
- Long Term Debt
- Total Loans
- Total Assets
- Preferred Dividends
- Common Dividends
- Book Value
- Book Value per share

- Shareholder Equity
- Preferred Equity
- Common Shares Outstanding
- Average Shares Outstanding
- Beta
- Alpha
- Standard Deviation

Appendix N Analysis of Other Regulations - Manufacturers

N.1 Regulations Potentially Affecting Manufacturers

EPA also accounted for other recently published proposed or final environmental regulations that may impose additional costs on Primary Manufacturing Industries beyond those reflected in facilities" baseline financial statements. The after-tax cash flow (ATCF) adjustment analysis, which EPA undertook to bring cash flow forward from the time of the survey (1996-1998) to the time of the regulatory analysis, accounts implicitly for additional regulatory costs incurred through the end of 2011. However, it does not capture the impact of new regulations that came into effect during, or soon after, this period and for which costs had not been incurred, or fully incurred, by the end of 2011.

To account for potential costs that had not been fully incurred by the end of 2011, EPA researched additional regulatory requirements that might apply to facilities in the Primary Manufacturing Industries, and for which costs were not likely to have been captured in the ATCF adjustment analysis. This research included searching the Federal Register and the EPA website for final or proposed regulations affecting the relevant NAICS groups and industry sectors within the timeframe of concern. These searches identified seven regulations that apply to the 316(b) Manufacturing Industries *and* could result in additional costs to Manufacturers after 2011. EPA did not include regulations that target either certain chemicals (such as Significant New Use Rules) or certain processes (such as certain National Emissions Standards for Hazardous Air Pollutants) as the 316(b) survey did not provide the information needed to determine whether these more narrow regulations would be applicable to the Manufacturers facilities. In addition, EPA did not include regulations that affected only one facility.

Table N-1 below summarizes these regulations (*Other Regulations*). The following discussion uses both the regulation number presented in the first column and the abbreviated regulation name in parenthesis in the second column.

Table N-1: Regulations Potentially Affecting 316(b) Manufacturers

No.	Regulation	Effective Date	Summary	316(b) Industries Affected	Compliance Date
1	National Emission Standards for Hazardous Air Pollutants from Petroleum Refineries (Petroleum NESHAP)	10/09	Amends the national emission standards for petroleum refineries to add maximum achievable control technology standards for heat exchange systems	Petroleum Refining Industry	Not later than 10/12
2	National Emission Standards for Hazardous Air Pollutants From the Pulp and Paper Industry (Paper NESHAP)	9/12	Amends national emissions standards for hazardous air pollutants for the pulp and paper industry.	Paper and Allied Products Industry	Not later than 9/12
3	National Emission Standards for Hazardous Air Pollutants for Chemical Manufacturing Area Sources (Chemicals NESHAP)	10/12	Issues national emissions standards for hazardous air pollutants for nine area source categories.	Chemicals and Allied Products Industry	Not later than 10/12
4	National Emissions Standards for Hazardous Air Pollutants: Primary Aluminum Reduction Plants (Primary Aluminum NESHAP)	-	Amends the national emissions standards for hazardous air pollutants for primary aluminum reduction plants.	Aluminum Industry	Three years after publication of final rule
5	Commercial and Industrial Solid Waste Incineration Units (CISWI)	2/13; 8/13; 4/13	Issues a final decision on emissions guidelines for commercial and industrial solid waste incineration units.	Chemicals and Allied Products, Paper and Allied Products, and Other Industries	Not later than 2/15
6	National Emission Standards for Hazardous Air Pollutants for Area Sources: Industrial, Commercial, and Institutional Boilers and Process Heaters (Area ICI)	2/13	Establishes requirements for industrial/commercial/institutional boilers and process heaters located at area sources to meet hazardous air pollutants standards reflecting the application of the maximum achievable control technology.	Food Production Industry and Other Industries	Not later than 3/14 (2015 if granted an extension)
7	National Emission Standards for Hazardous Air Pollutants for Major Sources: Industrial, Commercial, and Institutional Boilers and Process Heaters (Major ICI)	4/13	Establishes requirements for industrial/commercial/institutional boilers and process heaters located at major sources to meet hazardous air pollutants standards reflecting the application of the maximum achievable control technology.	Aluminum Industry, Chemicals and Allied Products, Paper and Allied Products, Petroleum Refining Industry, Steel Industry, and Other Industries	Not later than 1/16

Source: Rule preambles and supporting materials. See reference section.

To account for the potential impact of the Other Regulations listed in *Table N-1* on regulated Manufacturers, EPA determined which 316(b) industries EPA expects to be subject to these regulations, based on the NAICS codes reported in Federal Register notices as potentially regulated categories. EPA relied on information reported in the Federal Register notices and supporting documentation to develop per facility costs for the identified sectors. EPA restated these costs on an after-tax basis in $2011 and subtracted them from the estimated baseline free cash flow for each facility that EPA judged potentially affected by a regulation (see also *Chapter 5: Cost and Economic Impact Analysis - Manufacturers, Section 5.3*). EPA then determined if the potential costs associated with these regulations would affect either the baseline or the post-compliance severe impact findings for each facility. The remainder of this appendix discusses the methodology used for this analysis and the findings.

N.2 Methodology

N.2.1 Determination of Applicability to 316(b) Manufacturing Facilities

EPA first identified which of the regulated Manufacturers would potentially incur costs as a result of the Other Regulations. EPA based this determination on the NAICS codes and/or industry description reported in either the

Federal Register preamble or supporting documents of each regulation. EPA assumed that *all* regulated facilities with a 3- or 6-digit NAICS code, depending on the regulation, expected to be regulated by one of the Other Regulations would incur costs under that regulation. One exception to this rule is where the industries expected to be regulated under the Area ICI, Major ICI, and CISWI overlapped; in this case, EPA assumed facilities would comply with the most expensive of the applicable regulations.

EPA‟s assumption about the applicability of the regulation – i.e., that a regulated Manufacturer will incur costs under the regulation, if it belongs to a NAICS code that is subject to that regulation – may overstate or understate these regulations‟ additional cost burden on Manufacturers. Rules often only affect a specific part of an industry, depending, for example, on specific emission or discharge characteristics, or existing pollution control technology. This is true for a number of the Other Regulations, making it likely that not all regulated Manufacturers in a given NAICS code covered by a rule, would actually incur costs under that rule. Little information is available on those technical characteristics of regulated Manufacturers that would determine the applicability of the regulations to these facilities. On the other hand, the list of potentially affected NAICS codes provided in the Federal Register notices is not exhaustive and may not list all affected industries; to the extent that this is true, EPA may have understated the costs to Manufacturers.

N.2.2 Estimating Facility-Level Costs

As described in the earlier 316(b) Existing Facilities regulatory analysis documents, EPA considered several approaches for applying the costs of the Other Regulations to potentially affected 316(b) facilities. The cost application approach selected for each regulation depends on the level of detail that was available in the regulation‟s documentation. Regardless of specific approach, EPA calculated the average annualized per facility cost, on an after-tax basis, for each regulation. *Table N-2* summarizes the resulting per facility costs of the Other Regulations.

Table N-2: Per Facility Cost of Regulations that Affect 316(b) Industries[a]

No.	Regulation	Affected 316(b) NAICS Codes	Cost Application Method	Average Per Facility Cost (Pre-Tax; $2011)[a]
1	Petroleum NESHAP	324110	➢ Average annualized cost per facility ➢ Includes cost savings to facilities	$21,486
2	Paper NEHSAP	322	➢ Average annualized cost per facility	$18,421
3	Chemicals NESHAP	325	➢ Average annualized cost per facility	$7,424
4	Primary Aluminum NESHAP	331312	➢ Average annualized cost per facility	$20,269
5	CISWI	321, 322, 324, 325, 331, 332, 336, 339	➢ Average annualized cost per facility	$37,089
6	Area ICI	11, 311, 321	➢ Average annualized cost per unit (for coal, oil, and biomass) ➢ Assumed one affected unit per facility ➢ For facilities with capacity information, assumed that affected units relied on the same fuel as the generating units ➢ For facilities without capacity information provided, multiplied by the average facility cost (calculated over facilities with capacity information)	$16,030
7	Major ICI	321, 322, 324, 325, 331, 332, 336, 339	➢ Average annualized cost per unit (for coal, oil, natural gas, and biomass) ➢ Assumed one affected unit per facility ➢ For facilities with capacity information, assumed that affected units relied on the same fuel as the generating units ➢ For facilities without capacity information provided, multiplied by the average facility cost (calculated over facilities with capacity information)	$916,098

a. EPA used the GDP Deflator series published by the U.S. Bureau of Economic Analysis of the U. S. Department of Commerce to state average cost per facility in 2011 dollars.

Source: U.S. EPA Analysis, 2013

EPA summed the per facility costs in *Table N-2* for each affected Manufacturer (based on NAICS code or individual facility identification), converted to the resulting value to an after-tax basis, and subtracted this value from baseline adjusted after-tax cash flow (see discussion of the impact analysis method in *Chapter 5: Cost and Economic Impact Analysis - Manufacturers*). For all regulated Manufacturers that were operational in the baseline, EPA determined whether the additional cost of complying with the Other Regulations would cause the facility to (1) fail the baseline test and become a "baseline closure" or (2) fail the post-compliance impact test and be considered a "severe impact."

N.3 Results

N.3.1 Baseline Analysis

Of the 207 regulated sample Manufacturers that are operational in the baseline and have a design intake flow of at least 2 MGD, EPA found that no additional facilities would become a baseline closure (i.e., before incurring compliance costs under the final rule) due to application of the additional costs from the Other Regulations.[273]

N.3.2 Post-Compliance Analysis

The post-compliance analysis sets aside facilities considered baseline closures. Because the adjusted baseline analysis found that no additional Manufacturers would be assessed as baseline closures, EPA did not remove any additional facilities from the post-compliance analysis. Of the 207 sample manufacturing facilities (i.e., those that are not considered a baseline closure *after* applying the costs of the Other Regulations), EPA found that no *additional* facilities would experience a severe impact as a result of incurring both the final rule compliance costs *and* the costs of the Other Regulations.

[273] This analysis excludes 14 sample facilities with insufficient survey-based economic data and 28 sample facilities determined to be baseline closures without taking into account the impact of these other regulations.

Appendix O Economic Impact Methodology – Manufacturers

EPA conducted an economic impact analysis of the final rule and other options EPA considered for Manufacturers. Measures of economic impact include (1) a ***facility-level cost-to-revenue screening analysis***, (2) a ***facility-level impact analysis***, and (3) an ***entity-level impacts analysis***. This appendix details the methodology used for the second analysis. For the final rule, the potential facility-level impacts on the Manufacturers segment are defined in two ways:

- ***Severe impacts*** are facility closures and the associated losses in jobs at facilities that would close due to the regulation.
- ***Moderate impacts*** are adverse changes in a facility's financial position that are not threatening to its short-term viability.

In conducting these analyses, EPA closely followed the methodologies used to conduct analyses in support of the previous 316(b) rule analyses and, to the extent practicable, relied on similar data sources. See *Chapter 5: Cost and Economic Impact Analysis – Manufacturers* for data inputs and analysis approach details.

O.1 Facility-Level Impacts: Severe Impact Analysis

The assessment of severe impacts for Manufacturers is based on the change in the facility's estimated business value, as determined from a discounted present value analysis of baseline cash flow and the change in cash flow resulting from regulatory compliance. As described in *Chapter* 5, the assessment of *post-compliance* severe impacts also includes a test of whether annualized compliance costs exceed a *de minimus* threshold of one percent of revenue.

The cash flow concept used in calculating ongoing business value for the closure analysis is *free cash flow* available to all capital. Free cash flow is the cash available to the providers of capital – both equity owners and creditors – on an after-tax basis from business operations, and takes into account the cash required for ongoing replacement of the facility's capital equipment. Free cash flow is discounted at an estimated after-tax total *cost of capital* to yield the estimated business value of the facility. Details of the calculation of free cash flow and the discounting of free cash flow to yield the facility's estimated value are explained in the following sections.

O.1.1 Calculation of Baseline Free Cash Flow and Performance of Baseline Closure Test

Calculation of baseline free cash flow and performance of the baseline closure test involved the following steps:

Average survey income statement data over response years and convert to 2011 dollars: EPA first restated facility income statement data reported for 1996, 1997, and 1998 in 1998 dollars, using the GDP Deflator. For each of the data item, the Agency then calculated a simple average over the months and/or years for which data were reported to develop an annual average income statement in 1998 constant dollars. For example, if a facility reported income statement data for 1996, 1997, and 1998, then a simple average was calculated for the three reported years. EPA then restated the annual average income statement data in 2011 dollars, again using the GDP Deflator.

Calculate after-tax income excluding the effects of financial structure: The 316(b) survey responses include a calculation of after-tax income in accord with conventional accounting principles. However, this calculation reflects the financial structure of the business, which may include debt financing and thus interest charges against income. Because the cash flow concept to be discounted in the business value analysis is cash flow available to *all* capital, it is necessary to restate after-tax income to exclude the effects of debt financing, or on a *before-interest* basis. This restatement involves: (1) increasing after-tax income by the amount of interest charges and (2) increasing taxes (and thereby reducing after-tax income) by the amount of tax reduction provided by interest deductibility. This adjustment amounts to adding tax-adjusted interest expense to after-tax income and yields an estimate of after-tax income *independent of capital structure or financing effects*. In calculating the tax adjustment for interest, EPA used a combined federal/State corporate income tax rate. For this calculation, EPA used a tax rate that integrates the federal corporate income tax rate (35 percent) and state-specific state corporate income tax rates, based on facility location.

The combined federal/State corporate income tax rate was calculated as follows:

$$\tau = \tau_S + \tau_F - (\tau_S * \tau_F) \qquad \text{(O-1)}$$

where:

τ = estimated combined federal-State tax rate;

τS = State tax rate; and

τF = federal tax rate (35 percent).

After-tax income, *before interest,* was calculated as follows:

$$ATI\text{-}BI = ATI + I - \tau I$$

or (O-2)

$$ATI\text{-}BI = ATI + (1 - \tau)I$$

where:

ATI-*BI* = after-tax income before interest;

ATI = after-tax income from baseline financial statement;

I = interest charge from baseline financial statement; and

τ = estimated combined federal-State tax rate.

Calculate after-tax cash flow (ATCF) from operations, before interest, by adjusting income for non-cash charges: The calculation of after-tax income may include a non-cash charge for depreciation (and potentially amortization). To convert income to *ATCF* from operations, it is therefore necessary to add back any depreciation charge to the calculation of after-tax income, before interest. Cash flow, *before interest*, was calculated as follows:

$$ATCF\text{-}BI = ATI\text{-}BI + D \qquad \text{(O-3)}$$

where:

ATCF-*BI* = after-tax cash flow before interest;

ATI-BI = after-tax income before interest; and

D = baseline depreciation.

As a final step in the calculation of after-tax cash flow ATCF before interest, EPA eliminated the implied cash flow benefit of any negative taxes, as reported in the facility's income statement and after adjustment for removal of interest. That is, in these calculations, negative taxes increase after-tax income and cash flow, and thus appear to improve the financial performance and value of the facility in terms of cash flow from operations. However, whether *and when* the implied cash flow benefit of negative taxes can be realized depends on the overall profitability and tax circumstances of the total enterprise, including any other facilities owned by the same parent entity, and the extent of profitability in periods before or after the survey data periods. Not to overstate this effect, EPA assumed that a facility would not receive the implied cash flow benefit from negative taxes – negative taxes, after adjustment for interest, were set to zero in the baseline analysis. This assumption is consistent with a later step in the post-compliance analysis in which EPA limited the cash flow benefit of tax deductions on compliance outlays not to exceed the amount of taxes paid as reported in the baseline income statement (and adjusted for interest). In theory, the application of this limit could cause some facilities that would otherwise pass the baseline closure analysis, instead to fail the analysis if the reported amount of negative tax, after adjustment for interest, would be sufficient to offset the negative cash flow from operations independent of taxes. In practice, though, this limitation did not affect the findings of the baseline closure analysis. This limit was applied as a check and did not cause a different outcome.

Adjust ATCF to reflect estimated real change in business performance from the time of survey data collection to the present: EPA adjusted facility baseline cash flow to reflect the estimated real change (i.e., independent of inflation) in business performance in the manufacturing industries from the time of the facility survey, 1996-1998, to the 2011.

To calculate the adjustment factor, EPA collected ATCF data for public firms in the Primary Manufacturing Industries over a 24-year period and developed adjustment factors by industry and/or key industry segment (details of this analysis are contained in *Appendix L: Adjusting Baseline Facility Cash Flow*). Adjusted after-tax cash flow is calculated as follows:

$$\text{ATCF-}BI_{\text{ADJ}} = \text{ATCF-}BI * \text{Adj} \qquad \text{(O-4)}$$

where:

$\text{ATCF-}BI_{\text{ADJ}}$ = after-tax cash flow before interest adjusted to reflect the real change in business performance;

ATCF-BI = after-tax cash flow before interest; and

Adj = adjustment factor to reflect the real change in business performance.

Calculate free cash flow by adjusting ATCF from operations for ongoing capital equipment outlays: The measure of ATCF from the previous step, cash flow from operations, reflects the cash receipts and outlays from ordinary business operations, but includes no allowance for replacement of the facility's existing capital equipment. To sustain ongoing operations, however, a business must expend cash for capital replacement. Accordingly, to understand the true cash flow of a business, it is necessary to reduce cash flow from operations by an allowance for capital replacement. For the calculation of free cash flow, EPA estimated baseline capital outlays from a regression analysis of capital expenditures made by public firms in the Primary Manufacturing Industries over an 11-year period (details of this analysis and estimation framework are contained in *Appendix M: Estimating Capital Outlays Discounted Cash Flow Analyses*). Free cash flow is calculated as follows:

$$\text{FCF} = \text{ATCF-}BI_{\text{ADJ}} - \text{CAPEX} - \text{OTHREGS} \qquad \text{(O-5)}$$

where:

FCF = free cash flow

$ATCF\text{-}BI_{ADJ}$ = after-tax cash flow before interest adjusted to reflect the real change in business performance; and

CAPEX = estimated baseline capital outlays; and

OTHREGS = annualized after-tax cost of compliance with federal environmental regulations that were recently promulgated and whose costs are not likely to be reflected fully in the ATCF adjustment analysis (Other Regulations). This variable and the associated analysis are not part of the primary case analysis but were dealt with on an alternative, sensitivity case basis.[1]

Or on a more detailed accounting statement basis:

$$FCF = REV - TC - T - \tau I - CAPEX - OTHREGS \qquad (O\text{-}6)$$

where:

FCF = free cash flow

REV = revenue

TC = total operating costs, excluding interest, depreciation, and taxes

T = baseline income tax

τ = estimated combined federal-State tax rate;

I = interest charge from baseline financial statement;

τI = the increase in tax liability resulting from calculating income on a pre-interest basis;

CAPEX = estimated annual baseline capital outlays; and

OTHREGS = annualized cost of other compliance with federal environmental regulations that were recently promulgated and whose costs are not likely to be reflected fully in the ATCF adjustment analysis. This variable is only dealt with on an alternative, sensitivity case basis.

This calculation of free cash flow is based on a static representation of a facility's business. With the exception of bringing estimated cash flow forward from the time of the survey, 1996-1998, to approximately the present, 2011, the facility impact analysis assumes, in effect, that the facility's business will continue in the future – absent the effects of regulation – exactly as reflected in the baseline financial statements provided in the 316(b) survey responses.

Calculate baseline facility value as the present value of free cash flow over a 30-year analysis horizon: To calculate baseline business value, EPA expressed free cash flow over a 30-year analysis period in present-value

1 EPA also undertook an alternative case analysis in which it further adjusted baseline cash flow to reflect costs that facilities might incur from compliance with federal environmental regulations that were recently promulgated and whose costs are not likely to be reflected fully in the ATCF adjustment analysis. This analysis, which is documented in *Appendix N: Analysis of Other Regulations*, found no material effect on the facility impact analysis, as reported in this chapter. The alternative case analysis, which incorporated estimated compliance costs from the recent federal environmental regulations, found one additional baseline closure and no change in post-compliance closures.

terms using an estimated real (i.e., excluding the effects of inflation), after-tax cost of capital of 7 percent. The Agency calculated baseline business value of a facility as follows:

$$VALUE = \sum_{t=0}^{29} \frac{FCF}{(1+CoC)^t} \qquad \text{(O-7)}$$

where:

VALUE	=	estimated baseline business value of the facility
FCF	=	free cash flow
CoC	=	after-tax cost-of-capital (7.0 percent); and
t	=	year index, t = 0-29 (30-year discounting horizon).

In the present value calculation, annual cash flows are assumed to accrue at the beginning of the year. As a result, the first year of cash flows is already in present value terms – i.e., t = 0 for the first year of the analysis – and cash flows in the 30th and final year of the analysis period are discounted over a 29-year period – i.e., t = 29 in the final year of the analysis.

As explained above, EPA considered a facility to be a baseline closure if its estimated business value was negative before incurring regulatory compliance costs. Baseline closures were neither tested for adverse impact in the post-compliance impact analysis nor were their compliance costs included in the tally of total compliance costs.

O.1.2 Calculation of Post-Compliance Free Cash Flow and Performance of Post-Compliance Closure Test

For the post-compliance closure analysis, EPA recalculated annual free cash flow, accounting for changes in revenue, annual expenses, and taxes that are estimated to result from compliance-related outlays. EPA combined the post-compliance free cash flow value and the estimated compliance capital outlay in the present value framework to calculate business value on a post-compliance basis.

For the post-compliance analysis, EPA considered whether Manufacturers would be able to pass forward compliance costs to customers through increased prices. From the analyses presented in *Appendix K: Cost Pass-Through Analysis*, EPA concluded that an assumption of zero cost pass-through is appropriate for analyzing the impact of the regulatory analysis options on facilities in the six Primary Manufacturing Industries. Performance of the impact analysis under this assumption means that facilities must absorb all compliance-related costs and operating effects (e.g., income loss from facility shutdown during equipment installation) within their baseline cash flow and financial condition. To the extent that facilities would be able to pass on some of the compliance costs to customers through price increases, the analysis may overstate the potential impact on regulated facilities.

Calculation of post-compliance free cash flow and performance of the post-compliance closure test involved the following steps:

Adjust baseline annual free cash flow to reflect compliance outlay effects: Compliance-related effects on annual free cash flow include: annual change in revenue (assumed zero for this analysis); annually recurring operating and maintenance costs; the annual equivalent of permitting and re-permitting costs, which recur on other than an annual basis over the life of the analysis; the annual equivalent of the income loss from installation downtime; and related changes in taxes.[2] For the other options considered, Proposal Option 4 and Proposal Option 2, involving the installation of two technologies – IM technology and cooling tower - these compliance-related effects occur in two stages. For this analysis, EPA assumed that the impact of these compliance-related effects would be considered together in the year of the first technology installation and therefore conducted one analysis. The change in taxes includes: (1) the tax effect of these annually recurring and annualized expenses and (2) the tax effect from depreciation of initial compliance outlays. For calculating the tax effect of depreciation, EPA assumed that compliance capital outlays would be depreciated for tax purposes on a straight-line schedule equal to the assumed useful life of the technology. Post-compliance free cash flow was calculated as follows:

$$FCF_{PC} = FCF_{BL} + \Delta R - \Delta TC - \tau(- \Delta TC - \Delta D) \quad \text{(O-8)}$$

where:

FCF_{PC} = post-compliance free cash flow;

FCFBL = baseline free cash flow, as calculated above;

ΔR = change (increase) in revenue from pass through of compliance costs to customers3

ΔTC = change in total facility annual costs (excluding interest, depreciation and taxes), calculated as the cost of operating and maintaining compliance equipment plus the annual equivalent of certain non-annual costs, as described above, with costs associated with the first technology considered as of the year of first technology installation and costs associated with the second technology considered as of the year of second technology installation then discounted to the year of first technology installation;

τ = marginal tax rate for calculating compliance-related tax effects (combined federal-State tax rate); and

ΔD = change in depreciation expense, calculated as compliance capital outlay (CC), for each technology, divided by the useful life of the compliance technology.

Limit tax adjustment to not exceed taxes as reported in baseline financial statement: The tax effect of compliance outlays is to reduce tax liability. As a result, in the free cash flow calculation, the tax adjustment generally increases cash flow and business value and, all else equal, reduces the likelihood that a facility will fail the post-compliance closure test. However, the extent to which a facility would realize this contribution to cash flow depends on its tax circumstances. In particular, some businesses may not be paying sufficient taxes in the baseline to take full benefit of the implied tax reduction *at the facility level* – unless the unused tax loss can be transferred to other, profitable business units in the firm, these businesses would not be able to use fully the implied tax reduction on a current basis. Also, the marginal tax rate for businesses with relatively low pre-tax income may be less than the combined federal/State tax rate used in the analysis. While businesses may be able to carry forward

2 For the facility cash flow analysis, EPA treated the income loss from installation downtime on an annual equivalent basis even though this financial event occurs only once, and at the beginning of the assumed analysis period. EPA treated the installation downtime on an annualized basis for two reasons. First, the installation downtime is assumed to have a useful “financial life” of 30 years to reflect the total potential business life of the facility with the installed compliance technology (note that reinstallation of the basic capital equipment other than cooling towers, which is assumed to recur on a 20-, 25-, or 30-year interval depending on the specific technology, does not require a new round of downtime). Since compliance capital equipment is assumed to have a specific useful life and the discounted cash flow analysis is accordingly structured around this period, including the income loss from installation downtime (which is assumed to have a 30-year useful life) as a one-time up-front cost would overstate its impact in the discounted cash flow calculation. Second, calculation of the downtime cost on an annual basis allows the tax effect from the one-time income loss to be summed with other annual tax effects for applying the limit to tax offsets, as explained in the next step of the analysis.

3 As described above, EPA concluded that Manufacturers are likely to have little or no potential to pass through compliance costs to customers through price increases. Accordingly, this variable (ΔR) is assigned the value of *zero* in the Manufacturers impact analysis.

tax losses to reduce taxes in later years, EPA recognizes that the implied cash flow benefit from tax reduction may not be fully realized, particularly in circumstances involving single-facility parent entities. To reduce the risk of overstating this tax-offset benefit in its analysis thereby potentially understating business impact, EPA limited the amount of tax reduction from compliance outlays to be no greater than the amount of tax paid by facilities as reported in the baseline financial statement. The analysis effectively assumes that facilities will not be able to offset an implicit negative tax liability against positive tax liability elsewhere in operations of an owning entity or to carry forward (or back) the negative income and its implicit negative tax liability to other positive income/positive tax liability operating periods. Nevertheless, some businesses may be able to benefit from tax reductions that exceed facility baseline taxes, especially if the facility is owned by a multiple-site entity. Accordingly, EPA constrained the tax effect term in the free cash flow calculation, [-τ(- ΔTC - ΔD)] as specified above, to be no greater than baseline financial statement tax liability, T.

Calculate post-compliance facility value, including post-compliance free cash flow and the compliance capital outlay: As in the baseline analysis, EPA calculated post-compliance facility value as the present value of free cash flow and accounting for a two-stage compliance capital outlay.

For the other options considered – Proposal Option 4 and Proposal Option 2 - requiring the installation of two technologies, a two-stage compliance outlay is created with the first outlay occurring in the year of the first technology installation and a second outlay occurring in the year the second technology is installed. For the purpose of this analysis, EPA assumes that a facility will take into consideration both capital outlays when deciding whether to continue operating and therefore only one closure analysis is undertaken. Because the estimated performance life for some IM compliance technology installations would cease before the end of the 30-year analysis period, this analysis accounts for *reinstallation* of IM compliance technologies after the end of their initial performance period on a prorated basis. Facility post-compliance business value was calculated as follows:

$$VALUE_{PC} = \sum_{t=0}^{29} \frac{FCF_{PC}}{(1+CoC)^t} - CC \quad \text{(O-9)}$$

where:

$VALUE_{PC}$	=	estimated post-compliance business value of the facility
FCFPC	=	estimated post-compliance free cash flow
CoC	=	after-tax cost-of-capital (7.0 percent);
t	=	year index, t = 0-29 (30-year discounting horizon); and
CC	=	compliance capital outlay, calculated for the first technology as an undiscounted cash outlay in the year of first technology installation and for the second technology as the compliance capital outlay discounted to the year of first technology installation. For technologies with a useful life less than 30 years, the prorated cost of a second installation is also included in the compliance capital outlay.

Calculate the cost to revenue of compliance: EPA calculated the cost-to-revenue value as annualized, after-tax total compliance cost divided by facility-level revenue.

EPA considered a facility to be a post-compliance closure if:

1. Its estimated business value was positive in the baseline but became negative after adjusting for compliance-related cost, revenue and tax effects, *and*

2. Annualized compliance cost exceeded the *de minimus* threshold of one percent.

In addition to tallying closure impacts in terms of the number of estimated facility closures, EPA also measured the significance of closures in terms of losses in employment and output. Employment losses equal the number of employees reported by closure facilities in survey responses; output losses equal total revenue reported for regulatory closure facilities. EPA estimated national results by multiplying facility results by facility sample weights.

O.2 Facility-Level Impacts: Moderate Impact Analysis

The analysis of moderate impacts examined two financial measures:

Pre-Tax Return on Assets (PTRA): ratio of pre-tax operating income – earnings before interest and taxes (EBIT) – to assets. This ratio measures the operating performance and profitability of a business' assets independent of financial structure and tax circumstances. PTRA is a comprehensive measure of a firm's economic and financial performance. If a firm cannot sustain a competitive PTRA on a post-compliance basis, it will likely face difficulty financing its investments, including the outlay for compliance equipment.

Interest Coverage Ratio (ICR): ratio of pre-tax operating cash flow – earnings before interest, taxes, and depreciation (EBITDA) – to interest expense. This ratio measures the facility's ability to service its debt on the basis of current, ongoing financial performance and to borrow for capital investments. Investors and creditors will be concerned about a firm whose operating cash flow does not comfortably exceed its contractual obligations. As ICR increases, the firm's general ability to meet interest payments and carry credit also increases. ICR also provides a measure of the amount of cash flow available for equity after interest payments.

Creditors and equity investors review the above two measures as criteria to determine whether and under what terms they will finance a business. PTRA and ICR also provide insight into a firm's ability to generate funds for compliance investments from internally generated equity, i.e., from ATCF. The following sections detail the calculation and development of these threshold values.

O.2.1 Calculation of Moderate Impact Metrics

EPA calculated a facility's PTRA and ICR measures using data collected from the 316(b) survey, adjusted for inflation to 2011. The two measures are defined as follows:

Pre-Tax Return on Assets

$$PTRA = \frac{EBIT}{TA} \quad \text{(O-10)}$$

where:

PTRA = pre-tax return on assets,

EBIT = pre-tax operating income, or *earnings before interest and taxes*, and

TA = total assets.

Or, stated in terms of income statement accounts,

$$PTRA = \frac{REV - (TC + D)}{TA} \quad \text{(O-11)}$$

where:

PTRA = pre-tax return on assets;

REV = revenue;

TC = total operating costs (excluding interest, taxes, and depreciation/amortization) , with costs associated with the first technology considered as of the year of first technology installation and costs associated with the second technology considered as of the year of second technology installation then discounted to the year of first technology installation;

D = depreciation, for each technology; and

TA = total assets.

Interest Coverage Ratio

$$ICR = \frac{EBITDA}{I} \quad \text{(O-12)}$$

where:

ICR = interest coverage ratio;

EBITDA = pre-tax operating cash flow, or earnings before interest, taxes, and depreciation (and amortization) and

I = interest expense.

Or, stated in terms of income statement accounts,

$$ICR = \frac{REV - TC}{I} \quad \text{(O-13)}$$

where:

ICR = interest coverage ratio;

REV = revenue;

TC = total operating costs (excluding interest, taxes, and depreciation/amortization) , with costs associated with the first technology considered as of the year of first technology installation and costs associated with the second technology considered as of the year of second technology installation then discounted to the year of first technology installation; and

I = interest expenses.

Including the effects of compliance costs, post-compliance PTRA and ICR are:

$$PTRA_{pc} = \frac{[REV - (TC + \Delta TC + D + \Delta D)]}{(TA + CC)} \quad \text{(O-14)}$$

$$ICR_{pc} = \frac{[REV - (TC + \Delta TC)]}{(I + \Delta I)} \quad \text{(O-15)}$$

where:

PTRApc = pre-tax return on assets, post-compliance;

ICRpc = interest coverage ratio, post-compliance;

ΔTC = change in total facility operating costs (excluding interest, depreciation and taxes), calculated as operating and maintenance costs of compliance, with costs associated with the first technology considered as of the year of first technology installation and costs associated with the second technology considered as of the year of second technology installation then discounted to the year of first technology installation;

ΔD = change in depreciation expense, calculated as the compliance capital outlay (CC) for each technology divided by 10;

CC = compliance capital outlay (assuming all of the outlay would be capitalized and reported as an addition to assets on the balance sheet), calculated for the first technology as an undiscounted cash outlay in the year of first technology installation, with a prorated second installation if technology useful life is less than 30 years, and for the second technology as the compliance capital outlay discounted to the year of first technology installation; and

ΔI = incremental interest expense from financing of compliance capital outlays. As a simplifying, conservative assumption, incremental interest expense is calculated assuming that the compliance capital outlay, for each technology, is fully debt-financed at the overall real cost-of-capital of 7 percent. The annual incremental interest value is calculated as the annualized value of interest payments over 10 years, assuming a constant annual payment of principal and interest.

In calculating the baseline values of the PTRA and ICR measures, EPA applied the same cash flow adjustments as described above for the facility closure analysis, to the numerators of the PTRA and ICR measures. In the same way as described for the closure analysis, these adjustments are intended to capture the change in the financial performance of facilities in the Primary Manufacturing Industries between the time of the 316(b) survey and 2008 (see *Appendix L: Adjusting Baseline Facility Cash Flow*).

O.2.2 Developing Threshold Values for Pre-Tax Return on Assets (PTRA)

Pre-tax return on total assets measures management's effectiveness in employing the capital resources of the business to produce income. A low ratio may indicate that a borrower would have difficulty financing treatment investments and continuing to attract investment.

EPA used the following data from the Annual Statement Studies published by Risk Management Association (RMA) to calculate PTRA:

- *% Profit Before Taxes / Total Assets*$_{25th}$ – Ratio of profit before taxes divided by total assets and multiplied by 100 for the lowest quartile of values in each 6-digit NAICS code.

- *Operating Profit* – Gross profit minus operating expenses.
- *Profit Before Taxes* – Operating profit minus all other expenses (net).

RMA provides a measure of pre-tax return on assets that approximates the measure EPA defined for the moderate impact analysis. As defined by RMA, this measure is the ratio of pre-tax *income* to assets, designated ROA_{RMA}:

$$ROA_{RMA} = \text{Pre-Tax Income (EBT)} / ASSETS_{25th}$$

However, as defined by EPA for its analysis, the numerator of the PTRA measure requires the use of earnings before interest and taxes (EBIT) instead of pre-tax income (EBT). Defined as EBIT, the PTRA numerator will capture all return from assets, whether going to debt or equity. To derive a pre-tax, total return value, EPA adjusted RMA's measure of PTRA using the median percentage values of EBIT and EBT available from RMA. This adjustment yields the PTRA measure that EPA used in the moderate impact analysis, designated $ROA_{316(b)}$:

$$ROA_{316(b)} = ROA_{RMA} * EBIT / EBT$$

Negative values are included in the weighted-industry PTRA averages but a different method is used to adjust the ROA values reported in RMA to the value used in the moderate impact analysis. Specifically, using only those observations (i.e., 6-digit NAICS code and year combinations) with positive values for % Profit Before Taxes / Total Assets, Operating Profit, and Profit Before Taxes, EPA calculated an adjustment factor by subtracting the difference between $ROA_{316(b)}$ and ROA_{RMA} as follows:

$$ROA_{316(b)} - ROA_{RMA} = \text{adjustment factor.}$$

Those values were consolidated into industry-specific adjustment factors, weighted by 2010 value of shipments from the Economic Censuses (U.S. DOC, 2010). Each negative PTRA observation from RMA was adjusted by its industry specific adjustment factor to approximate the measure used in the moderate impact analysis:

$$ROA_{RMA} + \text{industry specific adjustment factor} = ROA_{316(b)}$$

The industry specific adjustment factors average 0.33 and range from 0.25 for the Other Industries to 0.48 for the Aluminum industry.

O.2.3 Developing Threshold Values for Interest Coverage Ratio (ICR)

Interest coverage ratio (ICR) measures a business' ability to meet current interest payments and, on a pro-forma basis, to meet the additional interest payments for new debt. A high ratio may indicate that a borrower would have little difficulty in meeting the interest obligations of a loan. This ratio serves as an indicator of a firm's capacity to take on additional debt, as might be required to finance installation of compliance technology.

The following data from Risk Management Association *Annual Statement Studies* were used to calculate ICR:

- $EBIT/Interest_{25th}$ – Ratio of earnings (profit) before annual interest expense and taxes (EBIT) divided by annual interest expense for the lowest quartile of values in each 6-digit NAICS code.
- *% Depr., Dep., Amort./Sales*$_{med}$ – Median ratio of annual depreciation, amortization and depletion expenses divided by net sales and multiplied by 100.
- *Operating Profit* – Gross profit minus operating expenses.

RMA provides a measure of interest coverage that approximates the measure that EPA defined for the moderate impact analysis. As defined by RMA, this measure is the ratio of earnings before interest and taxes to interest, designated ICR_{RMA}:

$$ICR_{RMA} = EBIT / INTEREST_{25th}$$

However, as defined by EPA for its analysis, the numerator of the ICR measure requires the use of earnings before interest, taxes, depreciation, and amortization (EBITDA) instead of earnings before interest and taxes (EBIT). Defined this way, the ICR numerator will include all operating cash flow that could be used for interest payments. To derive the desired ICR value (designated $ICR_{316(b)}$), EPA adjusted the RMA value as outlined below:

$ICR_{316(b)}$ = EBITDA / INTEREST

Therefore, $ICR_{316(b)} = ICR_{RMA} * (EBIT + DA) / EBIT$

or $ICR_{316(b)} = ICR_{RMA} * \{1 + [(DA / SALES) / (EBIT / SALES)]\}$

For consistency of calculation, EPA used the median values available from RMA for the adjusting both the numerator (DA / SALES) and denominator (EBIT / SALES) terms.[4]

EPA used the same method as described above to adjust the negative ICR values reported in RMA to the value used in the moderate impact analysis. Including only those observations with positive values for EBIT/Interest, % Depr., Dep., Amort./Sales, and Operating Profit, an adjustment factor was calculated by subtracting the difference between $ICR_{316(b)}$ and ICR_{RMA} as follows:

$ICR_{316(b)} - ICR_{RMA}$ = adjustment factor.

An industry specific adjustment factor was calculated for ICR values similar to the PTRA. Each negative ICR observation from RMA was adjusted by its industry specific adjustment factor to approximate the measure used in the moderate impact analysis:

ICR_{RMA} + industry specific adjustment factor = $ICR_{316(b)}$

The industry specific adjustment factors average 0.61 and range from 0.39 for the Aluminum industry to 1.16 for the Food and Kindred Products industry.

4 Numerator (% Depr., Dep., Amort./Sales) is available for quartile values; denominator (Operating Profit) only for median values.

Appendix P Analysis of the Final Rule Using the IPM V4.10 Platform

As discussed in *Chapter 7: Electricity Market Analysis*, EPA conducted IPM analysis of Proposal Option 1, which closely aligns with the final rule, using the IPM V4.10 platform. In the same way as presented for the proposed rule, this analysis looks at a range of impact measures, including changes in generating capacity, electricity generation, wholesale electricity prices, costs, and air emissions. *Section P.1* briefly discusses similarities and differences between the IPM analysis of Proposal Option 1 conducted in support of the proposed rule using the IPM V3.02_EISA platform and that conducted later, using the slightly updated IPM V4.10 platform. *Section P.2* presents results of the IPM analysis conducted using the IPM V4.10 platform. As discussed in *Chapter 7*, the IPM V4.10 platform is a more current platform compared to the IPM V3.02_EISA platform used for the proposed rule and includes the Proposed Transport Rule and the Proposed Toxics Rule, but is not as current as the IPM V4.10_MATS platform, which includes the final Mercury and Air Toxics Standards (MATS) and the final Cross-State Air Pollution Rule (CSAPR).

P.1 Analyses Using the IPM V3.02_EISA Platform and the IPM V4.20 Platform: Similarities and Differences

In the same way as presented for the proposed rule, this IPM analysis looks at incremental changes in generating capacity, electricity generation, generation costs, wholesale electricity prices, and air emissions. In conducting this analysis, EPA followed the same methodology as used in the IPM analysis for the proposed rule: EPA compared the findings for Proposal Option 1 to those for the baseline scenario. The main differences between the analysis conducted using the IPM V3.02_EISA platform and that conducted using the IPM V4.10 platform are:

- *Unit-aggregation scheme*: For the analysis based on the IPM V3.02_EISA platform, EPA used a Custom Base Case developed specifically for analysis of the 316(b) rule, where each generating unit behaves like a stand-alone plant and which supports analysis of unit-level closures. For the analysis based on the IPM V4.10 platform, EPA used model-plant aggregation/modeling, which does not support explicit analysis of unit closures; however, this aggregation does support analysis of full and partial plant closures, which approximates the concept of unit-level closures.
- *Facility/Unit universe*: The IPM V4.10 platform does not include 24 of the 1,453 (1.7 percent) generating units that were assigned compliance costs in the analysis based on the IPM V3.02_EISA platform. These units represent 0.6 percent of capacity at generating units assigned compliance costs in the analysis based on the IPM V3.02_EISA. As the result of this difference in the IPM generating unit universe, compliance costs are slightly understated. However, EPA believes that the difference in costs is very modest and is not likely to have had a material effect on analysis outcome.
- *Types of analyses/impacts captured*: For the analysis conducted using the IPM V4.10 platform, EPA analyzed impacts only for the 2015 IPM run-year because only 2015 results were available at the time this analysis was conducted. Because the IPM V4.10 platform analysis looks only at the 2015 run year, the only impacts of Proposal Option 1 that are captured in this analysis reflect the occurrence of downtime during technology installation period. Because downtime impact is assessed only at the level of electricity market, EPA did not conduct an analysis of impacts on regulated facilities as a group.
- *Technology-installation window*: In the IPM V4.10 platform, the 2015 run year represents three years – 2014, 2015, and 2016 – instead of the 5-year window of 2013 through 2017 in the IPM V3.02_EISA platform. Consequently, for this analysis, EPA assumed that regulated facilities will install technologies to reduce impingement mortality (IM technologies) during the 3-year window instead of the 5-year window.

- *Impact metrics*: Unlike the analysis done using the IPM V3.02_EISA platform, the analysis using the IPM V4.10 platform does not assess the impact on revenue and pre-tax income; the IPM V4.10 platform also does not assess the impact on wholesale electricity prices at the level of the NERC region.

P.2 Summary of Market-Level Analysis Results Using the IPM V4.10 Platform

As presented in *Table P-1*, with only a few facilities experiencing net downtime under Proposal Option 1, the estimated effects of the Proposal Option 1 – which reflect only the occurrence of technology installation downtime – are very low. Specifically, the incremental change for all economic measures, except the national wholesale electricity price, is less than 1 percent; wholesale prices increase by 1.1 percent. The estimated changes in air emissions are also very small, with the largest percentage change being a 0.7 percent decrease for SO_2 emissions.

Table P-1: Market-Level Impacts of 316(b) Proposal Option 1 for Run-Year 2015 (Dollars in $2011)

Economic Measures	Baseline	Value	Difference	% Change
Total Domestic Capacity (MW)	1,024,047	1,022,740	-1,307	-0.1%
Generation (GWh)	4,104,621	4,104,829	209	0.0%
Wholesale Electricity Price ($/MWh; $2011)	$52.47	$53.04	$0.56	1.1%
Costs (Millions; $2011)	$165,616	$166,417	$801	0.5%
Fuel Cost	$87,201	$87,587	$386	0.4%
Variable O&M	$15,174	$15,212	$38	0.2%
Fixed O&M	$51,811	$52,191	$380	0.7%
Capital Cost	$11,430	$11,427	-$3	0.0%
Variable Production Cost ($/MWh; $2011)	$21.24	$21.34	$0.09	0.4%
CO_2 Emissions (Million Metric Tons)	2,219	2,217	-2	-0.1%
Mercury Emissions (Tons)	9	9	0	-0.1%
NOx Emissions (Million Tons)	2	2	0	0.0%
SO_2 Emissions (Million Tons)	2	2	0	-0.7%

Source: EPA Analysis, 2013