From:	Martini, Jay
To:	Brent Jorgensen
Subject:	Fwd: Geothermal information
Date:	Thursday, February 26, 2015 11:11:41 AM
Attachments:	20150220_wind_solar_geother_SpL_Rv1 pd jd.docx

Hi Brent,

do you know if we have any GIS information on Geothermal developments that have occured in sage grouse habitats?

---------- Forwarded message ----------
From: **Solberg Schwab, Lisa** <lisa_solbergschwab@fws.gov>
Date: Tue, Feb 24, 2015 at 2:05 PM
Subject: Geothermal information
To: Jay Martini <jay_martini@fws.gov>, Katie Powell <katie_powell@fws.gov>, Jason Pyron <jason_pyron@fws.gov>

Good Afternoon,

I am writing the wind/solar/geothermal chapter for the GRSG listing and i'm having trouble drumming up information on geothermal development that have occurred in sage-grouse habitat.

Would you folks mind taking a look at my chapter in light of geothermal development and help fill in any gaps I might be missing with information from your state? And if you have any leads on GIS data of those developments I could really use it. We have been having a hard time finding anything we can use.

If you do not have the time to help me just let me know. I've included the version with Pat Deiberts edits. The geothermal paragraphs are really short if that helps at all :)

Thank you.

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Chapter 1: Wind, Solar, and Geothermal Renewable Energy

INTRODUCTION

Energy Development

Energy development is a significant risk to the greater sage-grouse (sage-grouse) in the eastern portion of its range (Montana, Wyoming, Colorado, and northeastern Utah – MZs I, II, VII and the northeastern part of MZ III)., ~~with t~~The primary concern ~~being~~ are the direct effects of energy development on the long-term viability of sage-grouse by eliminating habitat, leks, and whole populations and fragmenting some of the last remaining large expanses of habitat necessary for the species' persistence. The intensity of energy development is cyclic and based on many factors including energy demand, market prices, and geopolitical uncertainties. However, continued exploration and development of traditional and nonconventional fossil fuel sources in the eastern portion of the sage-grouse range is predicted to continue to increase over the next 20 years (EIA 2009b, p. 109).

Sage-grouse populations are predicted to decline 7 to 19 percent over the next 20 years due to the effects of oil and gas development in the eastern part of the range (Copeland *et al*. 2009, p. 4); this decline is, in addition, to the 45 to 80 percent decline that is estimated to have already occurred rangewide (Copeland *et al*. 2009, p. 4). Development of commercially viable renewable energy—wind, solar, geothermal, biomass—is increasing across the range of the sage-grouse with focus in some areas already experiencing traditional energy development (EIA 2009b, pp. 3-4; AWEA 2009a, entire).

In Wyoming, where wind development is advancing and predicted to increase by 10-fold (DOE 2008, p. 10), the effects of both conventional and nonconventional and renewable sources may claim a substantial toll on sage-grouse habitats and geographic areas that were in the past considered refugia for the species. Renewable energy resources are likely to be developed in areas previously untouched by traditional energy development. Wind energy resources are being investigated in south-central and southeastern Oregon where large areas of relatively unfragmented sagebrush dominated landscapes are important for maintaining long-term connectivity within the sage-grouse populations (Knick and Hanser, 2011, pp. 1-2.).

Sage-grouse populations are negatively affected by energy development activities, even when mitigative measures are implemented (Holloran 2005, pp. 57-60; Walker *et al* 2007a, p. 2651). ~~Energy development, particularly high density development,~~

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Comment [JD1]: Need to clearly state what kind of energy development we are addressing here (renewable energy – wind/solar/geothermal).

Comment [DP2]: I just broke this into 2 sentences – it was really, really long.

Comment [JD3]: Is this commonly accepted terminology? Suggest being more clear what types of energy development we are talking about.

Comment [JD4]: This was 6 years ago – so next 14 years? Any updated documents we can cite?

Comment [JD5]: Unclear how this relates to the renewable energy chapter.

Comment [DP6]: not in lit cited

Comment [JD7]: First use of biomass – should this be in the title? If we keep it in will need to follow through and address in the rest of the chapter.

Comment [JD8]: Unclear what we mean here.

Comment [JD9]: Again, we need to define what these terms mean – is traditional = oil and gas development?

Comment [JD10]: Not in lit cited.

Comment [JD11]: Is this prediction still valid – citation is 7 years old.

Comment [JD12]: See master's thesis by Natalie Macsalka – Assessing the conflict between wind energy development and sage-grouse in Wyoming…. http://www.uwyo.edu/cee/_files/docs/2011_macsalka_wind_energy_sage_grouse.pdf

Comment [DP13]: in WY, OR or rangewide? Also citation for this statement?

Comment [JD14]: Need to balance this analysis with the substantial regulatory measures to restrict renewable energy development in PACs and strongholds.

will continue to threaten sage-grouse populations, specifically in the MZs I and II, which contain the greatest numbers of birds throughout their range. Development of commercially viable renewable energy within the range of sage-grouse –wind, solar, geothermal,–is rapidly increasing rangewide with a focus in some areas already experiencing significant traditional energy development (e.g., MZs I and II). The effects of renewable energy development are likely similar to those of nonrenewable energy as similar types of infrastructure are required. Based on our review of the literature, we anticipate the impacts of these developments will negatively affect the ability of sage-grouse to persist in those areas in the future. The studies on the impacts of wind energy development on sage-grouse have shown impacts that are consistent with the Service's 2010 finding (75 FR 13910, p. 13951). Sage-grouse are avoiding powerlines and roadways. And rRecent studies on the impacts of predators on sage-grouse has shown that ravens in particular are selecting habitats with anthropogenic features and increased edge effects, and that female sage-grouse (yearlings and older females) are both avoiding habitats with increased numbers of predators, as a result of nest predation. Older females are not moving at the large distances as the yearlings, however they are overcoming site fidelity as a means of protecting themselves, their eggs, and their chicks. Behavioral avoidance, alteration of habitat quality, and changes in trophic interactions are showing important implications to greater sage grouse population responses to wind energy development. Anthropogenic features such as roads, powerlines, fences and wind towers are linked to elevated mortality rates and shifts in life history strategies, for example avoidance (Winder et al 2014, p.11, Holloran 2005, p. 1; Pruett *et al*, 2008, p. 6). If habituation to disturbance does not occur, behavioral avoidance to wind development may result in a population level response could contribute to behavioral avoidance to wind development resulting in and effective loss of habitat loss (Winder et al 2014, p.11). With the increasing pressures of energy use, renewable energy sources will be in more demand than ever putting more pressure on contiguous tracks of Sagesage-grouse habitat, whether to site transmission corridors or pieces and parts of large wind and solar arrays, as areas outside sage-grouse priority habitats are inundated with other uses.

THREAT DESCRIPTION

Nonrenewable fossil fuel energy development (e.g., petroleum products, coal) has been occurring in sage-grouse habitats since the late 1800s (Connelly et al. 2004, pp. 7-28). Wind energy power began in the 1850's in the United States with the start of the U.S. Wind Engine Company. With the passing of the Public Utility Regulatory Polices Act in 1978 wind energy production interest increases. However it isn't until 1992 with the onset of the Energy Policy Act and then in 2008 when the U.S. Department of Energy publishesd their 20 percent Wind Energy by 2030 initiative that wind energy production becoames the number-one source of nrenewable electricity (DOE, 2014, entire). Making renewable energy development (e.g., wind, solar, geothermal, biomass) a relatively more recent activity in sage-grouse habitats rangewide. The demand for electricity from renewable energy sources is increasing. Electricity production from renewable sources increased from 6.4 quadrillion British thermal units (Btu) in 2005 to 9.2 quadrillion Btu in 2013. Production was down slightly in 2007, but energy production by renewables reached 7.3quadrillion Btu by the end of 2008 (EIA 2009d, entire) and has since been increasing in production yearly to-date.

Comment [DP15]: may be true but we haven't established this yet.

Comment [DP16]: I added the clarity because there are other economically viable sources of renewable energy, such as wave energy, that aren't in the range of the bird.

Comment [JD17]: True? Need recent citation if we are going to say this.

Comment [DP18]: we may need to define; also citation

Comment [DP19]: citation? do they avoid because of predators, or are the numbers down because of their site fidelity and therefore they are dead in these areas?

Comment [DP20]: This sentence confused me and seemed "flipped" in logic. So the suggest edits. If I messed up the story than don't accept the changes.

has habituation to disturbance actually been documented in sage-grouse?

Comment [JD21]: Again, need a balance of threats and the substantial regulatory protections that are being worked out to prevent development in priority habitats, PACs, and strongholds.

Comment [DP22]: I think without documentation that development will be forced into priority areas this is adangerous assumption.

Comment [DP23]: this was not on the list above. Is biomass a threat within the range of sage-grouse?

Also, this sentence is incomplete

Comment [DP24]: relevance? if its at 9.2 in 2013 than is this sentence even necessary?

Also, is there a way to link the amount of energy produced to the size of the facility? did the increase from 2005 to 2013 result in 1 or 50 more facilities?

Wind

Wind energy resources are found throughout the range of the sage-grouse, and growth of wind power development is expected to continue. The Department of Energy (DOE) predicts that wind may provide 20 percent of the nation's energy needs by the year 2030, and substantial growth of wind developments will be required. With the advent of federal tax credits for wind energy facilities, wind development has more than doubled over the past five years (DOE 2008, p. 1).

Areas of commercially viable wind generation have been identified by the NREL (2014) and Bureau of Land Management (BLM) (2005, p. sage-grouse range. MZs III through VII each have approximately 1 to 14 percent of sagebrush habitats that are commercially developable for wind energy (Service 2014). Wind harvesting potentials are more concentrated and geographically extensive in sage-grouse MZs I and II that include parts of Montana, Wyoming, North Dakota, and South Dakota; areas of highest commercial potential include 40 percent of the available sagebrush habitats in these four States. Over 14 percent of the sagebrush lands in the sage-grouse range have high potential for wind power.

The Energy Policy Act (Public Law 109–58, August 8, 2005) establishes a goal for the Secretary of the Interior to approve 10,000 megawatts of electricity from non-hydropower renewable energy projects located on public lands. The State of Nevada, through the Renewable Portfolio Standard, has mandated that investor-owned utilities generate, acquire, or save 20 percent of their produced electricity from renewable systems by 2015. The State of California, has mandated that 33 percent of electrical power be derived from renewable energy sources by 2020. Nevada is predicted to experience the greatest increase in geothermal growth across the United States–doubling production from geothermal sources by 2025 (BLM and U.S. Forest Service (USFS) 2008b, p. 2-35).

The BLM, the major land manager in the sage-grouse range, developed programmatic guidance to facilitate the use of BLM land for wind development (BLM 2005a, entire). The BLM wind policy permits granting private right-of-ways and leasing of public land for 3–year monitoring and testing facilities and long-term (30 to 35 years) commercial generating facilities (American Wind Energy Association (AWEA) 2008, p. 4-24). Active leases for wind energy development on BLM lands increased from 9.7 km2 (3.7 mi2) in 2002 to 5,113 km2 (1,973 mi2) in 2008, and an additional 5,381 km2 (2,077 mi2) of lease requests were pending approval in the sage-grouse range (Knick *et al*., in press, p. 136).

The BLM indicates that approximately 600 km2 (232 mi2) of BLM-administered lands are likely to be developed in nine States within the sage-grouse's range before 2025 (BLM 2005a, pp. ES-8, 5-2). It is estimated that only 5 to 10 percent of a development will have a long-term disturbance that remains on the landscape for at least as long as the generating facility is viable (i.e., roads, foundations, substation, fencing) (BLM 2005a, p. 5-2). However, this estimate does not account for sage-grouse avoidance of developed areas and could be an underestimation of indirect effects. Based on what we know of oil and gas development (previously described), the impact of structures, noise and human activity can reach far beyond the point of origin and contribute

Comment [JD25]: Not according to the map presented.

Comment [DP26]: the reference is from 2008. do we have more current data? If not we should qualify this statement and give the timeframes.

Comment [JD27]: ??

Comment [JD28]: Cite table which then has the citation to the actual data source used to make these calculations (NREL).

Comment [JD29]: Suggest reorgainizing the following paragraphs by Management Zone instead of State.

Comment [DP30]: move this to geothermal. This is the section on wind.

Comment [DP31]: any info for FS lands?

Comment [DP32]: is this Knick et al. 2011? If so the page number will need to be updated. If not, this is not in the lit cited.

cumulatively to other human-made and natural disturbances that fragment and decrease the quality of sage-grouse habitats (Winder et al 2014, p.11, Holloran 2005, p. 1; Pruett *et al*, 2008, p. 6, Patricelli et al., 2013, p.231). The BLM's determination of the quantity of lands potentially impacted by wind energy development could be conservative considering the interest in reducing green-house emissions and the institution of State renewable energy mandates and incentives that have occurred since 2005. Wind development is guided by policy at BLM national and State levels that generally offers only guidance to avoid impacts to sage-grouse and habitats. A 2008 BLM Instruction Memo IM 2009-43 (BLM 2008e, p. 2) emphasizes the use of the Service's 2003 interim guidelines as voluntary and to be used only on a general basis in siting, design, and monitoring decisions. The BLM's Oregon State Office Instruction Memorandum OR-2008-014 (BLM 2007d, entire) is explicit in the placement of meteorological test towers to avoid active leks, seasonal concentrations, and collision; IM OR- 2009-038 (BLM 2009f, entire) reduces the ODFW's recommended buffer distance for wind farms and applies only guidelines for avoidance of sage-grouse leks and seasonal habitats.

A recent increase in wind energy development is most notable within the range of the south-central Wyoming subpopulation of sage-grouse in Management Zone (MZ) II where 1,387 km2 (535 mi2) have active wind leases and an additional 2,828 km2 (1,092 mi2) are pending (Knick *et al*., 2011, p. 136). The south-central Wyoming subpopulation has a loose association with adjacent populations where there is accelerated oil, gas, and coal development in the State – the Powder River Basin (MZ I) to the northeast and Pinedale-Jonah Gas Fields in the southwest Wyoming Basin (MZ II) (Connelly *et al*. 2004, p. 6-62). The Powder River Basin is home to an important regional population of the larger Wyoming Basin populations (Connelly *et al*. 2004, p. 6-62). In Wyoming, where wind development is advancing and predicted to increase by 10 fold or more, the effects of both conventional and nonconventional renewable sources may claim a substantial toll on sage-grouse habitats and geographic areas that were in the past considered refugia for the species. Wyoming does not have a requirement for increased reliance on renewable energy sources and no specific wind siting authority. However, large commercial construction projects in the State are subject to approval by an Industrial Siting Council (ISC) of the State Department of Environmental Quality, with the Wyoming Game and Fish Department (WGFD) providing recommendations for mitigating impacts to wildlife associated with development considered by the ISC. The ISC's review and approval of projects is subject to the Wyoming Governor's executive order (State of Wyoming 2008, entire) that is intended to prevent harmful effects to sage-grouse from development or new land uses in designated core areas. Wind developers in Wyoming understand that most proposed wind developments regardless of locale must be approved by the ISC and that development proposed in core areas is unlikely to be permitted by the ISC due to the Governor's Executive Order.

In addition to Wyoming, southeastern Oregon is a focus area for potential commercial-scale wind development. The BLM is the major land manager in this part of the southeastern Oregon, with jurisdiction over 49,000 km2 (18,900 mi2) (BLM 2009d, entire) that include much of the scantily vegetated ridge tops prone to high and sustained wind. At this time, most of the development activity is in the initial phase of meteorological site investigation and involves little infrastructure (AWEA 2009, entire; BLM 2009e). If ~~Many~~

Comment [DP33]: this is a prairie chicken article isn't it? If so it may be an overtattement to use it in this context of describing impacts to sage-grouse habitats

Comment [DP34]: ate these IM's still current?

Comment [JD35]: This section needs to be updated with the latest direction from BLM on avoidance and exclusions for wind development.

Comment [DP36]: If these are on BLM lands than this estimate far exceeds what they predicted as described in the preceeding paragraph.

Comment [DP37]: not sure I get the relevance of this and suggest deleting. If retained define "loose association"

Comment [DP38]: citation?

Comment [DP39]: but it does have a wind resources that is valuable to other states with that requirement, and wind energy in WY doesn't stay in WY.

Comment [DP40]: The citations are 6 years old so I don't know that we can say these are current.

Comment [DP41]: I changed the sentence to be less speculative.

~~of~~ these monitoring sites are subsequently developed ~~could be developed, considering the projected demand for renewable energy, contributing to~~ fragmentation of this relatively intact sagebrush landscape could have negative impacts on sage-grouse.

Comment [JD42]: Anything change in the last 6 years?

Although development of renewables is encouraged at a State level, siting authority for wind varies from State to State (AFWA and Service 2007, pp. 7, 8, 14, 28, 30, 36, 39, 43, 46, 49, 52; State of Oregon 2008, entire). For example, the State of Idaho provides tax incentives and loan programs for renewable energy development, but wind power is currently unregulated at any level of government (AFWA and Service 2007, p. 14). Colorado law requires incremental increases of renewable generation from 3 percent in 2007 to 20 percent by 2020 (AFWA and Service 2007, p. 8). Financial incentives, including grants and tax breaks, encourage private development of renewable sources. ~~Although development of renewables is encouraged at a State level, siting authority for wind varies from State to State (AFWA and Service 2007, pp. 7, 8, 14, 28, 30, 36, 39, 43, 46, 49, 52; State of Oregon 2008, entire). For example, the State of Idaho provides tax incentives and loan programs for renewable energy development, but wind power is currently unregulated at any level of government (AFWA and Service 2007, p. 14).~~ The North Dakota Public Service Commission regulates siting of wind power facilities over 100 megawatts using the Service's interim voluntary guidelines (Service 2003, entire).

States such as Nevada and Montana that have not been tapped for extensive wind power development are likely to experience significant new energy development within the next 20 years.

Comment [DP43]: citation?

Mud Spring Wind Ranch has announced the start of construction on its four-phase 240 MW, 120-turbine project on private land in Carbon County, Montana. The first three phases are each comprised of 80 MW (40 turbines); the fourth phase consists of substation and transmission line construction. The lease size is approximately 24,832 acres. This project location occurs in a PAC (Priority Area for Conservation) as identified in the 2013 COT Report (Wyoming Basin population) and core sage-grouse habitat as mapped by Montana Fish, Wildlife and Parks and most recently (September 2014) in Montana Executive Order 10-2014.

Comment [DP44]: This seems to contradict the previous paragraph.

Montana-Dakota Utilities constructed, owns and operates the 30-MW Diamond Willow wind farm in Fallon County near Baker, Montana. Constructed in three phases between approximately 2007 and 2010, this wind farm consists of 20 1.5 MW wind turbines. This project occurs in a PAC as later identified in the 2013 COT Report (Dakotas population) and core sage-grouse habitat as mapped by Montana Fish, Wildlife and Parks and most recently (September 2014) in Montana Executive Order 10-2014.

Comment [DP45]: this seems to contradict the above one-sentence paragraph.

The BLM manages more land areas of high wind resource potential than any other land management agency. In 2005, the BLM completed the Wind Energy Final Programmatic EIS that provides an overarching guidance for wind project development on BLM-administered lands (BLM 2005a, entire). This EIS provided an avenue to accomplish the DOE's 20 percent Wind Energy by 2030 initiative assisting with the nation's energy demands and also, providing a form of energy production that does not contribute to climate change. However, these projects cover tens of thousands of acres of BLM landscapes, largely composed of sagesteppe habitats creating another means of habitat degradation and fragmentation for species such as the sage-grouse.

Solar

In 2005 the BLM proposed to develop a new Solar Energy Program to further support utility scale solar energy development on BLM-administered lands in the six-state study area (Arizona, California, Colorado, Nevada, New Mexico, and Utah). The proposed Solar Energy Program would replace certain elements of BLM's existing solar energy policies with a comprehensive program that would allow the permitting of future solar energy development projects on public lands to proceed in a more efficient, standardized, and environmentally responsible manner. The proposed program would establish right-of-way (ROW) authorization policies and design features applicable to utility-scale solar energy development on BLM-administered lands. It would identify categories of lands to be excluded from utility-scale solar energy development and identify specific locations well suited for utility scale production of solar energy where the BLM would prioritize development (i.e., solar energy zones, or SEZs). The proposed action would also allow for responsible utility-scale solar development on lands outside of priority areas.

The scope of the analysis is limited to utility-scale solar energy facilities and required transmission connections from these facilities to the existing electricity transmission grid and other associated infrastructure such as roads . For the purposes of the Solar Programmatic Environmental Impact Statement (PEIS) and associated decision making, utility-scale solar energy development is defined as any project capable of generating 20 megawatts (MW) or more. As a result, BLM's new Solar Energy Program would apply only to projects of this scale; decisions on projects that are less than 20 MW would continue to be made in accordance with existing land use plan requirements, current applicable policy and procedures, and individual site-specific NEPA analyses. Viable utility-scale solar technologies considered likely to be deployed over the next 20 years (i.e., until about 2030) and analyzed as part of the Solar PEIS include parabolic trough, power tower, dish engine systems, and photovoltaic (PV) systems.

Geothermal

The hottest geothermal resources and where commercial electrical generation would most likely occur, are generally within central and northern Nevada, western Utah, southern and central Idaho, southern and northeastern California, southeast Oregon, and along the Cascade mountain range. (EIA 2009e, entire).

The BLM has the authority to lease geothermal resources in 11 western States (eight of which are in sage-grouse MZs). A programmatic EIS for geothermal leasing and operations was completed in 2008 (BLM and USFS 2008a, entire). Best management practices for minimizing the effects of geothermal development and operations on sage-grouse are guidance only and are general in nature (BLM and USFS 2008a, pp. 4.82-4.83). The EIS' reasonably foreseeable development scenario predicts that Nevada will

Comment [DP46]: this is repetitive of the discussion of the same at the beginning of the wind section. I suggest consolidating.

Comment [DP47]: citation? and are these occupied sage-grouse habitats?

Comment [DP48]: is there any information available on the amount of solar development current or proposed within the species range?

Comment [DP49]: but the new plan revisions and amendments will prohibit this.

Comment [JD50]: Decribe by MZ.

Comment [DP51]: but see the new plans experience the greatest increase in geothermal growth–doubling the production of electricity from geothermal sources by 2025 (BLM and USFS 2008, p. 2-35). Currently, approximately 1,800 km2 (694 mi2) of active geothermal leases exist on public lands primarily in the Southern (MZ IV) and Northern Great Basin (MZ III) and 1,138 km2 (439 mi2) of leases are pending (Knick *et al*., in press, p. 138).

Comment [DP52]: are these in the range of sage-grouse?

Comment [DP53]: check reference and page numbers.

Biomass?

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CURRENT IMPACTS

Mechanism

Wind

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~~As with oil and gas development, T~~The average footprint of a wind turbine unit is relatively small from a landscape perspective, but ~~the effects of~~ large-scale developments have the potential to reduce the size of sagebrush habitats directly, degrade habitats with invasive species, provide pathways for synanthropic predators (i.e., predators that live near and benefit from an association with humans), cumulatively contribute to habitat fragmentation, and increase noise levels due to wind facilities and roads in areas that were previously undeveloped. Wind generating facilities have increased in size and number, outpacing development of other renewable sources in the sage-grouse range.

Comment [DP54]: have the potential or do?

Comment [DP55]: citation?

Comment [JD56]: Doesn't tell me much. From what to what? Suggest quantifying this to the extent possible – at least ?? wind turbines occur within the range of the sage-grouse, directly impacting xx acres. Is there a figure we could include showing the change in the number of turbines constructed in the range over time.

Renewable energy facilities~~, including wind power,~~ typically require many of the same features for construction and operation as do nonrenewable energy resources (see the oil and gas energy chapter). Therefore, we anticipate that potential impacts from direct habitat losses, habitat fragmentation through roads and powerlines, noise, and increased human presence (Connelly et al. 2004, pp. 7-40 to 7-41) will generally be similar to those already discussed for nonrenewable energy development. Wind farm development begins with site monitoring and collection of meteorological data to accurately characterize the wind regime. Turbines are installed after the meteorological data indicate the appropriate siting and spacing. Roads are necessary to access the turbine sites for installation and maintenance. Each turbine unit has an estimated footprint of 0.4 to 1.2 ha (1 to 3 ac) (BLM 2005a, pp. 3.1-3.4). One or more substations may be constructed depending on the size of the wind farm. Substation footprints are 2 ha (5 ac) or less in size (BLM 2005a, p. 3.7). The average footprint of a turbine unit is relatively small from a landscape perspective although the impacts tend to be clustered and therefore can be significant at the local scale (citations?).~~ Turbines require careful placement within a field to avoid loss of output from interference with neighboring turbines. Spacing improves efficiency but expands the overall footprint of the field~~.

Comment [DP57]: power lines?

I've also read in the non-scientific literature that wind turbines create their own micro-climate, such that the underlying vegetation shifts. This could be important if the shifts in vegetation "bleed" out beyond the footprint of the wind farm, or if it facilitates invasives such as cheat grass. I don't know if this has been published in thescientific literature though….

In mid-2009, wind energy production facilities in the sage-grouse range in operation or under construction had a capacity of 11.93 gigawatts (AWEA 2009, entire). To achieve predicted levels of 49 to greater than 90 gigawatts capacity (DOE 2008, p. 10), the generation capacity will need to increase by 400 to 800 percent by 2030. Existing commercial wind turbines range from 1-2 megawatt generating capacity (AWEA 2009, entire). The forecasted increase in production would require approximately 37,000 to 78,000 or more turbines based on the existing technology and equipment in use. Assuming a generation capacity of 5 megawatts per km2 (0.4 mi2) density, Copeland *et al*. (2009, p. 1) estimated an additional 50,000 km2 (19,305 mi2) of land in the sage-grouse range would be required to meet the predicted level of wind-generated electricity by 2030.

Change in predator risk?

Solar

Solar-generating systems have been used on a small scale to power individual buildings, small complexes, remote facilities, and signs. Commercial solar generation results in direct habitat loss (i.e., solar fields completely eliminate habitat), fragmentation, roads, powerlines, increased human presence, and disturbance during facility construction with likely similar effects to sage-grouse as reported with oil and gas development. Solar-powered electricity generation is increasing. Solar energy infrastructure is often ancillary to other development, and large-scale solar-generating systems have not yet (?) contributed to any calculable direct habitat loss for sage-grouse;, but this may change as more systems come on line for commercial electricity generation. Solar energy systems require, depending on local conditions, 1.6 ha (4 ac) to produce 1 megawatt of electricity. For example, the 162-ha (400-ac) Nevada Solar One, the third largest solar electricity producer in the world, has a maximum potential of 75 megawatts from a 121-ha (300-ac) solar field (nevadasolarone.com 2008, entire).Between 2005 and the end of 2008, solar electricity generation increased from the equivalent of 66 trillion Btu to 83 trillion Btu (EIA 2009d, entire). Solar-generating systems have been used on a small scale to power individual buildings, small complexes, remote facilities, and signs. Solar energy infrastructure is often ancillary to other development, and large-scale solar-generating systems have not contributed to any calculable direct habitat loss for sage-grouse, but this may change as more systems come on line for commercial electricity generation. Solar energy systems require, depending on local conditions, 1.6 ha (4 ac) to produce 1 megawatt of electricity. For example, the 162-ha (400-ac) Nevada Solar One, the third largest solar electricity producer in the world, has a maximum potential of 75 megawatts from a 121-ha (300-ac) solar field (nevadasolarone.com 2008, entire).

Geothermal

Geothermal energy production is similar to oil and gas development such thatas it requires surface exploration, exploratory drilling, field development, and plant construction and operation. Each drill site could directly disturb approximately 0.10 acres, and the drill rig could be approximately 60 feet tall. Wells are drilled to access the thermal source and could take from 3 weeks to 2

Comment [DP58]: Is this still true?

Comment [JD59]: desired?

Comment [JD60]: E.g., See Winder et al. 2014 – Effects of wind energy development on survival of female greater prairie chickens. Journal of Applied Ecology.

Comment [DP61]: I deleted a lot of repetitive text.

months of continuous drilling (Suter 1978, p. 3), which may cause disturbance to sage-grouse. The ultimate number of wells, and therefore potential loss of habitat, depends on the thermal output of the well and expected production of the plant (Suter 1978, p. 3).

Comment [DP62]: direct, indirect?

Comment [DP63]: do we have more recent information on methodology?

~~Geothermal energy production requires surface exploration, exploratory drilling, field development, plant construction, and operation~~. Direct habitat loss occurs from development of well pads, structures, roads, pipelines, and transmission lines. ~~Intensive human activity is required during field development, but relatively reduced levels of human activity occur during operation.~~ The development of geothermal energy requires intensive human activity during field development and operation. The number of personnel required during construction varies significantly, but at any one point there may be a few hundred laborers and professionals on-site with attendant vehicle traffic. The number of people required for routine operation of a power plant is typically three per shift; however, additional personnel (as many as 12 total, depending on plant size) may be on site during the day for maintenance and management (EIA 2009e, entire). Geothermal plants could be in remote areas necessitating housing construction, transportation, and utility infrastructure for employees and their families (Suter 1978, p. 12). Accessing a thermal source can take 3–8 weeks of continuous well drilling (Suter 1978, p. 3) and can potentially cause toxic gas releases depending on the geological formation (Suter 1978, pp. 7–9). The type and effect of these gases depends on the geological formation in which drilling occurs (Suter 1978, pp. 7-9). ~~The amount of water necessary for drilling and condenser cooling may be high. Local water depletions may be a concern if such depletions result in the loss of brood-rearing habitat.~~Water is necessary for drilling operations and later for condenser cooling at the generation plants, which are similar in size to coal- or gas-fired plants. Thus, local water depletions may be a concern for sage-grouse if they result in the loss of brood-rearing habitat. The BLM and USFS completed a programmatic EIS for geothermal leasing and operations across much of the western United States in 2008 (BLM and USFS 2008b, entire). Best management practices were included for minimizing the effects of geothermal development and operations on sage-grouse, but they are guidance only and general in nature (BLM and USFS 2008b, pp. 4.82–4.83).

Biomass?

Results of impact (vital rate/population level effects (direct, indirect)

~~Renewable energy development is a relatively recent activity on the landscape.~~ Studies examining the impacts of renewable energy development on sage-grouse populations are limited. Renewable energy facilities typically require many of the same features for construction and operation as do nonrenewable energy resources. Therefore, we anticipate that potential impacts from direct habitat losses, habitat fragmentation through roads and powerlines, noise, and increased human presence (Connelly et al. 2004, pp. 7-40 to 7-41) will generally be similar to those already discussed for nonrenewable energy development (See chapter X: Oil and gas).

Wind

Most published reports of the effects of wind development on birds focus on the risks of collision with towers or turbine blades (Pruett et al 2009, p.013136). Sage-grouse could be killed by flying into turbin rotors or towers (Erickson et al. 2001, entire) although reported collision mortalities have been few. One sage-grouse was found dead within 45 m (148 ft) of a turbine on the Foote Creek Rim wind facility in south-central Wyoming, presumably from flying into a turbine (Young et al. 2003, Appendix C, p. 61). This is the only known known sage-grouse mortality at this facility during three years of monitoring. Sage-grouse hens with broods have been observed under turbines at Foote Creek Rim, which conceivably increases the potential for turbine collision (Young 2004, pers. comm.). We have no recent reports of sage-grouse mortality due to collision with a wind turbine; however, many facilities may not be monitored. No deaths of gallinaceous birds were reported in a comprehensive review of avian collisions and wind farms in the United States; the authors hypothesized that the average tower height and flight height of grouse, and diurnal migration habitats of some birds minimized the risk of collision (Johnson et al. 2000, pp. ii-iii; Erickson et al. 2001, pp. 8, 11, 14, 15).

No gallinaceous bird (including grouse) deaths were reported in a comprehensive review of avian collisions at wind farms in the United States (Johnson et al. 2000, pp. ii–iii; Erickson et al. 2001, pp. 8, 11, 14–15); average tower heights, flight elevations of grouse, and diurnal migration habitats minimize the risk of collision. However, sage-grouse can be killed by flying into turbine rotors or towers (Erickson et al. 2001, entire). One dead sage-grouse was found near a turbine over a 3-year monitoring period at a wind facility in Wyoming (Young et al. 2003, Appendix C, p. 61). For sage-grouse, the highest collision probabilities appear to occur when structures are located in areas where sage-grouse typically fly between foraging and loafing habitats. If the locations of such areas are known, impacts can be reduced by avoiding them when siting wind energy facilities (West, 2010). Preliminary data from research in Wyoming has indicated that direct mortality from collision occurs and may be greater than previously anticipated (Deibert 2012, pers. comm.).

Behavioral avoidance, alteration of habitat quality, or changes in trophic interactions may have more important implications to sage grouse population responses to wind energy development and could be more pervasive than direct effects of collisions (Winder et al 2014, p.2). Greater prairie chicken home ranges were found to increase 2 fold and space use had a positive relationship with the distance to wind turbines indicating female avoidance (Winder, 2014; p.1). There is a strong relationship between the extent of habitat fragmentation and prairie chicken home range size (Winder et al 2014, p. 11), further anthropogenic features such as roads, powerlines, fences and wind towers are linked to elevated mortality rates and shifts in life history strategies (Winder et al 2014, p.11).

The avoidance of human-made structures such as powerlines and roads by sage-grouse and lesser and greater prairie-chickens is documented (Holloran 2005, p. 1; Pruett *et al*, 2008, p. 6). Powerlines are served as an obstruction to Lesser prairie-chicken free movement creating additional fragmentation of habitats. The home ranges of prairie-chickens were found to overlap less often with

Comment [JD64]: Also see 2012 publication for additional references: http://www.fs.fed.us/pnw/pubs/pnw_gtr863.pdf

Comment [DP65]: There is a lot of recent publications on sage-grouse and windpower development (e.g. LeBeau and others). This section needs to be updated with this information.

Comment [DP66]: bird deaths are reported quarterly to OLE. I know that other sage-grouse have been found at different facilities, such as Top of the World. I suggest checking the OLE reports to update this information.

Comment [DP67]: this is probably outdated.

Comment [DP68]: this is repetitive of above and may not be current. I suggest updating and re-organizing to avoid duplication.

Comment [JD69]: Page #?

Not listed in Lit cited.

Comment [DP70]: check out LaBeau – he discusses this specifically for sage-grouse and has citations of other work on wind and grouse

Comment [JD71]: The first sentence needs to make it clear that the Winder study was on Greater prairie chickens.

than expected with powerlines. New powerlines and possibly other tall structures such as wind turbines may be avoided in previously suitable habitats and serve as barriers to movement (Pruett et al 2008, p.013138). If habituation to disturbance does not occur, population level response could contribute to behavioral avoidance to wind development resulting in habitat loss (Winder et al 2014, p.11).

Habitat fragmentation could potentially negatively affect demographic rates due to increased risk of predation or energy use (Winder et al 2014, p.11). Nests in fragmented habitats were 9 times more likely to be depredated as those in continuous habitats, and the majority of nests in fragmented habitats were depredated by corvids. ~~Fragmentation related to anthropogenic activities and wildfire appear to provide benefits to breeding ravens, suggesting that their use of edges and tall structures may be opportunistic rather than obligate (Howe et al, 2014, p. 46).~~ Sage-grouse female and nest survival has been linked to the distance from transmission lines (Gibson et al 2013, p.27). The probability of survival improves by 6 percent for each 5km between the nest and the transmission line with a limit of 20km (Gibson et al 2013, p.27).

Sage-grouse are nesting in less risky habitats farther away from potential perches and in areas that have lower densities of small, medium, and large avian predators (Dinkins et al 2014, p. 629). The survival of sage-grouse nests and broods decreased 7.1percent and 38.1 percent respectively with every 1.0 km increased distance from wind turbines (LaBeau et al 2014, p.522). Despite sage-grouse high site fidelity older sage-grouse hens with failed nests from the previous nesting season had lower nest site fidelity compared with hens with successful nests. As in previous findings in response to disturbance, yearling birds had relatively larger changes in their spatial locations than older birds whose spatial changes were at a smaller scale. Sage-grouse habitat use patterns could be explained by areas of relatively greater predation over time leading to low sage-grouse productivity (Dinkins et al 2014, p. 638). Sage-grouse are using direct and indirect mechanisms to avoid predators in habitat selection, possibly partially lowering their exposure to predation and nest predation (Dinkin et al 2014, p. 629).

In addition, mammalian meso-carnivores~~s mammals~~ and corvids, primary sage-grouse nest predators, may be attracted to wind energy developments because of subsidized food resources from deaths of birds by turbines, combined with low levels of human activity, whereas predators that prey on adults (e.g., golden eagles (*Aquila chrysaetos*)) may not (LaBeau et al. 2014, p. 528). Ongoing land use changes suggest there will be further increases in raven abundance in these fragmented sagebrush steppe habitats (Howe et al 2014, p. 44).

Noise is produced by wind turbine mechanical operation (gear boxes, cooling fans) and airfoil interaction with the atmosphere. No published studies have focused specifically on the effects of wind power noise and sage-grouse. In studies conducted in oil and gas fields, noise may have played a factor in habitat selection and decrease in lek attendance (Holloran 2005, pp. 49, 56). Recent noise research has shown noise from natural gas development negatively impacts sage-grouse abundance, stress levels, and behaviors (Patricelli et al., 2013, p. 231). Noise from natural gas development primarily is produced by drillingrigs, compressors, generators, and traffic on access roads. All of these noise sources are loudest in frequencies (i.e. pitch) <2.0 kHz. Male sage-grouse produce

Comment [JD72]: ??

Comment [DP73]: again, this really needs to be updated with current literature. Where that literature is lacking its o.k. to defer to other species, but we need to justify why that species may serve as an adequate surrogate for sage-grouse.

Comment [JD74]: See Winder's other publication (in Journal of Applied ecology) that found predation risk decreased. As Pat notes – may not be transferable to sage-grouse. At least we need to acknowledge that this was not a sage-grouse study.

Comment [DP75]: see above comment.

Comment [DP76]: citation, and is this for sage-grouse?

Comment [DP77]: I really wasn't sure how this fit in…

Comment [DP78]: so nest xurvival can only increase by 24%? Is it still less than survival without a transmission line?

Comment [DP79]: I'm having a really hard time following this paragraph. Is it about predator avoidance, or nest location? They may be tied together but I'm not getting that out of this discussion.

Comment [DP80]: citation?

Comment [DP81]: can this be tied back to the predation chapter of the species report?

Comment [JD82]: Citations – increase in db?

Comment [DP83]: it would seem these are very different noises than those produced by wind facilities. I think the noise discussion nis important, but we should properly qualify it if appropriate.

signals in a similar frequency range between 0.2 and 2.0 kHz, the potential exists for industrial noise to mask sage-grouse communication, interfering with the ability of females to find and choose mates. Noise may also increase predation risk by masking the sounds of approaching predators and increasing stress levels by increasing the perception of predation risk. In other vertebrate species noise has been found to impact individuals directly, by causing startling behaviors, increasing the heart rate, or increasing annoyance. All of these factors ~~that~~ may interfer with normal foraging, resting, and breeding behaviors and contribute~~ing~~ to higher stress levels and reduced fitness (Patricelli et al. 2013, p.231).

Comment [JD84]: Citations? Can "annoyance" be measured directly or where they measuring annoyance behaviors?

Immediate and sustained declines in male attendance on noise leks where 29 percent of the decline was due to drilling noises and 73 percent of the decline was due to traffic noises, with similar declines in female lek attendance (Patricelli et al. 2013, p. 231). There was evidence of elevated corticosteroid levels associated with increased physiological stress suggesting that males that did not physically abandon the lek ~~weer~~ were physiologically impacted. In addition, ~~there analysis of behavior indicated that~~ males altered the timing of their vocalizations in response to noise, increased~~ing~~ display rates during close courtship on leks with drilling noise, and waited~~ing~~ for gaps of quiet on leks with vehicle noise (citation). Sage-grouse do not appear to habituate to anthropogenic noise over time. The declines in male attendance observed in this study was immediate and sustained throughout the 3-year study period.~~,~~ E~~e~~levated stress hormones were observed in both second and third years of noise playback indicating that sage-grouse do not adapt to increased noise levels over time (Patricelli et al. 2013, p. 231).

Comment [DP85]: again, we need to provide the justification for using surrogate activities to assess the potential impacts of wind.

Each turbine is visited at wind energy facilities, on average of 4 times per year for operation and maintenance purposes. Whereas approximately 1,825 vehicle trips per year occurred on average at a producing natural gas well (Sawyer et al. 2009, BLM 2012). Reduced human activity within the wind development compared to oil and gas development may disturb sage-grouse less (Remington and Braun 1991, Holloran 2005, p.6), as far as the impacts of the activity of vehicle traffic. Other types of anthropogenic noise sources (e.g., infrastructure from oil, geothermal, and mining, as well as wind development, off-road vehicles, highway traffic and urbanization) are similar in acoustic frequency, amplitude, and timing to the noise played, suggesting that even through the Patricellli study did not use those noise sources the response by sage-grouse and therefore the impacts of these noise sources may be similar (Patricelli et al. 2013, p. 231).

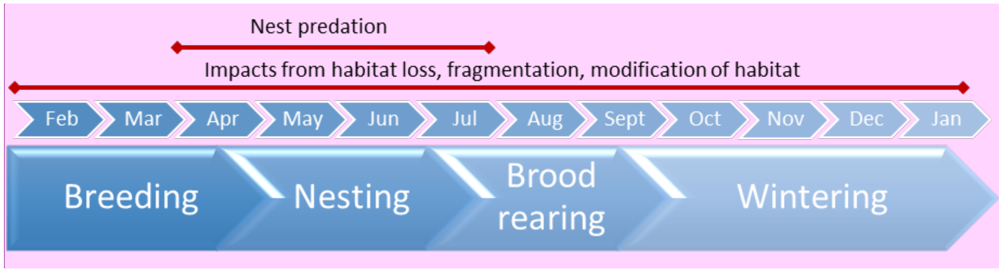
Comment [DP86]: so if there are 100 turbines there are 400 visits/year? also, citation?

Comment [DP87]: but these were drilling noise and weve not made the link that drilling and wind power make similar noises.

Timing

Figure X. Annual life cycle of sage-grouse. Impacts from renewable energy developments occur to varying degrees year round as indicted by red bar.

Comment [JD88]: The red bar doesn't indicate varying degrees.



Direct impacts due to noise and sage-grouse strikes due to wind, solar, and geothermal developments could occur year round once a development is constructed. Indirect effects such as habitat removal for pad locations, roads, and transmission lines would likely occur outside of the breeding, nesting and brood rearing time periods and before the winter concentration season begins. Habitat fragmentation due to the construction of development and its infrastructure associated with renewable energy development would likely occur outside of the breeding, nesting and brood rearing seasons, and before winter concentration season begins. However, the effects of habitat fragmentation resulting in habitat loss and modification is long term and would occur year round. Predation occurs mainly during the nesting and brood rearing seasons. Avoidance of the wind turbines, roads, and transmission lines likely occurs year round and would be influenced by seasonal habitat use and movements.

Location and extent

TABLE X-1—AREA OF SAGEBRUSH HABITAT WITH WIND ENERGY DEVELOPMENT POTENTIAL, BY MANAGEMENT ZONE. (DATA FROM SERVICE 2014)

SAGE-GROUSE MZ	Area of Sagebrush with Developable Wind Potential		
	km2	mi2	Percent of MZ
I	141937	54802	40.42
II	56275	21728	23.07

Comment [JD89]: Why specifically call out nest predation here? Wouldn't we also expect disturbance to nests from a variety of threats? Suggest deleting the nest predation bar.

Comment [DP90]: In general I don't think that we have established that noise is a direct impact outside the lekking period. I think this needs to be discussed further amongst the biologists so that all folks are treating it the same way.

Comment [DP91]: habitat removal is a direct impact.

Comment [DP92]: citation? do we know this for sure?

Comment [DP93]: see above comment

Comment [JD94]: Let's be more explicit about where this data comes from. I'm sure we calculated these figures using a data source outside of the Service. Cite the original data layer.

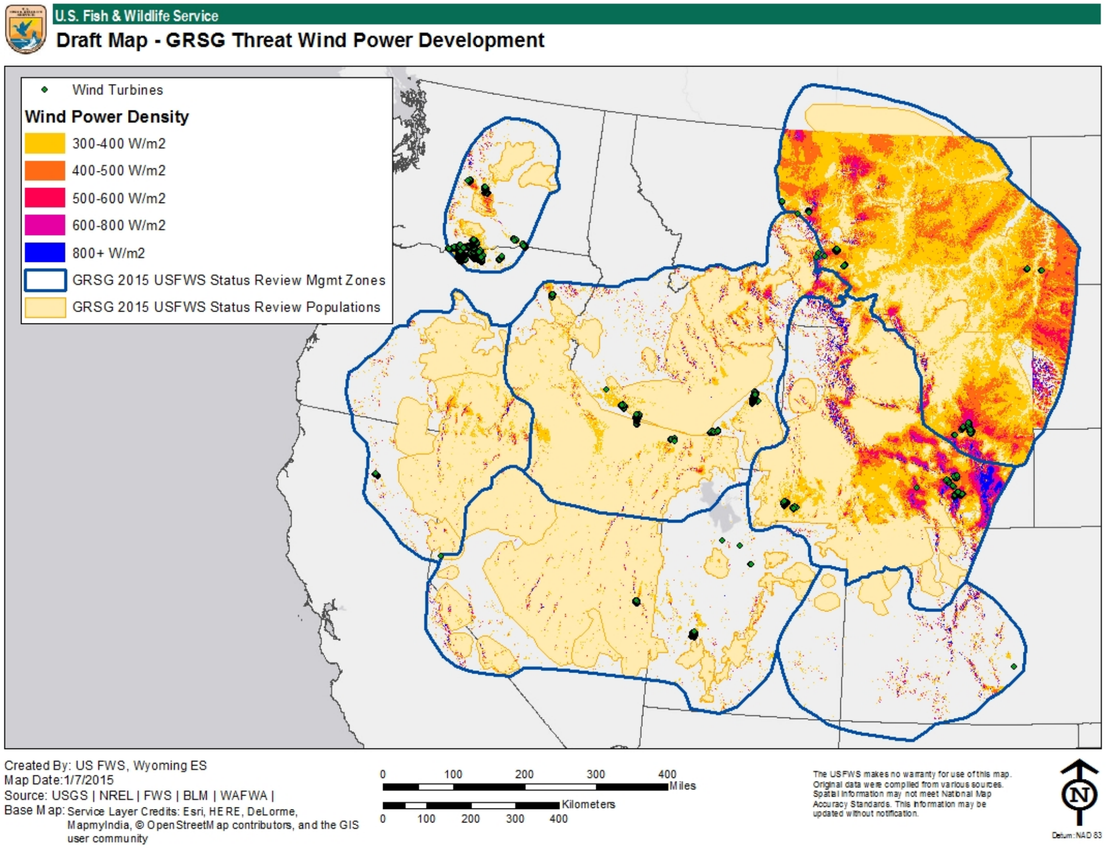
III	3880	1,498	1.22
IV	12,703	4,905	3.92
V	6,365	2,457	3.91
VI	1,528	590	2.36
VII	19	7	0.01
Total	222,708	85,988	13.74

Wind

~~We are not aware of additional wind projects specifically proposed in PACS.~~ We are currently aware of four preliminary, planning-stage wind project proposals in the State of Montana may ultimately encroach to a minor extent on general habitat polygons; however, whether or not these proposals may be further refined, or even constructed, is unknown (Berglund, 2015 pers comm). We are not aware of additional wind projects specifically proposed in PACS.

Comment [JD95]: This analysis seems incomplete. How thorough were we in seeking information on potential new wind projects? Did we obtain a database of permitted wind projects that have yet to be constructed? Did we look outside of PACs?

At a minimum we need to show that we looked across the range at the potential for future wind projects.



Comment [JD96]: What is the source of the wind turbine data?

We should also include permitted wind turbines that haven't been constructed yet (using a different color). Check with Rich Young – when we worked on our condor model we found that some of the datasets of wind turbines were incomplete.

For Oregon and Washington see: http://www.fs.fed.us/pnw/pubs/pnw_gtr863.pdf

Does this include info from FAA flight hazards database? Not mentioned in the source info.

Comment [DP97]: what are the green dots?

Solar

No commercial solar plants are operating in sage-grouse habitats at this time. Southern and eastern Nevada, the Pinedale area of Wyoming, and eastcentral Utah are the areas of the sage-grouse range with good potential for commercial solar development (EIA 2009e, entire). There are a total of 196 ha (484 ac) of active solar leases on BLM property in northern California (MZ IV) and central Wyoming (MZ II) (BLM 2009g, map) in sagebrush habitats within the current sage-grouse range and these leases will likely be developed.

Table X-2 presents the Reasonable Foreseeable Development Scenario (RFDS) for each state in terms of projected megawatts and estimated acres of land required to support that level of development. The calculated number of BLM- and non-BLM-administered acres likely to be developed over the next 20 years is based on the assumed RFDS and on a high-end estimated land requirement of 9 acres/MW (0.04 km2/MW) for development. As shown, the estimated amount of solar energy generation on BLM-administered lands in the study area over the 20-year study period is about 24,000 MW,with a corresponding dedicated use of about 214,000 acres (866 km^2) of BLM-administered lands. The estimated total amount of solar energy generation on all lands in the study area over the 20-year study period is 32,000 MW, with a corresponding dedicated use of about 285,500 acres (1,155 km^2) of land (BLM, 2012).

TABLE X-2 Projected 1 **Megawatts of Solar Power Development by 2030 and Corresponding Developed Acreage Estimates for the Reasonable Foreseeable Development Scenario (RFDS)[a]**

State	Landholding	Estimated MW under RFDS	Estimated Acres under RFDSb
California	BLM	15,421	138,789
	Non-BLM	5,140	46,260
Colorado	BLM	2,194	19,746
	Non-BLM	731	6,579
Nevada	BLM	1,701	15,309
	Non-BLM	567	5,103
Utah	BLM	1,219	10,971
	Non-BLM	406	3,654
Total	BLM	20535	184815
	Non-BLM	6844	61596

[a] See Appendix E of the Draft Solar PEIS for details on the methodologies used to calculate the RFDS.

Comment [JD98]: See NREL's publication utility scale solar power projects:

http://www.nrel.gov/docs/fy12osti/51137.pdf

Also see:
http://www.nrel.gov/docs/fy13osti/56290.pdf

Comment [DP99]: citation?

Comment [DP100]: what is the relevance of this number? Is this a requirement by the Energy Act, or does it meet a state objective somewhere?

Formatted: Superscript

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Comment [DP101]: This doesn't include the WY lease mentioned above. What is the differenct in this table and the estimates of development in the paragraph above?

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Comment [JD102]: Add citation.

Formatted: Superscript

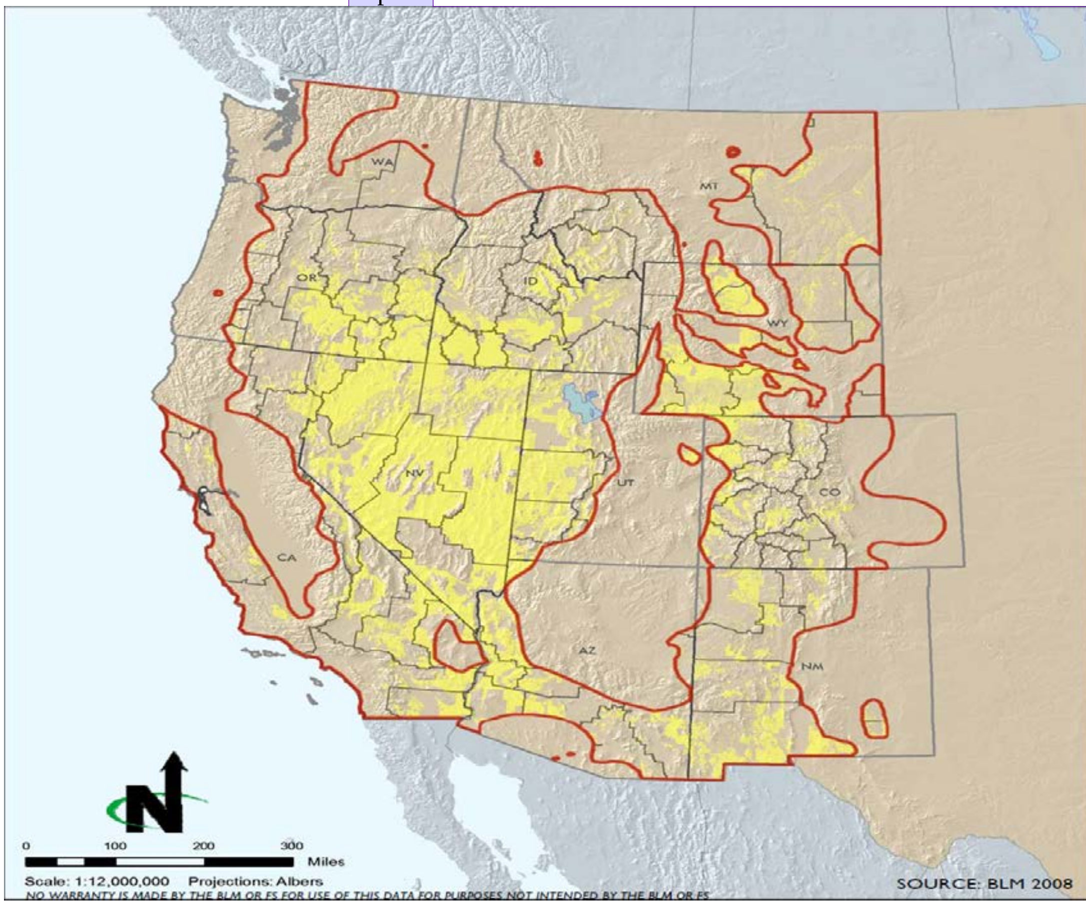
b Acreage calculated assuming land use of 9 acres/MW (0.04 km2/MW). To convert acres to km2, multiply by 0.004047.

Geothermal

Geothermal facilities are within the sage-grouse range in California (3 plants, MZ III), Nevada (5 plants, MZs III and V), Utah (2 plants, MZ III), and Idaho (1 plant, MZ IV). Since 2005, two additional plants were constructed is in current sage-grouse range – one in Idaho and one in Utah (Geothermal Energy Association 2008, pp. 2-7). One existing geothermal plant in southern Utah is in the vicinity of sage-grouse habitat in an area where wind power is being considered for development (First Wind-Milford 2009, entire),

Comment [DP103]: currently? If so, what are the acreages and how is that correlated with bird abundance and distribution (if we have that data)?

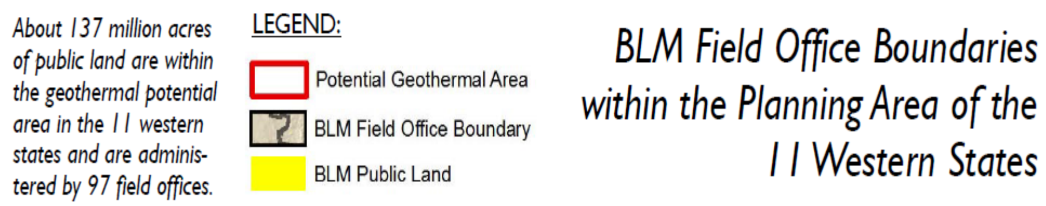
which will result in cumulative impacts.



Comment [DP104]: The following map would be more effective if clipped to sage-grouse extant range and the numbe or acres of potential range affected reported vs. the 137 million of the west….

Comment [JD105]: Agree with Pat – does the BER report have a map of geothermal potential? Also would be good if you could overlay the actual geothermal developments.

Example map - see: http://www.ucsusa.org/clean_energy/our-energy-choices/renewable-energy/how-geothermal-energy-works.html



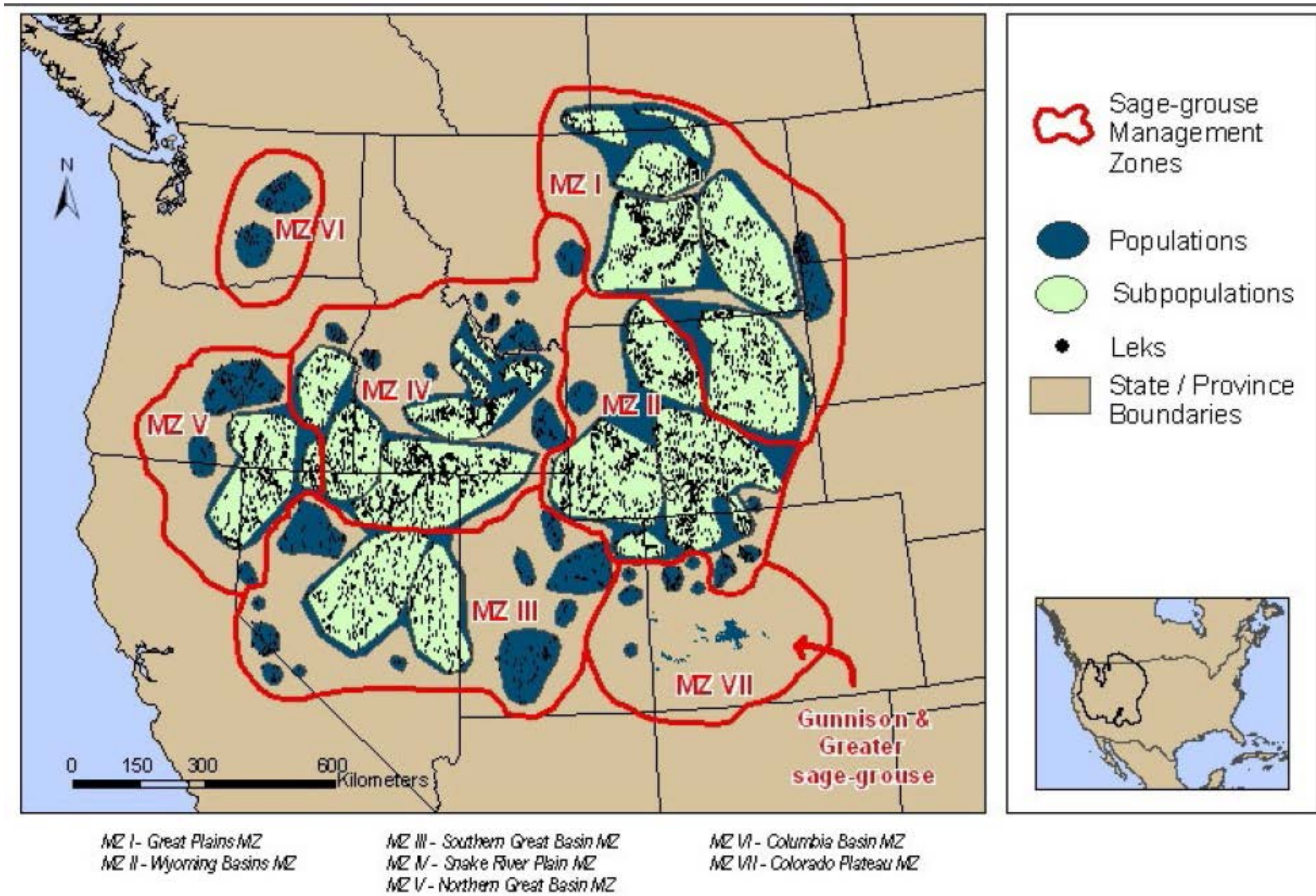
x

Comment [SSLM106]: Placeholder map for tech team to see where geothermal may occur until Jim finds the data to provide me a map.

Table X-3: List of impacts by management zone.

Management Zone	Timing of Impacts (Season)	Immediacy of Impacts	Severity of Impacts	Extent of Impacts	Resource or Life stage impacted	Notes
1						
2						
3						
4						
5						
6						
7						
8						

Map Showing Current Threats (this is "Map 2" that the GIS team is working on; we will not have this map for all chapters)


Sage-grouse Management Zones
Populations
Subpopulations
Leks
State / Province Boundaries
N
MZ I
MZ II
MZ III
MZ IV
MZ V
MZ VI
MZ VII
Gunnison & Greater sage-grouse
0 150 300 600 Kilometers
MZ I - Great Plains MZ
MZ II - Wyoming Basins MZ
MZ III - Southern Great Basin MZ
MZ IV - Snake River Plain MZ
MZ V - Northern Great Basin MZ
MZ VI - Columbia Basin MZ
MZ VII - Colorado Plateau MZ

Compounded effects

The compounding effects will be discussed in greater detail in the Compounded Effects chapter. In brief, the following impacts are likely to interact with the threat described in this chapter.

Comment [DP107]: how?

- Infrastructure
- Predation
- Noise
- Invasives
- Genetics
- Fire

PROJECTED FUTURE IMPACTS

a.Timescale for Projecting this Threat

Comment [JD108]: Either need to combine this with information above, or remove all the future impacts from above. E.g., see the table on reasonably foreseeable development scenarios – relating to future impacts.

Wind

The maximum potential development scenario (MPDS) was constructed by the National Renewable Energy Laboratory (NREL), a DOE laboratory focused on research of renewable energy resources. NREL has modeled and mapped the wind resources in each of the states and has assigned class designations to indicate the potential for wind power generation. Wind power classes range from 1 to 7; Class 7 has the highest potential wind power generation and Class 1 has the lowest. On the basis of projected wind technology development, NREL has determined that wind resources in Class 3 and higher could be economically developable over the next 20 years (i.e., the time frame for the PEIS analysis). In this PEIS, Class 3 resources have been characterized as having medium potential; resources in Classes 4 and higher have been characterized as having high potential (DOI, 2005).

Comment [DP109]: It would be helpful to tie this information on classes of wind potential to MZs

Solar

The scope of the impact analysis includes an assessment of the potential environmental, social, and economic impacts of utility-scale solar facilities and required transmission connections from these facilities to the existing electricity transmission grid andother associated infrastructure such as roads over an approximately 20-year time frame (i.e., until about 2030) (BLM, 2012).

Comment [DP110]: who's impact analysis?

Comment [JD111]: Also see NREL's publications I listed above.

Comment [DP112]: Is BLM the only source of potential solar development within the range of sage-grouse?

Geothermal

The utilization phase could last from 10 to 50 years and involves the operation and maintenance of the geothermal field(s) and generation of electricity (EIA 2009e, entire).

Comment [DP113]: starting and ending when? Also, do we have a more recent source of information?

Biomass?

Formatted: Heading 2

b.Likelihood of future impacts

The Department of Energy (DOE) predicts that wind may provide 20 percent of the nation's energy needs by the year 2030, in order for this to occur, substantial growth of wind development will be required. ~~In the United States, wind energy facilities have been constructed in at least 38 states, most in the past 5 years.~~ Wind energy technology has been improving in two different ways, first to become more energy efficient turbines have gotten taller and blades longer to be able to capture wind in low potential areas, the average wind turbine hub height has increased from 70 m to more than 80 m since 2004, and wind turbine rotor diameters increased from 70 m to 97 m. Larger rotors, taller towers, and better siting techniques have enabled wind developers to increase power production while simultaneously reducing costs (NREL, 2014, entire). In response to bird collisions wind companies are trying different techniques for bird deterrance and even detection such as: radar, gps tracking, ultrasonic acoustics, designing new turbine shapes, and strike detection (Drouin, 2014, entire). ~~Concerns over fossil fuel dependence and climate change have accelerated the development and deployment of renewable energy technologies in the United States.~~ Energy developers will be able to put wind turbines in locations that were previously considered uneconomical further fragmenting habitats. In addition, focusing new mitigation techniques on bird strikes does not address the more pertinent issues for sage-grouse such as, habitat fragmentation and habitat avoidance due to these changes in the landscape. Energy companies are developing new technology striving to minimize the impacts to sage-grouse, however as long as there are anthropogenic features on the landscape, habitat fragmentation and avoidance will still occur. Therefore, there is a high likelihood of continued future impacts in sage-grouse habitats due to renewable energy on the landscape.

Best management practices (BMPs) are prescribed in the Wind Energy EIS to minimize impacts of all phases of construction and operation of a wind production facility. The BMPs guide future project planning and do not guarantee protections specific to sage-grouse. We do not have information on how or where the EIS guidance has been applied since 2005 and cannot evaluate its effectiveness. The footprint of wind energy developments is reported to be small (BLM 2005a, p. 5-2). Areas of commercially viable wind generation have been identified by the NREL (2008b, entire) and BLM (2005, p. 2.4) in all 11 States in the sage-grouse range. MZs III through VII each have approximately 1 to 14 percent of sagebrush habitats that are commercially developable for wind energy (Service 2014, Lindstrom pers.comm). Wind harvesting potentials are more concentrated and geographically extensive in sage-grouse MZs I and II that include parts of Montana, Wyoming, North Dakota, and South Dakota; areas of highest commercial potential include 40 percent of the available sagebrush habitats in these four States. Over 14 percent of the sagebrush lands in the sage-grouse range have high potential for wind power (Table X).

In MZ I, II, III, IV, V, VII the BLM/FS lands are precluding wind and solar development in PPH (see table X-3). Primarily ROW for wind and solar energy facilities will be designated as avoidance areas. These designations will cause indeterminable impacts due to wind and solar development with the assumption that there will be no exceptions to the exclusion of wind and solar energy developments. The intent of an avoidance designation is to primarily exclude projects, however exceptions may be made under an avoidance designation allowing for more flexibility for the Authorizing Officer. With these management actions in place there is still a widespread threat present because it is unknown to what extent and where transmission projects may occur, and under which circumstances they may occur.

Although regulatory mechanisms are being developed for Wyoming's core areas (see threat ameloration section below), they are still largely subject to the impacts of both conventional and

Comment [DP114]: I deleted because I didn't see the tie to sage-grouse. Does this mean the potential impact to grouse could be reduced because of the wide distribution of the required renewable energy development (38 vs. 11 states)?

Comment [DP115]: relevance to assessing impacts on sage-grouse?

Comment [DP116]: but above we stated that we knew little of collisions, and that it might be a minor source of mortality to grouse. Will these modifications reduce that threat even more?

Comment [JD117]: Should cite primary literature rather than a news article.

Comment [DP118]: citation? sage-grouse habitats?

Comment [DP119]: now I see the tie-in to above. I think the two sections should be combined and condensed.

Comment [DP120]: how will habitat fragmentation and avoidance be achieved with new technology?

Comment [DP121]: citation?

Comment [DP122]: do we have more recent information

Comment [DP123]: this is very repetitive with previous information – is there a way to consolidate or simply reference back to prevous sections?

Comment [DP124]: ?

Comment [DP125]: so if there are no exceptions will there be no impacts? I don't understand this section.

renewable energy development. Twenty-one percent of Wyoming core areas have high wind development potential, and 51 percent are subject to either wind or authorized development of oil and gas leases (Doherty *et al*., in press, p. 31).

Comment [DP126]: the regulatory mechanisums are in place and no wind is permitted in core. I'm not following this discussion.

The BLM has developing a programmatic EIS for leasing and development of solar energy on BLM lands. The EIS planning period has been extended to analyze the effects of concentrating large-scale development in selected geographic areas including sage-grouse habitats in east-central Nevada and southern Utah (BLM 2009h, entire) because of the considerable administrative and public interest in developing public lands for solar generated electricity (BLM 2009i, entire). At this time, we do not have enough information available to evaluate the scale of future impacts of solar power generation in sage-grouse habitats. We will continue to evaluate and monitor the impacts of solar power development in sage-grouse habitats as more information becomes available. We are not aware of any investigations reporting the impacts of solar generating facilities on sage-grouse or other gallinaceous birds.

Comment [DP127]: has developed or is developing?

Comment [DP128]: the citation is nearly 6 years old – has the planning period been completed?

Solar array development requires similar infrastructure as other renewable and nonrenewable energy sources. Direct habitat loss can be significant because much of a solar project site would have vegetation removed. The BLM recently completed a programmatic EIS on solar development in six southwestern States including Nevada and California, and through this process identified exclusion areas or areas where solar development would not be allowed (BLM 2012b, p. ES-7). The EIS only affects utility-scale developments (greater than 20 megawatts) occurring on BLM-managed lands, but recognized occupied sage-grouse habitat as a criterion for exclusion (BLM 2012b, p. ES-8).

Comment [DP129]: above you stated that BLM was developing the programmatic EIS. is this different?

Comment [DP130]: is there the potential for solar development off BLM lands? If so do we have any information for other land owernships?

The Geothermal leasing in the Western United States ROD (2008), did not provide any specific lease stipulations for the protection and conservation of sage-grouse. However, geothermal leases would be subject to the stipulations that are being developed by the BLM/USFS as part of the rangewide sage-grouse land use amendments. These plans did not specifically address geothermal activities or assign specific management actions for geothermal activities, however, there are management actions that apply to all activities such as the percent of habitat disturbance caps within PPH, the cap for the amount of anthropogenic disturbances within PPH, as well as, the no surface occupancy stipulations and the timing limitations stipulations would apply to these activities. Therefore, there is a moderate chance of the likelihood of future impacts due to geothermal development within MZ II, III, IV, V, and VII due to the fact that there will still be some measure of habitat removal from development, habitat, fragmentation, and noise impacts despite the management actions in place. There will be a slight chance of future impacts in MZ I only because there are far fewer geothermal resources identified for leasing in this MZ, otherwise the impacts would be the same. Geothermal development poses a widespread threat due to the extent of the development potential.

Comment [DP131]: but geothermal activities are considered under fluid minerals, so wouldn't they be subject to the same restrictions as developed for fluid minerals in the plans?

Comment [DP132]: quantify?

Comment [DP133]: will be or is? also can you quantify the slight chance?

Comment [JD134]: Not sure this is true. Need a map or some other source of information to cite.

See NREL's publication: http://www.ucsusa.org/clean_energy/our-energy-choices/renewable-energy/how-geothermal-energy-works.html

c. Anticipated changes from present ~~**(direct, indirect; same amount of range? Populations?)**~~

Sage-grouse populations in existing wind developments are likely to see continued declines due to habitat fragmentation and infrastructure causing behavioral avoidance due to predation pressures from indirect mortality of adults, eggs, and chicks as sage-grouse move out of the edge habitats to denser cover away from predation pressures. Female sage-grouse are moving farther away from edge habitats and anthropogenic features as their nests and young are predated, yearling females are moving their nests at even greater distances. These behaviors will result in no further recruitment of sage-grouse in these habitats, changing life history strategies in previously functioning habitats.

Comment [DP135]: Sentence is a run on and I'm not sure what it is saying…

Comment [DP136]: how can mortality be indirect?

Comment [DP137]: citation?

Comment [DP138]: yearling females are not moving nests further than their previous nest because they didn't have a previous nest. Also, locating would be a better descriptor than moving.

The BLM and USFS are proposing to ~~not allow~~exclude wind development in preliminary priority habitats (PPH) until there are no longer impacts to sage-grouse populations. Some plans are extending this protection to right-of-way (ROW) exclusion, which will cause indeterminable impacts due to wind and solar development with the assumption that there will be no exceptions to these designations. The Solar EIS recognized occupied sage-grouse habitat as a criterion for exclusion of solar energy development. The Geothermal leasing in the Western United States ROD (2008), did not provide any specific lease stipulations for the protection and conservation of sage-grouse. However, geothermal leases would be subject to the stipulations that are being developed by the BLM/USFS as part of the rangewide sage-grouse land use amendments. However, many plans (as seen in the threat amelioration summary) are providing ROW avoidance protection. These designations provide protections for sage-grouse from wind turbines, however cross county transmission lines and roadways could still be constructed under an avoidance designation also creating habitat fragmentation, behavioral avoidance, and change life history strategies for sage-grouse. In addition, the pressures for developing renewable energy may render exceptions to the elimination of wind energy projects within PPH in the future.

Comment [JD139]: This paragraph will need to be rewritten to include the latest info on allocations from the BLM/FS when they are received.

Comment [DP140]: these are now called priority habitats

Comment [JD141]: ??

Comment [DP142]: ?. If these are exclusion areas with no exceptions how will there be inpacts?

Comment [DP143]: above you stated that there were none, or they were unknown.

Comment [DP144]: define

Comment [DP145]: citation?

THREAT AMELIORATION

Comment [JD146]: Organization of this chapter needs some work – note that above you discuss threat amelioration from the BLM/FS plans. Either move that information into this section, or combine the two sections.

Active Conservation

Through the Conservation Efforts Database (CED), the Service collected information relating to conservation actions that were completed, in progress, or planned. Based on a summary report of that information created on XXXXXX, the following table indicate the number of actions and approximate areas for threat amelioration. These numbers are self-reported; the Service will further review and certify these actions if they are pivotal to any determination.

The Service addresses regulatory actions in a separate chapter????

Comment [KNorman147]: Do we want to make this easier on folks? Does that undermine the "take away"?

Table 4: List of Conservation Efforts (ameliorating threat described in this chapter) by management zone

Management Zone	Type of Conservation Effort	Sum of Acres or Miles	Number of Actions	Notes
1				
2				
3				
4				
5				
6				
7				

8

Threat Amelioration Summary

Table X-5 Summary of BLM/USFS Draft RMP/EIS Wind/Solar Energy Actions

Comment [JD148]: This will need to be updated when we get the final allocation decision maps. Would be more effective as a map.

NV and NE CA Draft RMP/EIS		
	Exclusion	Avoidance
Designate PPMAs and PGMAs as ROW exclusion for utility-scale wind facilities in PPMAs and PGMAs	X	
ROW Designation for solar energy facilities in PPMAs and PGMAs	X	
PPMAs would be managed as ROW/SUP avoidance areas.		X
NW CO Draft RMP/EIS		
ROW Designation in PPH for large transmission lines on 68,000 acres		X
ROW Designation in PPH for large transmission lines on 881,000 acres	X	
ID and SW MT Draft RMP/EIS		
PPMA: Solar and wind energy development is not allowed.	X	
PMMA: Wind and solar energy development would be restricted where adverse effects could not be mitigated. Ancillary facilities such as roads, electric lines, etc. could potentially be authorized provided there is no net loss of GRSG habitat		X

Comment [DP149]: these terms need definitions

Comment [DP150]: terminology needs to be defined and updated to match the FEISs

through mitigation.		
PGMA: Lands shall be considered avoidance areas for wind and solar development.		X
Designate PPMA as ROW Avoidance areas and exclusion areas for wind and solar development . New authorizations for the following uses are not allowed: Transmission facilities (greater than 50kV in size), wind energy testing and development, commercial solar development, commercial geothermal development, nuclear development, oil and gas development, mineral development, airports, and ancillary facilities associated with any of the aforementioned development; paved roads and graded gravel roads, landfills, airports, and hydroelectric projects. Communication sites would be allowed.	X	X
PMMA: Designate PMMA as ROW Avoidance areas. Access roads or loop roads would be addressed during the ROW authorization processing and on a case-by-case basis.		X
PGMA: Same as PMMA.		X
ROW Designation in Idaho-CHZ		X
ROW Designation in Idaho-IHZ		X
MT-HiLine Draft RMP/EIS		

ROW Designation for Commercial Wind Energy Development of 885, 661 acres		X
ROW Designation for Commercial Wind Energy Development of 1,518,695 acres	X	
MT-Miles City Draft RMP/EIS		
Renewable energy ROW (wind and solar) of 1.2 million acres		X
Renewable energy ROW (wind and solar) of 12,000 acres	X	
MT-Billings Resource Management Plan and EIS		
Renewable Energy on 78,088 acres	X	
Renewable Energy on 331,088 acres		X
ND Greater sage-grosue Draft RMPA/EIS		
ROW Designation in PH on 32,000 acres	X	
ROW Designation in PH on 80 acres		X
Oregon Sub-Region Greater sage-grouse Draft RMP/EIS		
Exclusion Area: PPH/PPMA/Core Area habitat (257,154 acres).	X	
Exclusion Area: PGH/PGMA/Low Density habitat (288,195 acres)	X	
Avoidance Area: PPH/PPMA/Core Area habitat (4,289,889 acres)		X
Avoidance Area: PGH/PGMA/Low Density habitat (1,672,025 acres)		X
South Dakota Draft RMP/EIS		
Renewable energy ROWs within Sage-grouse PPAs andareas outside of PPAs within 4.0 miles of leks, sage-grouse wintering areas 55,761 acres	X	

Renewable energy ROWs within Sage-grouse nesting and brood rearing areas outside of PPAs 84,384 acres		X
Utah Greater Sage-grouse Draft LUPA/EIS		
PPMAs Designation for Wind Energy Development 2,760,300 acres	X	
PPMAs Designation for Wind Energy Development 9,400 acres		X
Wind Energy Development outside of GRSG habitat 82,400 acres	X	
Wind Energy Development outside of GRSG habitat 462,500 acres		X
Areas outside PPMAs but within 1.0 mile of an occupied lek, if the lek is located within a PPMA	X	
Areas outside PPMAs but within 4 miles of an occupied lek located within a PPMA		X
wind energy development within 1.0 mile of an occupied lek located in PGMA	X	
Wyoming Sage-grouse Land Use Plan Amendment		
New ROW or SUA permits within Sage-grouse core habitat areas		X
sage-grouse general habitat areas		X
Wind energy development within sage-grouse core habitats	X	

Utah Greater Sage-grouse Draft LUPA/EIS

Geothermal
NSO within 4 miles of occupied leks. CSU/TL in outside of 4-mile lek buffers.

ASSESSMENT OF POTENTIAL THREAT

Sage-grouse could be killed by flying into turbine rotors or towers (Erickson et al. 2001, entire) although reported collision mortalities have been few. Behavioral avoidance, alteration of habitat quality, or changes in trophic interactions may have more important implications to greater sage- grouse population responses to wind energy development and could be more pervasive than direct effects of collisions (Winder et al 2014, p.2). In addition, sage-grouse are also being negatively impacted by the associated habitat loss and fragementation that results from development. The transmission line and road infrastructure associated with wind energy development has revealed behavioral impacts to sage-grouse. ~~Studies on the impacts of transmission lines found sage-grouse avoidance.~~ Further anthropogenic features such as roads, powerlines, fences and wind towers are linked to elevated mortality rates and shifts in life history strategies (Winder et al 2014, p.11).

Recent studies on the impacts of predators in sage-grouse habitats, show the common raven in particular selects anthropogenic features and edge habitats for nesting and foraging. Female sage-grouse that have had nests predated are moving their nest locations, older females at smaller increments than yearlings, suggesting that predation pressures are overriding female sage-grouse habitat site fidelity. Human manipulation of habitat that promotes increased densities of avian predators may limit sage-grouse populations, because even habitat that has high quality cover and forage may become functionally unavailable to sage-grouse as avian predator densities increase (Dinkins et al, 2014). The noise disturbance due to development also impacts sage-grouse abundance, stress levels, and behaviors cause sage-grouse to avoid areas impacted by noise. Habitat fragmentation and behavioral avoidance are occurring as a result renewable energy development and the associated infrastructure. At this time with the current technology, exclusion of these activities in sage-grouse breeding, nesting, foraging, and winter habitats is the only way to ensure this threat does not persist.

Comment [DP151]: citation?

Comment [DP152]: this will be covered in the transmission section – I suggest referencing to that section.

Comment [DP153]: how does this tie to the renewable energy threat? I get the implication but suggest tying it together a bit more.

Comment [DP154]: citation?

Comment [DP155]: is this realistic? If not what will the threat look like in the future?

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Comment [JD156]: We cite DOE 2008, but don't see that here.

Comment [JD157]: Include date accessed and make sure you have the website printed to .pdf on that date for the admin record.

This goes for all websites cited.

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