# ADAPTATION AND MITIGATION CONCEPTS FOR EASTERN FORESTS

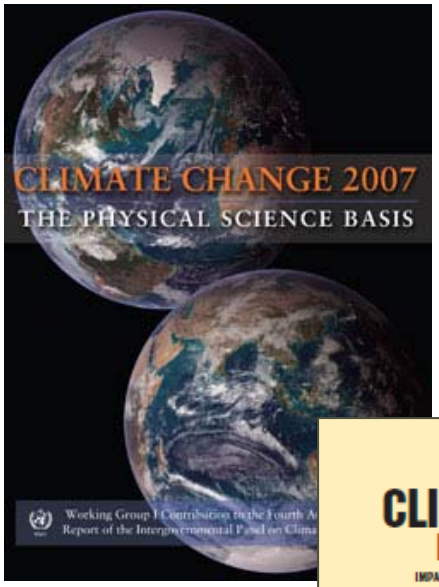
Maria Janowiak

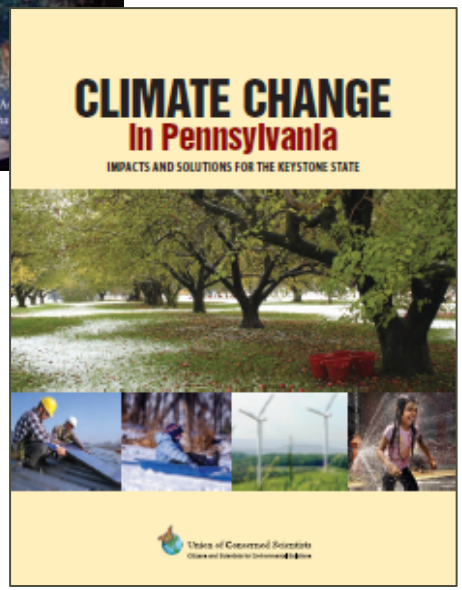
Adapting to Climate Change in the Mid-Atlantic

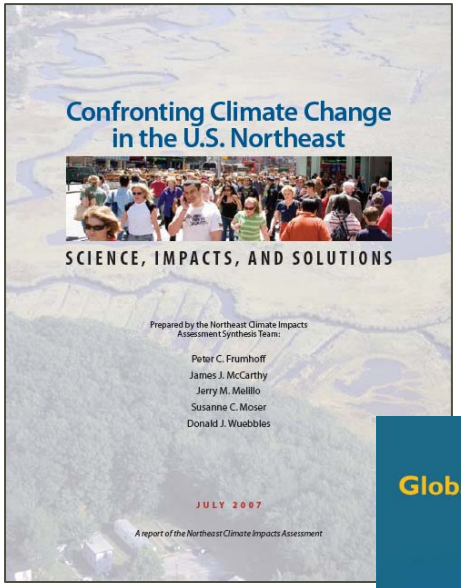
24 March 2010 ▪ Cambridge, MD

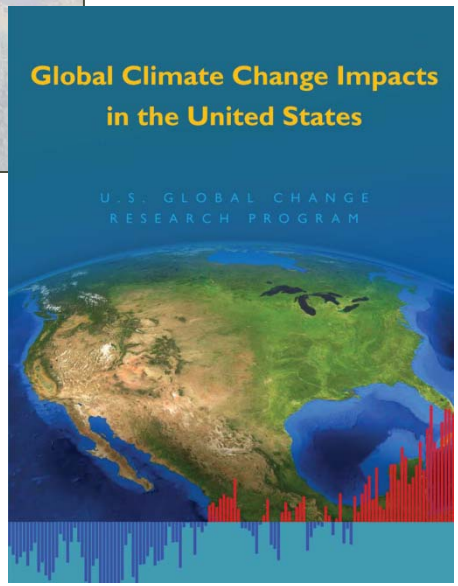
Northern Institute of Applied Carbon Science

# CLIMATE CHANGE IMPACTS



# FOREST ADAPTATION & MITIGATION

***ADAPTATION*.**

- Actions to moderate the vulnerability of forests to climate change
- Positions forests to become more healthy, resistant, & resilient

***MITIGATION*.**

- Use of forests to sequester carbon, provide renewable energy from biomass, & avoid carbon losses from fire, mortality, conversion, etc.

**THESE ARE NOT MUTUALLY EXCLUSIVE.**

*Spittlehouse and Stewart 2003, Malmsheimer et al. 2008*

# FOREST ADAPTATION

Desired Future Condition

TIM

F

# FOREST ADAPTATION

Desired Future Condition

Climate
Change
Trajectory

?

TIM
E

# FOREST ADAPTATION

Desired Future Condition

*Increasing resources needed to maintain DFC*

Climate Change Trajectory

?

TIM

F

# FOREST ADAPTATION

Desired Future Condition

Adaptation

Climate Change Trajectory

?

TIME

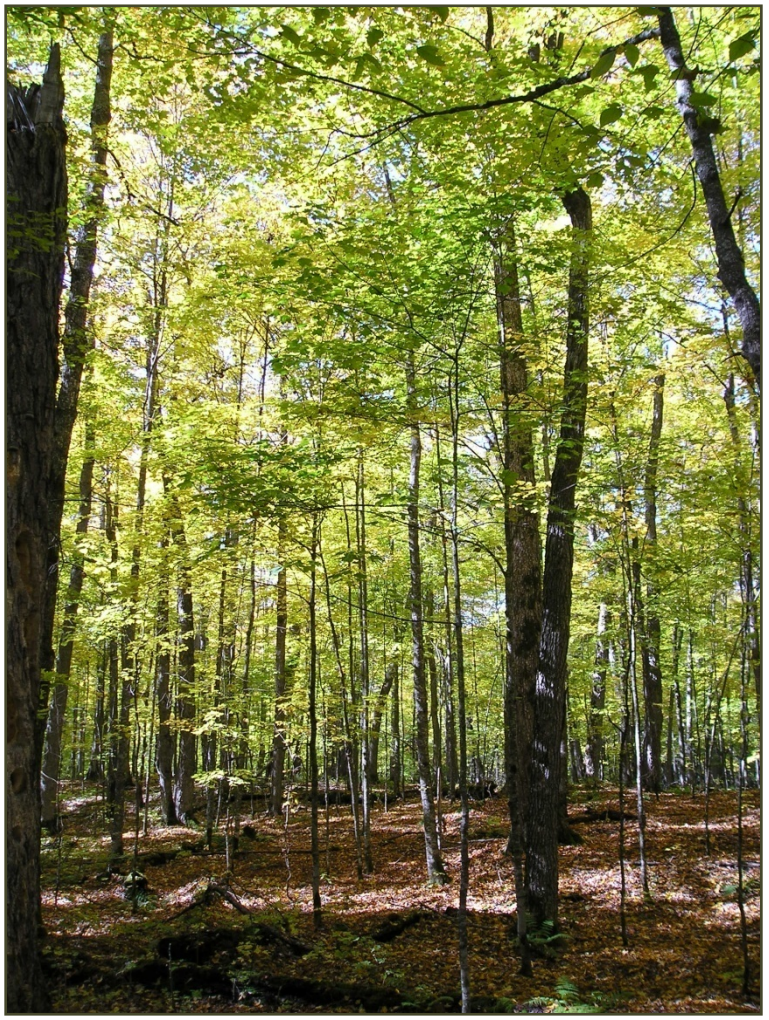
# ADAPTATION #1: RESISTANCE

# ADAPTATION #1: RESISTANCE

Improve the defenses of the forest against effects of change.

- Short-term
- High-value

*Photo: USFS*



*Millar et al. 2007*

# ADAPTATION #2: RESILIENCE

Accommodate gradual change, usually returning to a prior condition after disturbance

Examples:

- Thinning stands to improve overall health & vigor
- Management of vegetation following disturbance

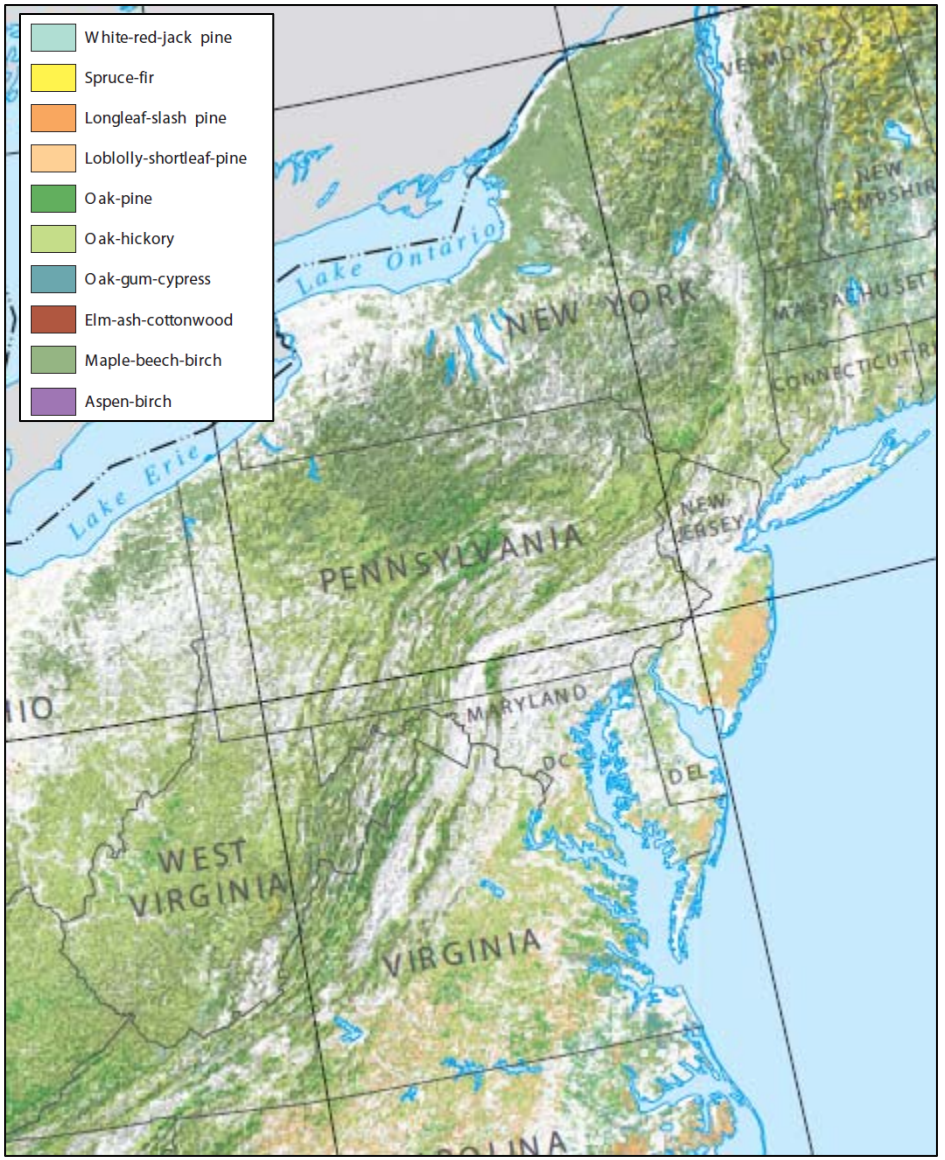
*Photo: USFS*

*Millar et al. 2007*

# ADAPTATION #3: RESPONSE

Intentionally accommodate change, enabling ecosystems to adaptively respond

*Photo: USFS*

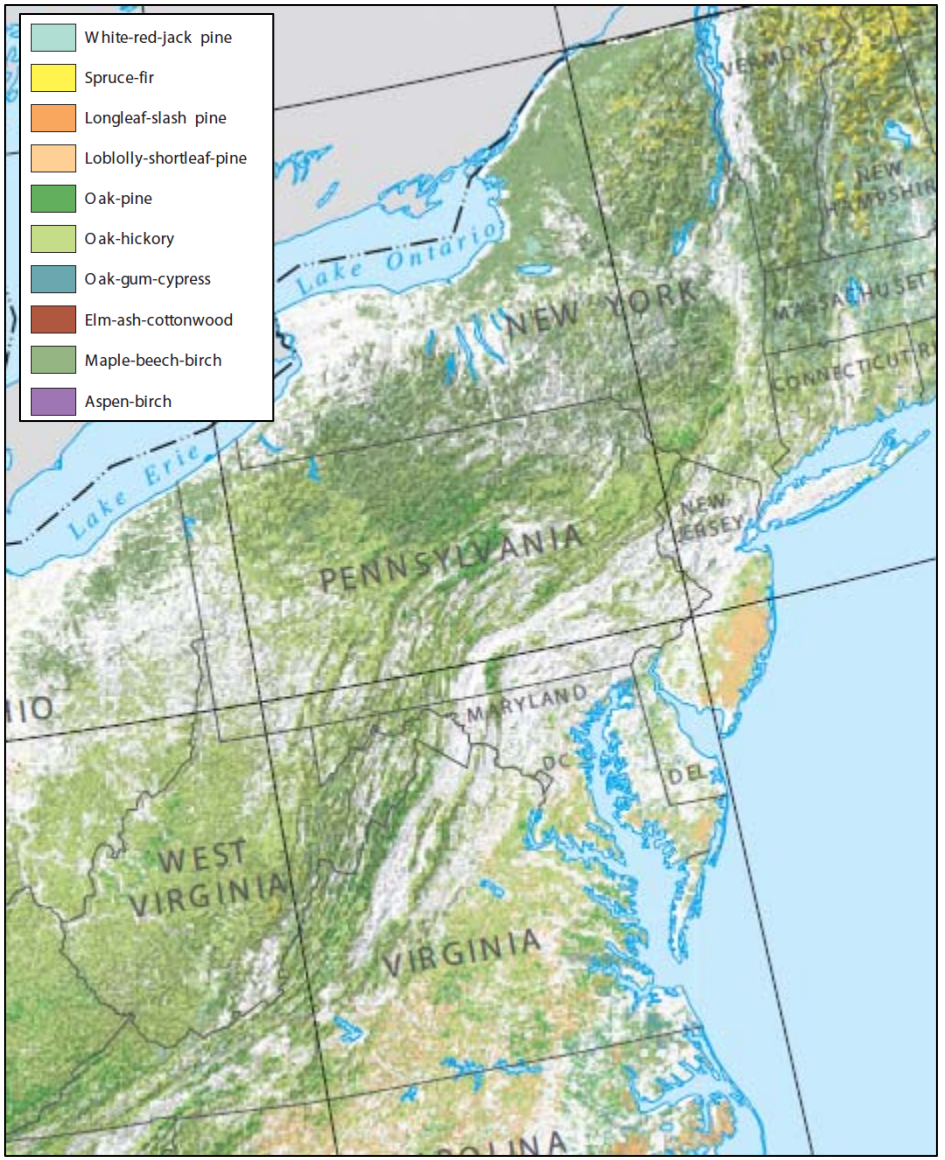



*Millar et al. 2007*

# ADAPTATION #3: RESPONSE

- Increase connectivity for migration corridors
- Assist transitions and range shifts
- Manage refugia
- Realign  severely disrupted systems

*Photo: USFS*

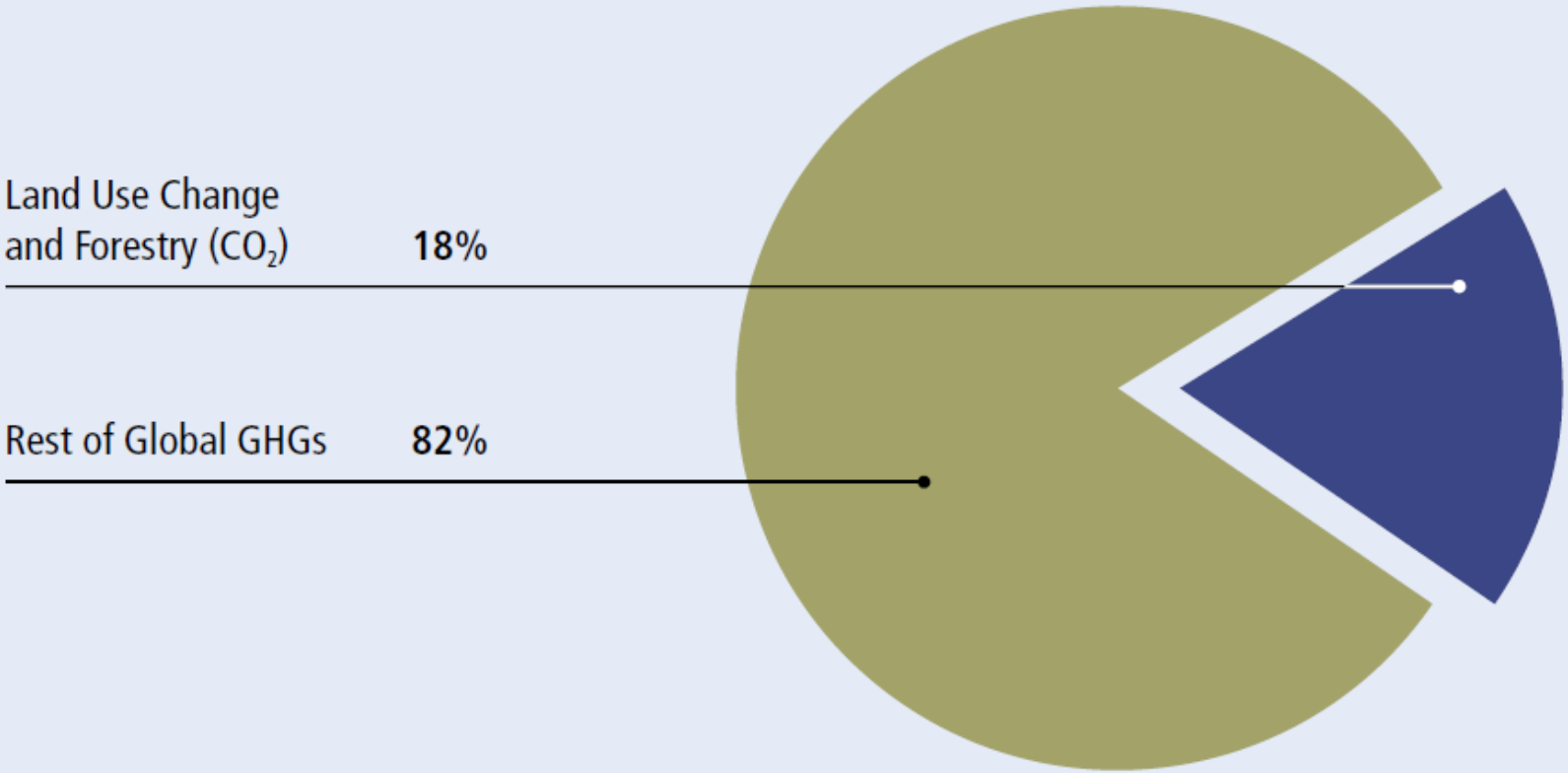



*Millar et al. 2007*

# MITIGATION

# MITIGATION

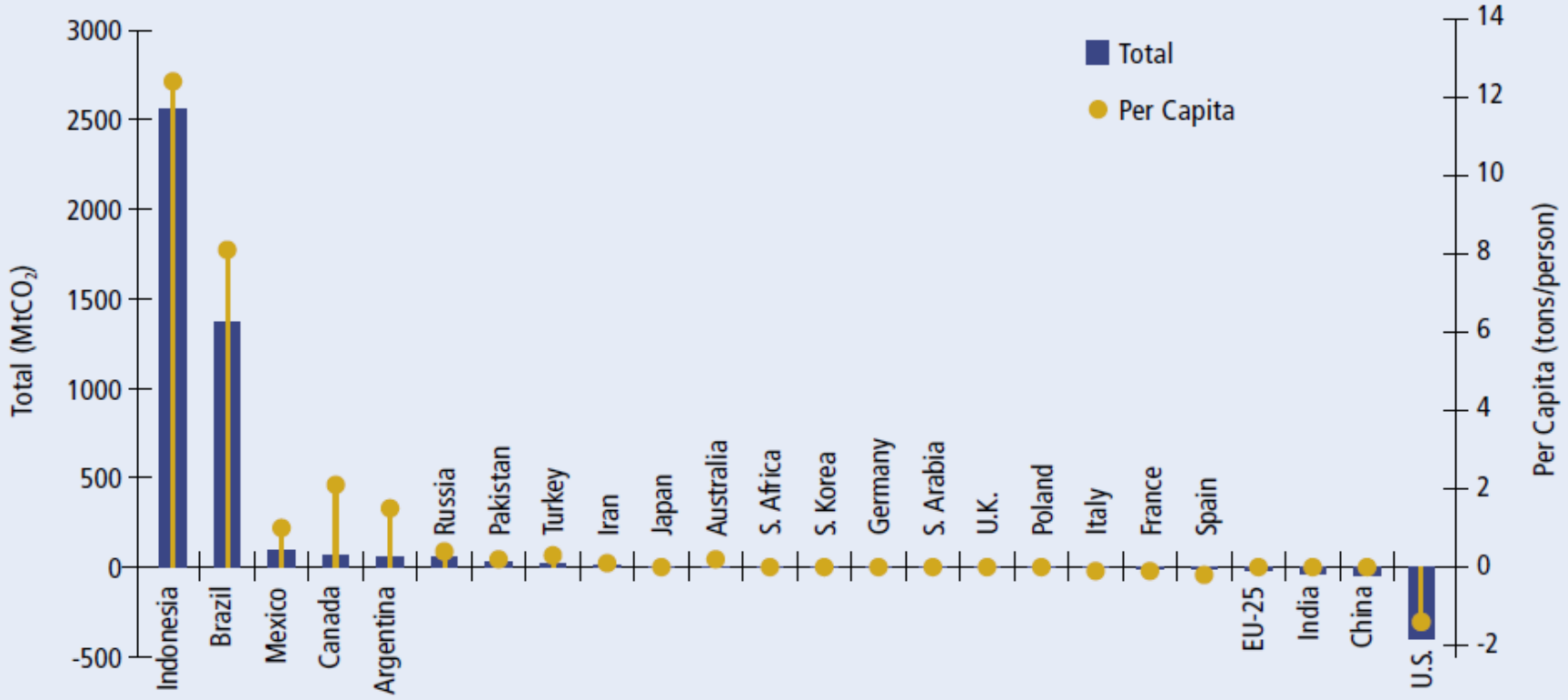
**Figure 17.1. $CO_2$ from LUCF**




*WRI 2005*

# MITIGATION

**Figure 17.3.** $CO_2$ **from Land-Use Change, Total and Per Capita, 2000**
*Top 25 GHG emitters*




Source: WRI, CAIT (based on Houghton, 2003a).

*WRI 2005*

# MITIGATION

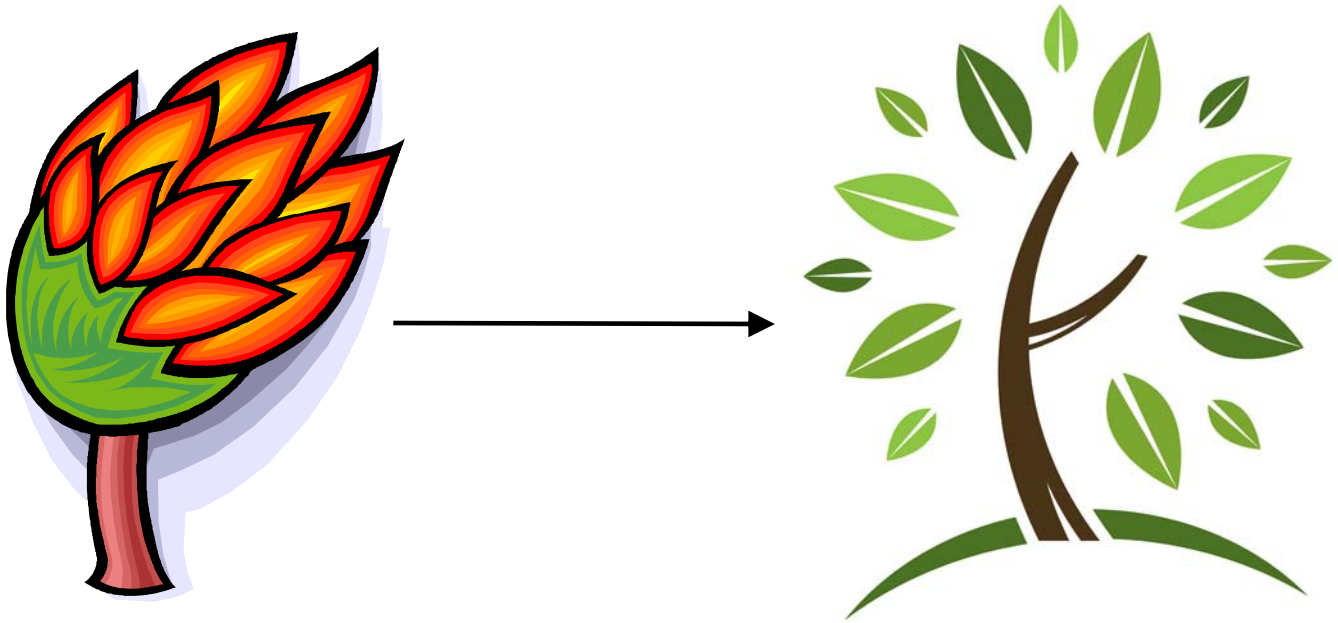





EPA 2007

# MITIGATION #1: EMISSION AVOIDANCE

Prevent emissions from occurring compared to a ‘business



*Brown 1999, Maness 2009*

# MITIGATION #1: EMISSION AVOIDANCE

## Avoided deforestation

| Type of Ecosystem (North America) | Mean Carbon Stock (Mt C/ha) |
|---|---|
| Settled Lands | 10 |
| Agriculture | 80 |
| Grassland | 107 |
| Forest | 222 |
| Peatlands | 1470 |

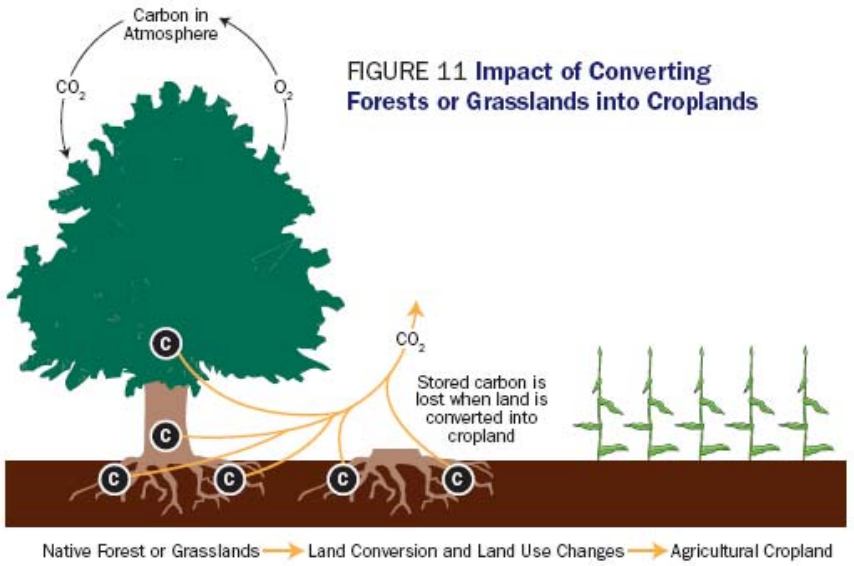



FIGURE 11 **Impact of Converting Forests or Grasslands into Croplands**

*CCSP SAP 2.2 2008, Figure: UCS 2007*

# MITIGATION #1: EMISSION AVOIDANCE

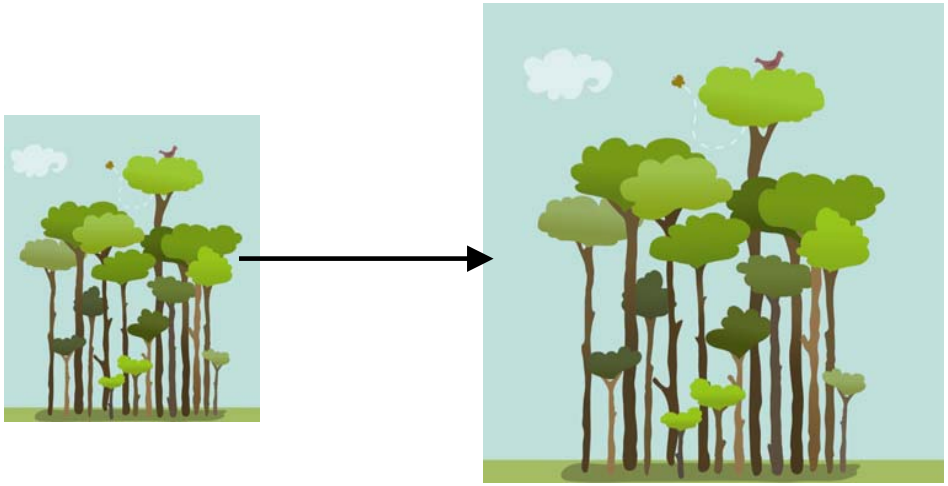
Reduced impacts from <u>catastrophic</u> disturbances

- Annual carbon emissions in US from fire ranges from 9 to 59 Mt C, equal to 4-25% of annual sequestration in US forest ecosystems

*CCSP 2007, Images: USFS*

# MITIGATION #2: SEQUESTRATION

Use management in forest ecosystems to sequester additio

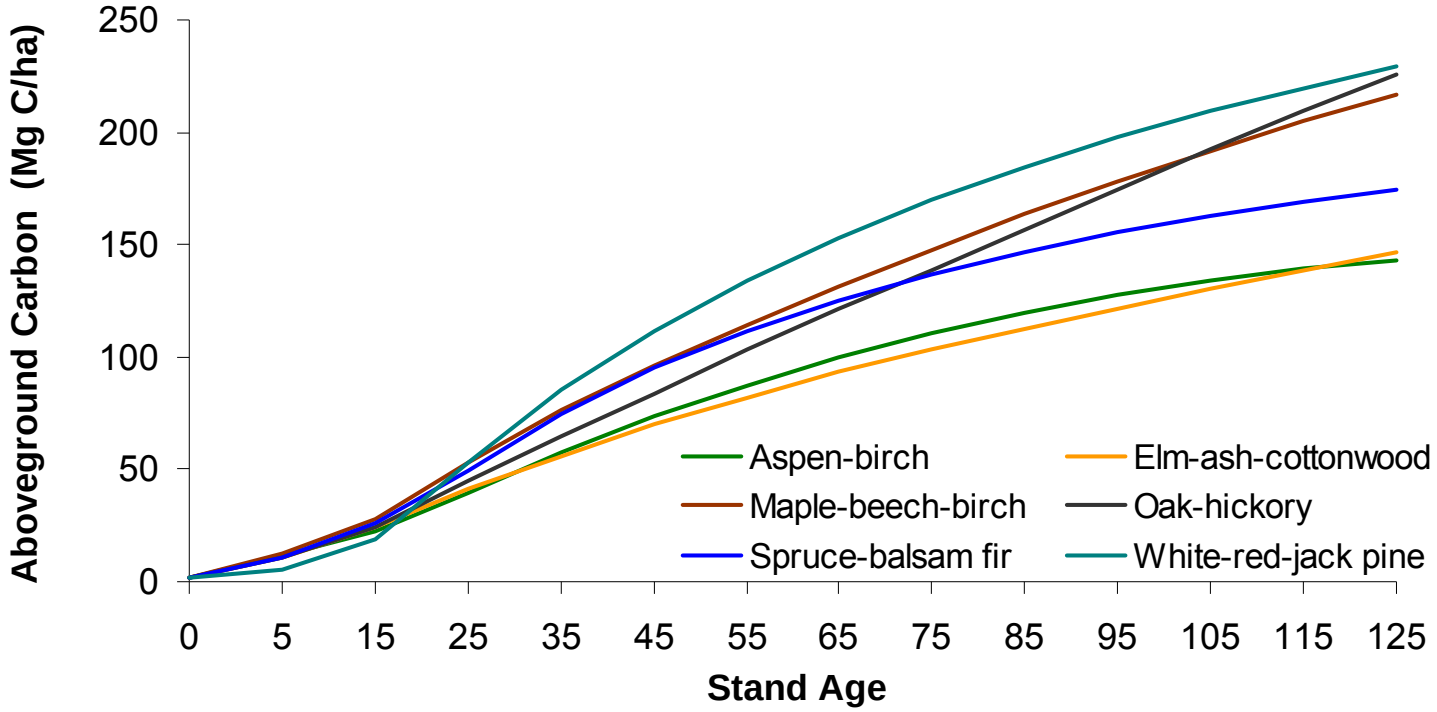


*Brown 1999, Maness 2009*

# MITIGATION #2: SEQUESTRATION

Afforestation (convert marginal lands to forest)

- Increases sequestration by 1.5 to 6.4 Mg C/ha/yr for 120 yrs

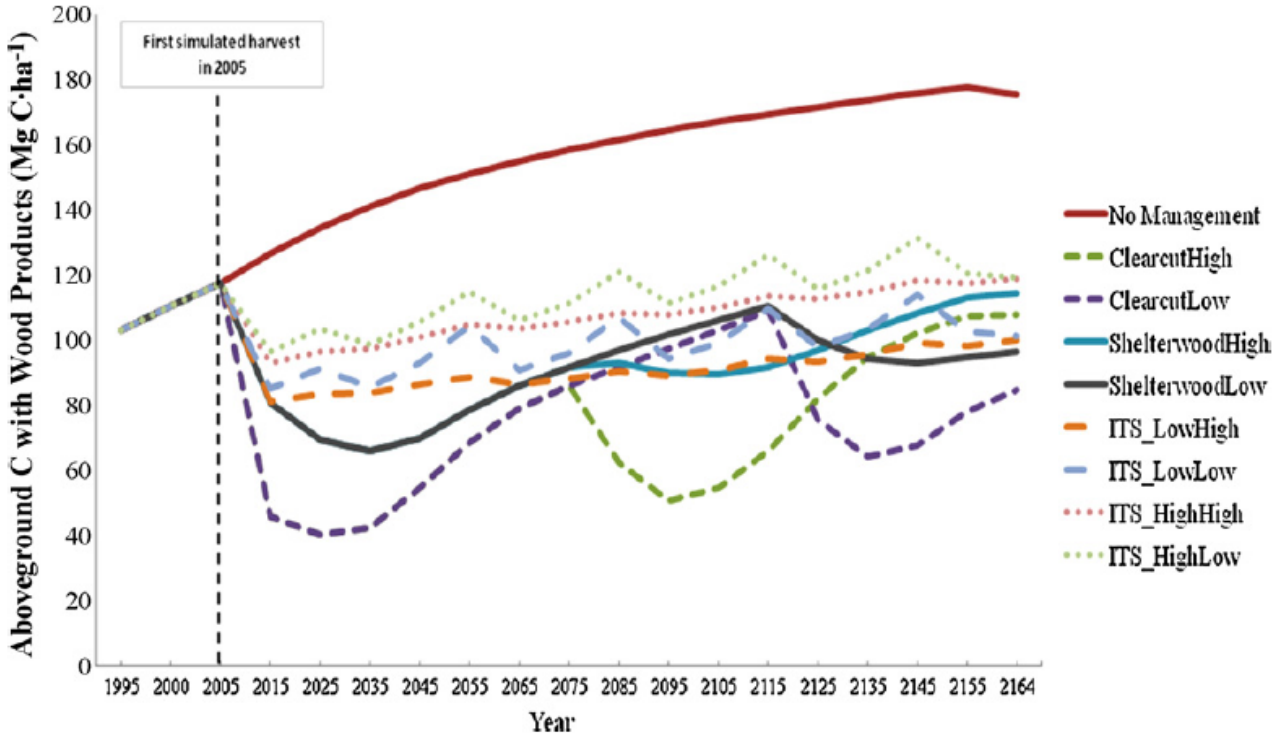



*Birdsey 1996, CBO 2007, Figure data: Smith et al. 2006*

# MITIGATION #2: SEQUESTRATION

Forest management for increased carbon storage

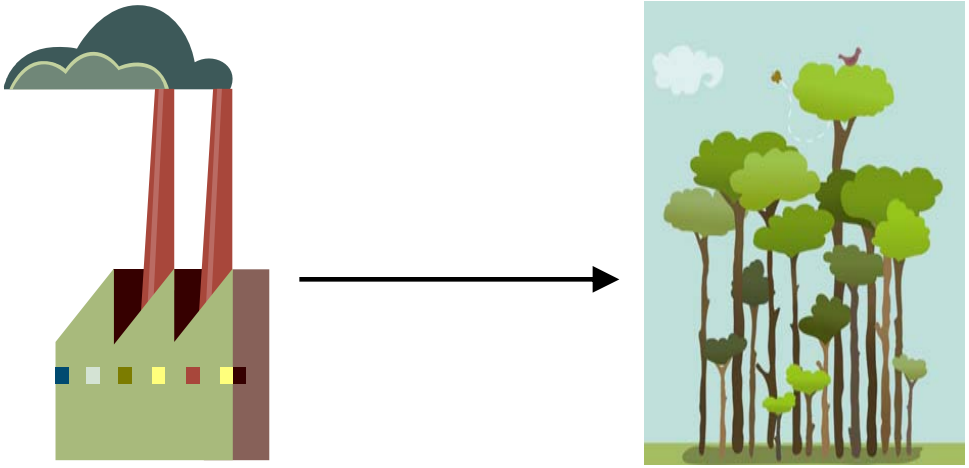
- Stand management to increase forest carbon stocks
- Production of  durable wood products that sequester C




*Brown 1999, Maness 2009, Figure: Nunery and Keeton In Press*

# MITIGATION #3: SUBSTITUTION

Reduce greenhouse gas emissions from fossil fuels by using

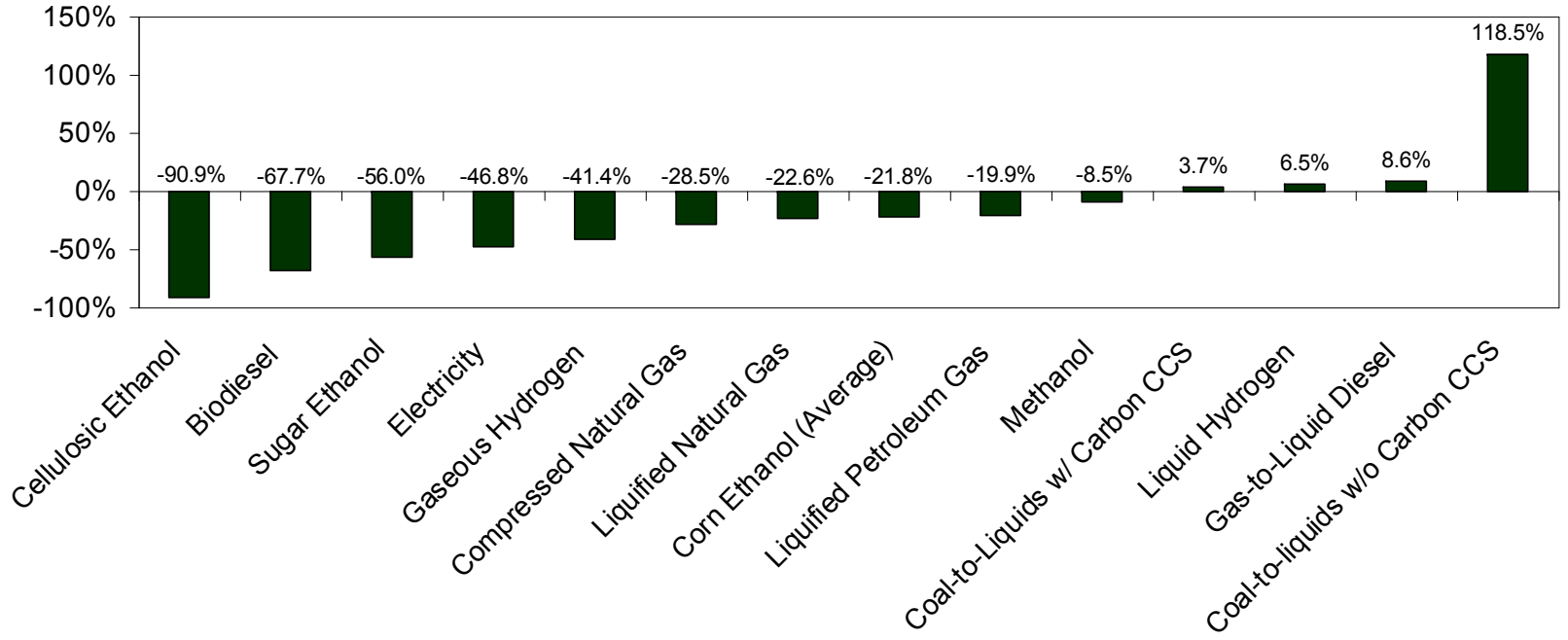


*Brown 1999, Maness 2009*

# MITIGATION #3: SUBSTITUTION

Renewable energy production from biomass that replaces

*Percent change in lifecycle greenhouse gas emissions, relative to the petroleum fuel that is displaced*




*Brown 1999, Maness 2009, Figure data: EPA 2007*

# MITIGATION #3: SUBSTITUTION

Wood products used in place of materials that are more en

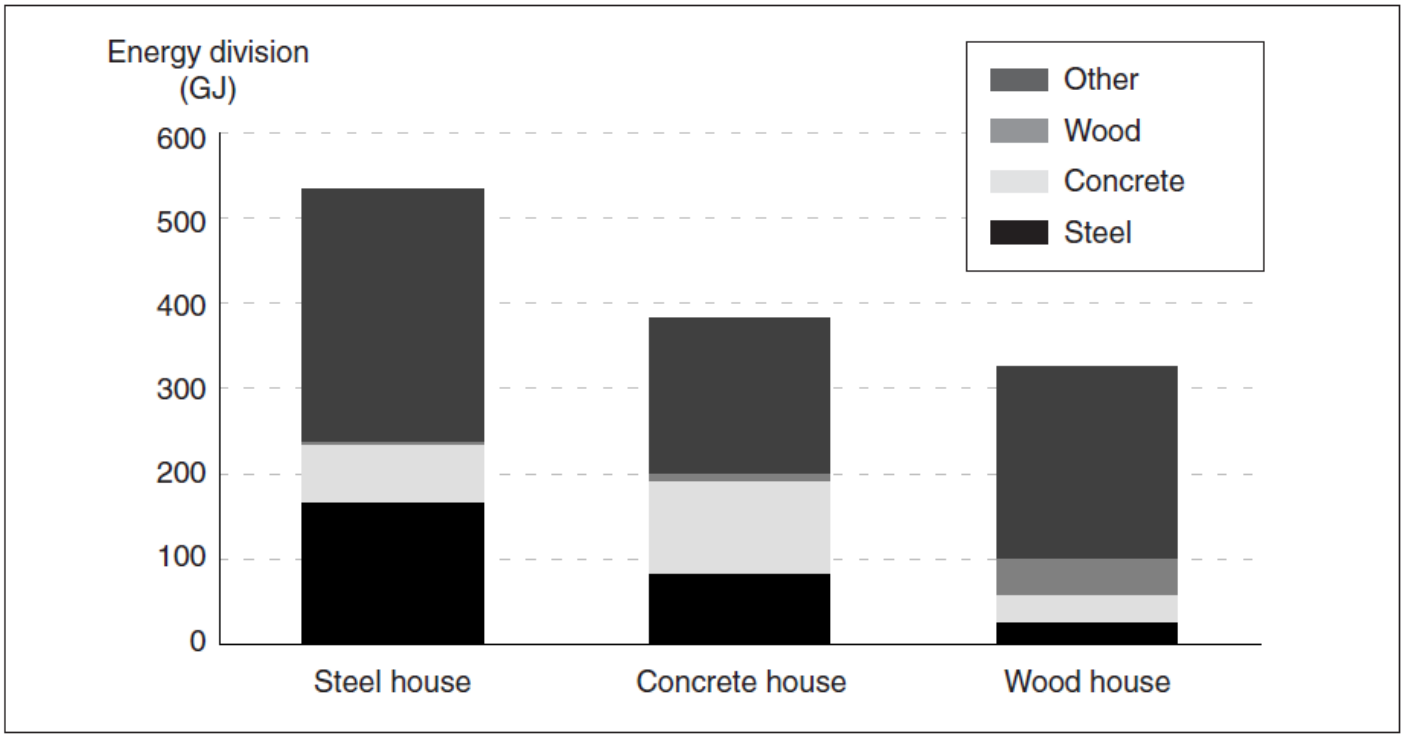



***Figure 2.*** **A breakdown of the embodied energy in the components for each type of house.**

*Brown 1999, Maness 2009, Figure: Glover et al. 2002*

# FOREST ADAPTATION & MITIGATION

# FOREST ADAPTATION & MITIGATION

Adaptation and mitigation are not mutually exclusive.

*Photo: USFS*

- Forests help to mitigate the severity of climate change.
- Well-adapted forests are better poised to sequester carbon.

# FOREST ADAPTATION & MITIGATION

With climate change, management becomes more complex. But management has always been complex.

*Photo: USFS*

*Photo: USFS*

# SUMMARY

# SUMMARY

- Adaptation and mitigation need to be considered as management moves forward in the face of climate change.
- Robust actions will look at adaptation, then mitigation.
- Uncertainty is high. Look for “win-win” and “no regrets” approaches.
- There is no shiny new tool. Rather, we have the same old tools but new applications.

# FOREST ADAPTATION

Desired Future Condition

Adaptation

*Increasing resources needed to maintain DFC*

Climate Change Trajectory

?

TIM

F