IEA Bioenergy Workshop: Sustainability of Bioenergy Supply Chains

Linking measurement and governance: wood pellets from the southeastern United States

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http://www.ornl.gov/sci/ees/cbes/

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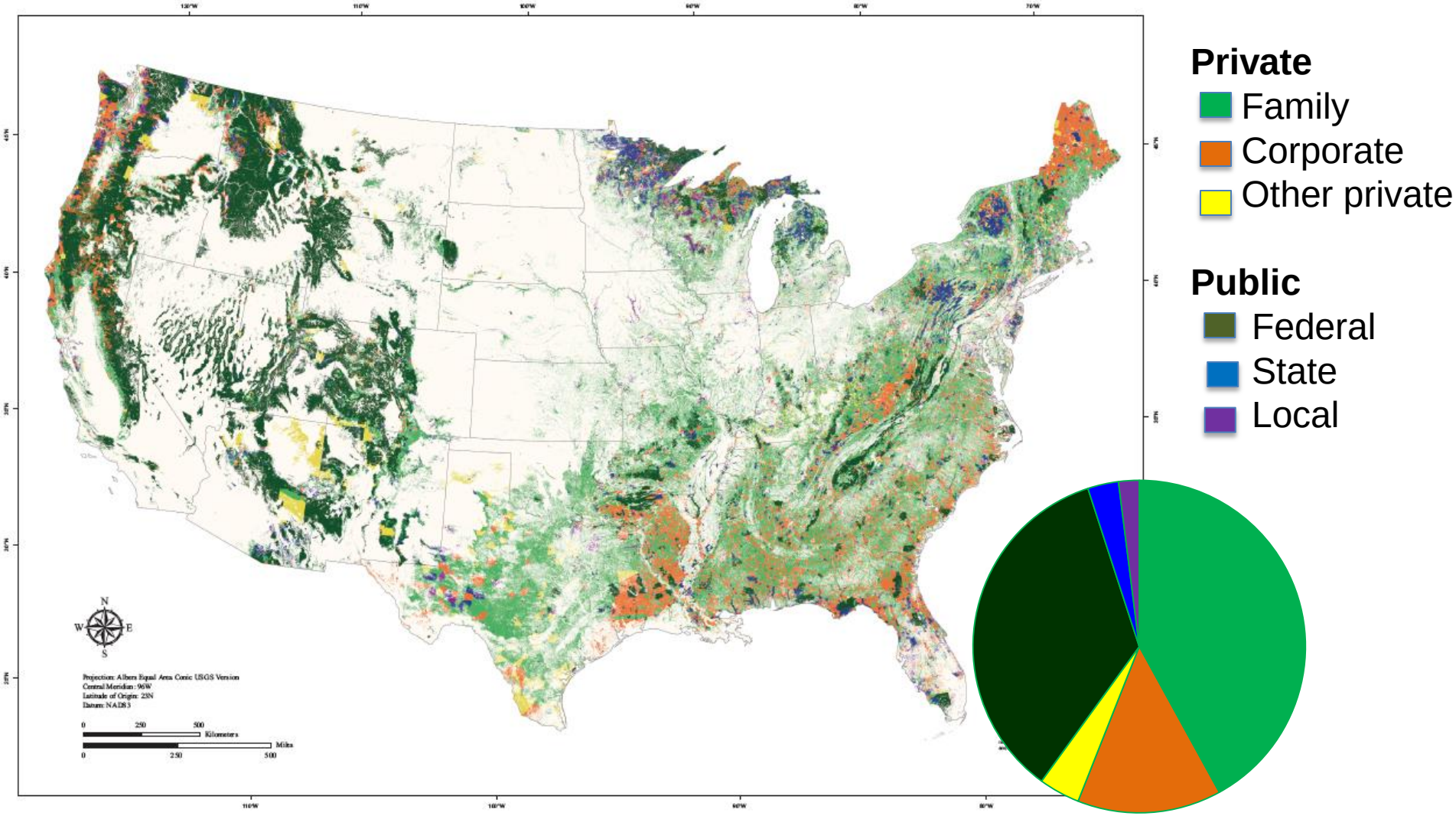
Private forest land in the southeast (SE) is the "timber basket" of the US



Hewes et al. 2014

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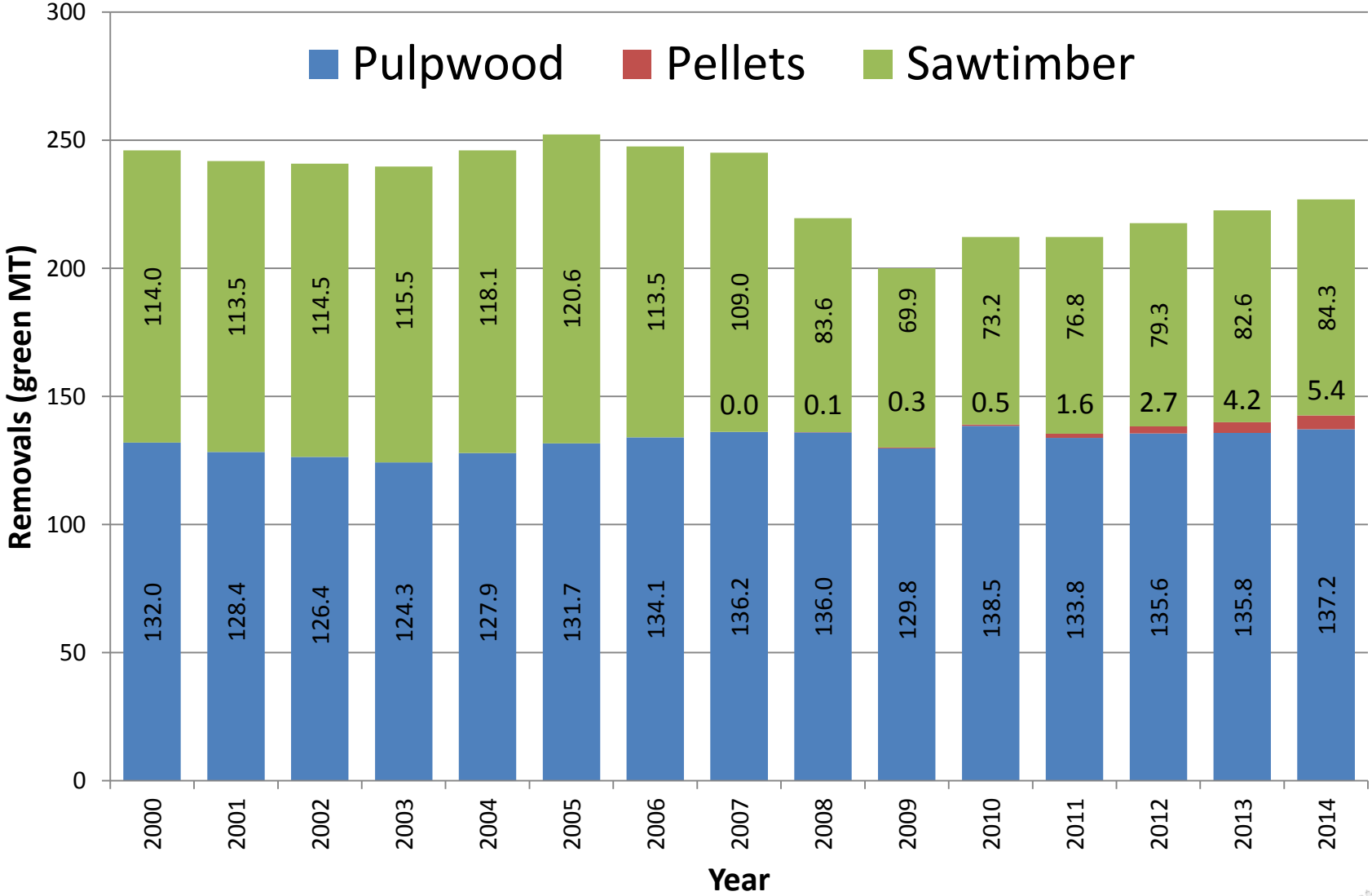
Wood based pellets are <3% of wood products from SE US



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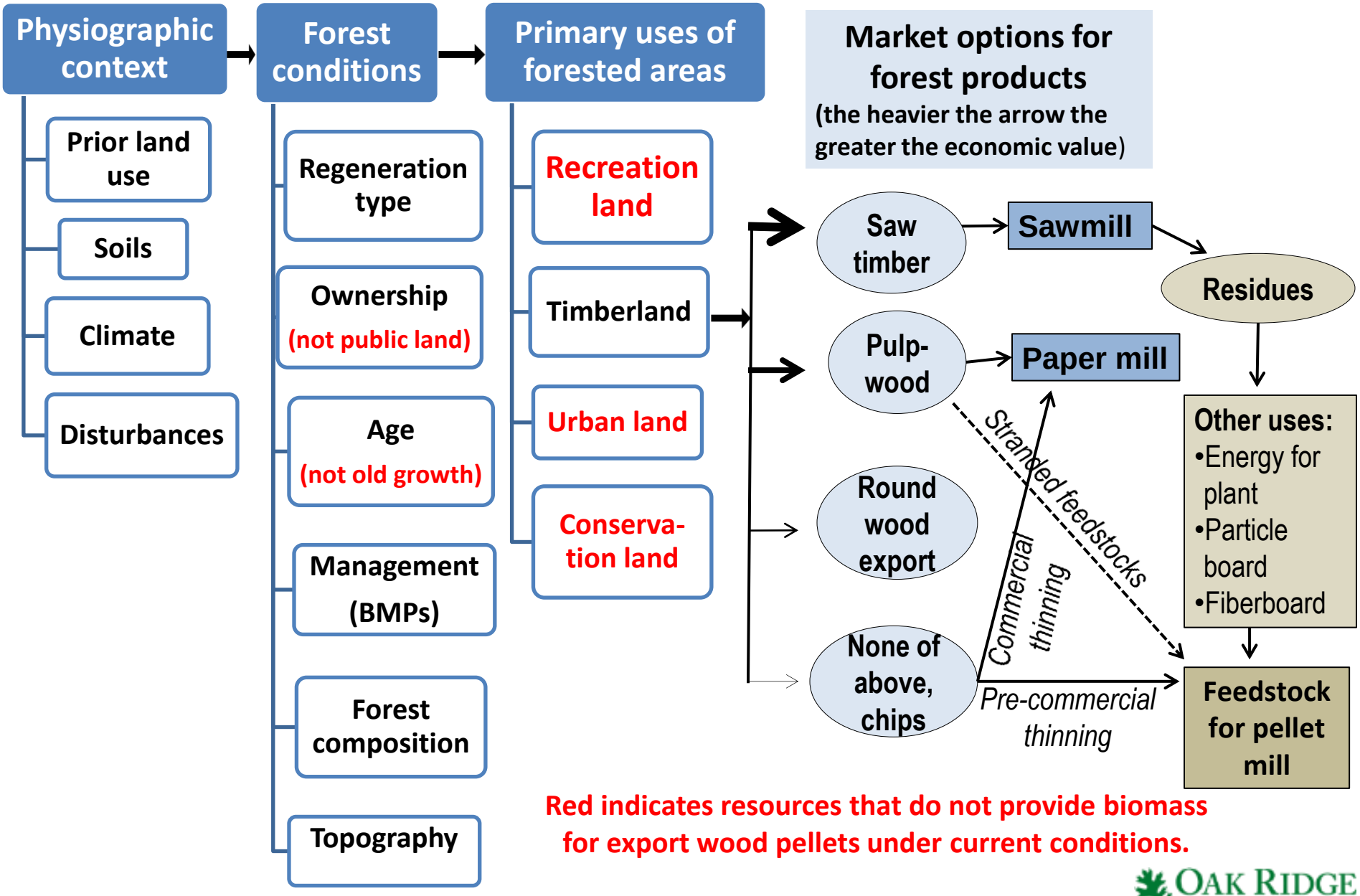
Dale et al. (2017) Forest Ecol & Mgmt)

Influences on SE US export wood pellet production



Red indicates resources that do not provide biomass for export wood pellets under current conditions.

Parish et al. (In review)

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Biomass stranded without markets ("unloved wood")

- Eventually burns or decays
- Reduces incentives to keep private lands forested

Status of US Forest System

- **Systems are in place for**
  - Monitoring, reporting, and regulating
  - Stewardship of public forests
- **Examples**
  - Forest Inventory & Analysis
  - Public & private land conservation;
  - State-driven programs
    - “Best management practices”
    - "State Forest Action Plans“
    - 1,500 state government entities implement forest policies and programs (Ellefson et al. 2002)
- **Forestry and agriculture laws & regulations**
  - Target air, water, & endangered species
  - Complex due to multiple layers of authorities: federal, state, local, tribal

When assessing effects of woody biomass use, the counterfactual or reference scenario should be based on

- Historical conditions
  - Past agriculture cleared much of the SE US forests
    - For example - only 3% of original long leaf forest remains
  - Little old growth remaining is largely protected

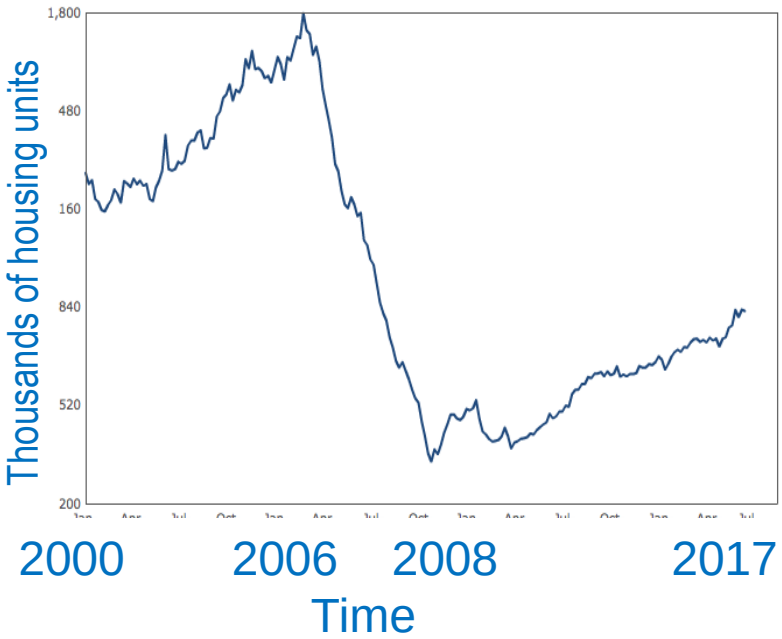
Rare photo of large trees in SE US

Sources: Davis 1996. Varner et al. 2005, Southern Forest Futures Report, Wear & Greis, 2013

When assessing effects of woody biomass use, the counterfactual or reference scenario should be based on

- Historical conditions
  - Past agriculture cleared much of the SE US forests
  - Little old growth remaining is largely protected
- Realistic assumptions for future projections & risks of disturbances
  - Development is prime pressure for deforestation in SE US
  - Forest management decisions largely driven by demand for higher price forest products than pellets

US Housing Starts
www.census.gov/starts



Sources: Southern Forest Futures Report, Wear & Greis, 2013; Wear & Coulston, 2015)

US wood pellets

Trends in demand for pellets

- Forest management is primarily driven by local market demands: lumber and pulpwood prevail in most places.
- US pellet industry has substantially grown in the past decade as a result of European demand.
- US pellet industry is <3% of total harvest removals in the SE US and <2% of harvest value (2016).

Benefits of pellet production

- Production and use of wood-based biomass for energy can contribute to mitigating climate change.
- Markets for low-value wood create incentives for management practices that decrease risks of insect outbreaks, disease and destructive wildfire.
- Jobs

Dale et al. 2017 (GCB Bioenergy)

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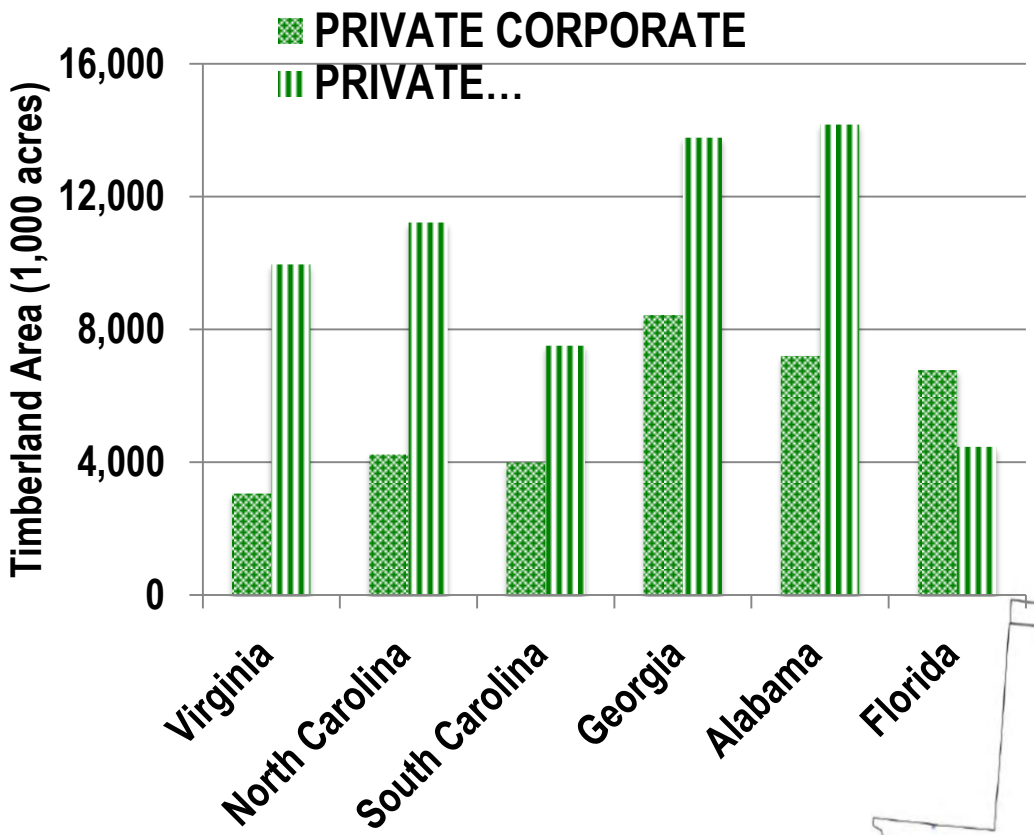
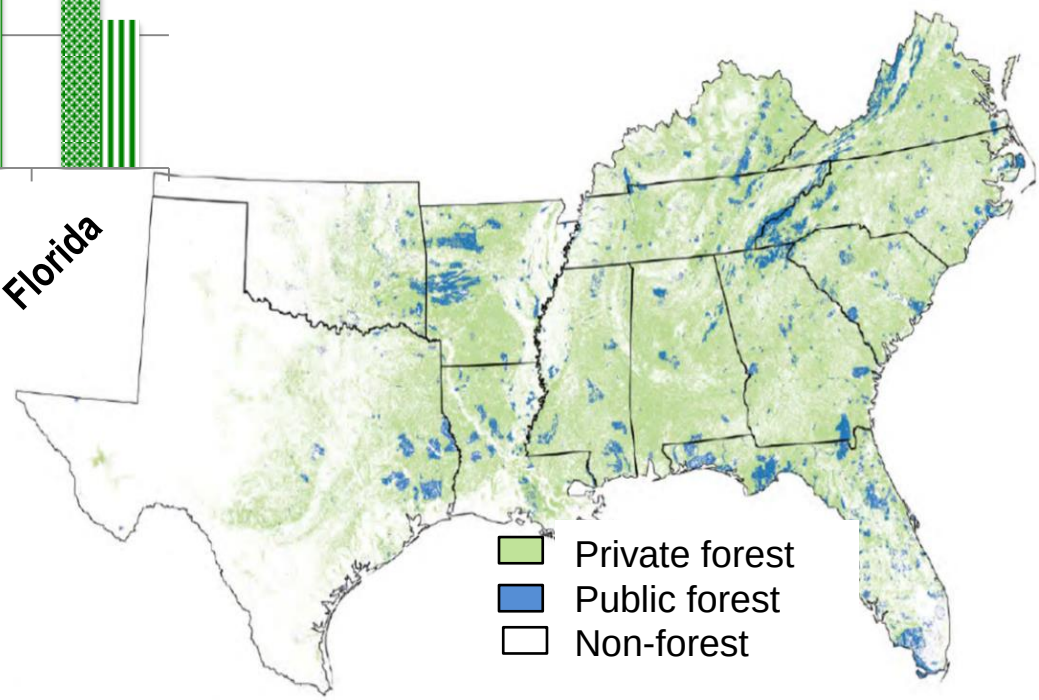
Most biomass for pellets in SE US sourced from private forests



Oswalt et al. (2014)



Wear and Greis (2013)

Different groups have different priorities for SE US forest
We are filling gaps & making connections

Indicator categories	Stakeholder groups					
	Env NGOs	EU	Industry (?)	Landowner		Workers
				Corporate	Family (?)	
GHG	+	+		+		
Soils	+	+		+		
Water	+			+		
Biodiversity	+	+		+	+	
Air	+			+		
Productivity	+			+		
Profit			+	+	+	+
Energy security			+			
External trade		+	+			
Social wellbeing				+	+	+
Social acceptability			+	+		
Resource conservation	+				+	

Eastern US Bioenergy Survey
Willingness to Supply Wood for Energy

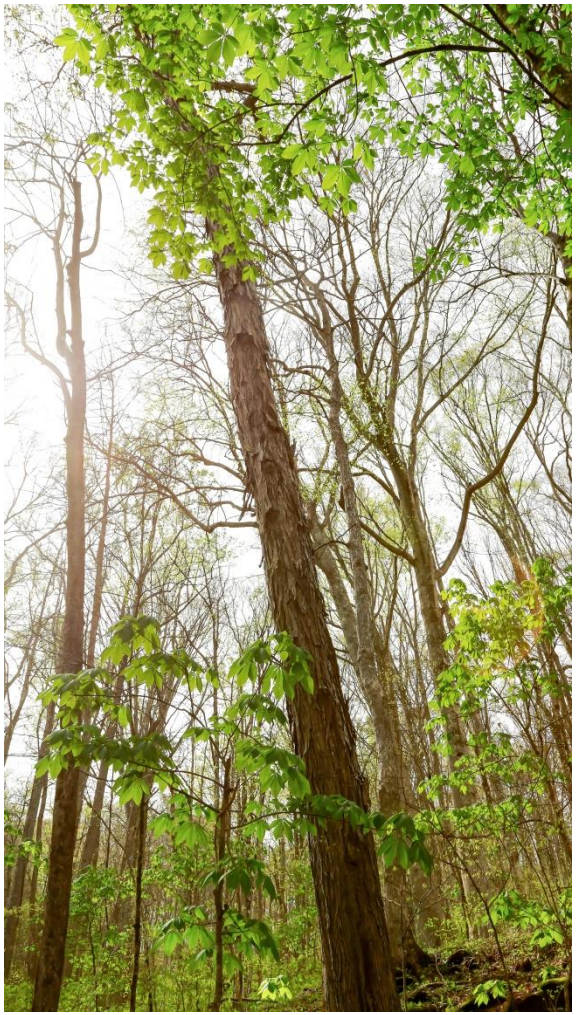
University of Tennessee and Pennsylvania State University

Objectives

1. **Will the supply of wood-based biofuel from private forests meet the demand?**
2. **What are the opportunities and concerns of *communities*, residents, and existing wood-based industries regarding biofuel facilities?**
3. **How will communities and residents respond to these opportunities and concerns?**

Methodology

- **Conducted in Spring/Summer of 2015**
- **All US states east of Mississippi River and bordering to the west**
- **About 900 interviews with family forest landowners**



(Hodges et al. 2016)

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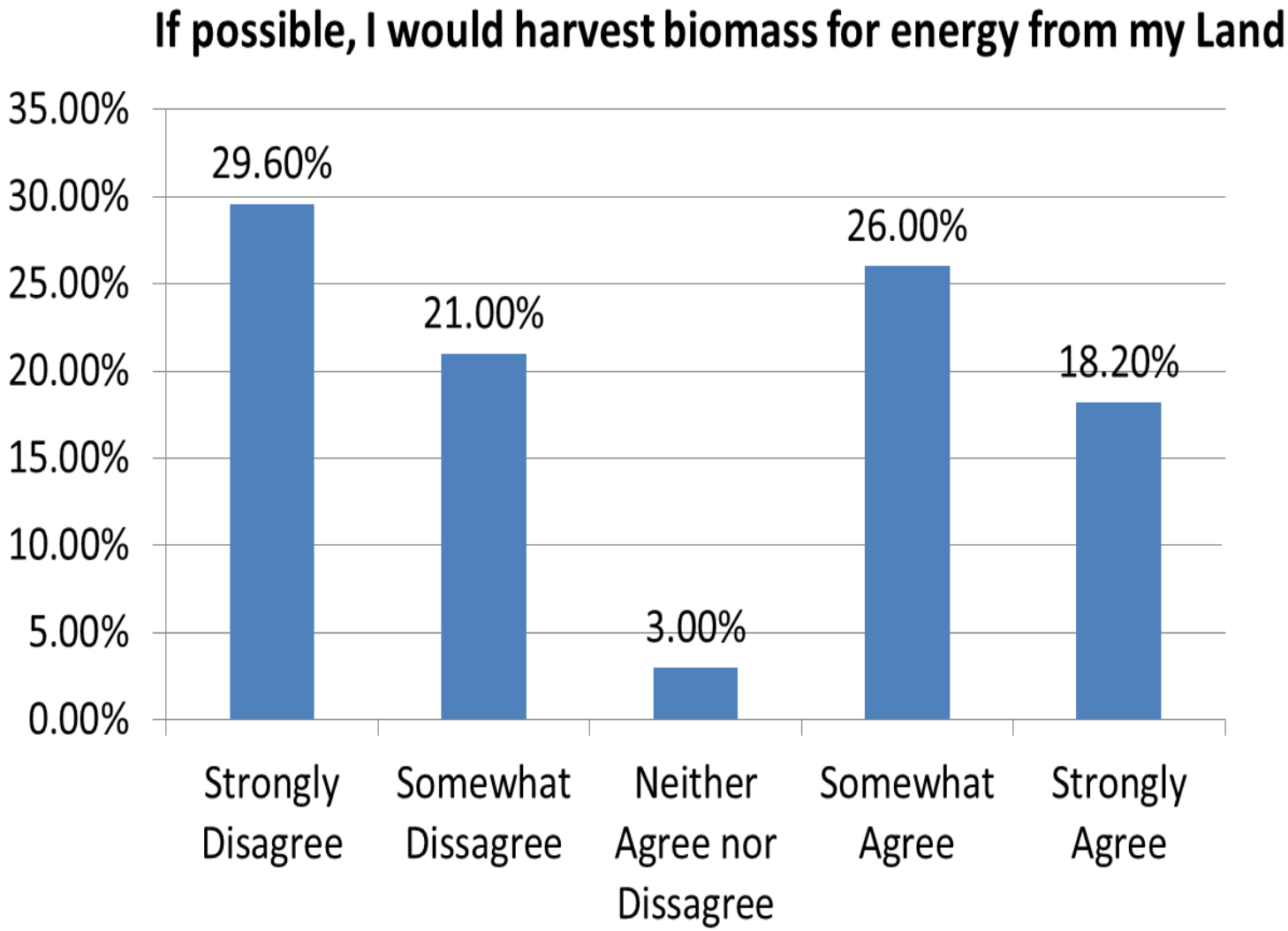

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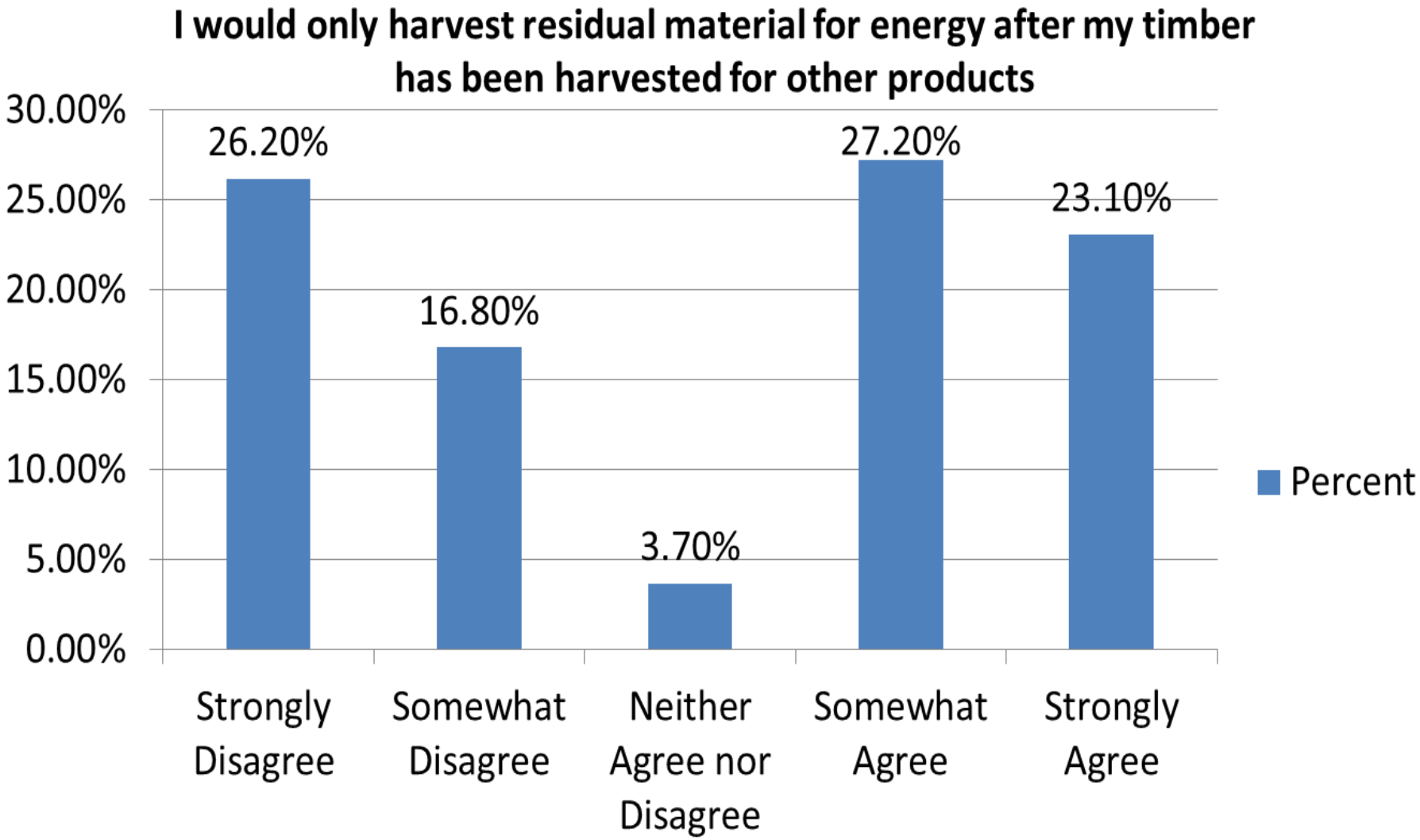

(Hodges et al. 2016)

Variable Description

Variable	Definitions	Mean	Std. Dev.	Min	Max
Harvest	Respondent would harvest for bioenergy (1=Yes, 2=No)	0.46	0.50	0	1
Grow trees for sale	Importance of growing trees for sale (1=Very Unimportant,..., 5=Very Important)	2.28	1.51	1	5
Grow trees for personal	Importance of growing trees for personal use (1=Very Unimportant,..., 5=Very Important)	3.62	1.52	1	5
Cut for sale in past	Cut for sale in past (1=Yes, 2=No)	0.41	0.49	0	1
Cut for sale in future	Likelihood of cutting for sale in future (1=Very Unlikely,..., 5=Very Likely)	2.36	1.68	1	5
Cut for use in past	Cut for personal use in the past (1=Yes, 2=No)	0.74	0.44	0	1
Cut for use in future	Likelihood of cutting for personal use in future (1=Very Unlikely,..., 5=Very Likely)	3.47	1.74	1	5
Age	Age in years	51.05	14.98	19	97
Gender	1 if the respondent is male, 0 if female	0.59	0.49	0	1
Education	Education (1=None,....,8=Graduate/Professional Degree)	5.58	1.63	2	8
Political ideology	Political ideology (1=Liberal,...., 5 Conservative	3.64	1.31	1	5
Acres	acres	3.55	1.69	1	9
Total number of observations = 786					

U.S. DEPARTMENT OF ENERGY

(Hodges et al. 2016)

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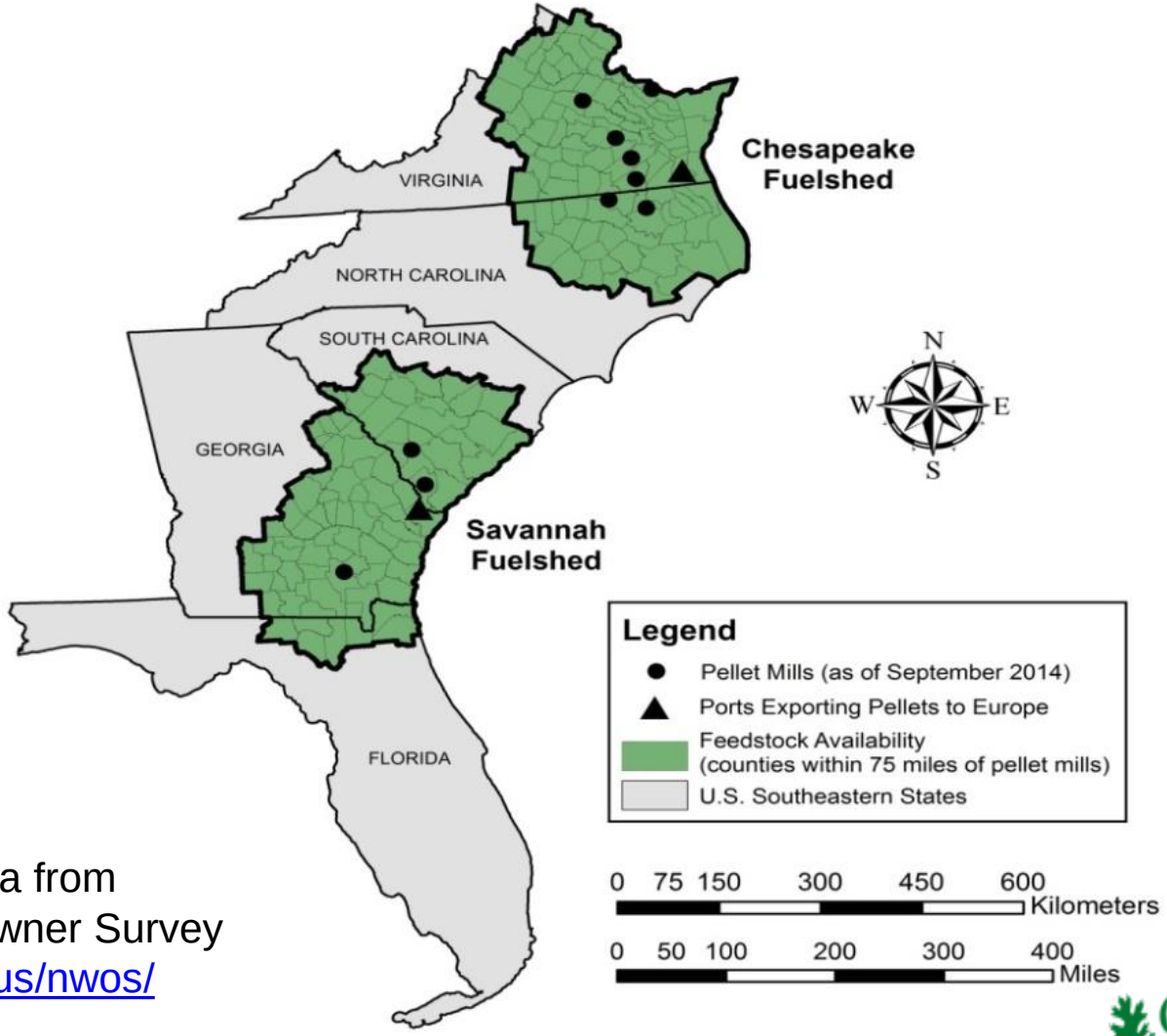
Noncorporate forest land owners' perspectives regarding wood-based energy (conclusions to date)

Survey of ~900 family forest land owners in eastern US on biomass for energy:

- Concern for the overall environment is paramount
- Potential impacts on existing industries are a concern
- There was a willingness to support use of biomass for energy as long as
  1. Land health is not compromised
  2. The price is right

Hodges et al. 2016)

Focused on family-owned forests considering two fuelsheds that dominate exports of wood pellets to Europe from the SE US



Source: Subset of data from National Woodland Owner Survey https://www.fia.fs.fed.us/nwos/
Butler et al. (2016)

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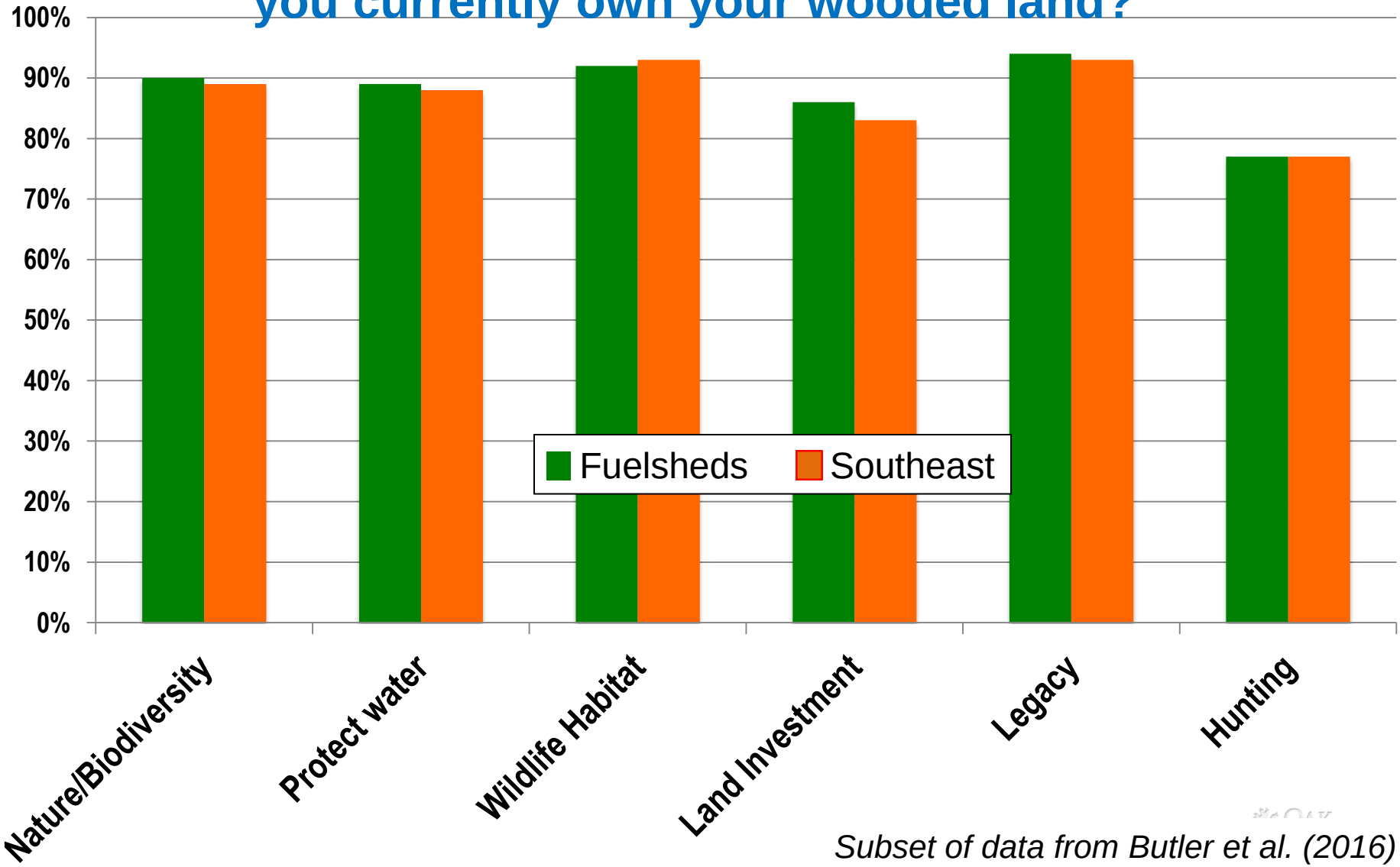
Past Management Activities of
Study Fuelshed Owners vs SE Owners

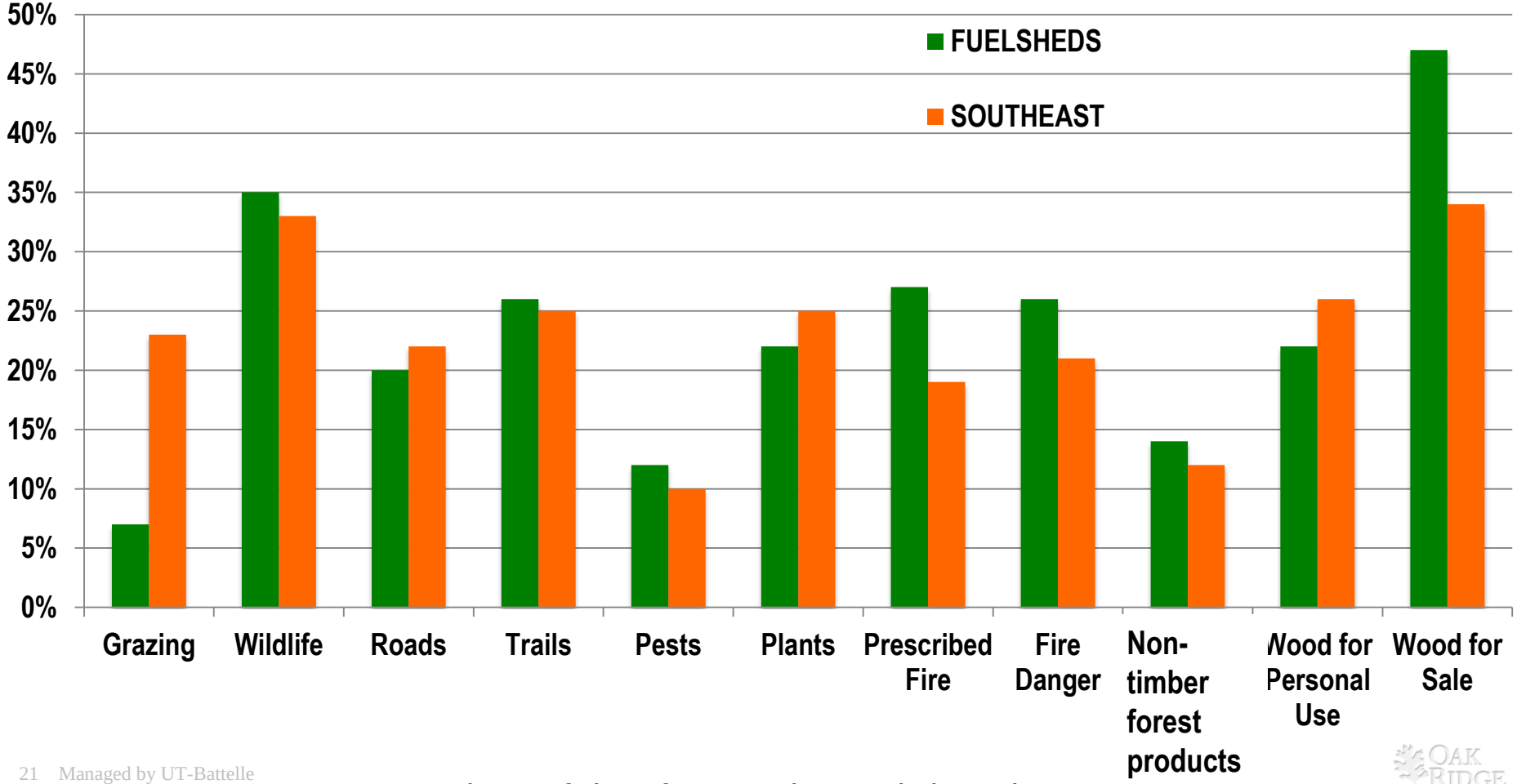
How important are the following as reasons for why you currently own your wooded land?



Subset of data from Butler et al. (2016)

Past Management Activities of
Study Fuelshed Owners vs SE Owners

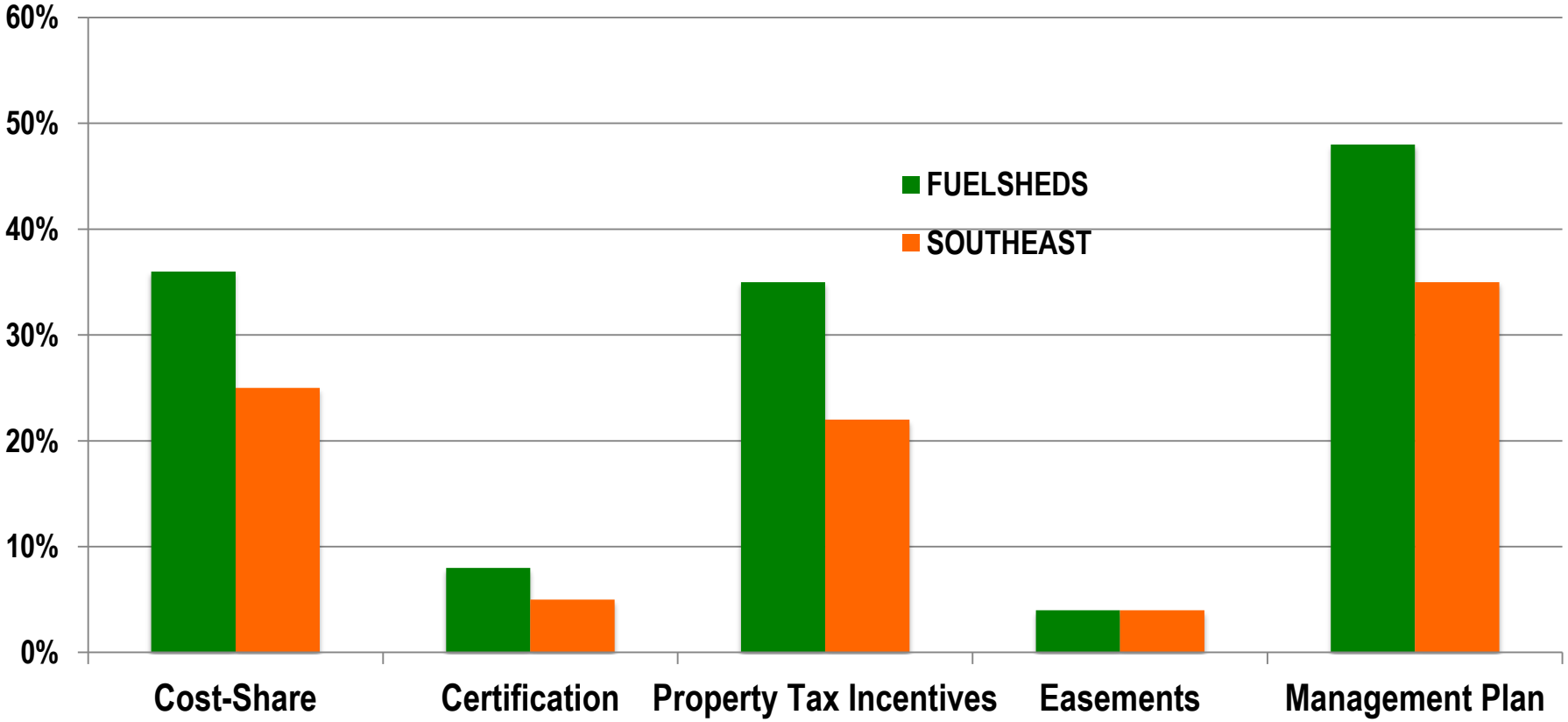
Which of the following have occurred on your wooded land in the past 5 years?



Subset of data from Butler et al. (2016)

Management Participation of
Study Fuelshed Owners vs SE Owners

Is your wooded land enrolled in any of the following written management or stewardship plan?



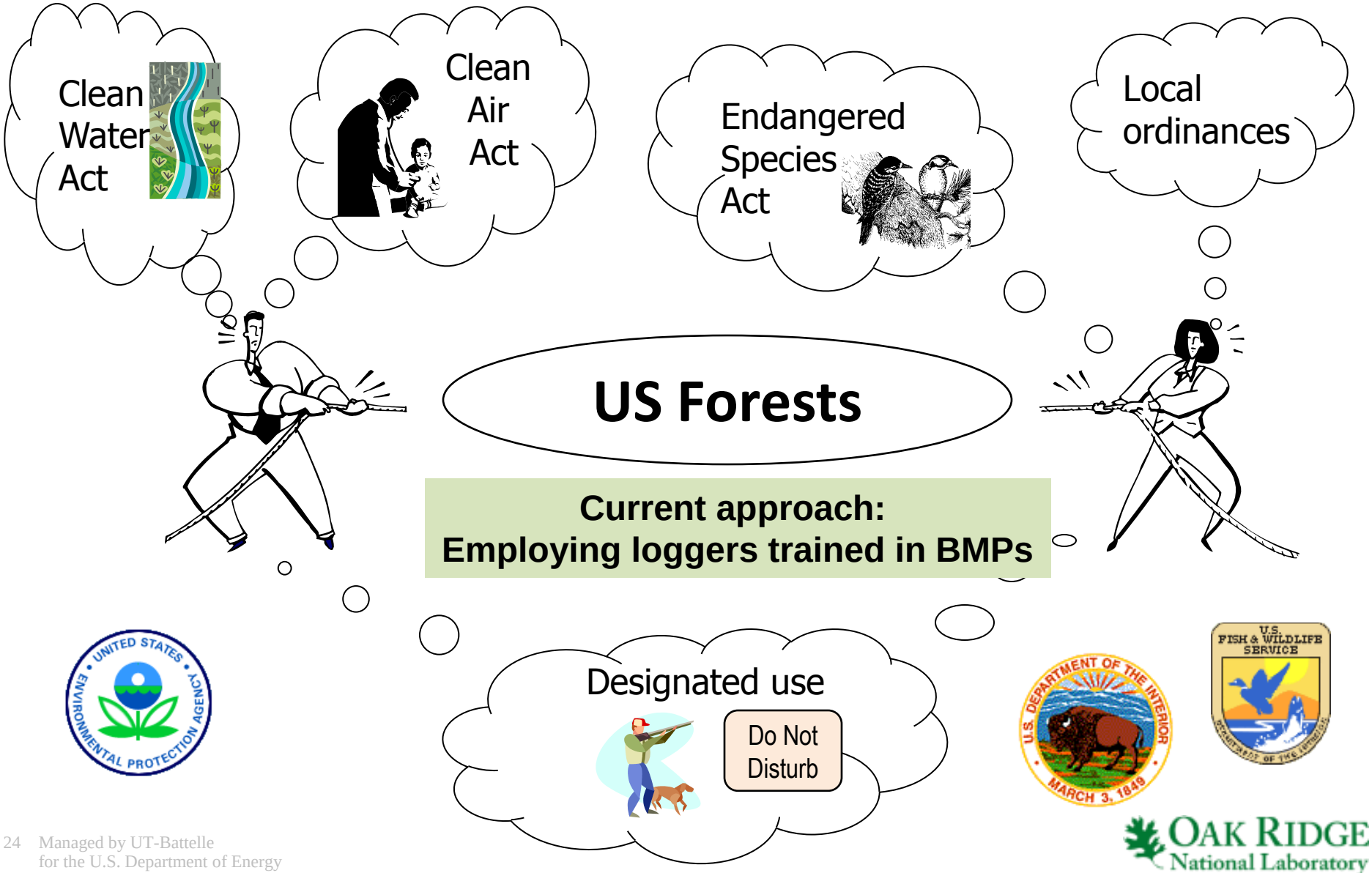
Subset of data from Butler et al. (2016)

Benefits of logger training

- Only 17% of wood is certified to any standard in SE US
- However mills that produce pellets require feedstock to originate from sites supervised by logging professionals trained in wildlife habitat conservation, water quality, & other BMPs.
    - Logger training is a component of the Sustainable Forestry Initiative's (SFI's) certified Fiber Sourcing Standard.
- **<u>Focus on forests attributes rather than paperwork.</u>**

Dale + 34 coauthors (2017) GCB-Bioenergy

Land owners work to address their goals while obeying environmental laws



US has a robust forest monitoring program

USDA Forest Inventory Analysis

- Long-term survey
- All forests in the US
- Information on a variety of forest statistics
  - Forest area and location
  - Species
  - Tree size, growth, health, and mortality
  - Removals by harvest
  - Carbon accumulation

Results from analysis of FIA data

- **Both fuelsheds:** Significant increases in
  - Timberland volume in plantations
  - Areas with large trees
  - # standing dead trees/ha in naturally regenerating stands
- **Chesapeake fuelshed:** Sign. Increases in
  - Timberland volume in plantations
  - Harvestable carbon
- **Savannah fuelshed**
  - Sign. increases in
    - Timberland volume
    - All carbon pools
  - Sign. decreases in # standing dead trees/ha in plantations

Conclusions

- Provides empirical support of prior estimates that production of wood-based pellets in the SE US can enhance GHG sequestration.
- Calls for further study of effects on biodiversity of declines in # of standing trees/ha
  - Note: others recommend thinning & hardwood midstory control in pine plantations to provide habitat for declining bird species (consistence with use of biomass for energy & reducing risk of fire).
  - ORNL will focus analysis on an organism that may be affected by such declines

Dale et al. (2017) For Ecol & Mgt

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There is no one key for effective timber management, but having a bioenergy market can help

- Reduce inefficiencies
- Improve forest habitat
- Lower carbon emissions, & mitigate the effects of global climate change (Cowie et al. 2013)
- Retain forests. As demand for wood increases, net forest area typically expands (Miner et al. 2014)
- Provide jobs

Thank you!

CBES
Center for BioEnergy Sustainability

http://www.ornl.gov/sci/ees/cbes/

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References

- Butler, Brett J.; Hewes, Jaketon H.; Dickinson, Brenton J.; Andrejczyk, Kyle; Butler, Sarah M.; Markowski-Lindsay, Marla. 2016. USDA Forest Service National Woodland Owner Survey: national, regional, and state statistics for family forest and woodland ownerships with 10+ acres, 2011-2013. Res. Bull. NRS-99. Newtown Square, PA: U.S. Department of Agriculture, Forest Service, Northern Research Station. 39 p.
- Cowie A, Berndes G, Smith T (2013) On the timing of greenhouse gas mitigation benefits of forest based bioenergy. IEA Bioenergy ExCo: 2013:04 www.ieabioenergy.com/publications/on-the-timing-of-greenhouse-gas-mitigation-benefits-of-forest-based-bioenergy. Viewed 19 Jan 2017.
- Dale VH, KL Kline, ES Parish, AL Cowie, TC Smith, NS Bentsen, G Berndes, et al., 2017. Status and prospects for renewable energy using wood pellets from the southeastern United States. GCB Bioenergy. GCB Bioenergy doi: 10.1111/gcbb.12445. http://onlinelibrary.wiley.com/doi/10.1111/gcbb.12445/full
- Dale VH, Parish ES, Kline KL, Tobin E (2017) How is wood-based pellet production affecting forest conditions in the southeastern United States? Forest Ecology and Management 396: 143-149. doi.org/10.1016/j.foreco.2017.03.022 https://authors.elsevier.com/a/1UxyW1L~GwCo5V
- Davis MB (editor) (1996) Eastern old growth forests: prospects for discovery and recovery. Island Press, Washington, DC. 383 p.
- Hewes J, Butler B, Liknes GC, Nelson MD, Snyder SA. 2014. Map of distribution of six forest ownership types in the conterminous United States. Res. Map NRS-6. Newtown Square, PA: U.S. Department of Agriculture, Forest Service, Northern Research Station. [Scale 1: 10,000,000, 1: 34,000,000.] https://www.nrs.fs.fed.us/pubs/46386
- Hodges, Donald G., Eric C. Larson, James C. Finley, A.E. Luloff, Adam S. Willcox, and Jason S. Gordon. 2016. Wood bioenergy and private forests: perceptions of owners in the eastern United States. In: Forest Economics and Policy in a Changing Environment: How Market, Policy, and Climate Transformations Affect Forests—Proceedings of the 2016 Meeting of the International Society of Forest Resource Economics. Frey, Gregory E.; Nepal, Prakash, eds. 2016. e-Gen. Tech. Rep. SRS-218. Asheville, NC: U.S. Department of Agriculture Forest Service, Southern Research Station.
- Parish, Dale , Kline and Abt (in review) Reference scenarios for evaluating wood pellet production in the Southeastern United States. WIRES.
- Oswalt SN, Smith WD. 2014. US forest resources facts and historical trends. USDA Forest Service FS-1035. https://www.fia.fs.fed.us/library/brochures/docs/2012/ForestFacts_1952-2012_English.pdf
- Miner RA, Abt RC, Bowyer JL, et al. (2014) Forest carbon accounting considerations in US bioenergy policy. Journal of Forestry, 112, 591–606.
- Varner JM, Gordon DR, Putz E, Hiers JK (2005) Restoring fire to long-unburned Pinus palustris ecosystems: Novel fire effects and consequences for long-unburned ecosystems. Restoration Ecology, 13, 536-544.
- Wear, DN and JW Coulston 2015. From sink to source: Regional variation in U.S. forest carbon futures. Sci. Rep. 5, 16518; doi:10.1038/srep16518
- Weir D, Greis J. The Southern Forest Futures Project: Technical Report Gen. Tech. Pre. SRS-178. United States Department of Agriculture. Forest Service, Research and Development, Southern Research Station, 2013. 553 pg.