Integrating pellet production into sustainable landscape design for the Southeastern USA

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(and support from many others)

December 2, 2014
Utrecht University, Netherlands

Center for BioEnergy Sustainability
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Oak Ridge, Tennessee
http://www.ornl.gov/sci/ees/cbes/

U.S. DEPARTMENT OF ENERGY

OAK RIDGE NATIONAL LABORATORY
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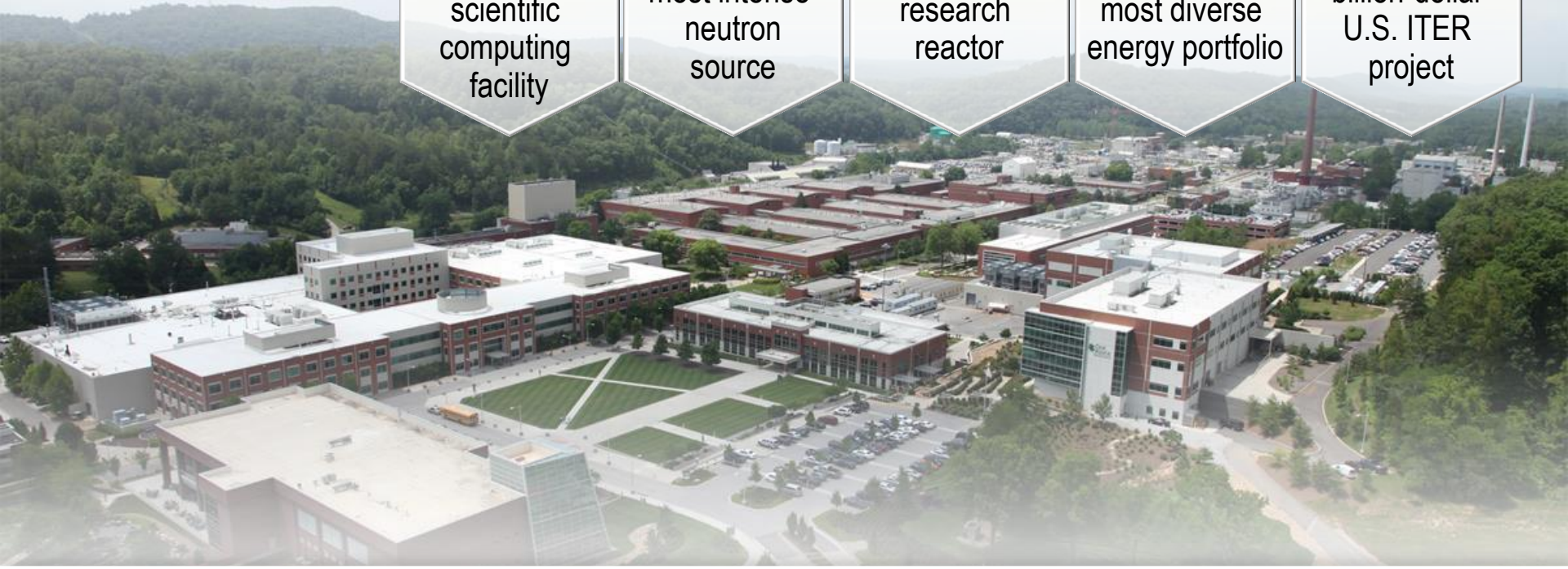
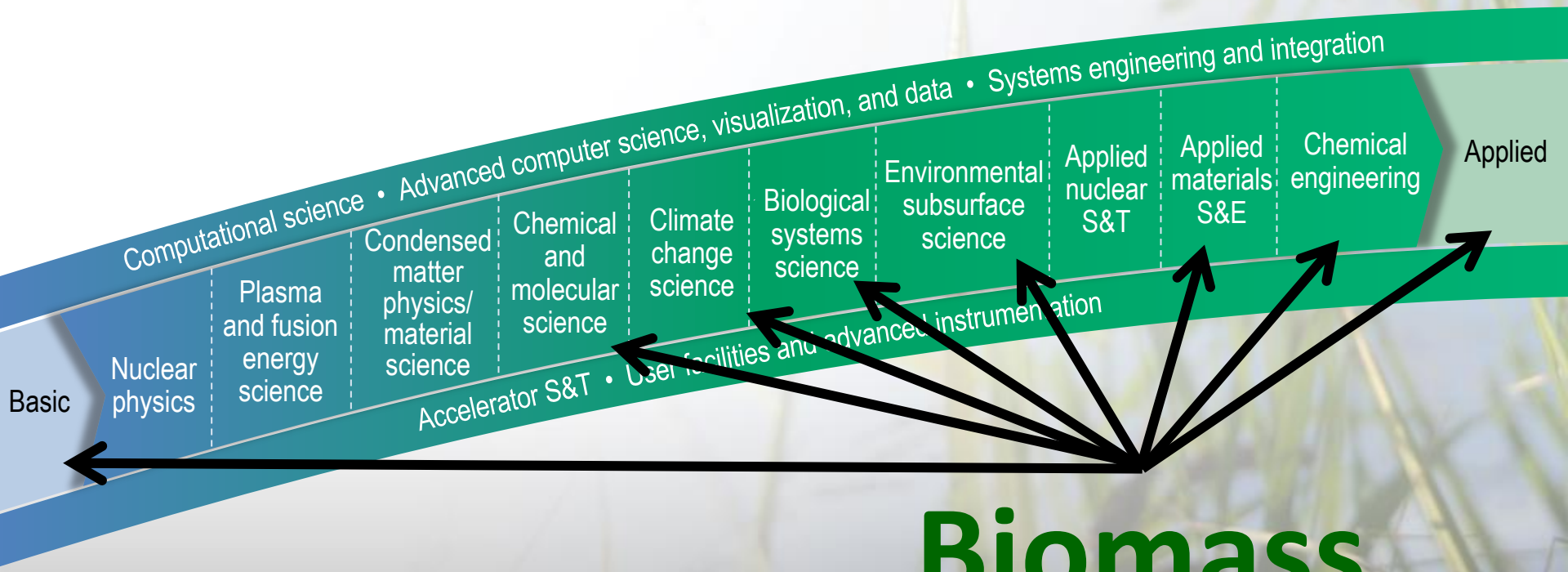
What is Oak Ridge National Laboratory (ORNL)? U.S. Department of Energy's Largest Science and Energy Research Center:

- $1.65B budget
- 4,400 employees
- 3,000 research guests annually
- $500M modernization investment
- Nation's largest materials research portfolio
- Most powerful open scientific computing facility
- World's most intense neutron source
- World-class research reactor
- Nation's most diverse energy portfolio
- Managing billion-dollar U.S. ITER project



ORNL's Mission

Deliver scientific discoveries that accelerate the development and deployment of solutions in clean energy and global security, and in doing so, create economic opportunities



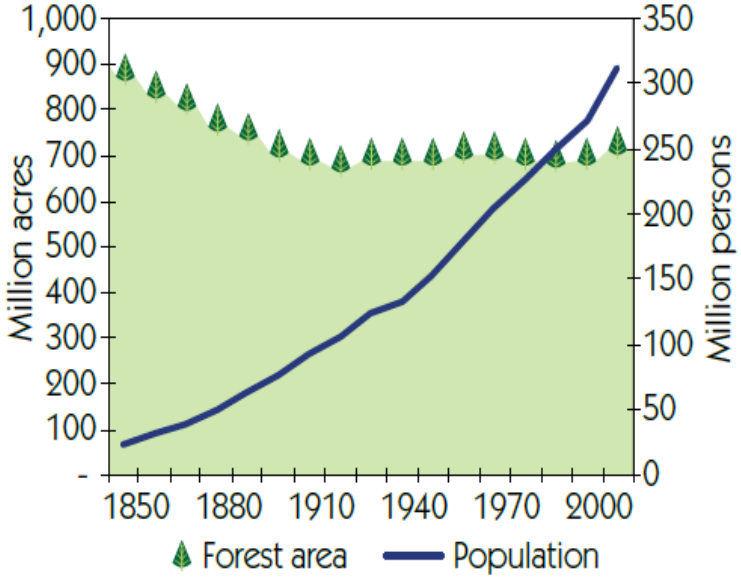
Biomass

OAK RIDGE National Laboratory

SE USA Biomass for Pellets

- Supply influenced by
  - Industry activity (higher value driven)
  - Logistics, infrastructure and proximity to mills and ports
  - Prices and future expectations
  - Land ownership
- Sustainability issues
  - Land cover, land management
  - Reference case -vs- viable options
  - Biodiversity, flood plain/riparian forests
  - Jobs/sustainable incomes
  - Water quality/regulation
  - Aesthetic/social/cultural values
  - EU market access (GHG accounting)
- Assessment approach
  - Two cases studies
  - Collaborations
  - Test proposed indicators
  - Evaluate anticipated outcomes
- Common ground: incentives and management to maintain forest cover, forest health, and ecosystem services

US Forest area and timberland

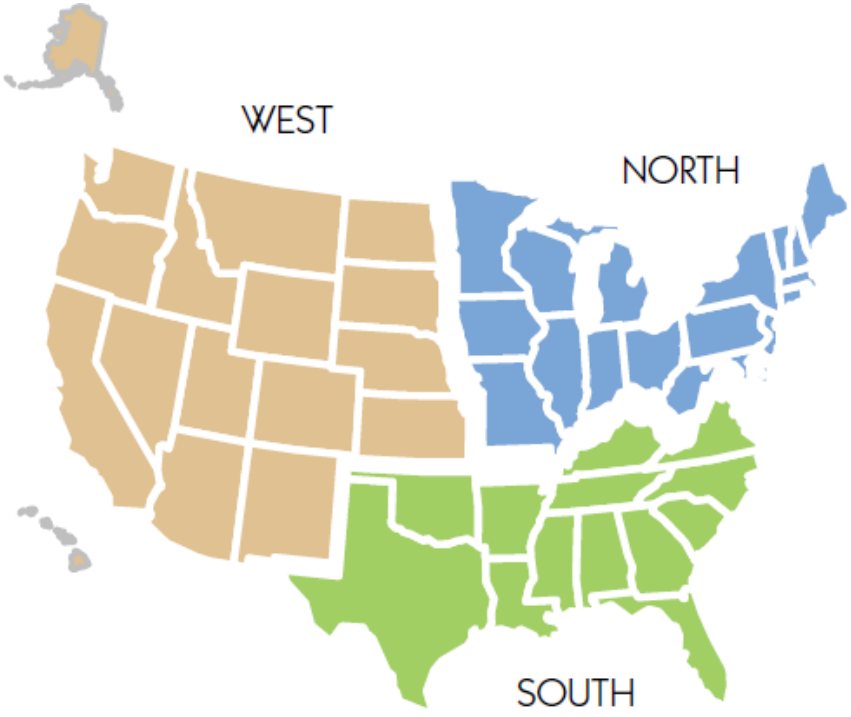


Forest area and population trends in the United States, 1850–2010.

Category	Year	Region			
		U.S.	North	South	West
		Million acres			
Land	2012	2,261	413	533	1,315
Of which:					
Forest	2012	766	176	245	346
	2007	752	172	235	346
	1997	742	170	231	341
Of which:					
Timber land	2012	521	167	210	144
	2007	514	164	204	146
	1997	504	159	201	143
	1987	485	155	195	135
	1977	491	153	198	139
	1963	515	156	209	150
	1953	509	154	205	150
Reserved forest[2]	2012	74	7	4	63
	2007	75	6	3	65
	1997	52	8	4	40
	1987	35	7	3	25
	1977	29	6	2	21
	1963	25	4	1	19

Source: FIA RPA 2012; Timberland: forestland capable of >20cft/acre-year of industrial wood

US Forest area and timberland



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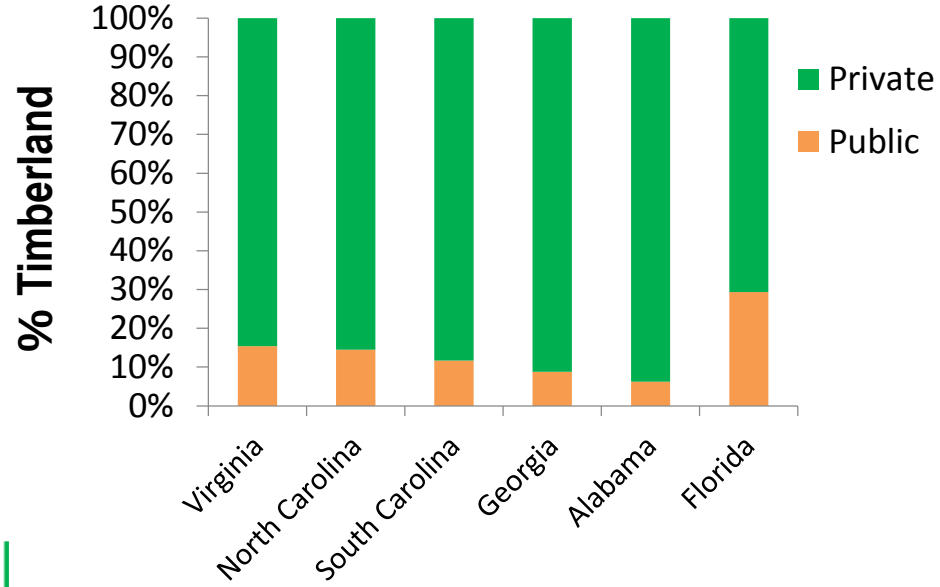
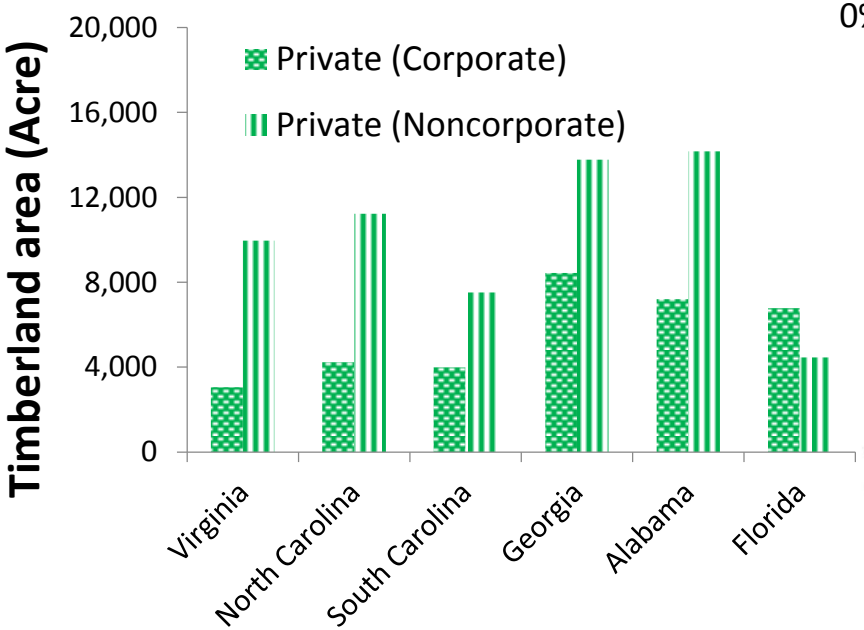
Source: FIA RPA 2012; Timberland: forestland capable of >20cft/acre-year of industrial wood

SE Timberland: area by ownership

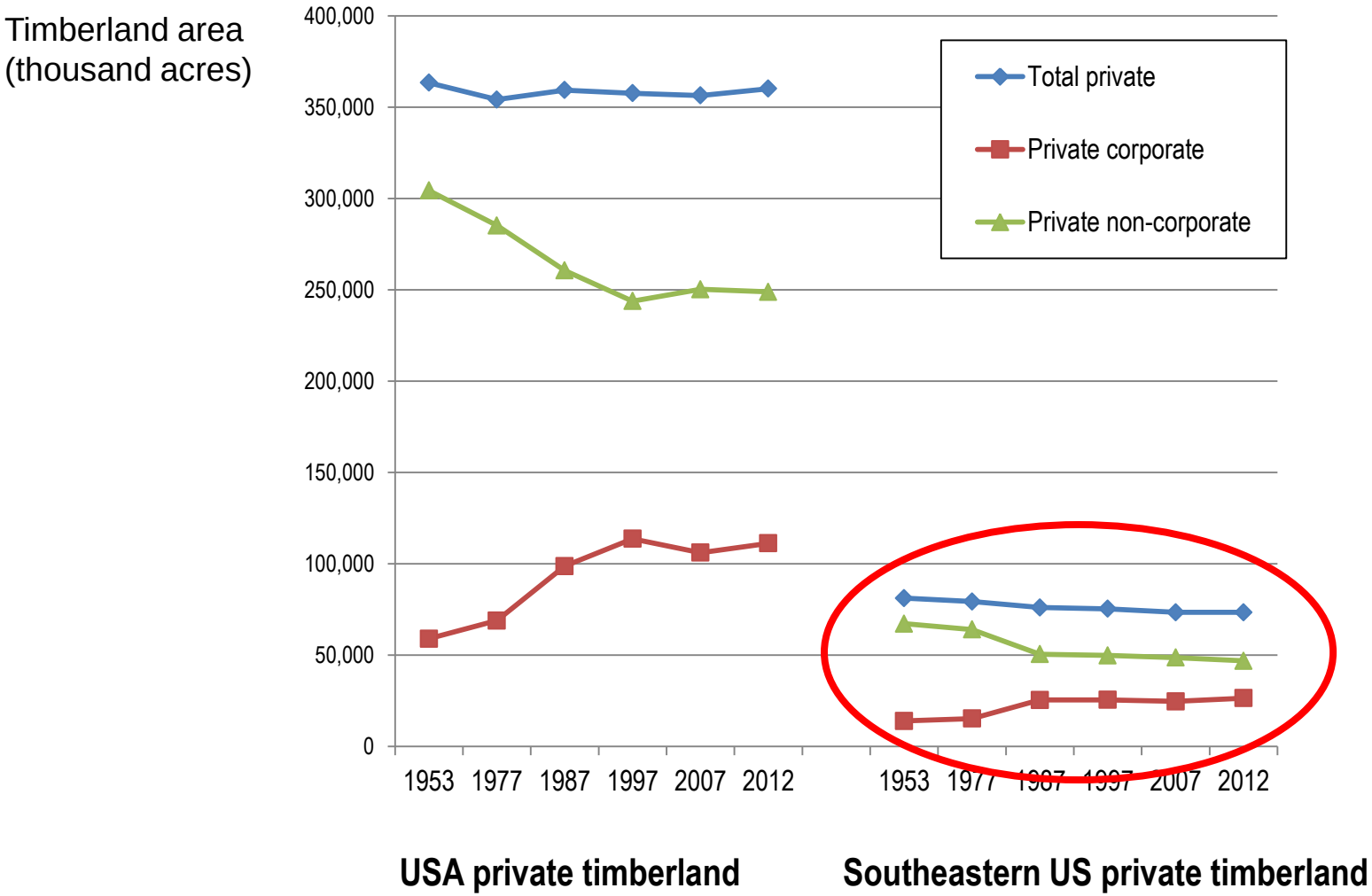




Source: FIA RPA 2012; Timberland: forestland capable of >20cft/acre-year of industrial wood

Southeast US private timberland area trends

Private timberland in SE (VA, NC, SC, GA, FL) declining due to development



Source: Forest Inventory Analysis Resource Planning Act (2012)

Southeast US private timberland area trends

Private timberland in SE (VA, NC, SC, GA, FL) declining due to development

Percent change in "interior forest" area by US county, 2001-2006. A measure of fragmentation, typically from urban expansion

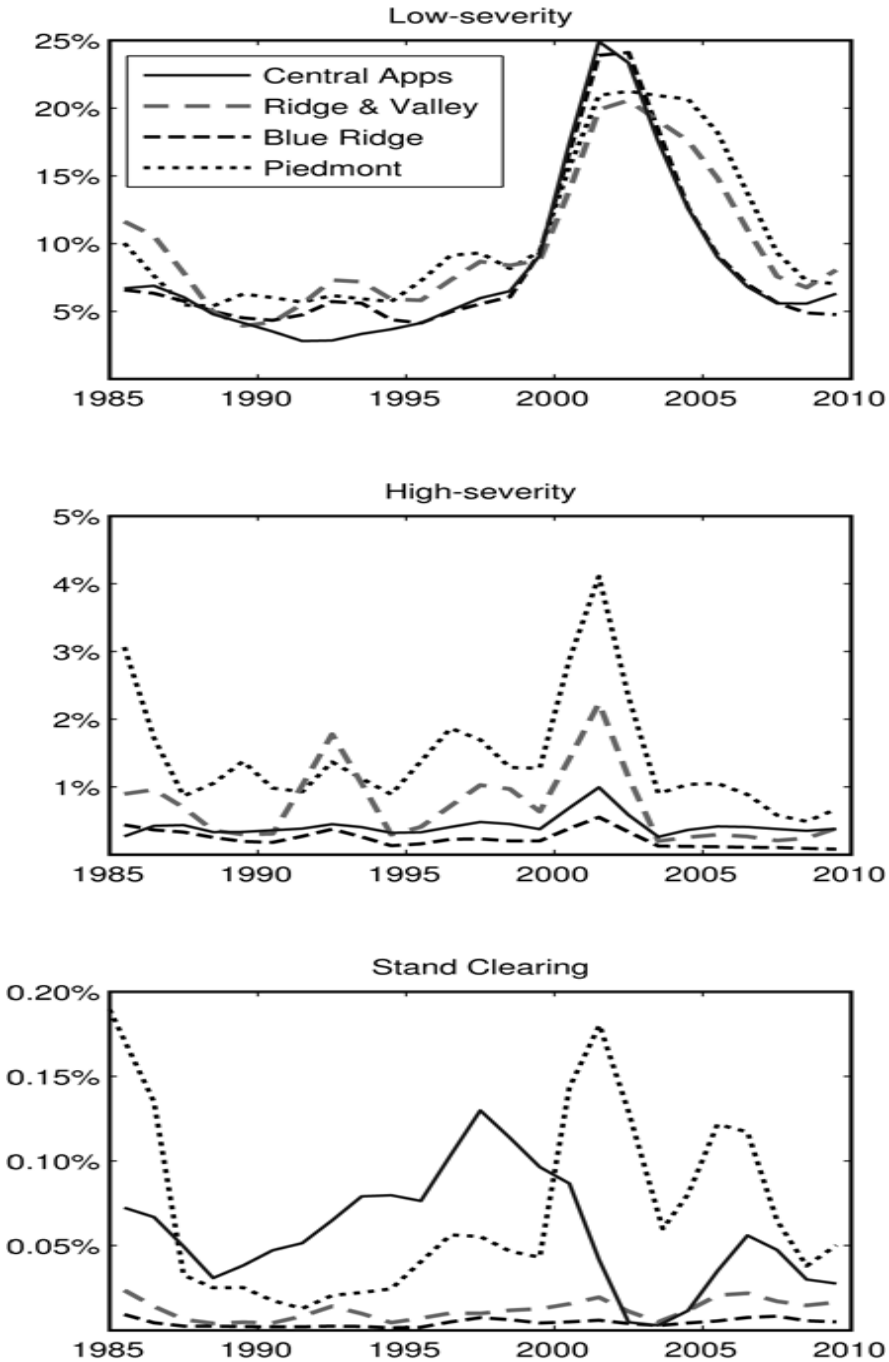
Source: Forest Inventory Analysis Resource Planning Act (2012)

Each year, 5-25% of SE US forest area was impacted by disturbance (1985-2010)

Key disturbances

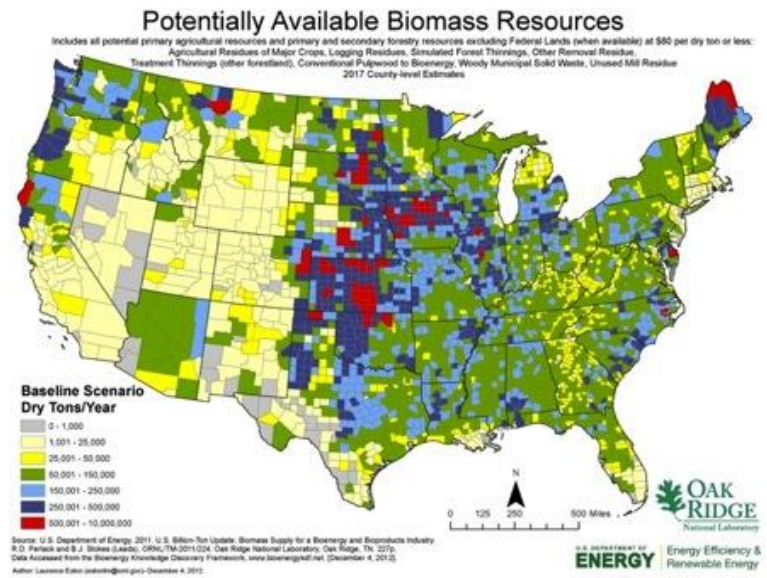
- Extensive anthropogenic disturbance
  - Urban and residential development
  - Forest conversion related to resource extraction
- Periodic droughts
  - Widespread and of low severity
  - Associated with high-severity fire and insect outbreaks
  - May exacerbate with climate change

Dale, Hughes & Hayes (In press)

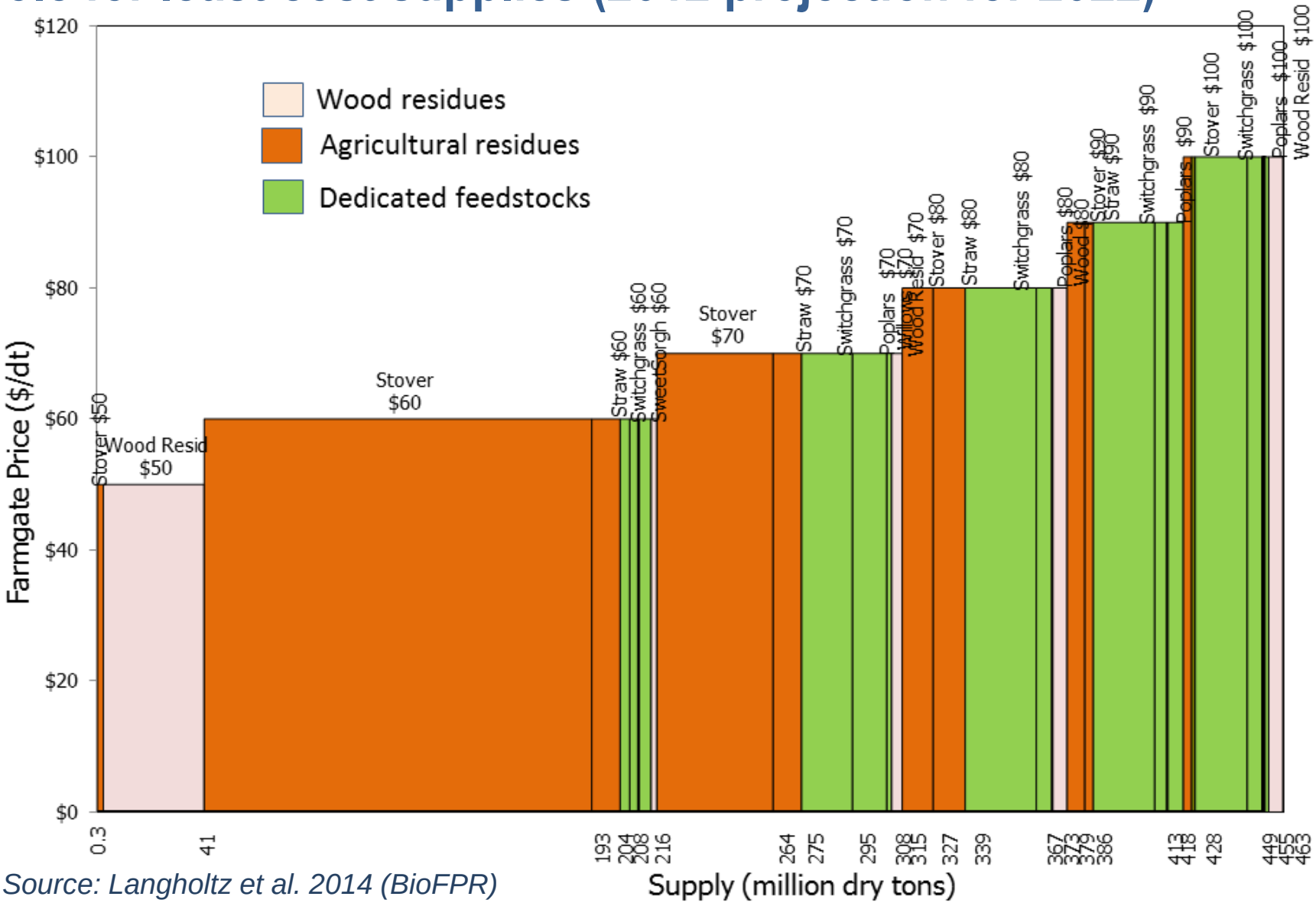


Future supply estimates

- Billion-Ton Study of 2005 helped support US renewable fuel volumes
- Billion Ton Update of 2011 included county-level cost & supply projections
- Conclusion: US has ample feedstock to replace up to 1/3 of petroleum with advanced biofuels
- Feedstock is roughly 1/3 cost of fuel: cost reductions and efficiency in feedstock supply are imperative
- Billion ton update 2016 to incorporate more sustainability considerations
- Multi-institutional effort (DOE & USDA)
  - 20-year projections of economic availability of biomass at county level by year
  - price, location; various scenarios
- Primary Resources
  - Forest resources (thinning, residues…)
  - Ag resources (corn stover)
  - Energy crops (switchgrass)



Future sources depend on costs – Residues play major role for least cost supplies (2012 projection for 2022)



Source: Langholtz et al. 2014 (BioFPR)

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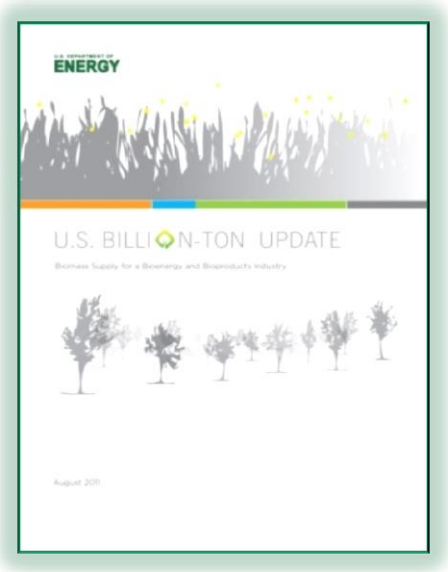
U.S. Bioenergy supply model Billion Ton Update (USDOE 2011)



- Forecasts of potential biomass
  - POLYSYS partial equilibrium model of US agricultural and forestry sectors.
  - 20-year projections of economic availability of biomass (price, location, scenario)

- Forest resources
  - Logging residues
  - Forest thinnings (fuel treatments)
  - Conventional wood
  - Fuelwood
  - Primary mill residues
  - Secondary mill residues
  - Pulping liquors
  - Urban wood residues
  - [Algae is separate study]

- Agricultural resources
  - Crop residues
  - Grains to biofuels
  - Perennial grasses
  - Perennial woody crops
  - Animal manures
  - Food/feed processing residues
  - MSW and landfill gases
  - Annual energy crop (added for 2011)

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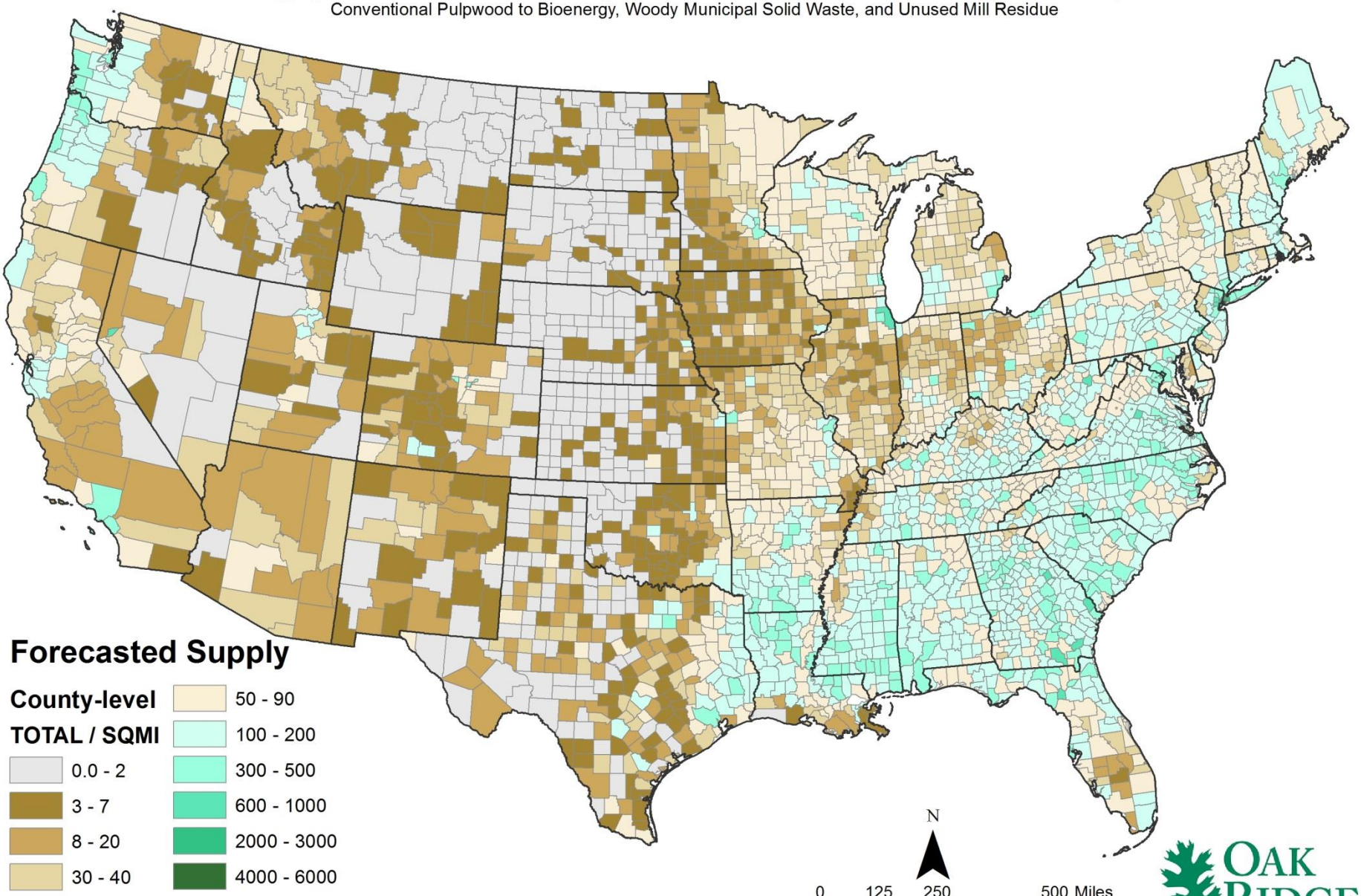
Potential Forestry Biomass Resources, 2012

Includes all potential primary and secondary resources excluding Federal Lands (when available) at $80 per dry ton or less:
Logging Residues, Simulated Forest Thinnings, Other Removal Residue, Treatment Thinnings (other forestland),
Conventional Pulpwood to Bioenergy, Woody Municipal Solid Waste, and Unused Mill Residue



Source: U.S. Department of Energy. 2011. U.S. Billion-Ton Update: Biomass Supply for a Bioenergy and Bioproducts Industry. R.D. Perlack and B.J. Stokes (Leads), ORNL/TM-2011/224. Oak Ridge National Laboratory, Oak Ridge, TN. 227p.

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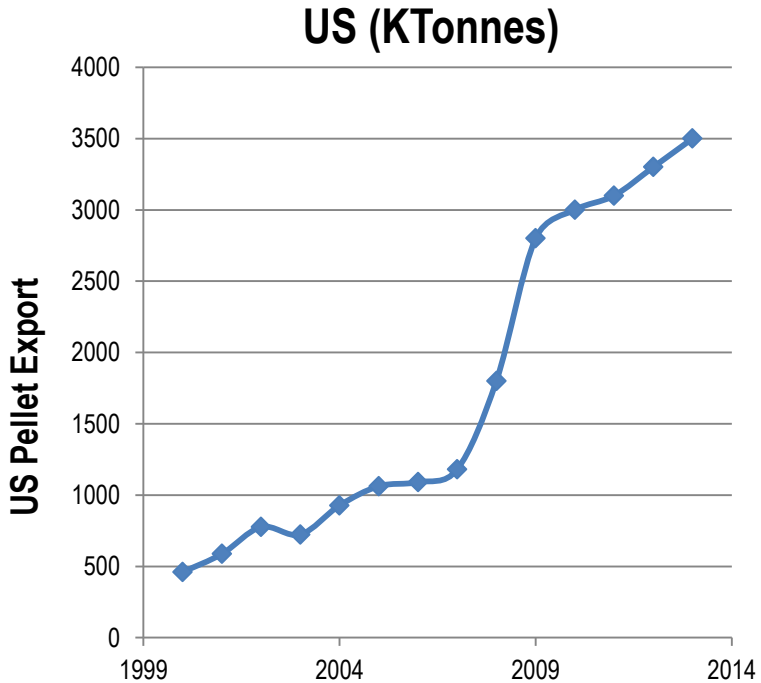
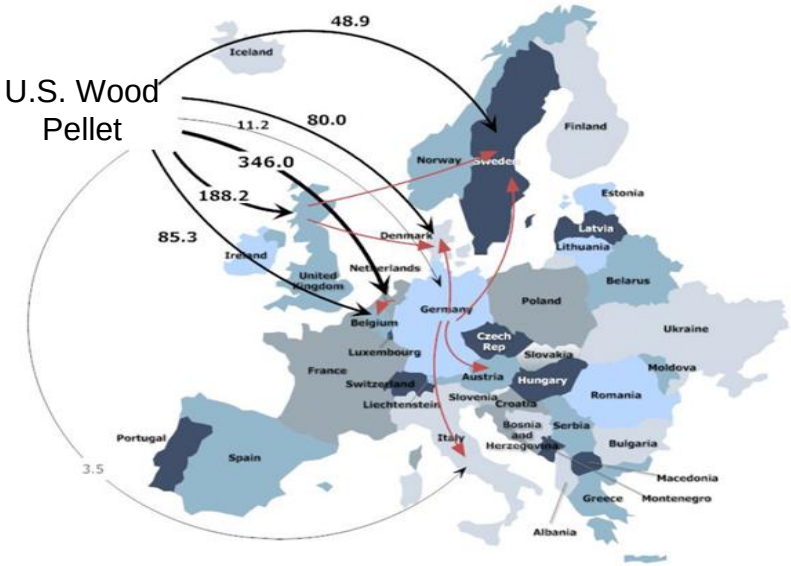
U.S. Wood Pellet Trade flow

Figure: U.S. Pellet Export (US EIA, 2014)

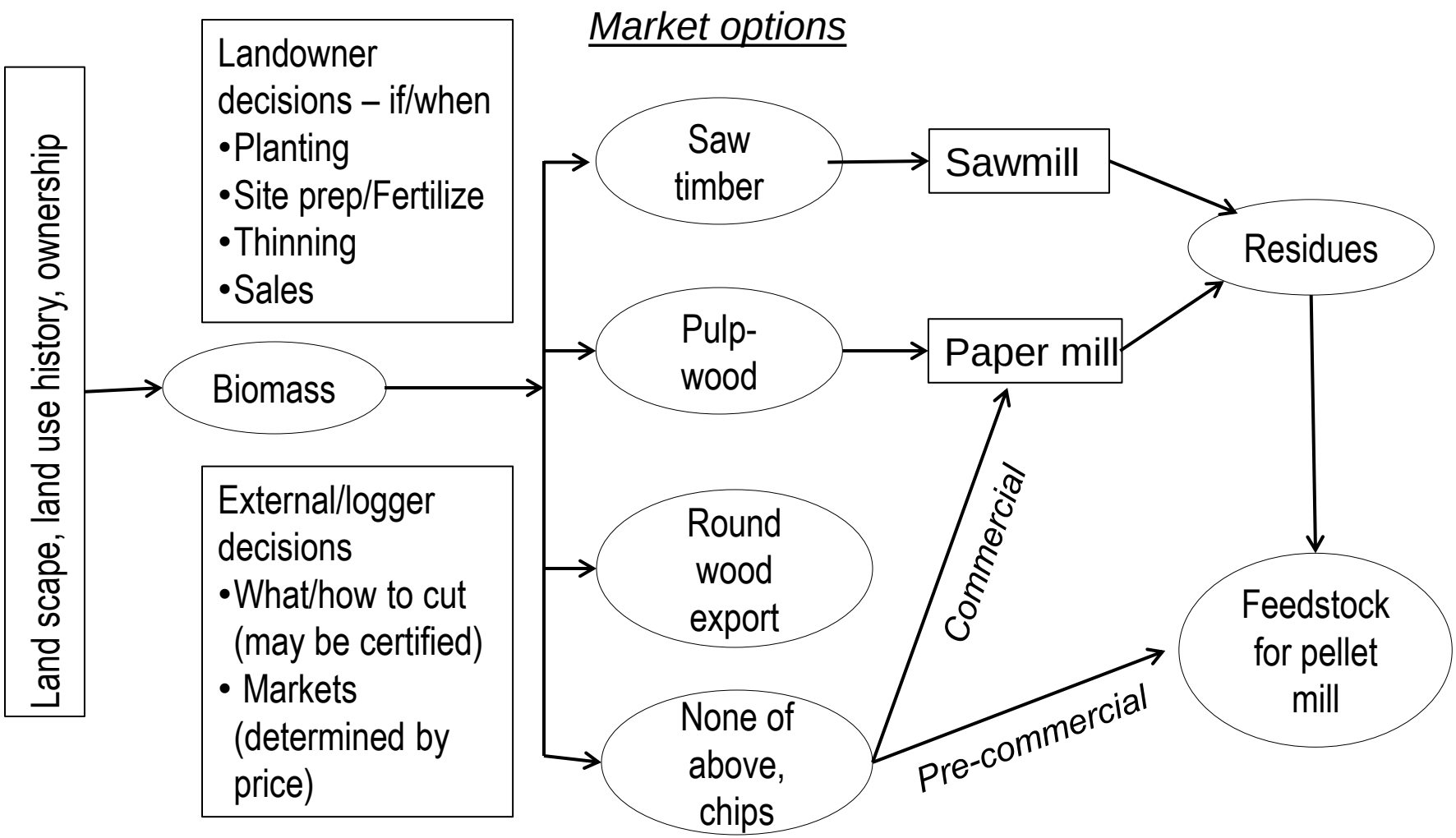




2010 Wood Pellet Trade flow from US to major EU markets and from Net exporters within EU , in 1000 MT

Data source: Lamers et al., 2013 and Eurostat, 2012

Woody Pellet Feedstock Supply Chain

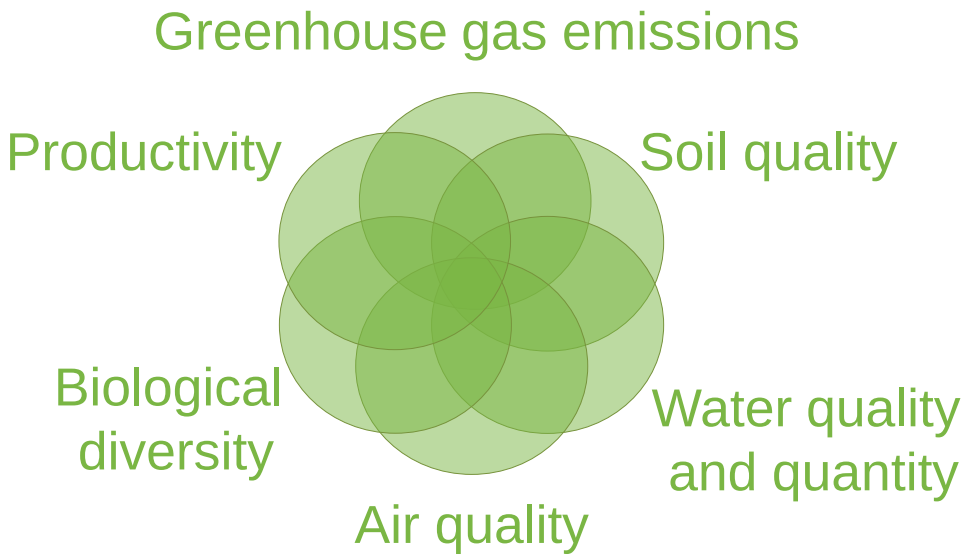


Trees are cut and sorted by size, qualities.

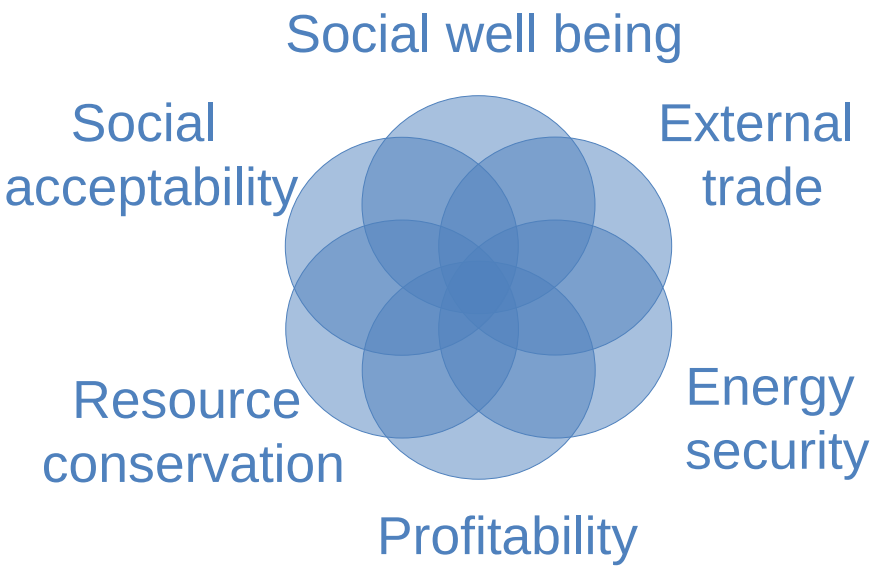
- Harvest meets Sustainable Forestry Initiative (SFI) standard
- Protection of places providing unique ecosystem services
- Targeting multiple round-wood markets (4): saw timber; pulp; low-value ‘form wood’ to China; remainders to pellets
- All branches and other residues, remain in forest
- Tagging, weighing systems in field supports “Chain of custody”

Plum Creek
Ticket #
3540124514
LOGISTICS
Logger Name: Southeast Logging Inc
County: Liberty State: GA
Harvest Unit: 110H-CB JONES-2THIN
Front Log Count: 42 Avg. Length: 19.6
Back Log Count: 44 Avg. Length: 13
Created Time: 10:13 AM Created Date: 10/23/13
Product: PST Cut to Length
Destination: East Coast Terminal
Haulier Name: Wall Timber Products Inc
j2799 Truck #: Robbie Finch
Authorization:
Contractor Signature:
Time: 10/24/13 07:45 AM
Location:
Latitude: 31.71831
Longitude: -81.45925
Contract: 350F6502

Categories for environmental and socioeconomic sustainability



McBride et al. (2011)
Ecological Indicators
11:1277-1289



Dale et al. (2013)
Ecological Indicators
26:87-102.

Recognize that measures and interpretations are <u>context</u> specific
Efroymson et al. (2013) *Environmental Management* 51:291-306.

Looking at the biofuel supply chain in terms of sustainability indicators

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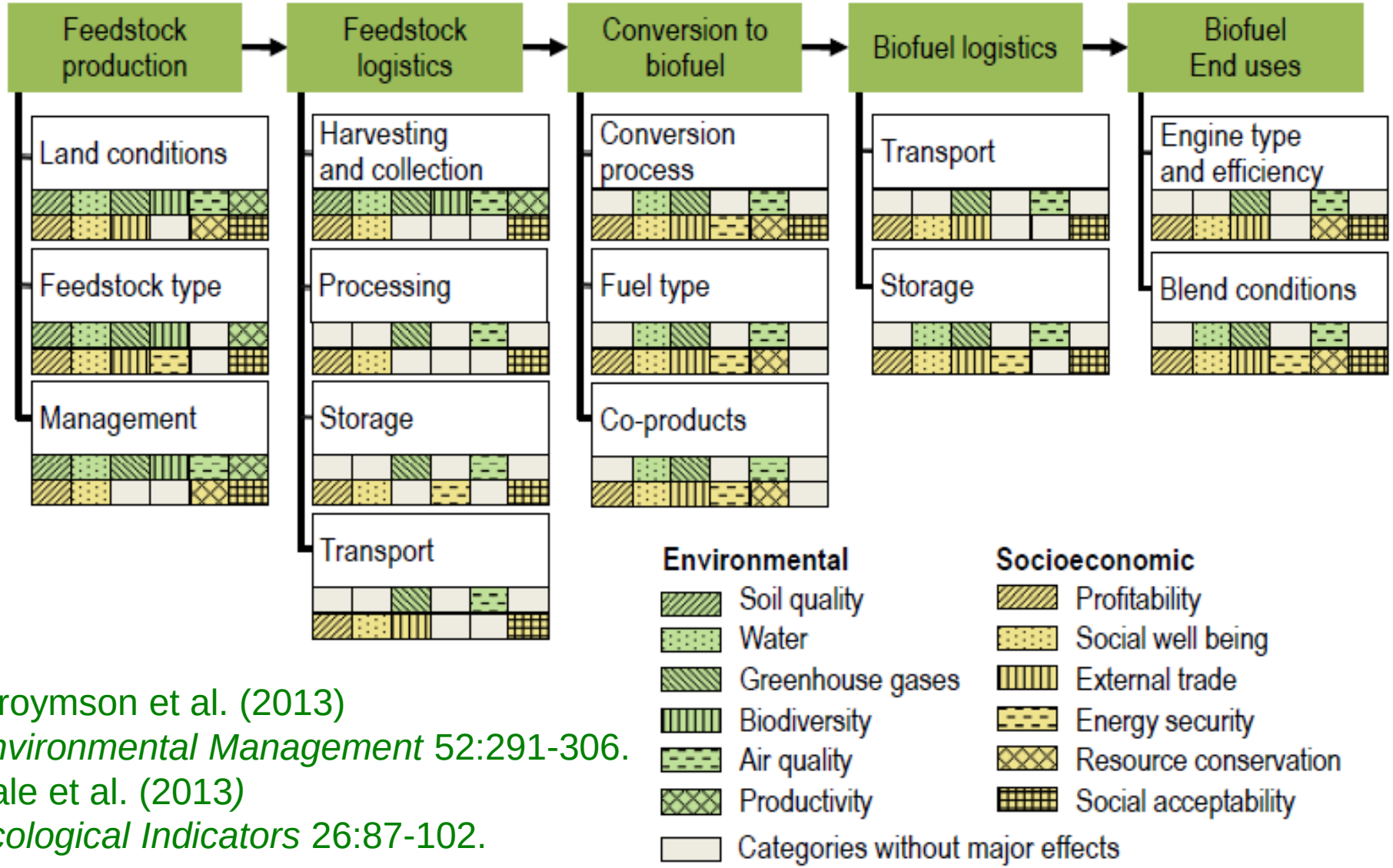

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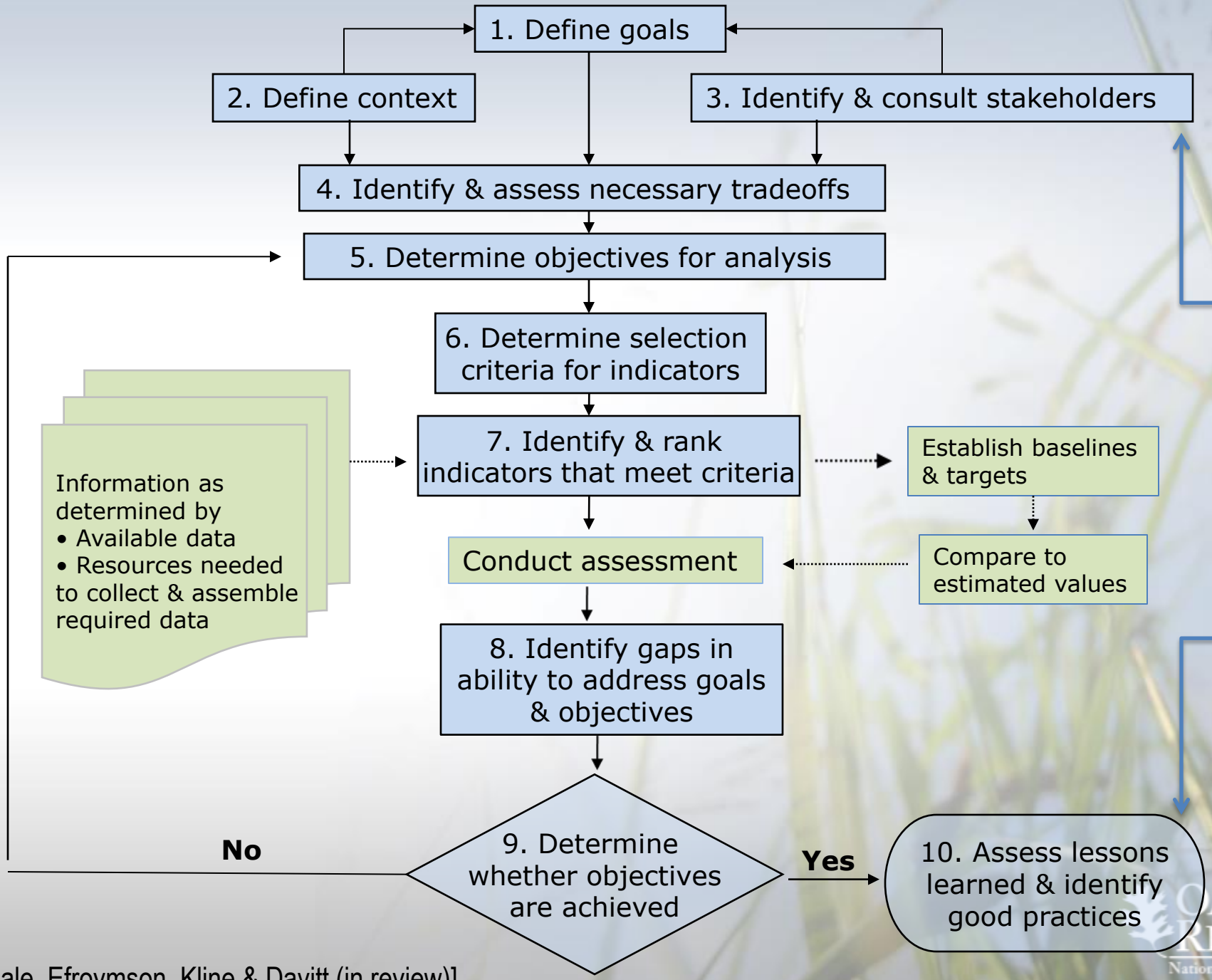

[Dale, Efroymson, Kline & Davitt (in review)]

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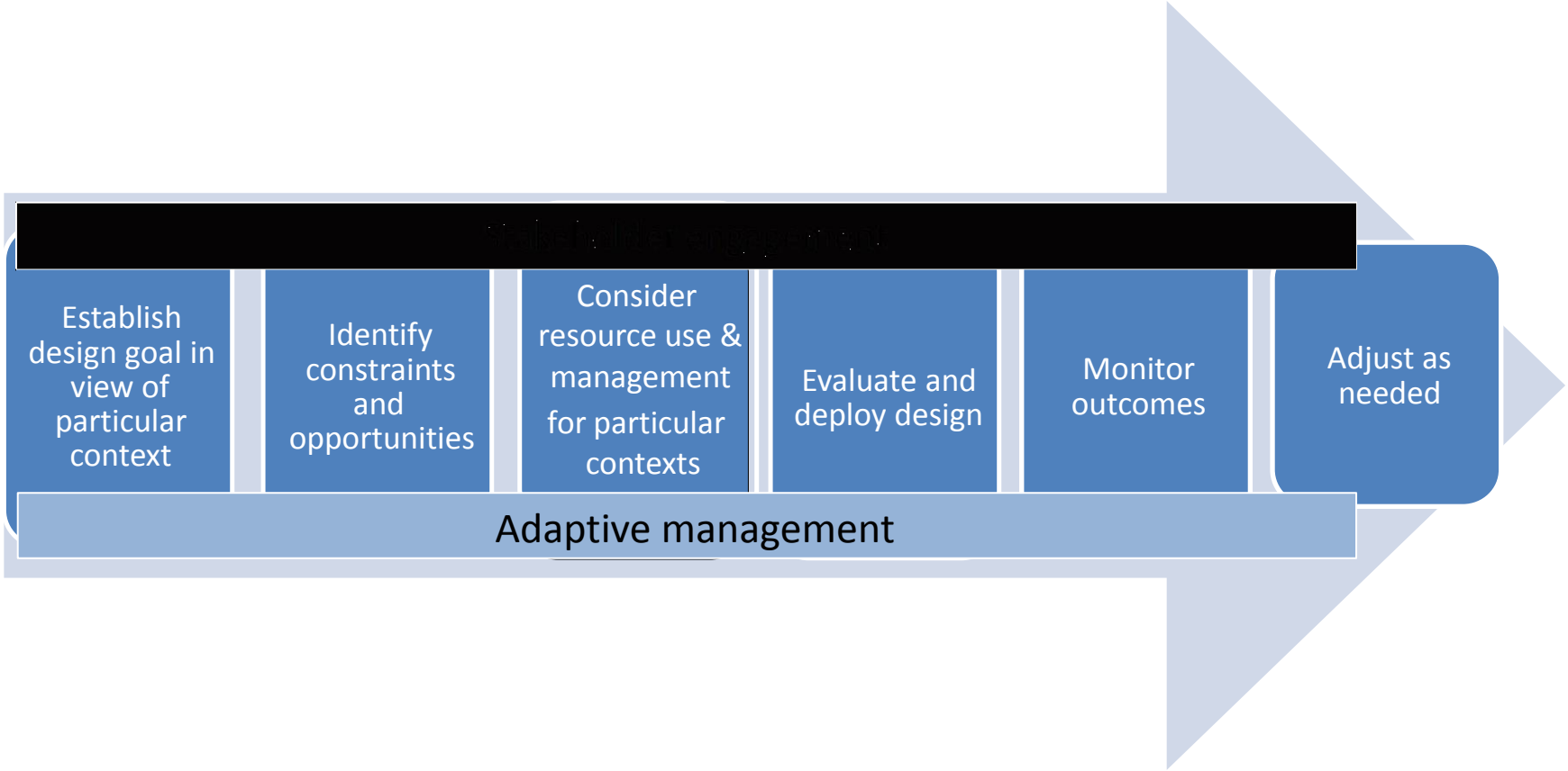
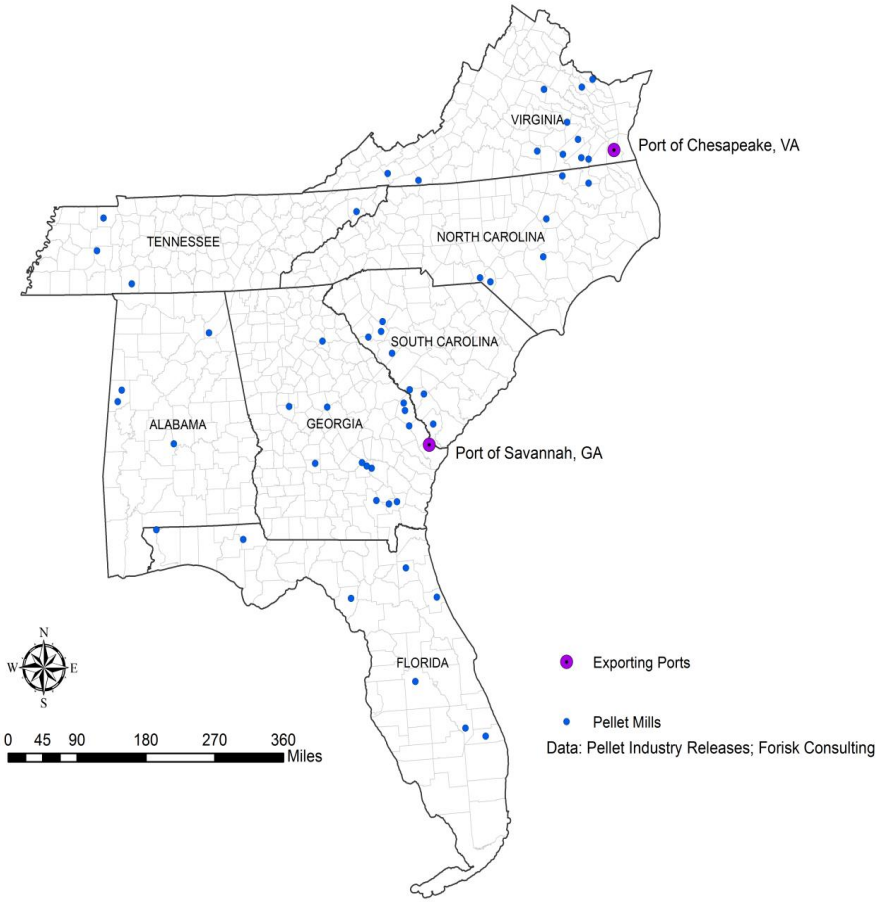
Landscape design

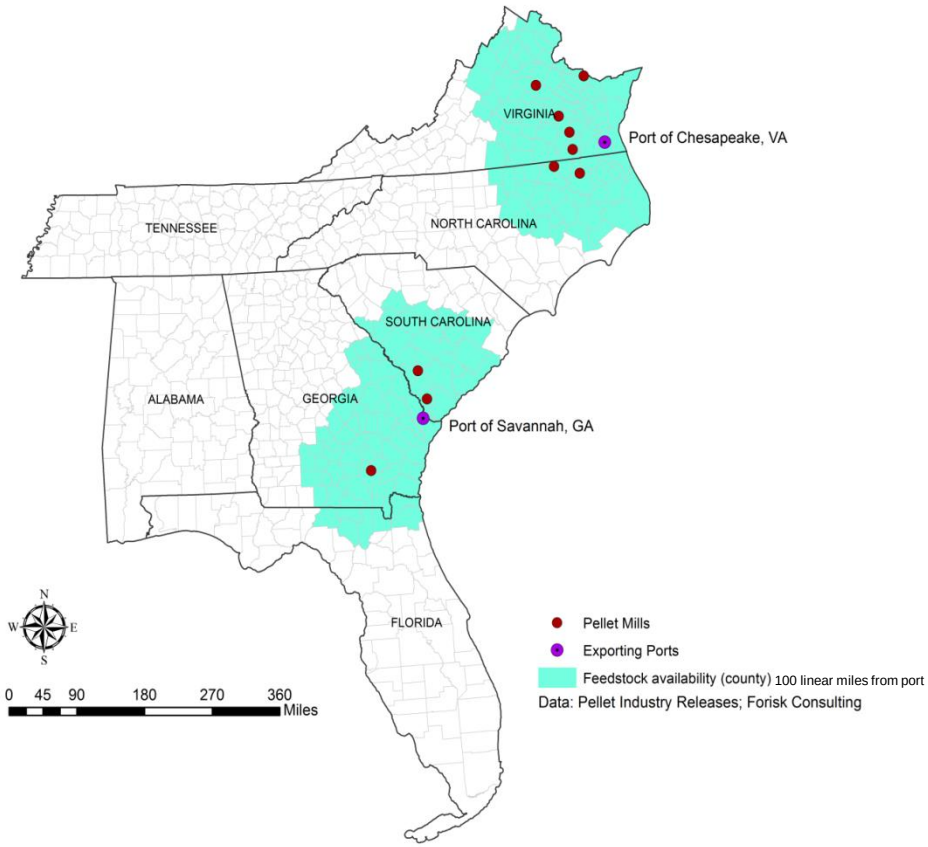


Study focuses on pellet mills feeding two ports

- Savannah: intensively managed pine plantations
- Chesapeake: more importance of bottomland hardwoods



Location of pellet mills in Southeast U.S.



Feedstock counties and pellet mills that use Chesapeake, VA and Savannah, GA port

IEA Task 43: Biomass feedstocks for energy markets

- **Overall approach**
  - Empirical case studies: environmental, economic and social changes over time*
  - Can methodology* be coordinated to improve consistency and comparability among cases?
  - Policy messages: barriers and opportunities to overcome them
- **Case studies**
  - Mobilization of forest* bioenergy supply chains in boreal and temperate forests (Canada, US and N Europe & Australia)
  - Mobilizing agricultural residues for bioenergy and biorefinieries
  - Regional biogas production from organic residues
  - Cultivation of grasslands and pastures – the sugarcane ethanol case
  - Integration of bioenergy crops into agricultural landscapes*

* ORNL is in discussion with IEA Task 43

Thank you!

CBES

Center for BioEnergy Sustainability

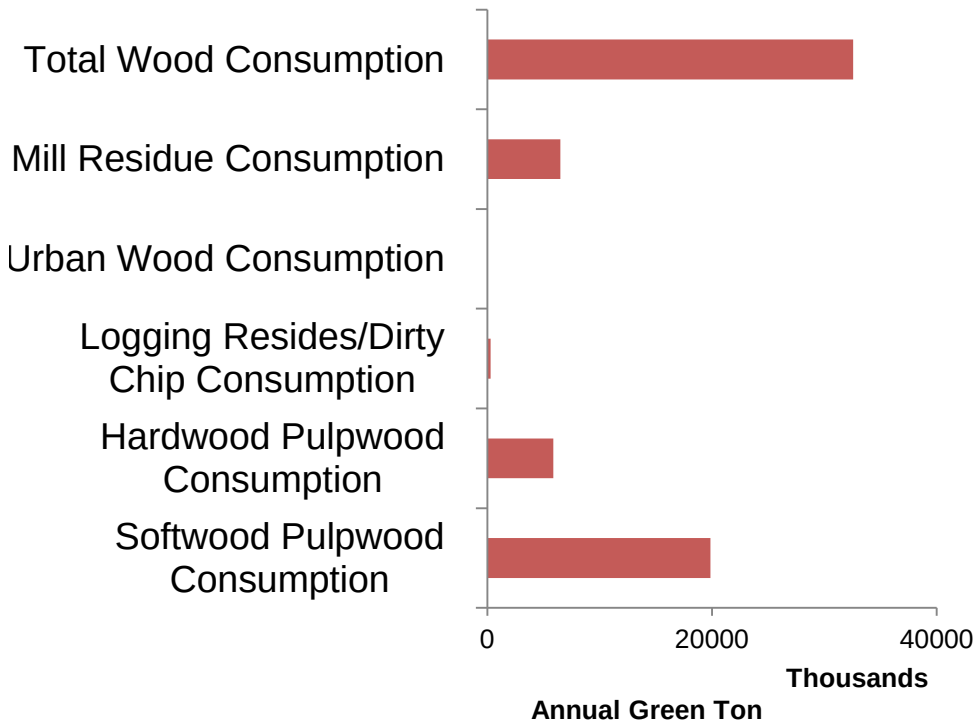
http://www.ornl.gov/sci/ees/cbes/

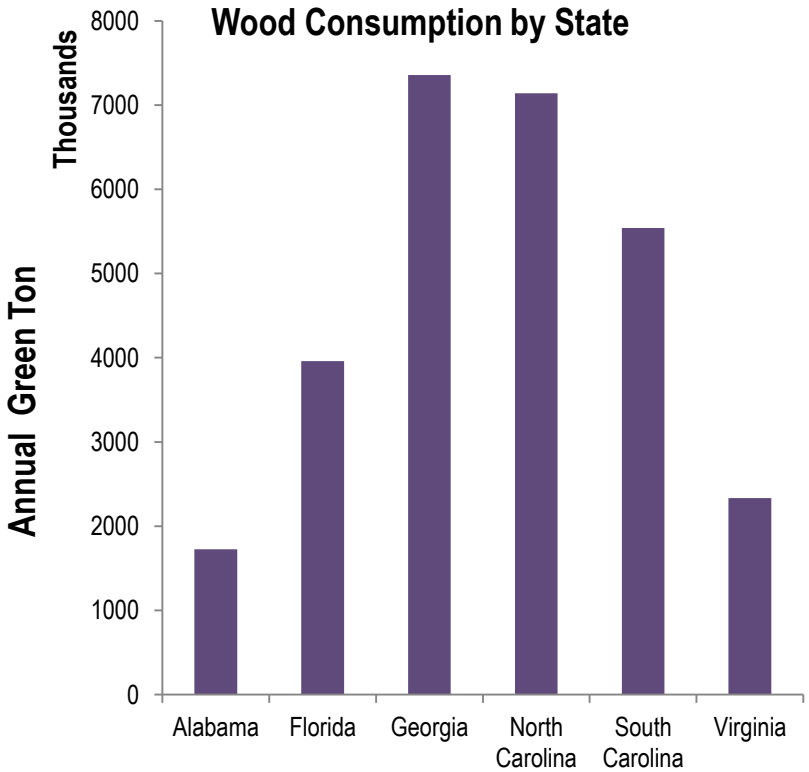
Requirements for pellet industry in SE US to move toward sustainability*

- Document GHG emissions below thresholds
- Avoid negative impacts on “high biodiversity” and “high carbon” areas
- Avoid impacts on wetlands
- Maintain or increase soil qualities and productivity
- Document chain-of-custody
- Verify via third party that biomass is “legal and sustainable”

***Results from Pinchot workshop; Savannah, Ga, October 2013**

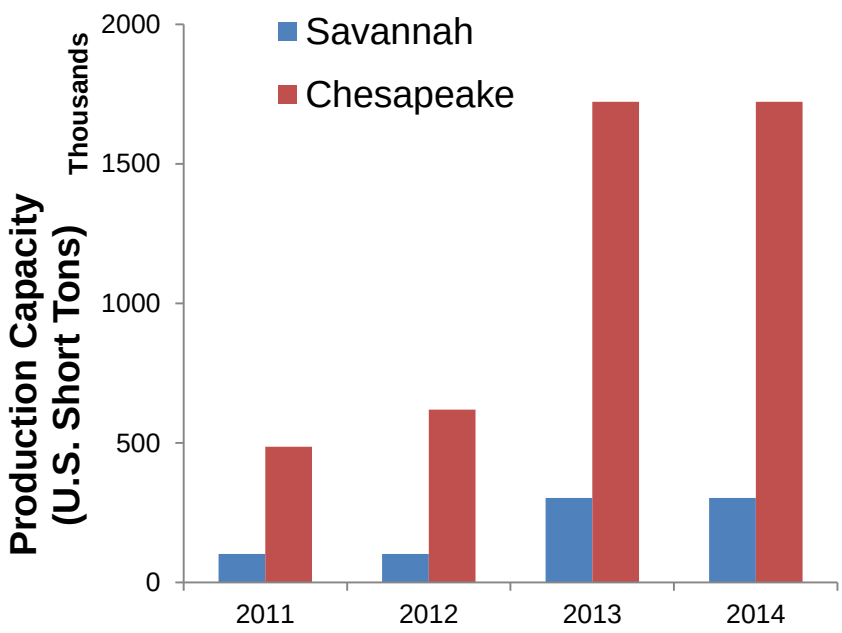
Southeast Pellet Mills Wood consumption (Annual Green Tons)

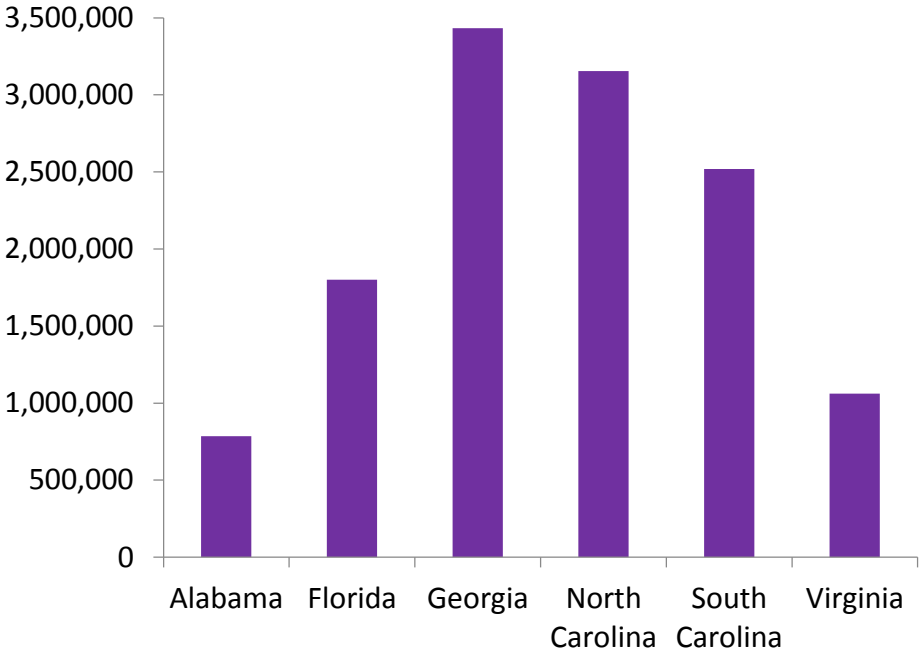




Forisk, as of September 2014

Annual Pellet Production Nameplate Capacity





Forisk , September 2014

Recommended practices

- Consider management goals and options within the broader context
- Attention to site selection and effects in the
  - location and specification of feedstock
  - handling and transfer of feedstock
  - refinery processing
  - Distribution and use of bioenergy
- Monitoring and public reporting of key measures of sustainability
- Attention to what is “doable”
- Stakeholder engagement throughout process

McBride et al. (2011) Ecological Indicators 11:1277-1289.
Dale et al. (2013) Ecological Indicators 26:87-102.

For more information Bioenergykdf.net

BIOENERGY KNOWLEDGE DISCOVERY FRAMEWORK
KDF
U.S. DEPARTMENT OF ENERGY

KDF
bioenergykdf.net

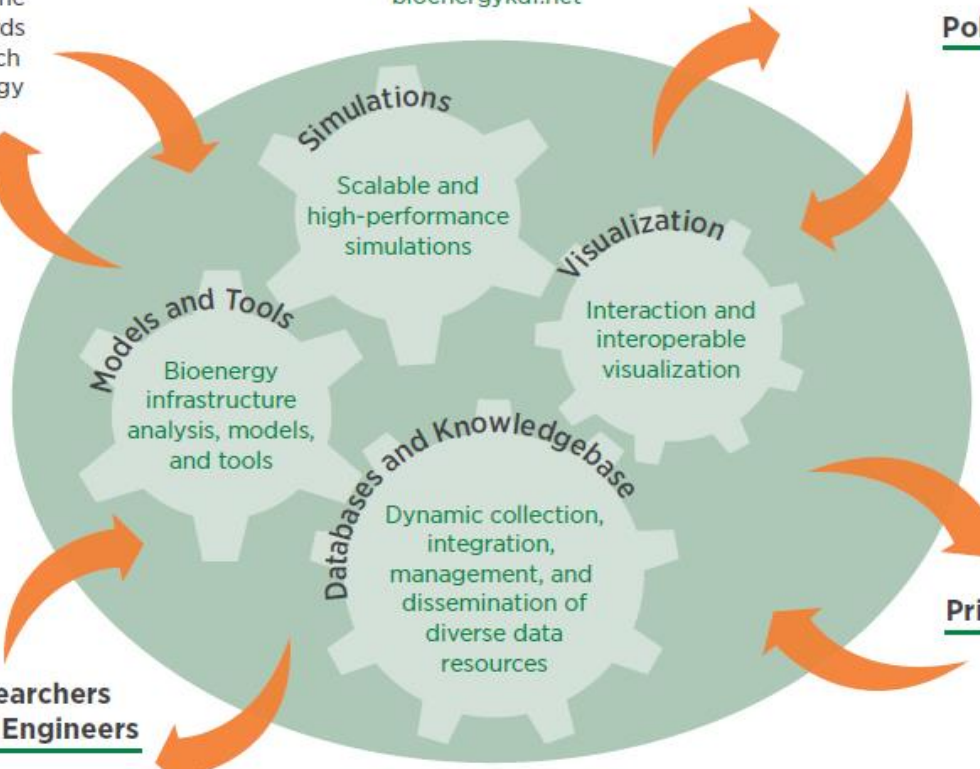
Consumers

Consumers can learn about the newest sustainability standards and explore the latest research on the impact of the bioenergy industry on the economy, environment, and local communities.

Policy Makers

- Federal
- State
- Local

Policy makers can decide on areas for research and demonstration funds and assess vulnerabilities in the bioenergy supply system, such as the impact of crop failures, transportation shutdowns, or lower-than-anticipated volumes of biofuel production.



Private Industry

- Feedstock Producers
- Biorefinery
- Transportation Sector
- Distribution and Retail
- Transportation Technology Developers

Private industry can identify feed-stock production potential, energy-demand patterns, and available infrastructure in order to develop market strategies and invest in bioenergy business opportunities.

Researchers and Engineers

- Academia
- National Laboratories
- Non-Governmental Organizations

Researchers and engineers can share data on sustainability metrics—such as water availability, soil type, land-use patterns, and climate trends—and connect multiple institutions that perform complex assessments of

For video, see: https://www.youtube.com/watch?v=sm1Yt-kPZpE&list=UUSRLqX2RF5hWFxb2AY891wg

Percent of Forested Land by Ownership Type

Private Forest

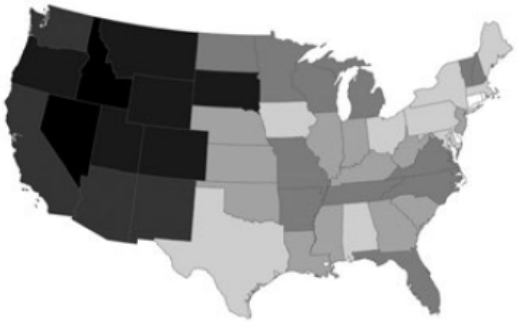
Family*

Corporate

Other private**

Public Forest

Federal



State

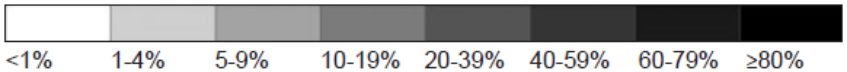
Local

*Family includes individuals, families, trusts, estates, and family partnerships.

**Other private includes conservation and natural resource organizations, unincorporated partnerships and associations, and Native American tribal lands.

0 500 1,000 Miles

Scale and legend apply to all six ownership type maps.



FIA, 2009