Opportunities and Costs of Wood-Based Bioenergy in the Southeastern United States (SE US)

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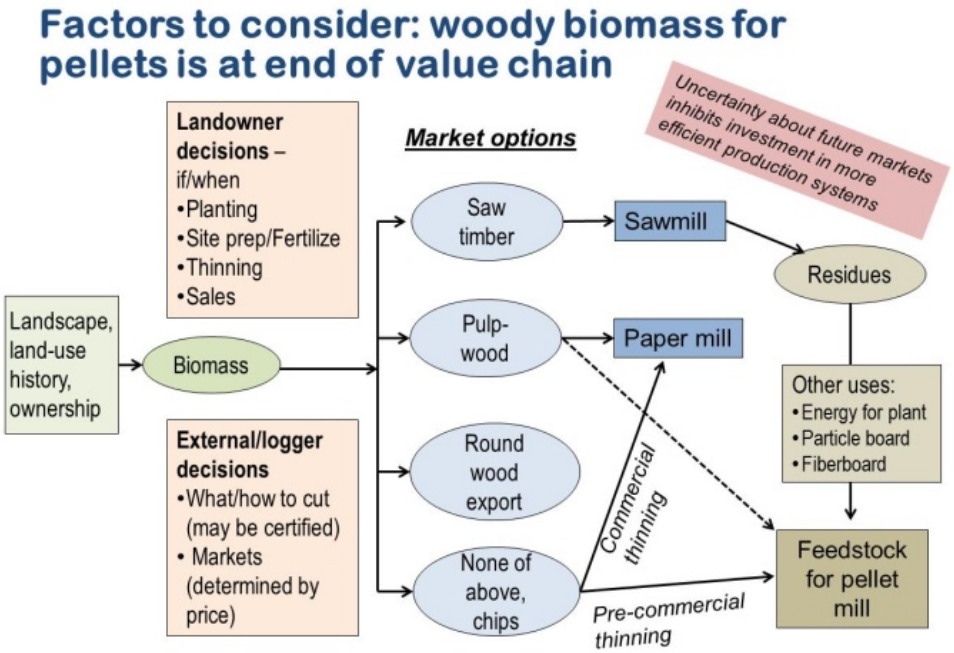
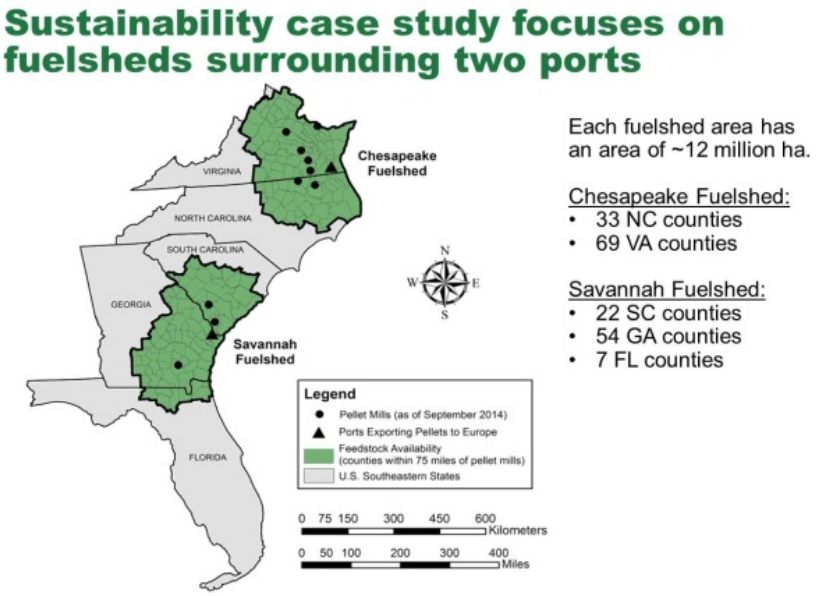
Background:

- Use of woody biomass for energy from forestry operations in the SE US has grown rapidly since 2007, with wood pellet exports to Europe more than doubling from 2012 to 2014.
- Several European and American environmental groups have expressed concerns about the long-term sustainability of using SE US wood pellets for biopower.
- Wood pellets are largely a byproduct of the timber harvested for lumber, paper and pulp and are only a very small part of the total US wood export (~2-4%)



Analysis: ORNL used Forest Inventory Analysis (FIA) data collected by USDA [http://www.fia.fs.fed.us/tools-data/]

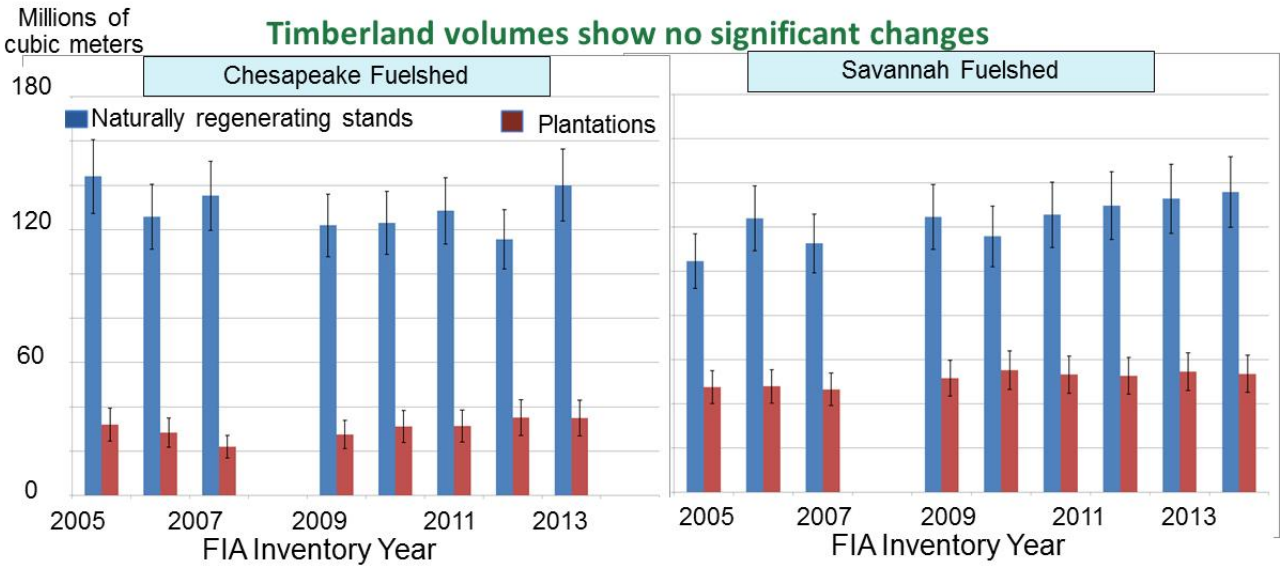
- Based on empirical measures of
  - Forest area and location
  - Species, size, and health of trees
  - Total tree growth, mortality, and removals by harvest
  - Wood production and utilization rates by various products
  - Forest land ownership
- Calculated estimates of carbon in 9 categories.

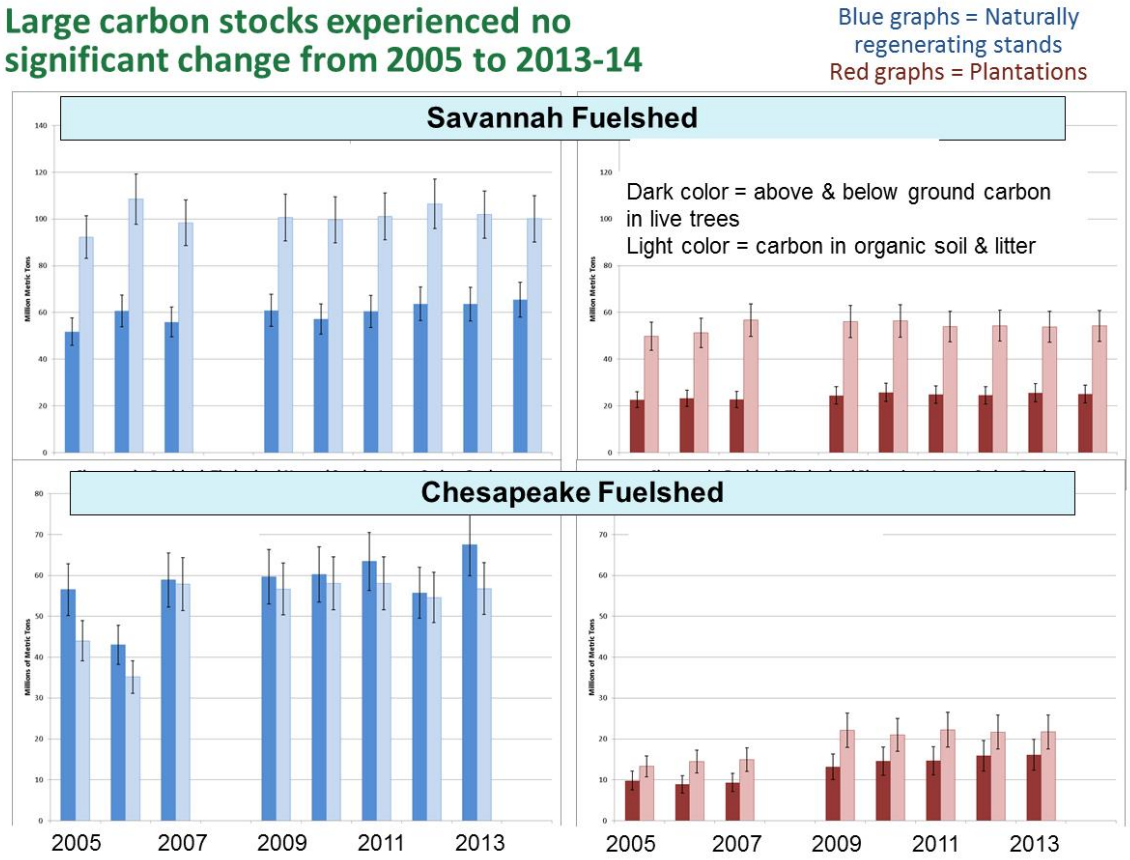


Results: No significant changes in two major fuelsheds in the SE US are evident up to 2014 for

- Stand size distribution (small, medium, large)
- Number of standing dead tree
- Carbon in four categories: litter and soil, other non-harvestable material, harvestable material, or above-ground biomass
- Forest area or volume
- Timberland area or volume

Note: Error bars indicate FIA % sampling error at 95% confidence level





Opportunities, Barriers, and Paths Forward for Sustainable Use of Bioenergy

Bioenergy offers an opportunity to replace use of fossil fuels with a renewable energy option that, if produced and managed sustainably, could address environmental, social, and economic needs. Developing the technology to successful transfer to a sustainable bioeconomy requires understanding major opportunities and barriers. Key opportunities include conservation of fossil resources for future generations, improved energy security, more stable jobs, reduced risk of catastrophes, better management of renewable resources, environmental benefits, reduced waste and inefficiencies, use existing infrastructure and technologies, retention of land in forest and agriculture, and enhanced food security. While the greatest barrier to progress toward more sustainable bioenergy is lack of economic demand, other factors are public perceptions, unmet expectations about costs and timetables, lack of infrastructure, uncertainty about future demand and price structure, and inconsistent approaches to measuring and promoting more sustainable production. Taking advantage of opportunities and recognizing barriers can lead to paths that include building on existing infrastructure; increased system resilience by using existing technology; clarifying underlying assumptions; applying context specific technology and solutions; expanding use of higher blends (E85) and flex fuel vehicles; making high octane and mid-level ethanol blends available; using wastes, residues and sustainable cellulosic feedstock; supporting clear, fair rules for international trade; and engaging stakeholders in review of options, costs and benefits.

Opportunities

A sustainable bioeconomy brings opportunities to enhance social welfare, environmental conditions, and economic prospects. The diversity of products and importance of the biomass sector in the US economy is large and increasing, representing more than $369 billion in 2013, and has strong growth potential. Opportunities provided by a more sustainable bioeconomy include conservation of fossil resources for future generations, improved energy security, more stable jobs, and reduced risk of catastrophes. In addition, a more sustainable bioeconomy would encourage better management of renewable resources, provide environmental benefits, reduce wastes and inefficiencies, use existing infrastructure and technologies, retain land in forest and agriculture, and enhance food security. Each of these potential opportunities is context-specific, meaning that they could best be achieved relative to other options in particular times and places. The realization of benefits also depends on application of good management practices and a supportive social and political environment. Hence, studies documenting benefits from bioenergy often focus on particular situations and feedstocks or conversion processes. Major opportunities provided by a sustainable bioeconomy are listed below.

- Better management of renewable resources
  - Reducing waste and inefficiencies
  - Existing infrastructure, know-how and technologies
  - Retaining land in agriculture or forest
- Improve environmental conditions
  - Soils and water
  - Biodiversity
  - Carbon and GHG
- Enhance food & energy security
  - Conserving fossil energy resources
  - Reducing risk of catastrophes
- Increase rates and stability of employment

Barriers

The largest barrier to progress toward more sustainable bioenergy is economics, characterized by relatively cheap fossil fuels, unstable policies, high first costs and technical challenges of new energy systems, an uneven playing field, and the need for significant new high-risk investment. The economic barrier is bolstered by public perceptions, unmet expectations about costs and timetables, lack of infrastructure, uncertainty about future demand and prices, and inconsistent approaches to measuring and promoting more sustainable production. The following obstacles operate in concert:

- Public perception
  - Unmet expectations
  - Uncertainty in future demand and prices
- Economics
  - Unstable policy
  - Up-front costs, technical challenges and risks of new systems
  - Uneven playing field (subsidies, lack of infrastructure for new systems, and easy access to inexpensive fossil fuels)
- Sustainability concerns
  - Food security
  - Biodiversity
  - Carbon emissions

Paths forward toward a sustainable bioeconomy

It will take time and an alliance of strong political and private-sector support (policies and investment) to fully develop biofuel production capacity and achieve the important role envisioned for bio-based fuels and industries in a more sustainable society. Identifying locations, feedstocks, production pathways, management practices, and technologies that support progress toward sustainable bioenergy must be specific to particular contexts. Even so, there are many opportunities, and the barriers are not insurmountable. The costs and benefits should be fully transparent and communicated to the diversity of stakeholders. Bioenergy is not a "one-size-fits-all" solution for addressing energy needs; it is a renewable source of energy that could meet society's needs while protecting or conserving ecosystem services in some locations. Key elements in this process are

- Continual monitoring
- Using wastes and residues
- Being context specific: Build on existing infrastructure & knowhow; communicate costs and benefits
- Promoting better management**:** Integrated agriculture & landscape design

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