

Summary Presentation of GREC Biomass Assessment

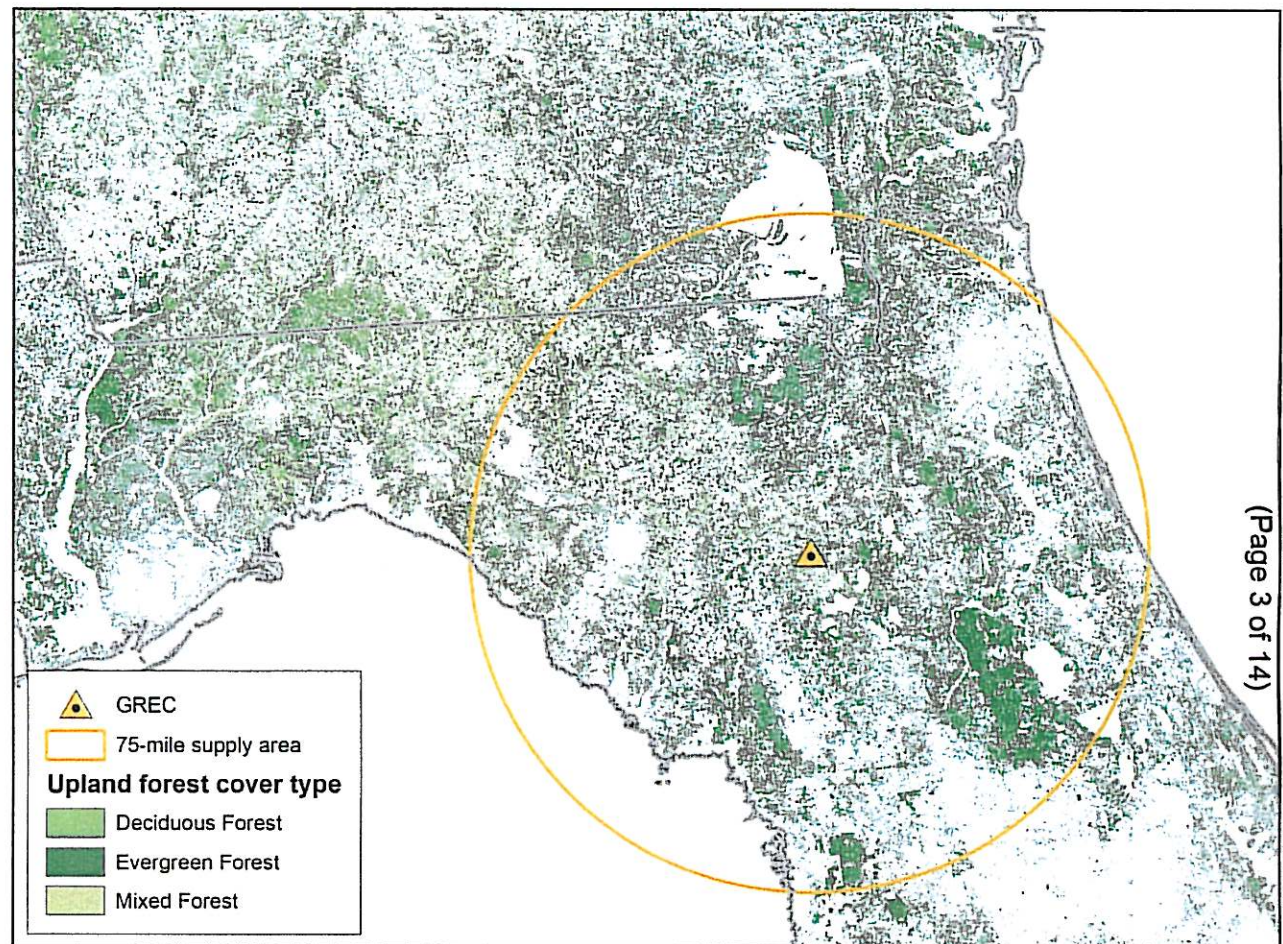
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Presentation Outline

- Definition of biomass supply area
- Methodology and data utilized
- Generation and procurement of target fuel supply composition
- Regional & historic perspective on major biomass users
- Sustainability of Florida's forest resource
- Integration of biomass production into conventional forestry production

The GREC Biomass Supply Area

- Within the GREC biomass supply area, there are 6.3 million acres of upland forests.
- The biomass supply area for GREC is considered to be the land area within 75 miles of the facility.
- This represents the approximate distance where freight costs are not so excessive as to elevate delivered fuel costs.
- Along with the supply area, this map plots the distribution of upland forest cover in the region, an important resource for GREC's fuel supply and the focus of much of this overview.



National Land Cover Dataset from USGS.

Data Sources and Methods for Estimating Biomass Generation

Urban-Derived Biomass

- Population-distributed using census tract data
- Per capita generation rates based on published data
- Adjusted based on population density factors and knowledge of local conditions; cross checked with FL DEP solid waste reports

Mill Residues

- As reported by USDA FS Timber Products Output data
- Confirmed with telephone interviews and site visits to local mills

Forest-Derived Biomass

- Forest acreage and first thinnings volumes from pine age and acreage data from USDA Forest Service Forest Inventory and Analysis data
- Logging residue as reported by USDA Forest Service Timber Products Output (TPO) data
- Confirmation of above by stand-level growth and yield modeling of north FL pine productivity in collaboration with local forestry consultants and landowners

Over 5 million tons of Potential Biomass Feedstock Generated in GREC Supply Area

- GREC’s demand for biomass fuel is 1 million tons/yr.
- Data indicate that biomass generation within the GREC supply area exceeds 5 million tons/yr, summarized in the table below.
- That is, more than 5 times as much potential biomass fuel is generated in the supply area as is needed by GREC.

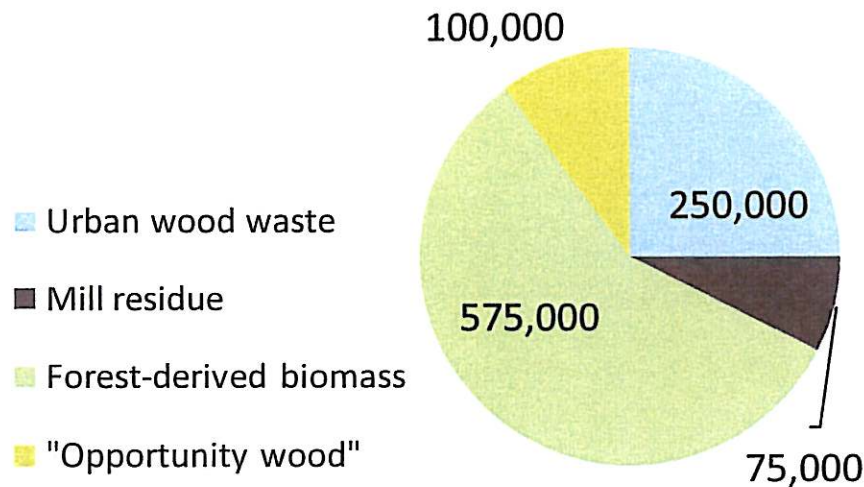
Material	Generated in supply area (green tons/yr)	Target procurement volume for GREC (green tons/yr)
Urban wood waste	410,000	250,000-300,000
Forest-derived biomass		
First thinnings	540,000	150,000-200,000
Logging residue	1,600,000	400,000-500,000
Mill residue	3,300,000	75,000-100,000
Total	5,850,000	1,000,000

Perspective on the Feasibility of Capturing the Targeted Volumes

For those not accustomed to evaluating information about biomass feedstocks, a few references to the scale and scope of some current FL biomass fuel operations may be helpful

- 250,000 tons/year of urban wood waste
 - For comparison, Okeelanta uses 900,000 tons/year for their biomass electrical generation, virtually all from S FL urban sources
(http://www.floridacrystals.com/content/112/renewable_energy.aspx)

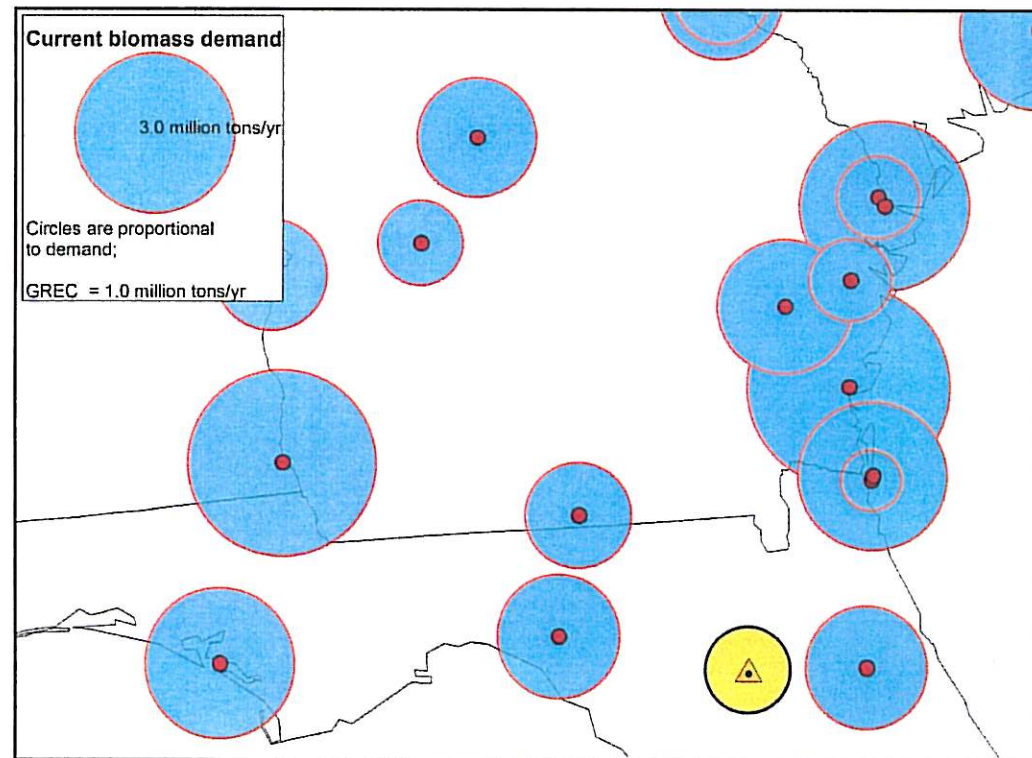
GREC fuel supply composition (green tons/yr)



- 75,000 tons/year of mill residue
 - Over 3 million tons/year generated in procurement area
 - We need to capture less than 3% of total, we will have transport advantage for some mills
- 100,000 tons/year of "opportunity wood"
 - Wood sourced from any of the above categories, as well as storm debris, beetle-killed timber, and attractively-priced spot market forestry wood
 - Telogia (12 MW) and Monticello (8 MW) operate almost exclusively with wood from these sources

The Biggest Consumers of Biomass in the Region: Pulp Mill Demand in North FL and South GA

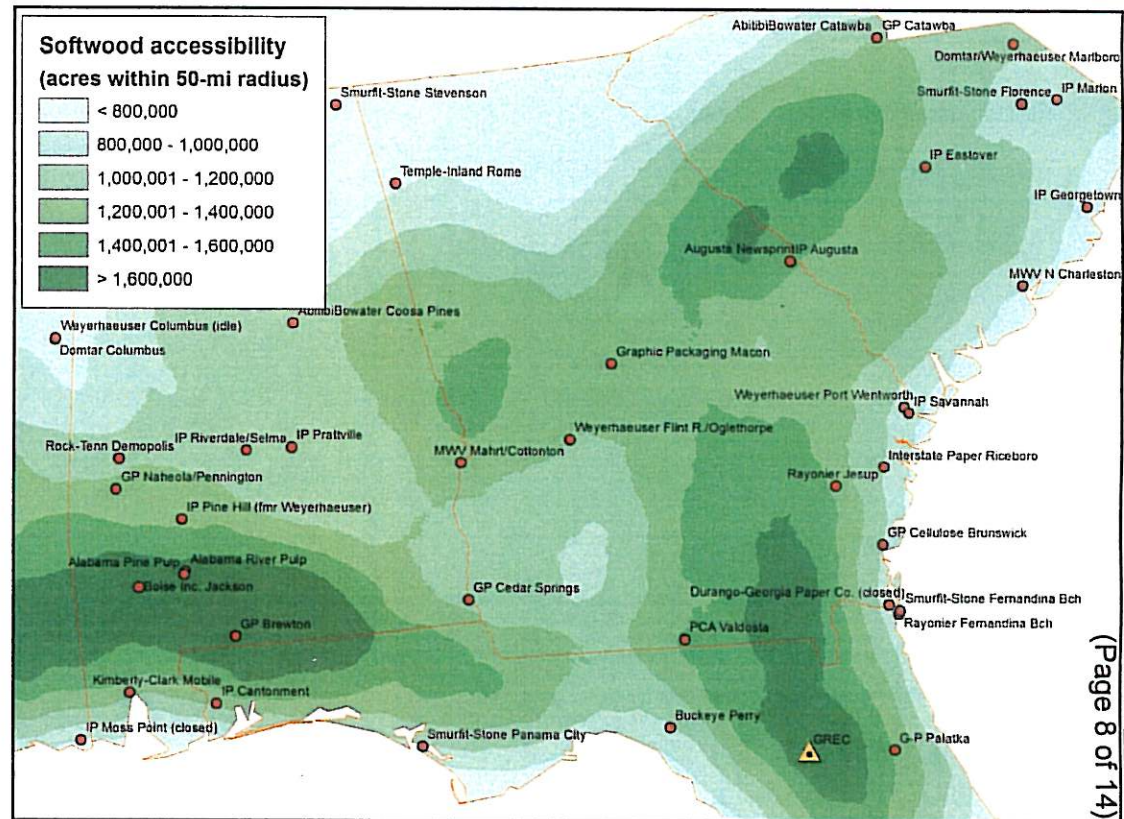
- The map at right plots the locations and wood demand from existing pulp mills, the largest biomass users in the region. Circles are proportional to their wood demand.
- In particular, note the intense concentration of biomass use on the Georgia coast.
- These pulp mills have been operating for decades, without driving each other out of business or depleting the forest resource to the point where it could no longer sustain their operation. These facilities can only draw wood from the west due to their coastal location.
- Relative to many areas in the Southeast, the GREC region's forests have relatively less pressure, and GREC can draw wood from all directions.



Lockwood-Post Directory of Pulp & Paper Mills – Americas Edition 2008.

Access to Softwood Acreage in the Southeast US

- This map summarizes the portion of the SE landscape occupied by southern pines, the most productive forest type in the region.
- The red points on the map indicate pulp mills.
- The values indicate the number of softwood acres contained in a 50-mile radius of any point on the map.
- In other words, imagine standing anyplace on this map and counting up all the acres of pine forest within 50 miles of where you are standing, and that is the value reported in the map.
- Note that GREC is located in some of the highest densities of pine acreage in the Southeast.
- Note also that many pulp mills, most of whom have greater wood demands than GREC, are located in areas with much lower pine acreage densities.



Data from National Land Cover Dataset.

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Florida Forest Resources Going Forward

USDA FS Inventory Data

- Latest data indicates gain of 1.2 million acres of timberland in FL from 1995-2007 (planted pines down 100,000 acres over period)
- Annual harvesting data indicates 191,000 harvested acres/yr, with replanting at 156,000 acres/yr and natural regeneration of 31,000 acres/yr (avg. 1995-2007)

Tree Planting Data

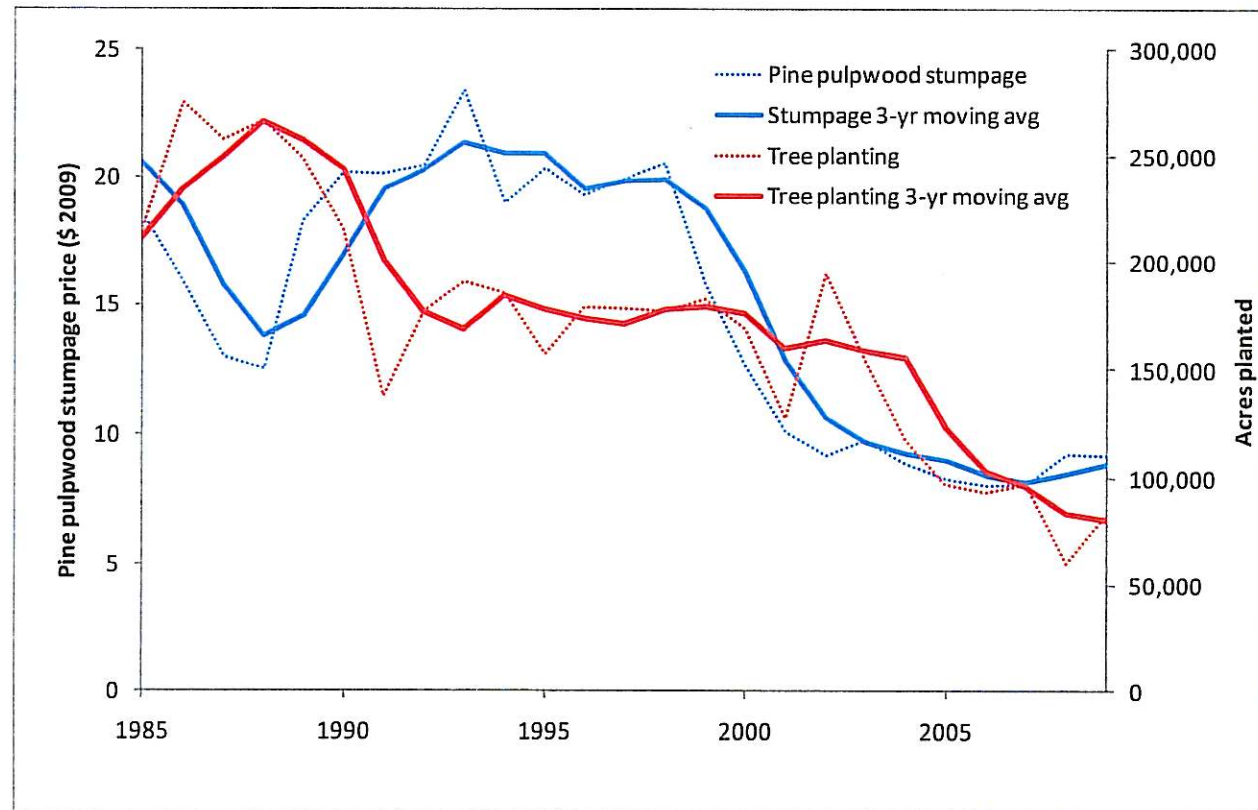
- Nursery management cooperative data maintained by Auburn University indicate recent significant declines in tree planting
- These data indicate a potential deficit in replanting activity on the order of 90,000-100,000 acres/year in recent years

Based on the tree planting data, it has been suggested that Florida may be facing impending shortfalls of timber over the long-term

-- However, this may be at least partially explained by recent price movements in timber markets as discussed on the following slide

25 Years of Stumpage Values and Tree Planting

- We believe that landowners are deciding to allow their trees to grow into larger size classes rather than accepting the historically low pulpwood prices of the past several years. Many landowners have told us as much.
- This would translate to fewer harvested acres due to the delay in cutting, and clearly stands are not replanted until they are harvested.

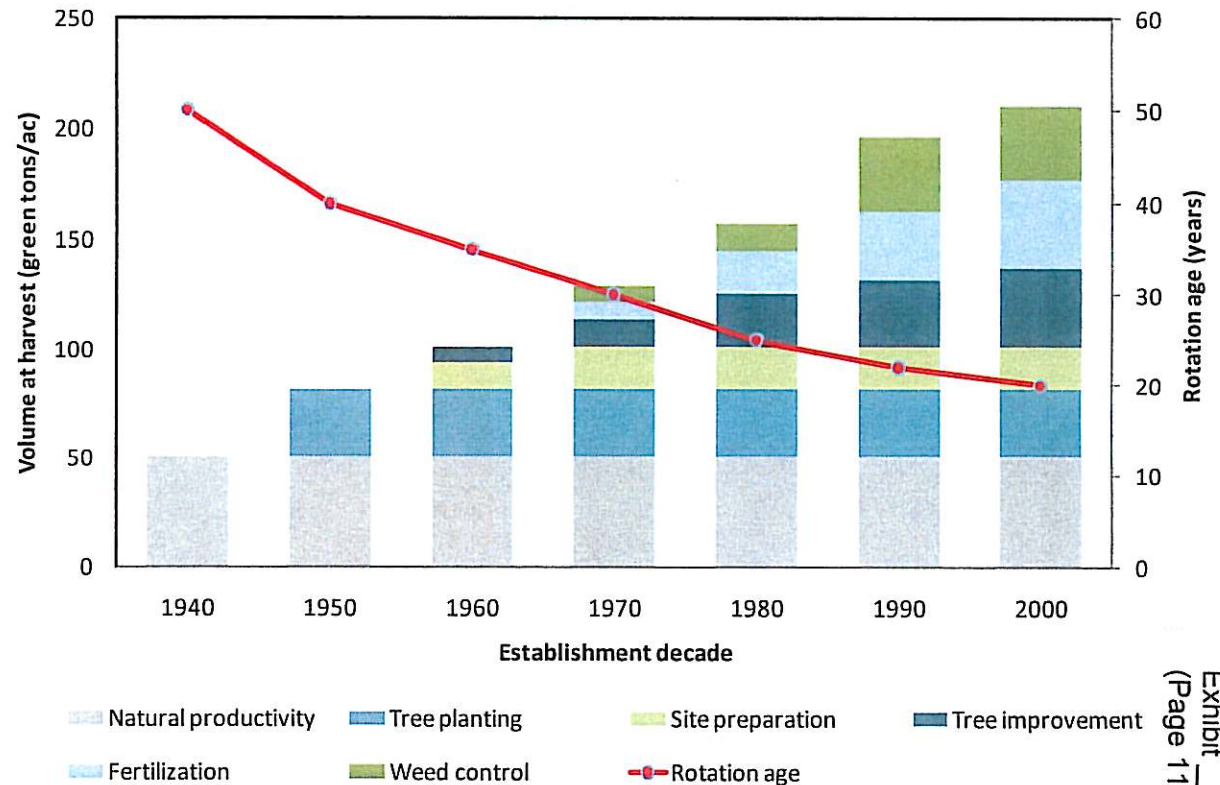


Stumpage price data from Timber Mart South; Tree planting data from Southern Forest Nursery Mgmt. Coop.

While there are many factors involved in landowner decisions to replant acreage, the graph above suggests that when pulpwood prices decline, in the years that follow so does tree planting.

Southern Pine Productivity: 6 Decades of Improvement

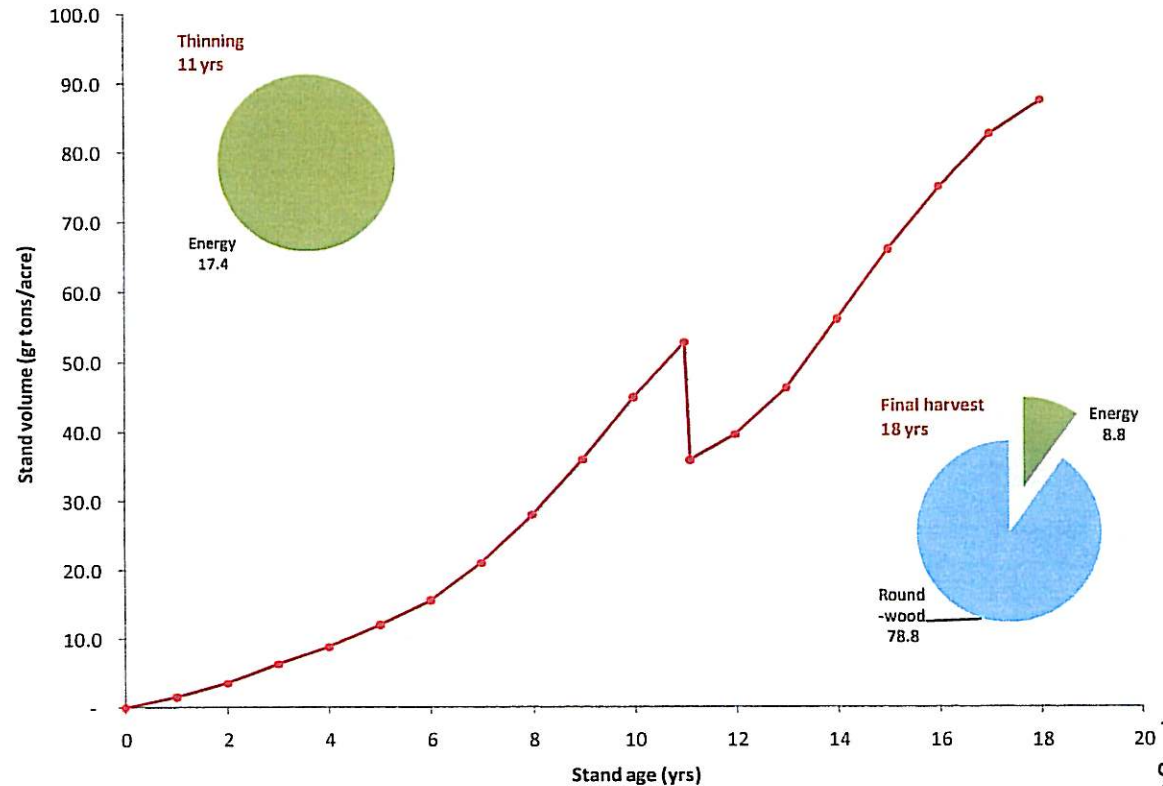
- The productivity gains in southern pine production simply cannot be ignored.
- Decades of land grant university and industry research have transformed the South into the “fiber basket” of the US.
- The productivity contribution of a host of advancements in forestry practices is illustrated at right.
- Relative to stands established in the 1950s, stands currently being planted can produce twice as much volume in about half the time.
- This has paralleled the doubling of output by the timber products industry in Florida over the same period.



Adapted from : Jokela, EJ, TR Fox, and HL Allen. 2007. *The Development of Pine Plantation Silviculture in the Southern US. Journal of Forestry*, 105: 337-347.

Growing 1.5 tons/ac-yr of Biomass Fuel in a Conventional Forestry Regime

- The growth curve plotted here indicates the standing volume over the course of a conventional pulpwood rotation in N FL (except that in many cases thinning is not conducted).
- The graph indicates how 1.5 tons/ac-yr can be produced without substantially modifying the prevailing current system.
- As shown in the graph, a 33% (or third-row) thinning is conducted at age 11, with all of the harvested volume being used for biomass energy.
- At age 18, the stand is harvested, the roundwood is sent to the mill, and the unmerchantable logging residue is harvested for biomass energy.
- The thinning yields 17.4 tons/ac, while the final harvest generates 8.8 tons/acre of residues, totaling 26.2 tons/ac over the 18 year rotation.
- On average then, this yields 1.5 tons/ac-yr of biomass material that would not otherwise be utilized.
- In other words, 1.5 tons/ac-yr in biomass fuel was generated in this scenario without altering the flow of products to the traditional forest industry.
- Note that productivity here is much lower than the productivity reported in the last slide. This is for 2 reasons: pine productivity in north FL is generally lower than much of the rest of the South AND we want to be conservative.
- We believe that it will be possible to exceed 1.5 ton/ac-yr once producers make a few alterations to their current system.



From Two Perspectives, GREC's Demand for Forest-Derived Biomass is Feasible and Sustainable

Publicly Available Data

- Public data from USDA FS and other sources indicate that in excess of 2 million tons of logging residues and first thinnings are generated in the supply area
- The GREC procurement target for these materials is 575,000 tons/year
- This indicates that more than 3.5 times the target volume is generated in the supply area – material that is not currently being utilized

Stand-Level Output Estimation With Landowners

- 1.5 tons/ac-yr of first thinnings and logging residue can be generated from planted pines in north Florida without diverting material from roundwood production
- GREC procurement target is 575,000 tons/yr, equating to the thinning and residue output of 385,000 acres of pines
- There are over 4 million acres of pine in the supply area, indicating that the project will capture its forest-derived biomass from less than 10% of the total pine acreage
- GREC is currently in active procurement discussion with landowners who have access to over 1 million acres of timberland within the supply area

Conclusions

- More than 5 times GREC's annual demand for 1 million tons of biomass fuel is generated within the supply area
- From a number of different perspectives, the feasibility and sustainability of procuring the volume and types of material targeted by GREC is apparent

Publicly available data cross-checked and verified with operators and landowners all tell a consistent story