Forest Bioenergy in the United States: Current Status and Outlook

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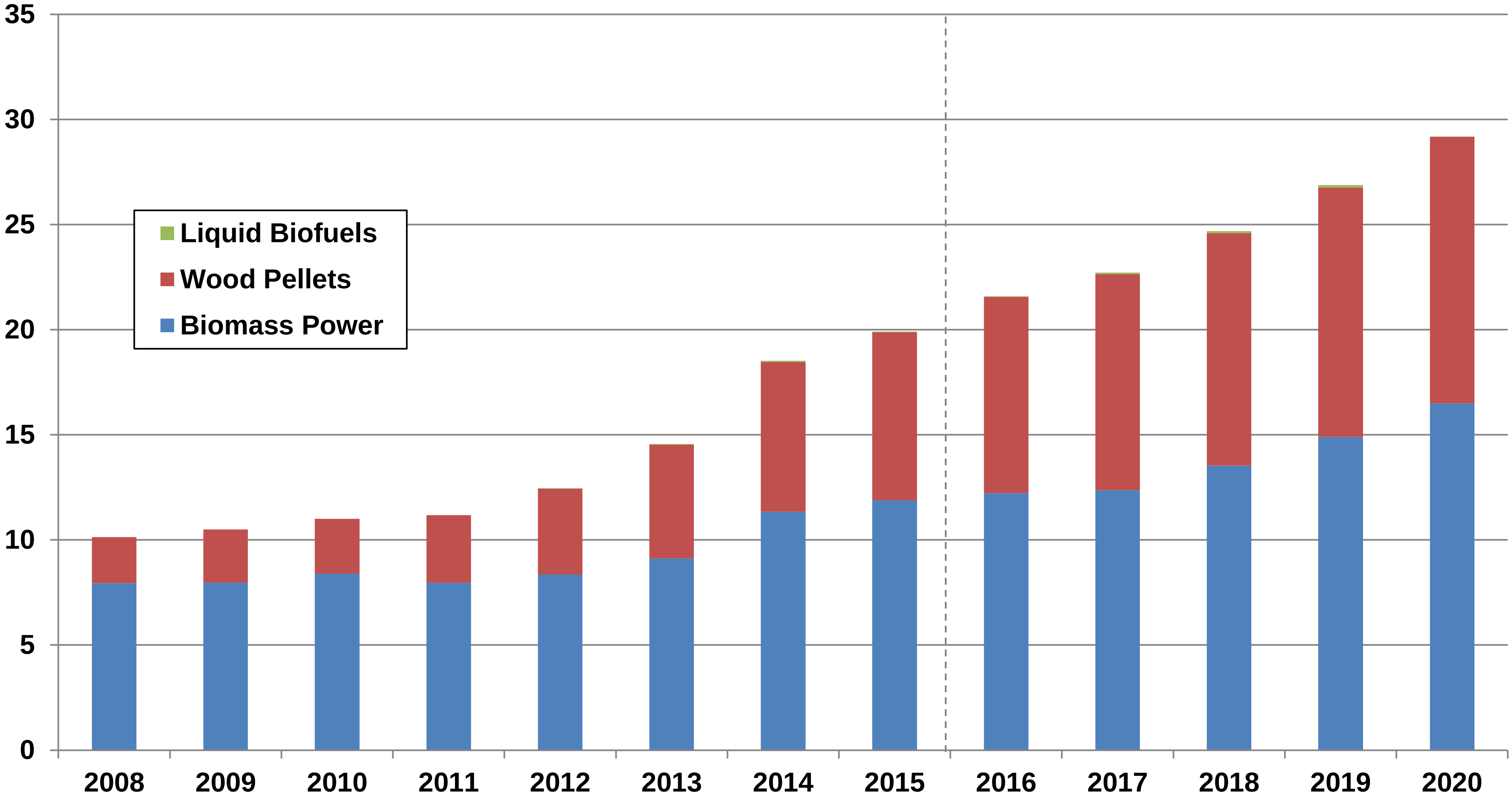
Energy From the Forest

- Biomass Power
  - Stand-Alone Plants
  - Forest Products Industry
- Wood Pellets
  - Domestic Heating Markets
  - Industrial Exports
- Liquid Biofuels
  - Cellulosic
  - Pulping by-products
  - No significant impact in the US over the near term

Woodfiber Consumption by Bioenergy

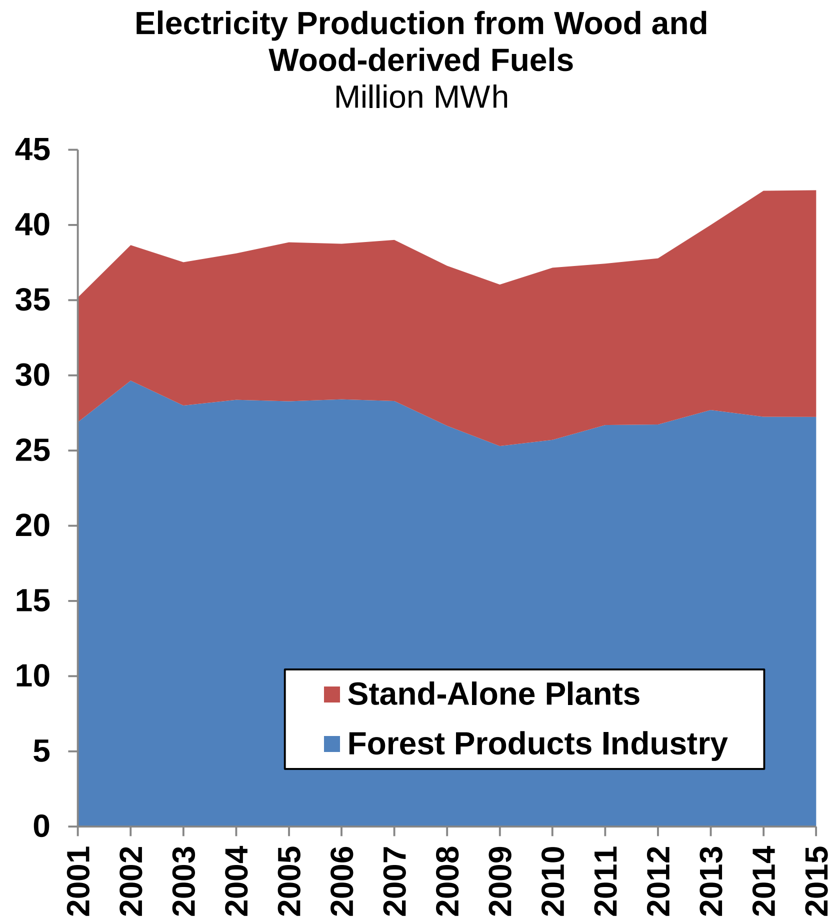
Million dry short tons



Source: RISI

Electricity Generation

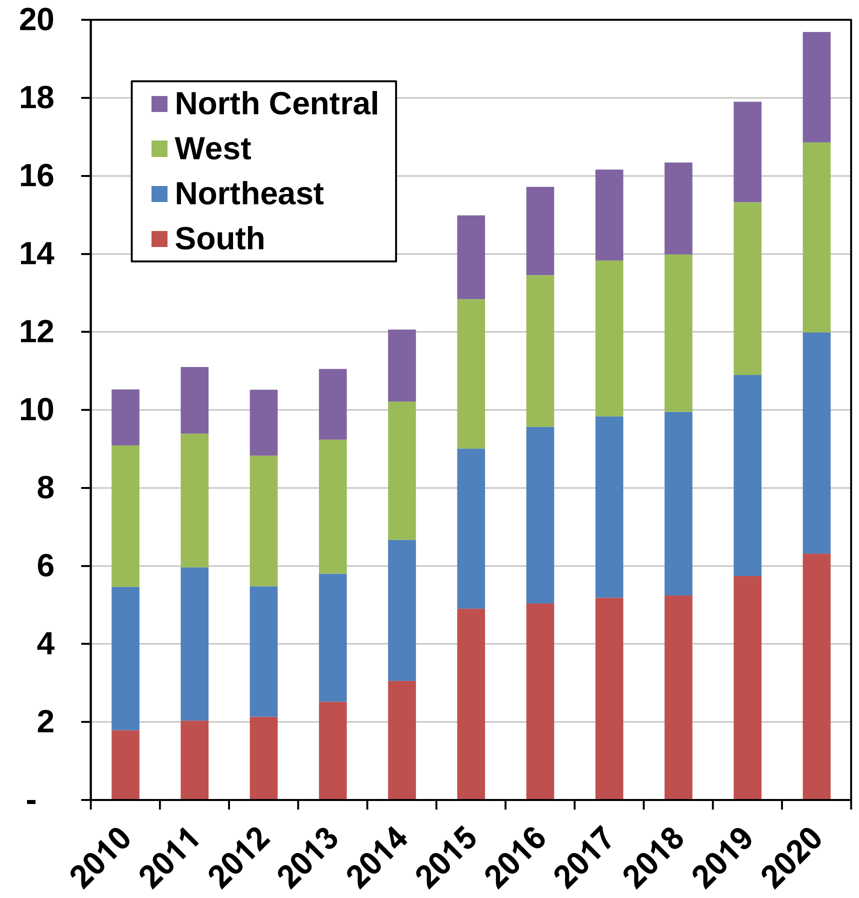
- Forest product industries produce 64% of electricity from wood and wood-derived fuels in the US
  - Little to no growth
- Production at stand-alone biomass power plants has nearly doubled over the past 15 years
  - 8 million MWh in 2001
  - 15 million MWh in 2015



Source: EIA

Wood Biomass Power in the United States

- Most significant recent growth in the South
  - Dominion Power – VA
  - Gainesville Renewable Energy – FL
- Historically Northeast was the biggest market
  - Little growth due to woodfiber price/availability constraints
- Moderate growth in West peaked in 2005, bottom in 2012
  - Sawlog dominated market (lumber production)
  - End of housing boom



Source: RISI

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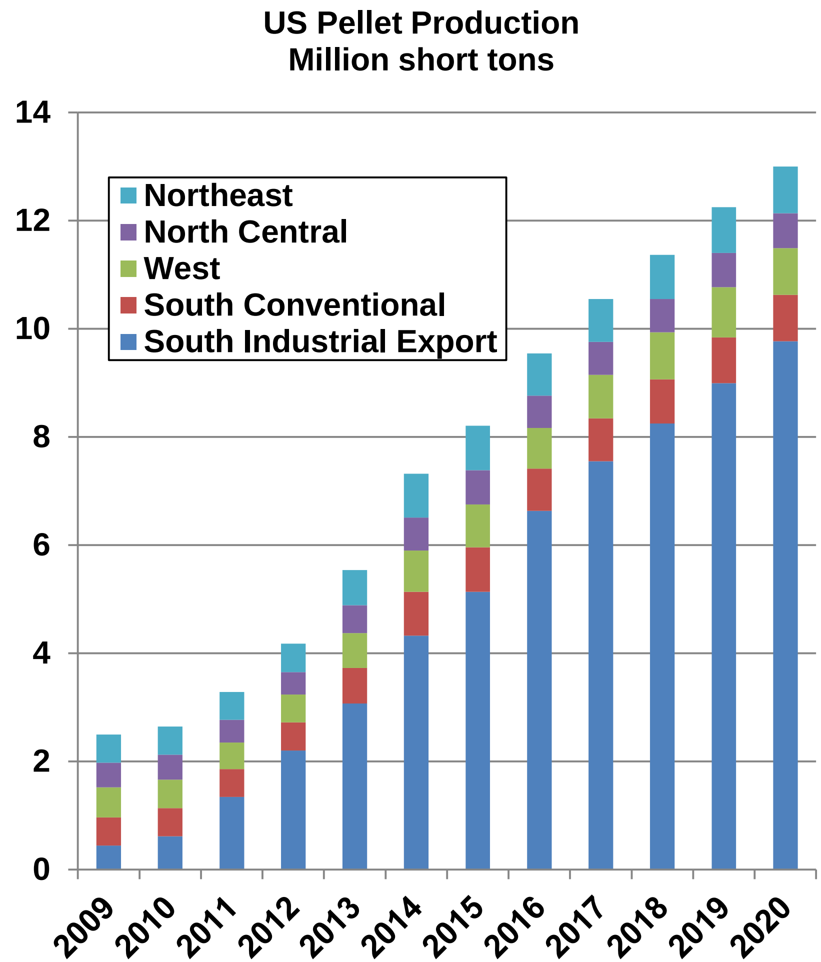
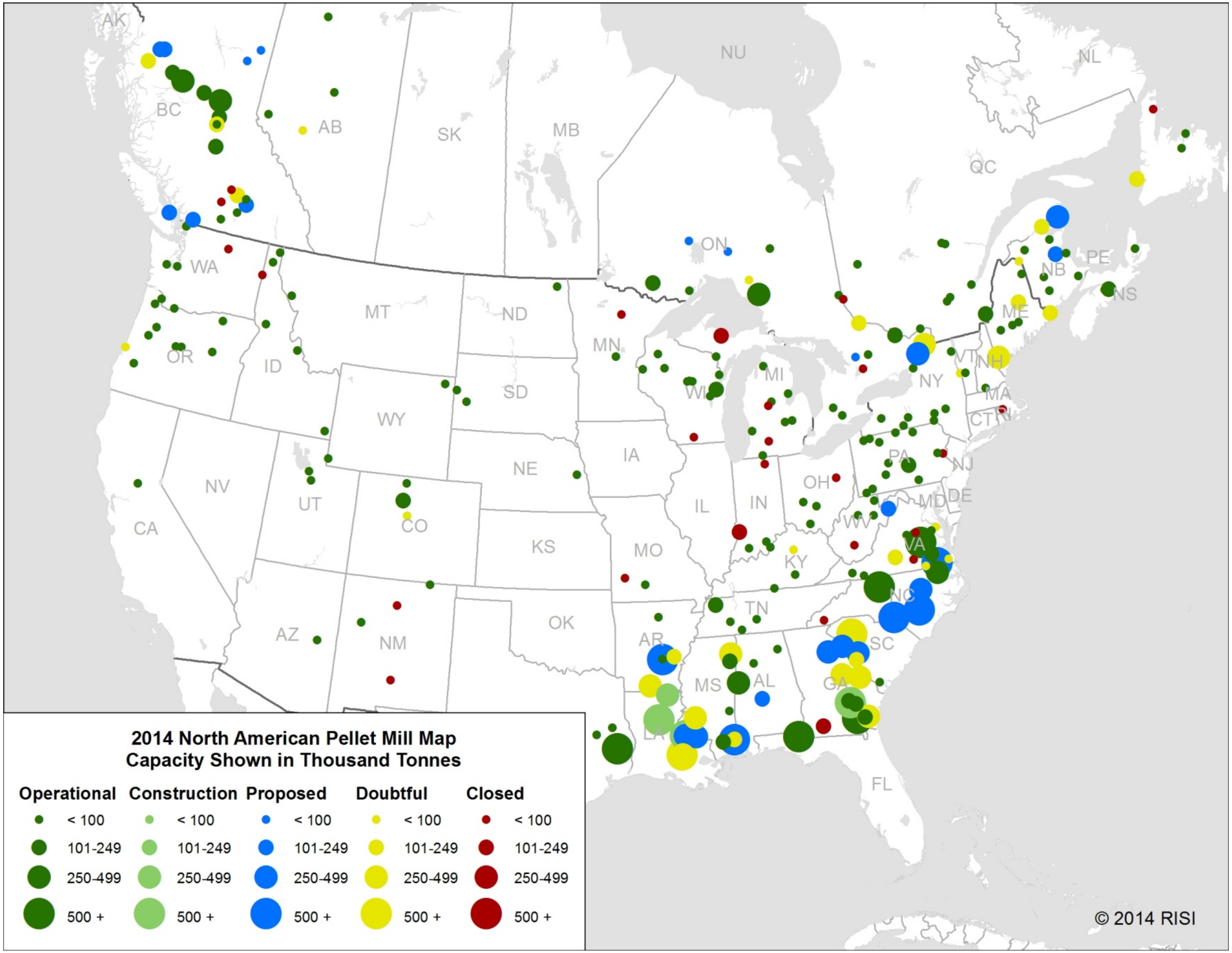
Wood Pellet Production

- Emergence of a significant export market to Europe
  - Driven by renewable energy and CO_2 reduction policies
  - Primarily UK, Belgium
  - Displacing coal in power plants
- Smaller domestic heating market has been around for decades
  - Low oil prices, warm winters have really hurt this market



Source: RISI

North American Pellet Supply



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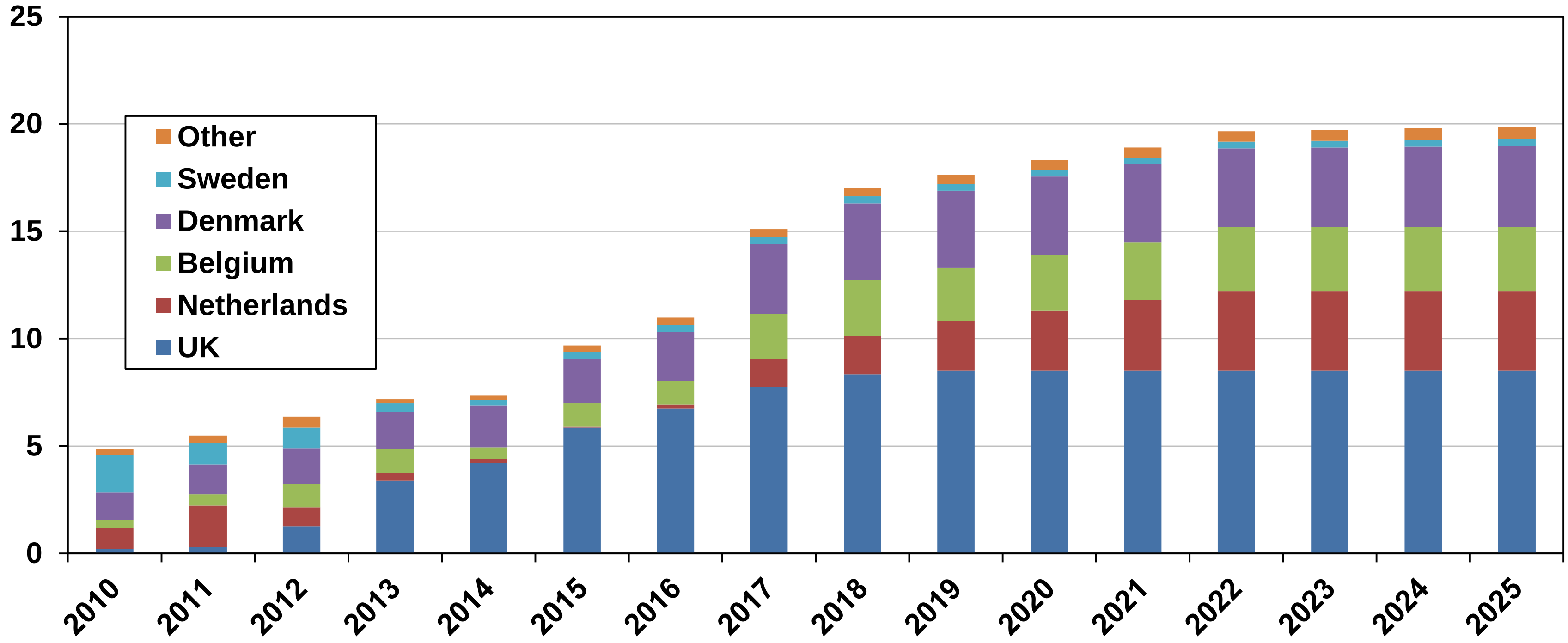
Development of the European Industrial Wood Pellet Market

- Primarily focused in UK, Belgium, Netherlands, Denmark
  - Countries without a significant amount of domestic resources
  - Previous reliance on coal

European Industrial Pellet Demand
Million metric tons



Source: RISI

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United Kingdom

Policy: Transition period from Renewables Obligation (RO) to Contracts for Difference

- Limited by budgetary constraints (Levy Control Framework) – removal of Levy Exemption Credits, few units qualified for CfD
- European Commission investigating whether CfD violates state-aid guidelines

Major Players: Drax (3x 660MW units), RWE (400MW), MGT Power (greenfield CHP – mostly wood chips)

Sources: US, Canada, Latvia, Portugal, Brazil

Market Size: ~6-7 million mt

Market Potential: ~9-10 million mt

Denmark

Policy: Fossil Fuel tax aversion, FiT (significantly less impact)

Major Players:

Central power stations and district heating

Dong, Hofor, Verdo Energy

Sources: Latvia, Estonia, Sweden, Russia, Germany, US

Market Size: ~2 million mt

Market Potential: ~3-4 million mt

Belgium

Policy: Green Certificate Program – varies by region (Flanders and Wallonia)

- Flanders shut down pellet consumption for several months in 2014
- Disagreement with Flemish forest products groups

Major Players:

Engie - Rodenhuize (Ghent), Les Awirs (Liege)

E.ON - Antwerp, Genk (sold to German Pellets)

Bee Power Ghent

Sources: US, Canada

Market Size: ~1 million mt

Market Potential: ~3 million mt

Netherlands – Co-firing

Policy: SDE+ (guaranteed minimum price of electricity)

- Sustainability criteria had to be established (certification requirement , limitations of biomass coming from natural forest to plantation conversion)
  - Smaller holdings exempt for the short term < 1000 hectares
- 2 companies applied in 2015 (RWE, Engie) – unsuccessful (budget)
- 2016 budget >2x 2015

Major Players:

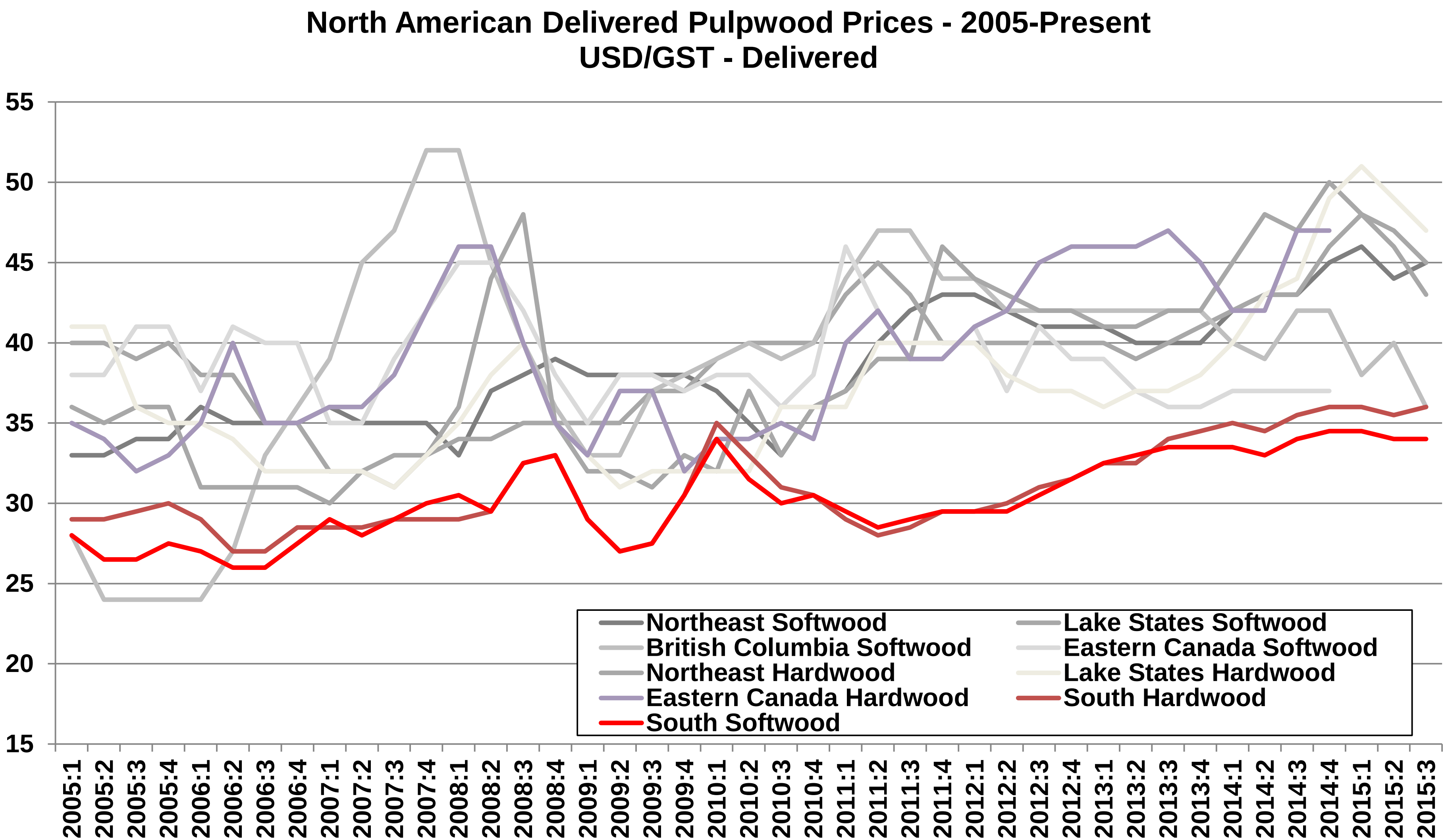
RWE, E.ON, Engie (GDF Suez)

Sources: US, Canada, Portugal

Market Size: insignificant

Market Potential: ~4 million mt

Why the US South?



Source: RISI North American Woodfiber and Biomass Markets

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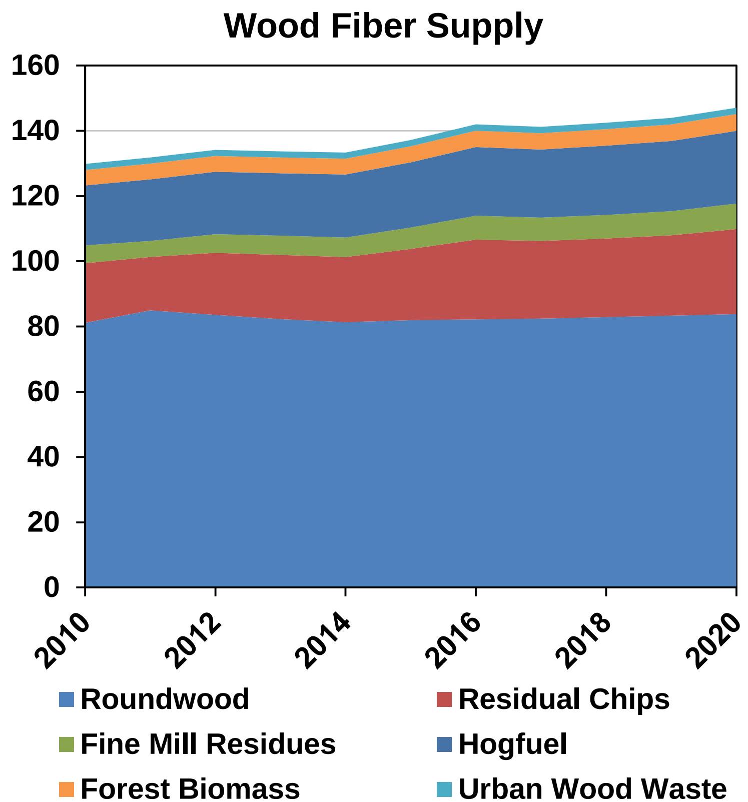
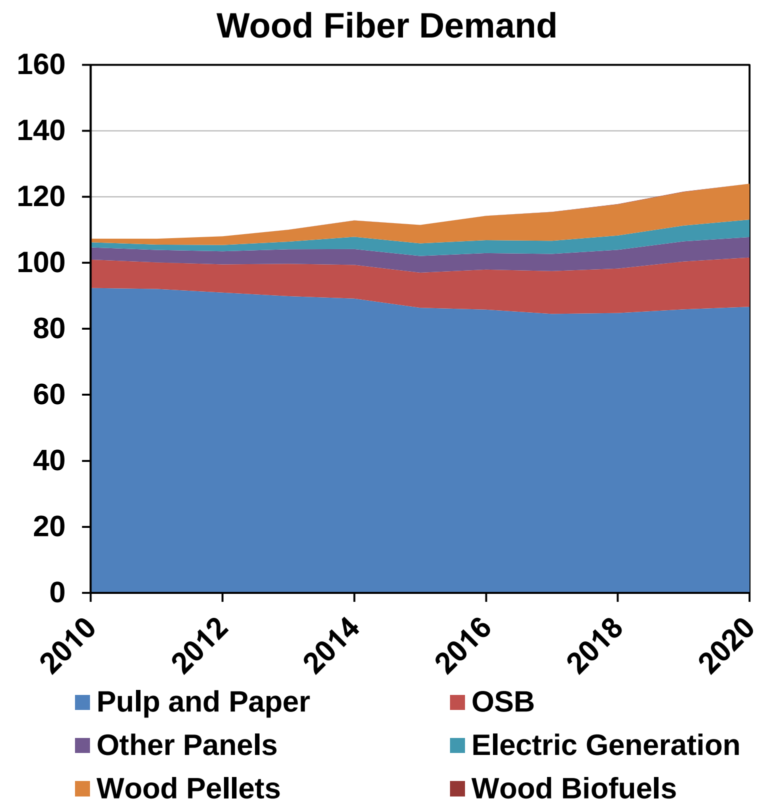
Southern Wood Fiber Supply and Demand

- 63% of US timber harvest occurs in the South
- Nearly 3/4 of all US low grade (pulpwood, residuals and biomass) woodfiber demand is in the South





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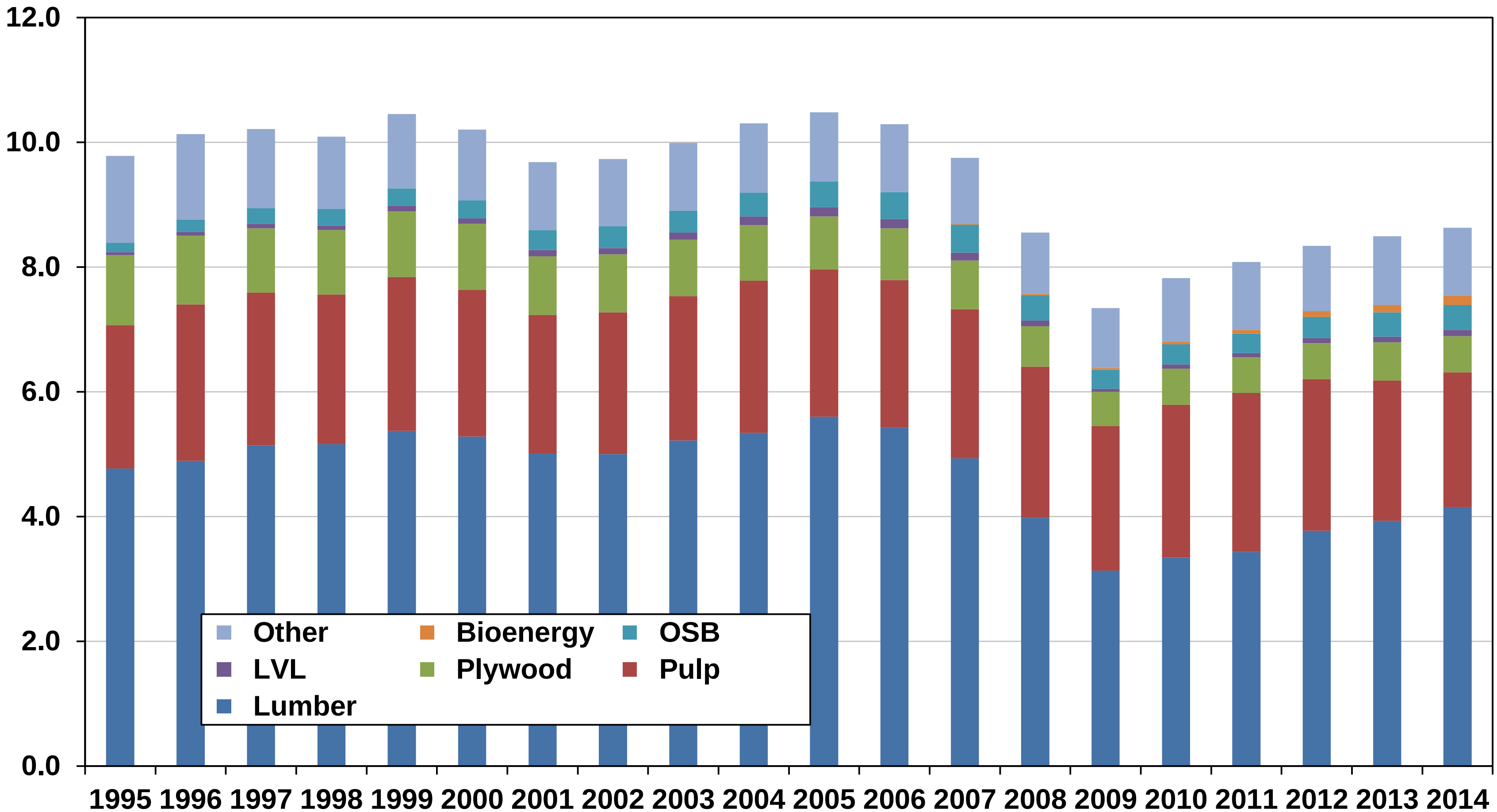
Historical US Softwood Growing Stock Removals by End Use

Billion Cubic Feet



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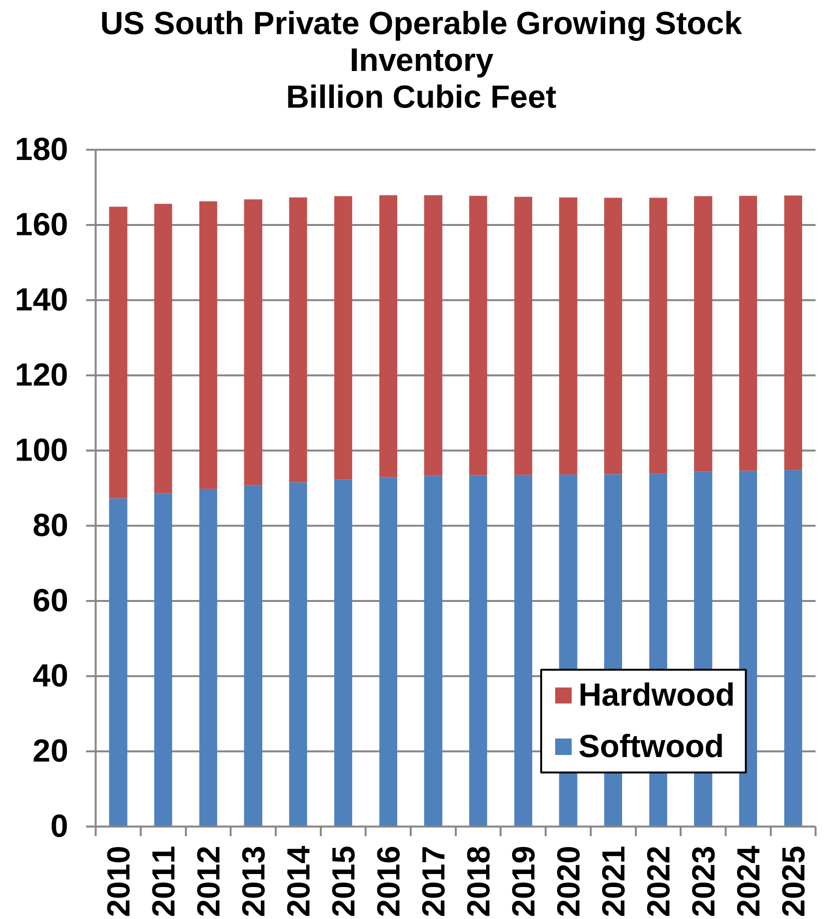
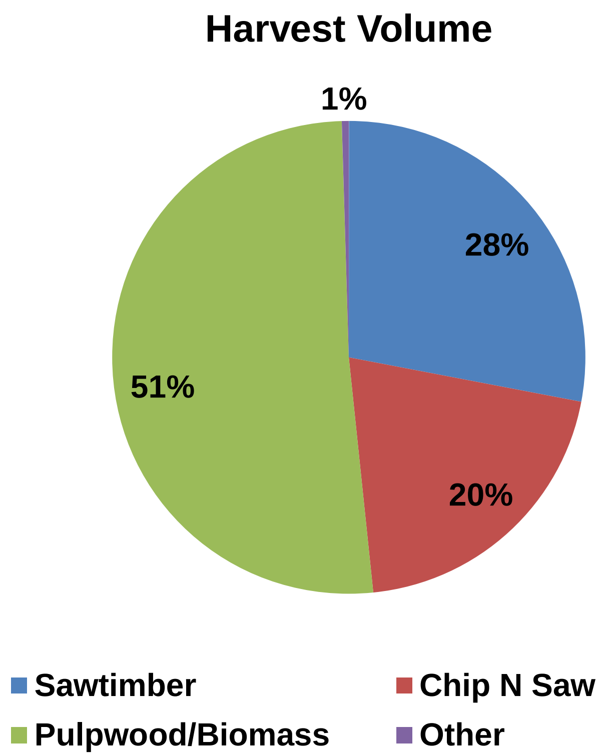
Timber Supply Outlook

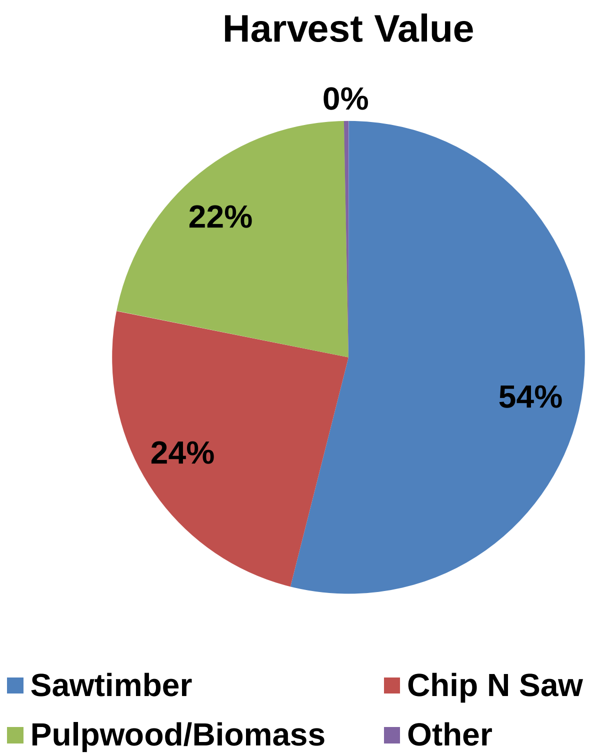
- Really boring chart!
  - Stable inventory outlook
- Some transition from managed hardwood to softwood
- Does not include public / reserved lands
  - Where growing stock (carbon) is increasing



2015 US South Timber Harvest Value and Volume

- Even though sawtimber represent only 28% of total Southern timber harvest volume, it represents 54% of the value.
- Conversely, while pulpwood and biomass account for 51% of total timber harvest volume, they represent only 22% of the total value.
- Sawlog harvest is still the major driver of forest management in the US South

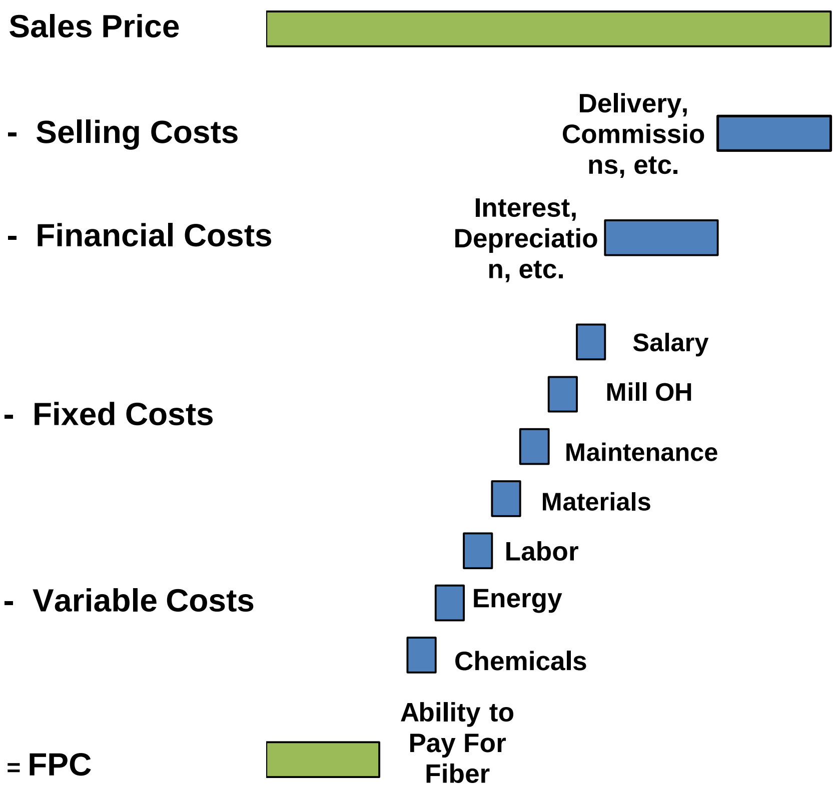


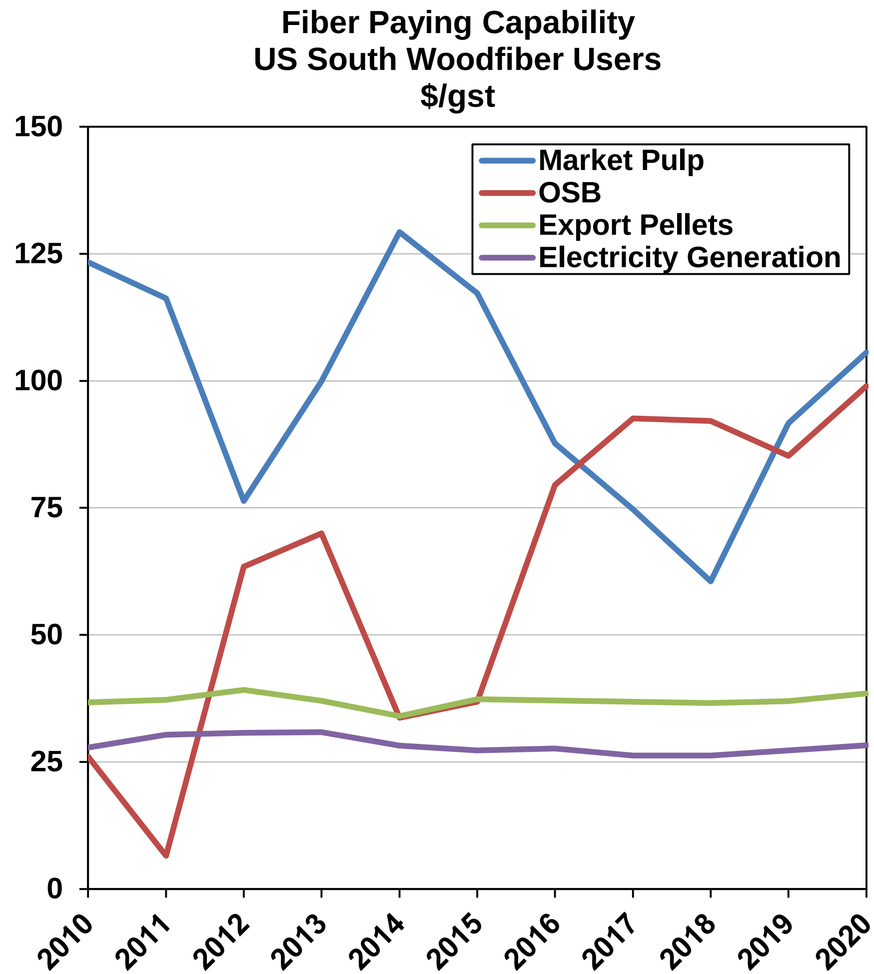


Source: RISI Timber Transaction Price Service

Fiber Paying Capability

- A measure of the relative competitiveness of various wood using industries
    - Essentially the margin left to pay for wood at breakeven
- Bioenergy industries require low cost stable feedstocks





Key Takeaways

- Domestic Biomass Power Sector
  - Opportunistic (needs low cost feedstocks)
  - Relatively moderate growth
  - To this point, no significant federal support + low fossil fuel prices
- Rapid emergence of industrial wood pellet export sector
  - Growth slowing, but a major player in US South fiber markets
- Forest volume/carbon stocks
  - Stable outlook despite increased consumption
  - Increased demand > higher price > more supply
- Bioenergy industries bottom of the barrel economically
  - Not driving forest management practices
  - Timber management based on value maximization from sawlog production

See the forest through the trees!

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