

# **Potential for Forest Biomass Use**

## **-An Electric Utility Perspective**

**Council on Forest Engineering**  
**June 23, 2008**

# *Forest Biomass as Fuel*



## **Market Drivers**

- I. Need for Electricity in South Carolina**
- II. Need for Renewable Electricity in South Carolina**
- III. Sources of Renewable Electricity in South Carolina**
- IV. Technology Review of Bio-Fuel Use**
- V. Economics**
- VI. Challenges and Opportunities**



# *Who is Santee Cooper?*



- **aka South Carolina Public Service Authority**
- **A public power company serving 46 counties in South Carolina**
- **Supplying power to 2 million people**
- **The power provider to 20 rural electric co-operatives across the state**

# *The Need for Electricity in SC*

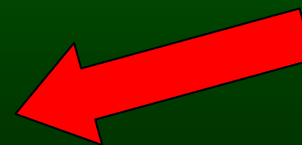


- **South Carolina is growing well above national average**
  - State population will increase 25% in next 15 years
  - 1 million new residents
- **Santee Cooper currently has capacity of 5,700 MW**
- **South Carolina currently has capacity of 22,800 MW**
- **Additional generating capacity needed just by Santee Cooper is**
  - 525 MW by 2013
  - 835 MW by 2015

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**Remember  
this number**

# *The Need for RENEWABLE Electricity in SC*



- **Everyone uses it, more of it each year**
- **Some not in favor of building any more electric generation**
  - **Beyond NIMBY – Not In My Backyard**
  - **Now BANANA – Build Absolutely Nothing Anywhere Near Anything**
- **What Electric Generation to Build?**
  - **Coal – lowest cost, carbon emissions issue**
  - **Nuclear – clean, non-GHG**
  - **Renewables – what kind? Solar – Wind – Biomass**



## **Santee Cooper's Commitment**

**40% of Generation from  
Non-Greenhouse Gas  
and Biomass Sources  
by 2020**

# *The Need for Electricity in SC*



## **The Current Energy Mix of Santee Cooper Power in SC**

- **Coal – 77%**
- **Nuclear -10%**
- **Natural Gas – 8%**
- **Hydro – 1%**
- **Landfill methane gas - <1%**
- **Recycled oil - < 1%**
- **Purchases and net interchanges - 3%**

## **South Carolina as a whole**

**51% Nuclear, 40% Coal, 6 % Natural Gas**

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Our starting  
point

## **South Carolina as a whole**

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# *The Need for RENEWABLE Electricity in SC*



**An important market driver for the whole renewable industry:**

**Renewable Portfolio Standard (RPS) – a requirement that electricity providers have an energy “mix” or “portfolio” that includes certain percentages of renewables.**

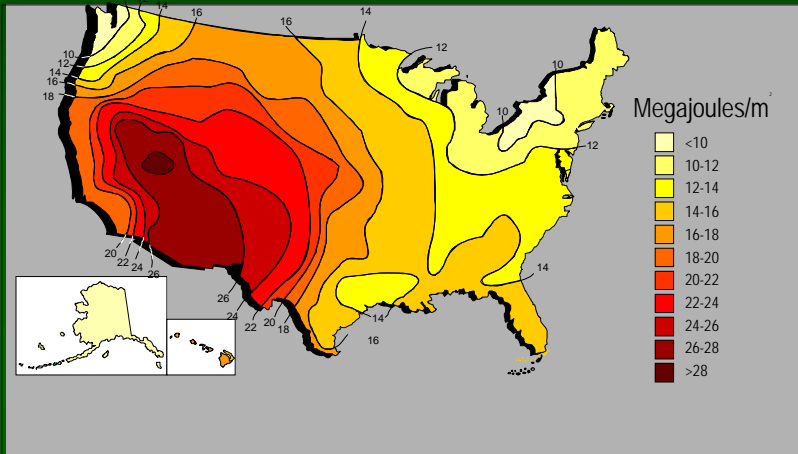
**In North Carolina this was enacted as an Environmental Portfolio Standard**

**A national RPS has been proposed  
but nature is not fair in its distribution of resources**

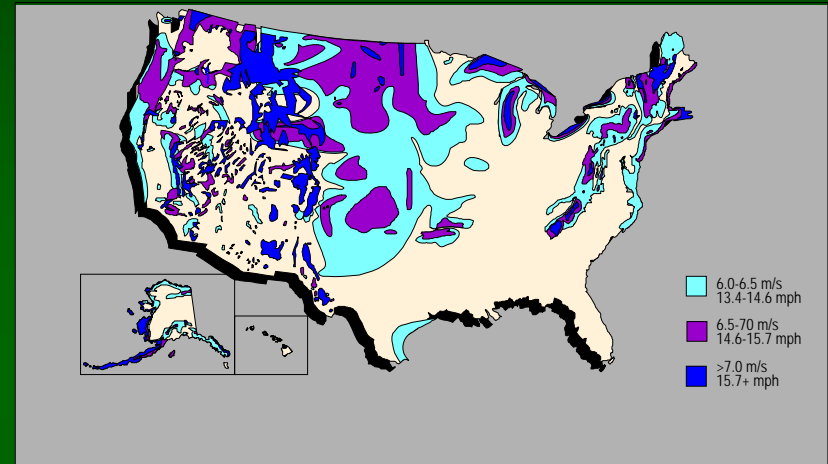
# U.S. Renewable Energy Resources



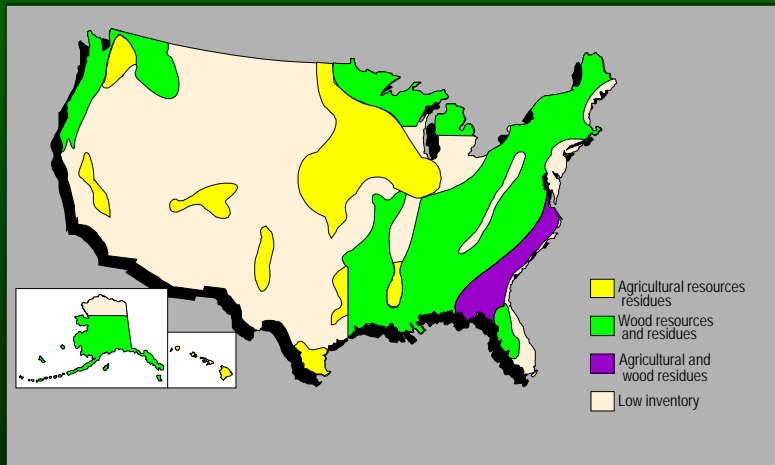
## Solar



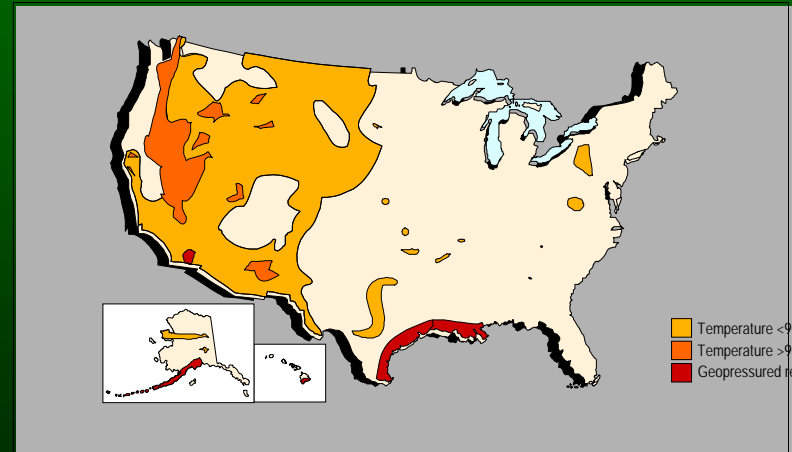
## Wind



## Biomass



## Geothermal



# *South Carolina's Options for Renewable Electricity*



## **Solar PV**

- **high capital cost (\$10,000/kW)**
- **low capacity factor (<20%)**  
(considers both weather and daytime hours in SC)

## **vs Conventional generation**

- **4x higher capital**
- **1/4 the generation**

**Geothermal – not on utility scale**

**Wind – offshore in SC, no rules**

**Fuel Cells – not green**

**Hydro – small only (incremental or low-impact)**

# South Carolina's Options for Renewable Electricity



<b>La Capra Study</b>		<b>Technical Potential</b>	<b>Practical Potential</b>
<b>Biomass</b>	<b>Wood Biomass</b>	<b>1,599 MW</b>	<b>423 MW</b>
	<b>Agricultural By-products</b>	<b>362 MW</b>	<b>68 MW</b>
	<b>Landfill Gas to Energy</b>	<b>90 MW</b>	<b>70 MW</b>
	<b>Offshore Wind</b>	<b>Studying</b>	<b>?</b>
	<b>Hydro</b>	<b>210</b>	<b>105</b>
		<b>Total</b>	<b>665 MW</b>

Practical = available within 10 yrs in SC at reasonable cost

# South Carolina's Options for Renewable Electricity



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Doesn't satisfy Santee Cooper's need, much less total state need.

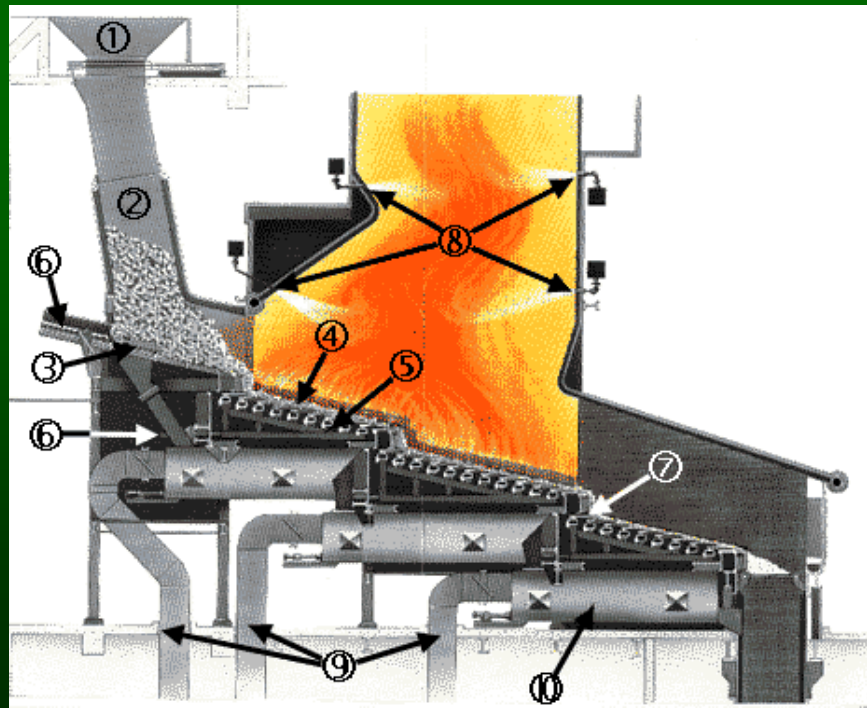


# Technologies



- **Stoker Grate**

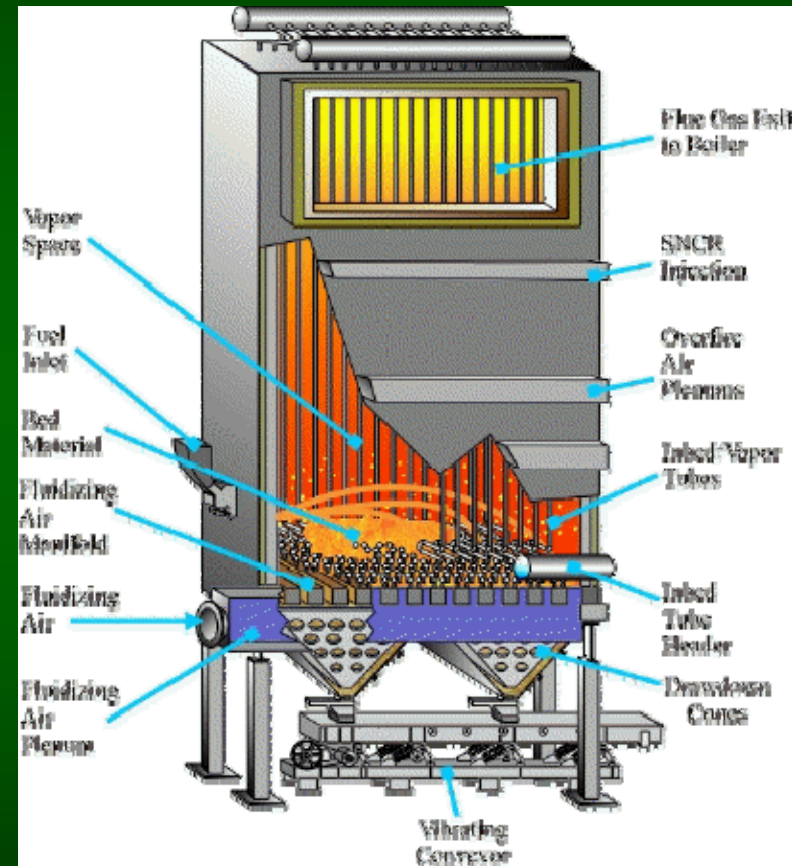
- Commercial Technology
- Lower capital cost and net heat rate than other direct fire technologies
- Limited in fuel flexibility and ability to accommodate high moisture fuels
- Limited or no SO<sub>2</sub> and NO<sub>x</sub> mitigation in the combustion process



# BioFuel Technologies



- **Bubbling Fluidized Bed (BFB)**
  - Commercial Technology
  - Good fuel flexibility except with high btu fuels such as coal
  - Good SO<sub>2</sub> and NO<sub>x</sub> mitigation through combustion control and additives
- **Circulating Fluidized Bed (CFB)**
  - Commercial Technology
  - Very good fuel flexibility including high btu fuels such as coal
  - Good SO<sub>2</sub> and NO<sub>x</sub> mitigation through combustion control and additives
  - Highest capital cost and heat rate of direct fire technologies





- **Cofiring (Blending)**
  - Mature Technology
  - Limited generating capability, typically 5% of unit rating
  - Increases unit heat rate (up to 1%)
  - May be limited by existing systems
  - Less fuel flexibility due to effects on other existing systems
  
- **Cofiring (Retrofit/Direct Injection)**
  - Mature Technology
  - Somewhat limited generating capability, typically 10-15% of unit rating
  - Increases unit heat rate (up to 2%)
  - More fuel flexibility than blending due to separation of fuel handling

# *BioFuel Technologies*



- **Gasification**
  - **Emerging Technology**
  - **Limited Cost and Operational data for Commercial Units**
  - **Higher complexity**
  - **Lower Emissions**

# *Economics*



- **Coal \$55/ton = \$2.20/million Btu @12,500 Btu/lb**
- **Wood chips \$25/ton = \$2.80/million Btu @4,500 Btu/lb**
  
- **For 100 MWh of electricity**

<b>Coal</b>	<b>Wood chips</b>
<b>\$2,200</b>	<b>\$2,800</b>
<b>80,000 lbs</b>	<b>222,000 lbs</b>
<b>2 truckloads</b>	<b>9 truckloads</b>

# Wood Biomass Resources

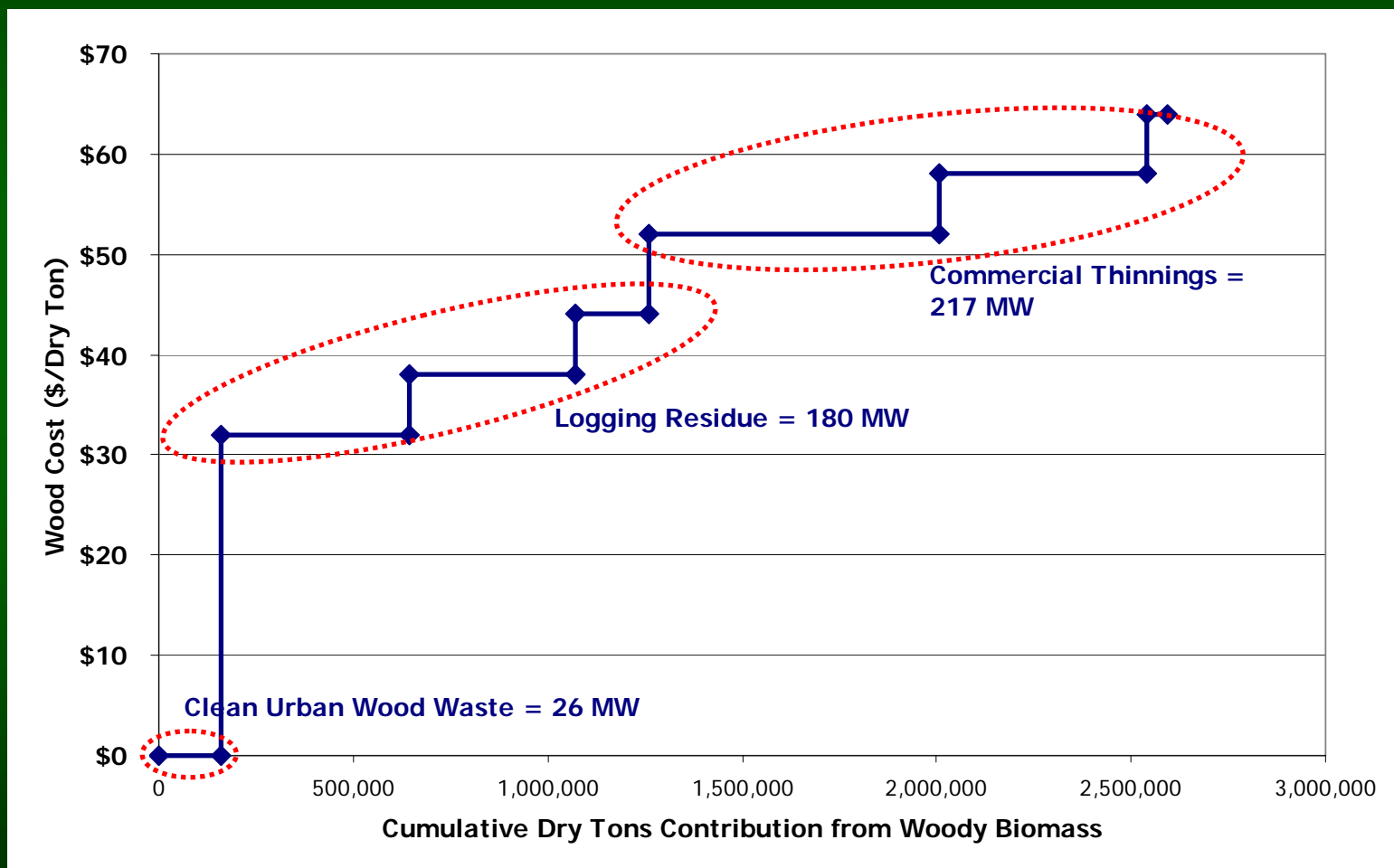


## Wood Biomass Heating Values

	Moisture %	Appx. Btu/lb
Residue, Thinning, Whole tree chips	50	4000
	40	4500
	30	5200
	20	6000
Urban Waste	15	6600
Mill Residue	10	7000



# Wood Biomass Fuel Supply Curve



Total Resource Availability in South Carolina

# *Barriers to Entry for Electric Utility*



## **Wood fuel purchase contracts**

- Not in wood market
- No long term or forward pricing contracts
- Much more variability in biofuel quality
- Btu content of fuel – about half (twice the fuel volume)

## **Co-fire obstacles**

- Risk to boiler
- Boiler derate

# *Economics*



## **La Capra Study**

<b>Technology</b>	<b>Installed Cost (\$/kW)</b>	<b>40MW Plant Cost (\$000's)</b>	<b>Net Heat Rate (Btu/kWh)</b>	<b>Fixed O&amp;M (\$/kW)</b>	<b>Variable O&amp;M (\$/MWh)</b>
<b>Stoker</b>	<b>2,800</b>	<b>112,000</b>	<b>13,000</b>	<b>75</b>	<b>10</b>
<b>BFB</b>	<b>3,000</b>	<b>120,000</b>	<b>14,000</b>	<b>75</b>	<b>10</b>
<b>CFB</b>	<b>3,000</b>	<b>120,000</b>	<b>14,000</b>	<b>75</b>	<b>10</b>
<b>Coal (PC)</b>	<b>2,000</b>	<b>80,000</b>	<b>10,000</b>	<b>15</b>	<b>2</b>

# *Project Considerations*



- **Site Considerations**

- **Proximity to fuel supply**
- **Proximity to infrastructure: Road, Rail, Transmission**
- **Availability of land (typically 50-100 acres)**
- **Community Support and Economic Impact**
- **Environmental Impact**
- **Proximity to other biomass consumers**

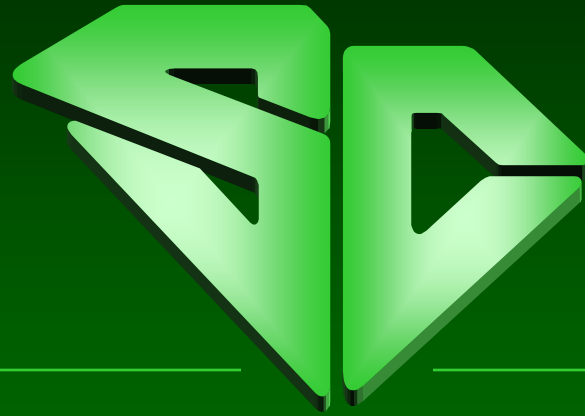


# *Conclusions*



## **In South Carolina**

- **Low cost electricity is an economic development tool.**  
(Good for industry, a disincentive to renewable generation)
- **Wood biomass provides the largest immediate resource for renewable electric generation.**
- **The cost of biomass generation will be higher than current costs of generation.**
- **Will be some kickback from existing wood users who will fear competition for fuels.**



# **Potential Forest Biomass Use**

## **-An Electric Utility Perspective**

**Council on Forest Engineering**  
**June 23, 2008**

# *Liz's Soapbox*



**We are fat, dumb and happy.**

- **Have made our claim for a right to continue our excessive energy consumption.**
- **Are dependent on foreign fuel (out of state, and/or out of country)**
- **Are incapable of self-control when our comfort is threatened.**

**Utilities can advise on conservation, but consumer has to make it happen.**

**Utilities have been working for 60+ years to get you low cost, dependable power.**

**No Silver Bullet**

# FFD



**Foreign Fuel  
Dependency**  
(a US problem)  
aka “Energy  
Independence”

**Or**

**Fossil Fuel  
Dependency**  
(a world problem)

# FFD



**Renewables**  
**Solar**  
**Wind**  
**Biomass**  
**Geothermal**



**Develop all renewables**  
**wherever nature put them**

# FFD

- RENEWABLES

Solar  
Wind  
Geothermal  
Biomass

What is left  
depends on how  
much progress is  
made

- GRID EFFICIENCY

- PLUG-IN HYBRID AUTOS

- ENERGY EFFICIENCY

- FUEL CELLS  
especially  
transportation

- NUCLEAR POWER

- HYDROGEN  
Generation Transport  
Storage



# *South Carolina's Options for Renewable Electricity*



**Define terms for comparison of renewables**

**Capacity factor – % of the time it can run**

**Heat rate – Btu's/kWh - a measure of the fuel efficiency**