

# Reinhold Environmental Ltd.



2008 APC Round Table  
& Expo Presentation

*July 13-15, 2008, in Savannah, GA*



# Biomass-Based Renewable Generation

**2008 APC/PCUG Conference**  
*APC Roundtable Pre-Conference*  
*Savannah, Georgia*  
*July 14, 2008*



# **Biomass Power Technology Program**

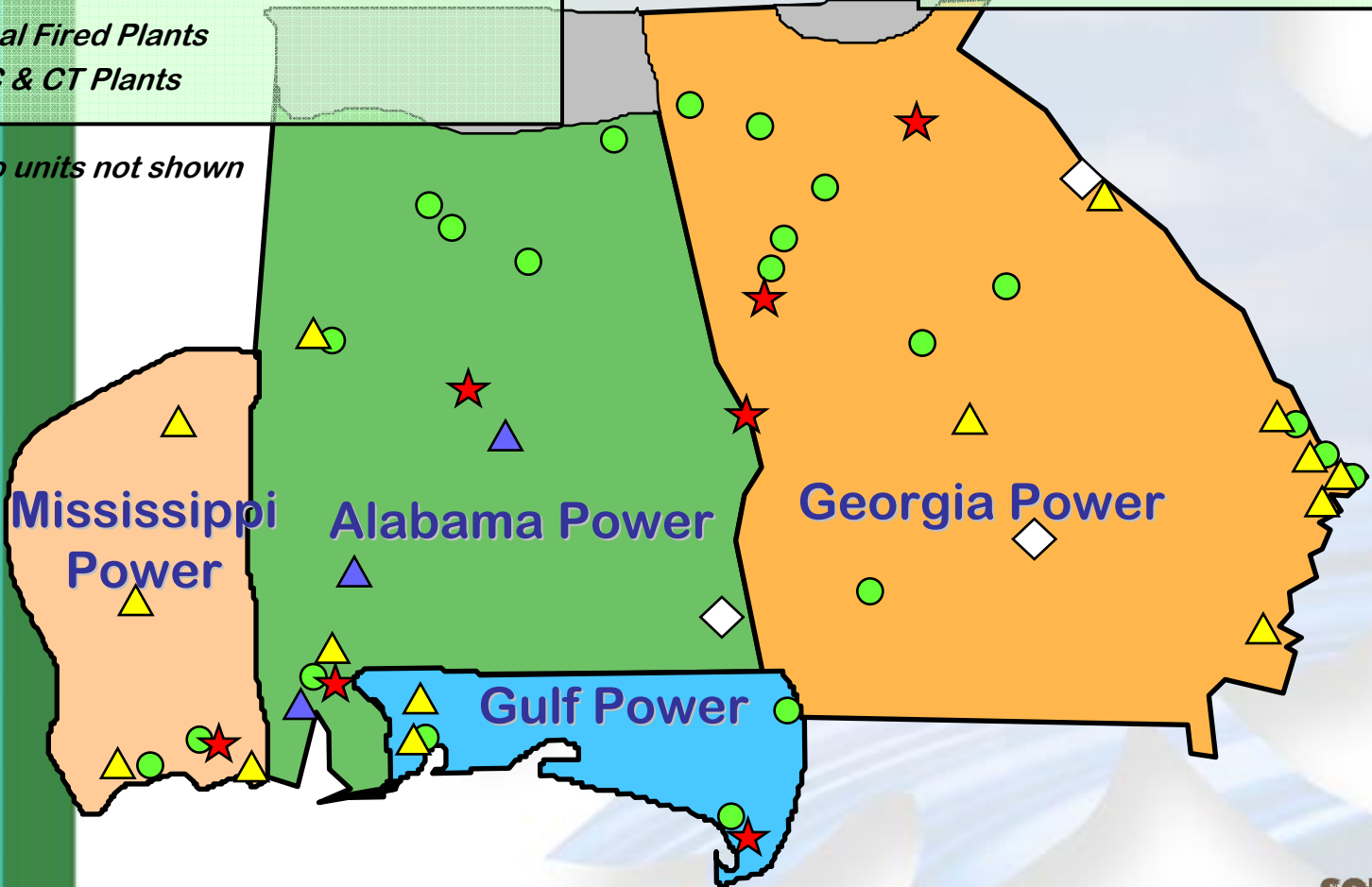
- 1. Southern Company overview**
- 2. Renewable resources and technology issues**
- 3. Biomass co-firing test program**

# Southern Company

- ▲ Gas Cogen Plants
- ▲ Existing Gas-Fired and Oil-Fired Plants
- ◇ Nuclear
- Coal Fired Plants
- ★ CC & CT Plants

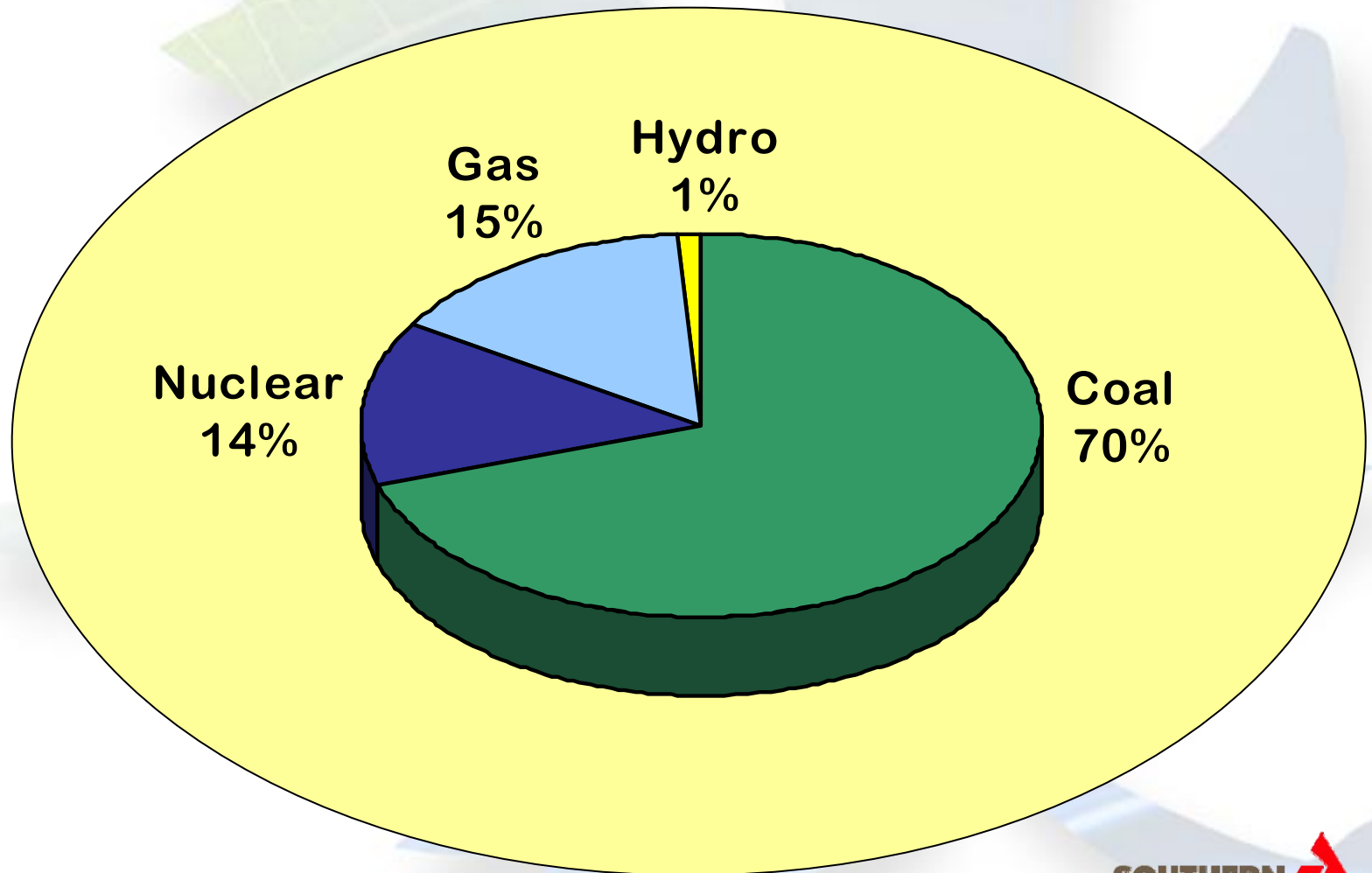
2007 System Statistics  
System Capacity.....about 42,000 MW  
Coal Based Generation.....70%

Hydro units not shown



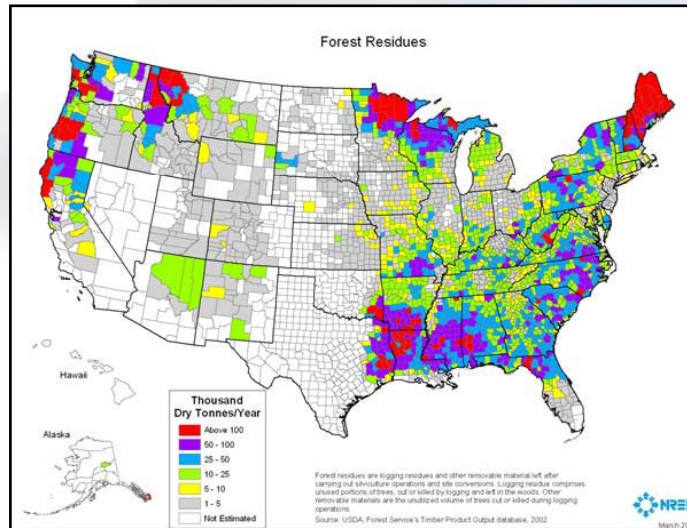
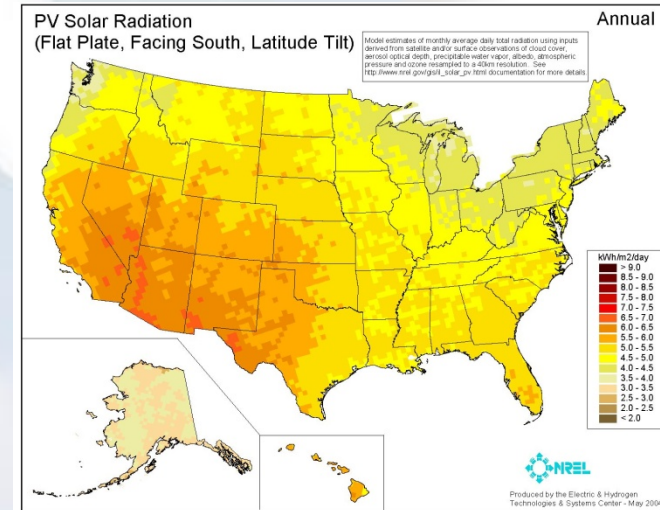
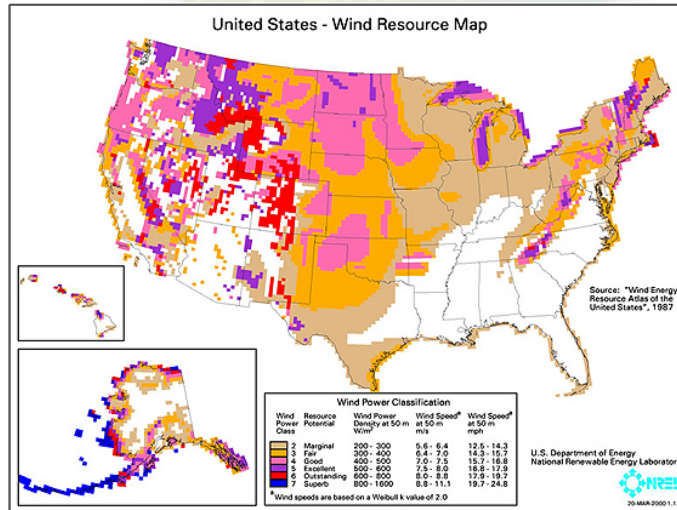
# Southern Company

## *2007 Generation Mix (energy basis)*



# Renewable Power Generation

## *Resource Potential*



Source: National Renewable Energy Laboratory



# Renewable Power Technology Program

## *Technology Issues*

- High capital cost
- Lower capacity factors for wind and solar PV in southeast
- Lower energy density compared to fossil fuels
- Not dispatchable
- *Biomass is most plentiful resource in the southeast, but dedicated biomass power plants are expensive*


# Biomass Co-firing

ENVIRONMENT

MY REALITY  
"Finding the most efficient mix of wood chips and coal that will produce electricity with lower CO<sub>2</sub> emissions."

Bert Blevins - Alabama Power Engineer II, Plant Gadsden  
Gadsden, Alabama

Because biomass has the highest potential for providing renewable electricity in the Southeast, we continue to evaluate this option. Our research and development program has studied co-firing coal with several types of biomass, including switchgrass, sawdust, and wood chips. And now we're testing the feasibility of generating electricity from 100 percent biomass. We want to develop a process that can cost-effectively generate electricity.





# Advantages

## *Biomass Co-firing*

- Lower capital cost
- Emissions reductions
- Customer



# Disadvantages

## *Biomass Co-firing*

- Lower energy density
- Compatibility with pulverized coal feed systems
- Cost

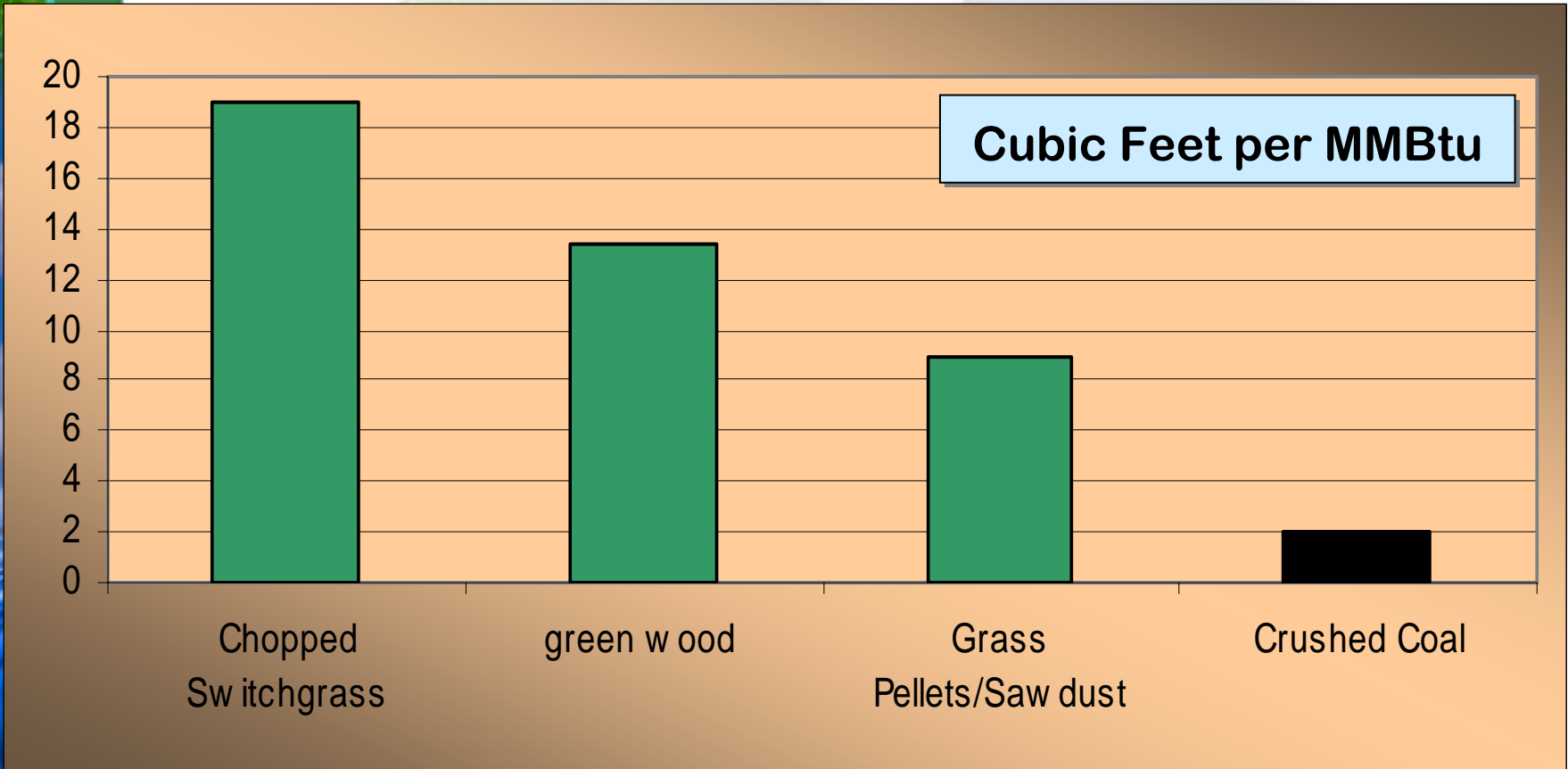


# Biomass Co-firing

## *Fuel Types Tested*

- Ground switchgrass
- Sawdust
- Wood chips (nominally 1 inch plus)
- “Small” wood chips (nominally 1/2 inch or less)

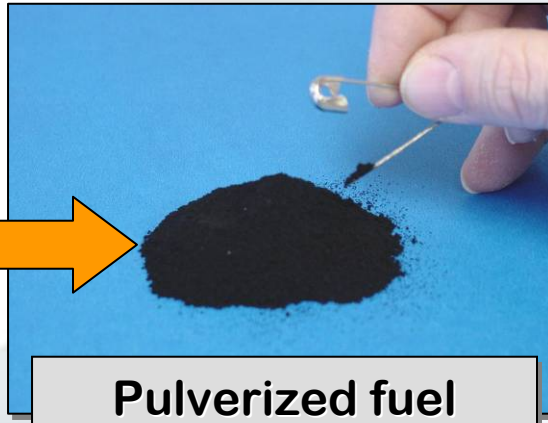
# Low Volumetric Energy Density for Biomass Increases Handling and Transport Costs



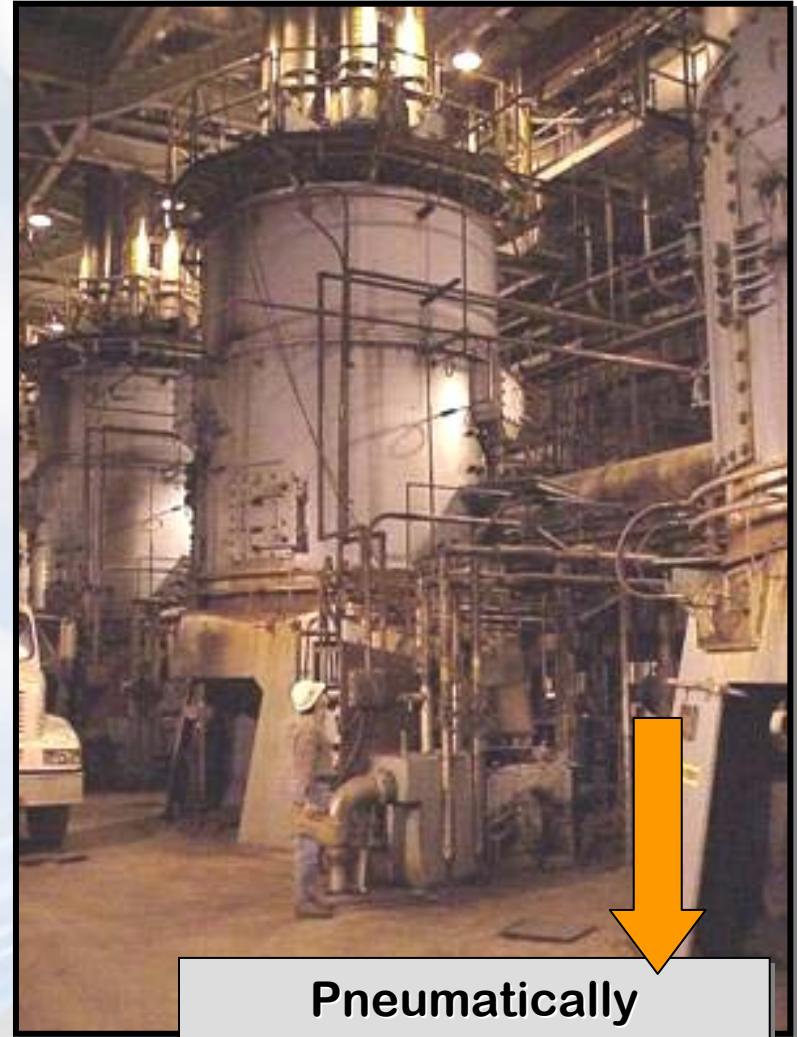
# Biomass versus Coal

<b>Component</b> (as received)	<b>Sawdust</b> (Hickory)	<b>Switchgrass</b> (Alamo)	<b>Coal</b> (Bituminous)
<b>Heating Value (Btu/lb)</b>	<b>5,399</b>	<b>7,380</b>	<b>12,053</b>
<b>Moisture (%)</b>	<b>35.14</b>	<b>12.18</b>	<b>6.04</b>
<b>Ash (%)</b>	<b>0.71</b>	<b>5.33</b>	<b>13.17</b>
<b>Sulfur (%)</b>	<b>0.01</b>	<b>0.13</b>	<b>1.92</b>
<b>Nitrogen (%)</b>	<b>0.12</b>	<b>1.17</b>	<b>1.42</b>

# Pulverized Coal System



**Pulverized fuel**  
*powder-like*



**Pneumatically  
conveyed to burners**



# Biomass Co-firing Approaches

- **Direct injection** – Introduce ground biomass pneumatically into the boiler through dedicated burners
  - Higher co-firing percentages (10% or more by energy)
  - Separate on-off control
- **Co-milling** – Mix biomass with coal and introduce into the boiler through the coal handling system
  - Reduced capital cost
  - Minimal on-site processing costs
  - Lower co-firing percentage (1 to 5%)

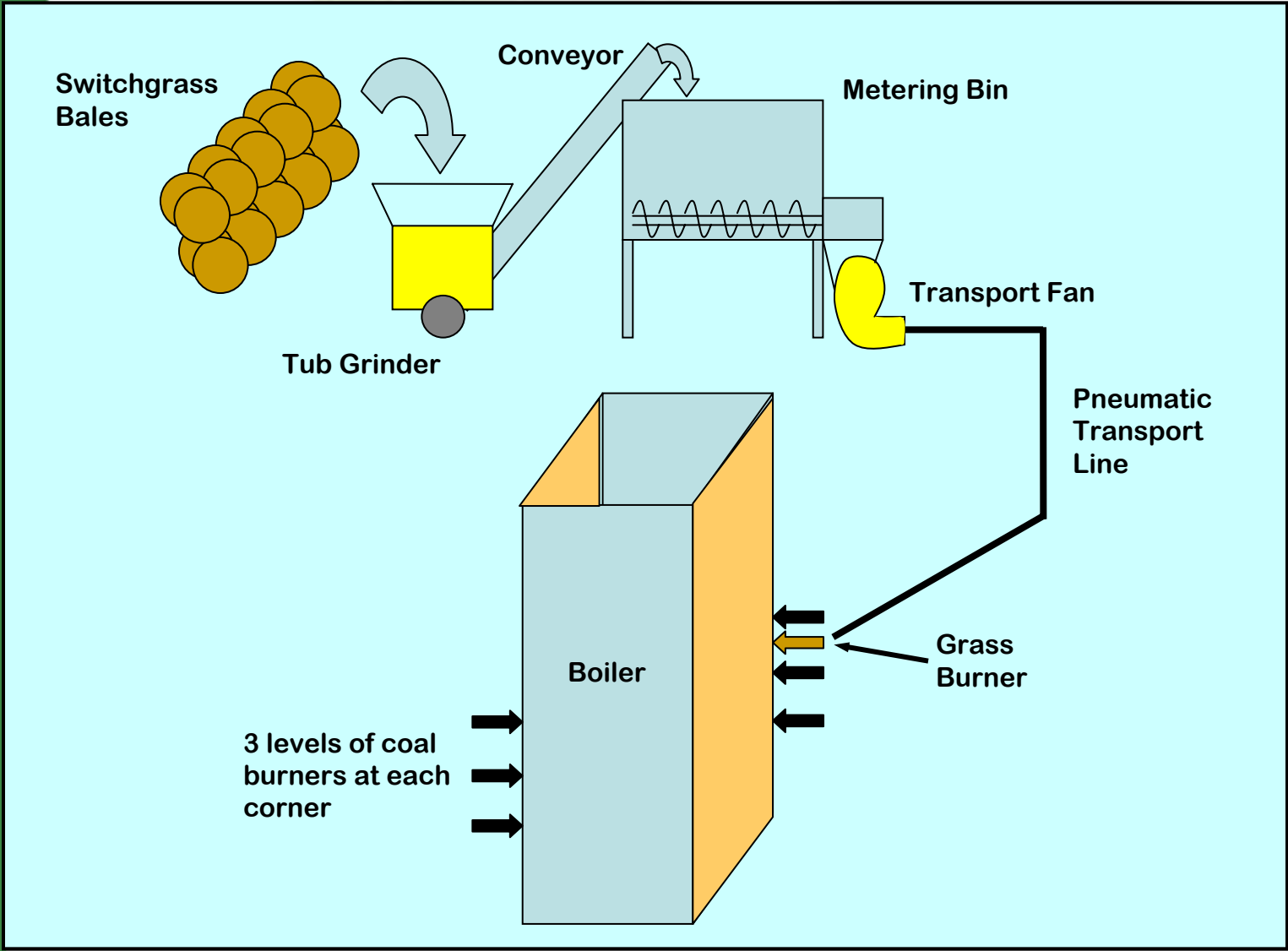
# Switchgrass

- Resilient, native grass
- High productivity
- Grows on marginal land
- Minimal fertilizer, insecticide
- Farmed with existing equipment



# Switchgrass Direct Injection

## *Simplified Schematic*



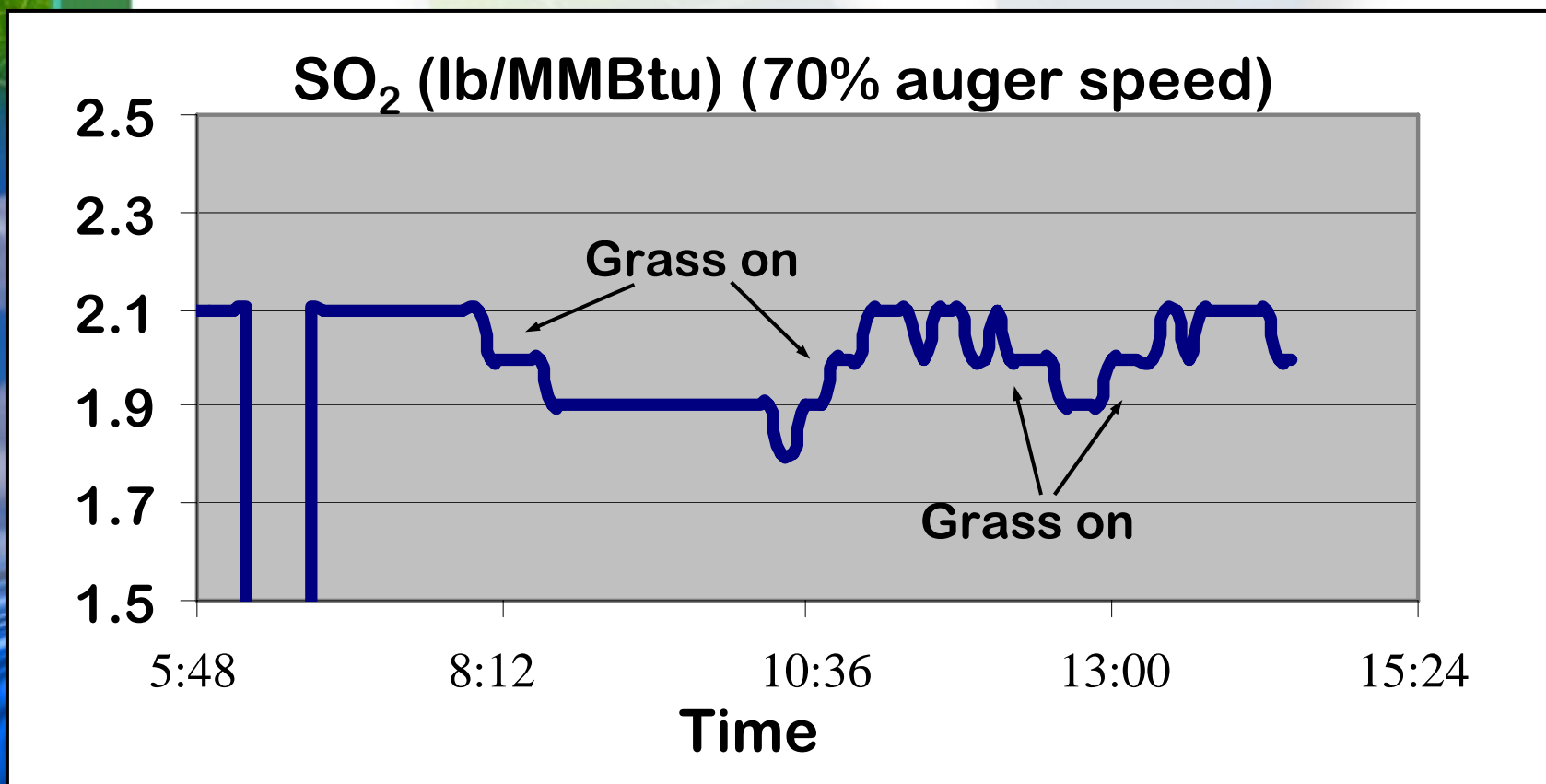
# Switchgrass Grinding Facility



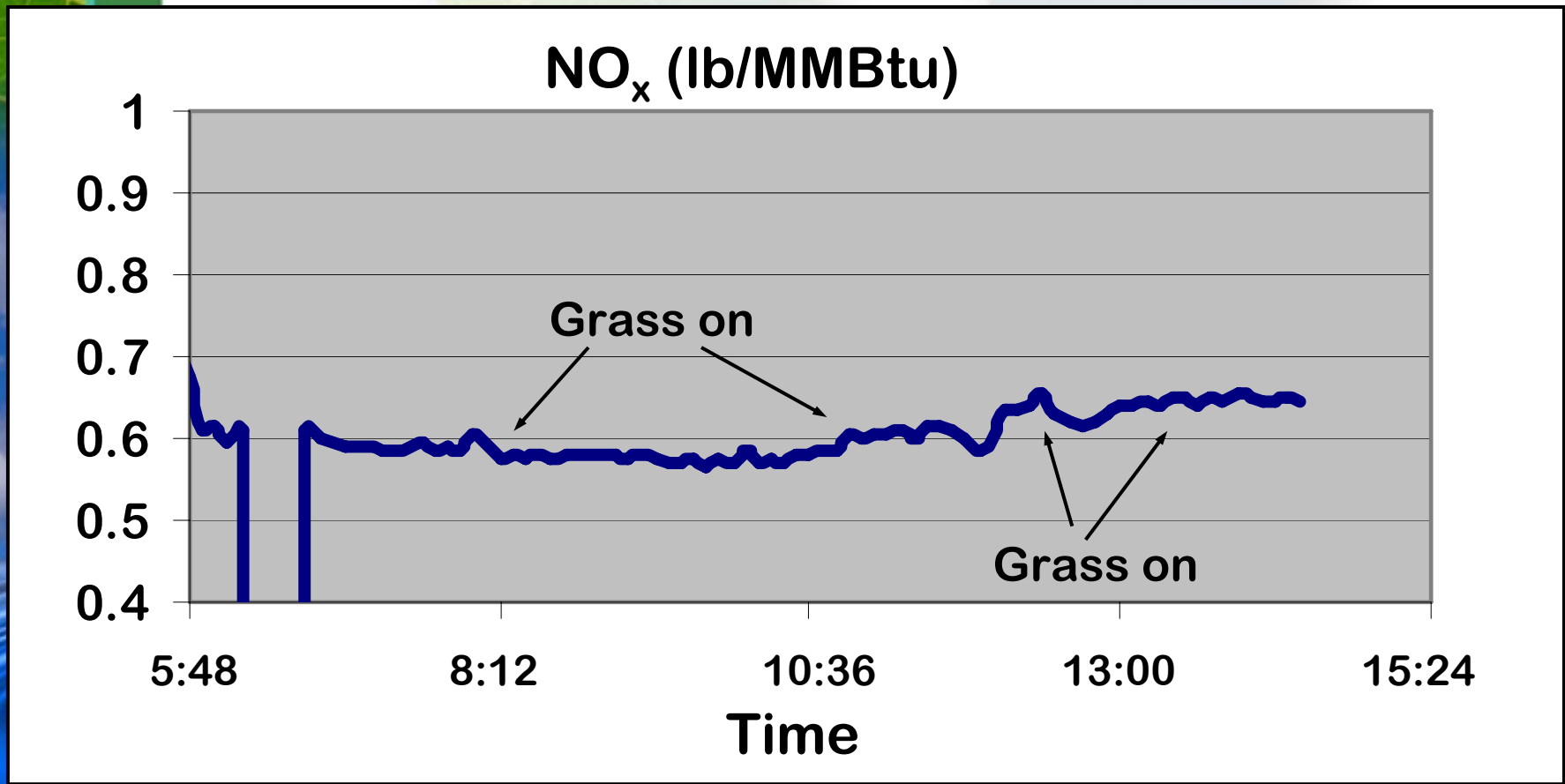
# Switchgrass Grinding Facility



# SO<sub>2</sub> Reductions



# NO<sub>x</sub> Reductions???



# Switchgrass Direct Injection at Plant Gadsden

## *Basic Operating Facts*

- Support for RE pricing program and R&D tests
- Began operation in 2001
- Co-firing range 5 to 10%
- Lower SO<sub>2</sub> emissions
- About 500 tons of switchgrass per year (200 hours --- 1<sup>st</sup> shift)

