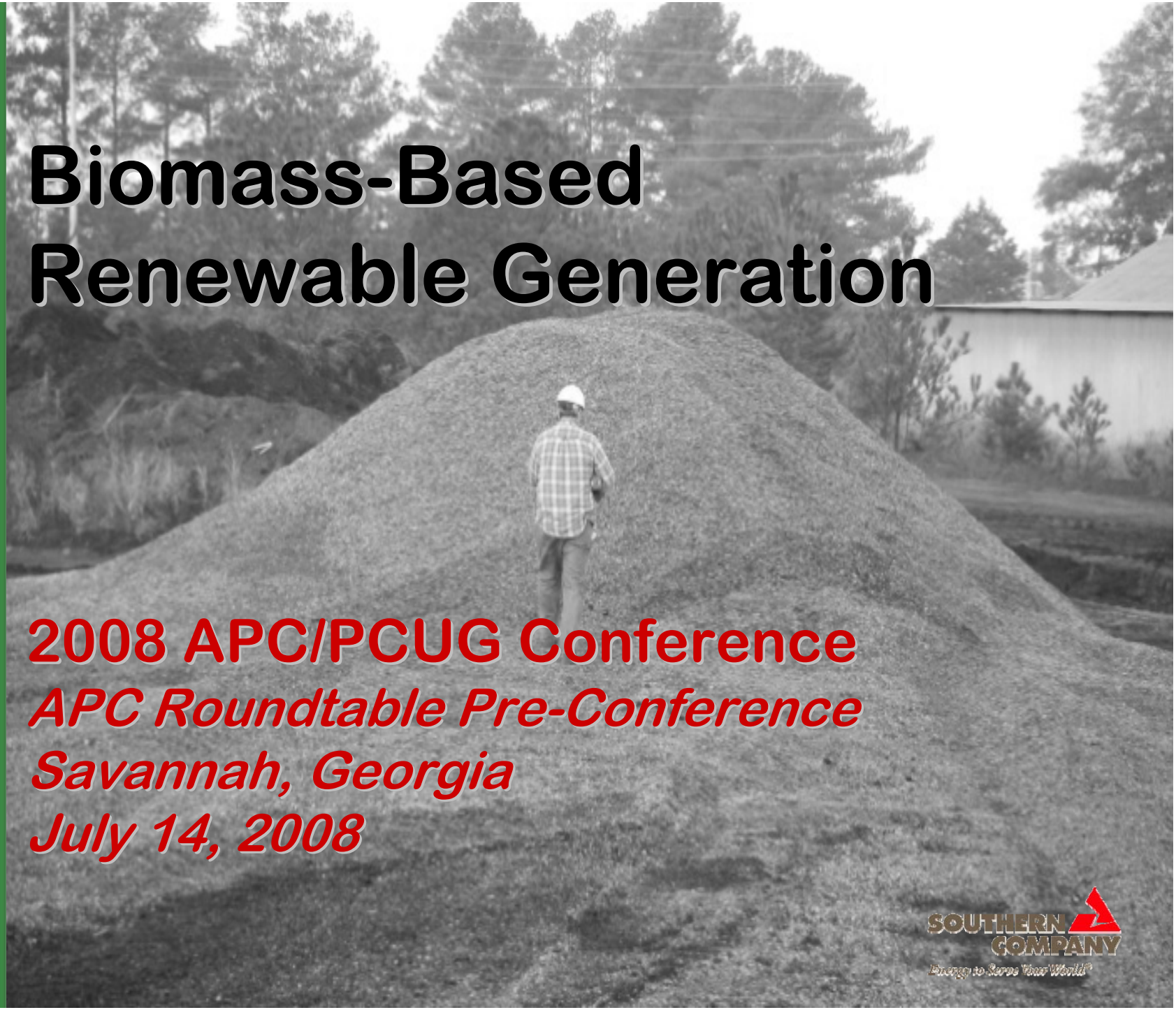
Reinhold Environmental Ltd.

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

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Biomass Power Technology Program

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

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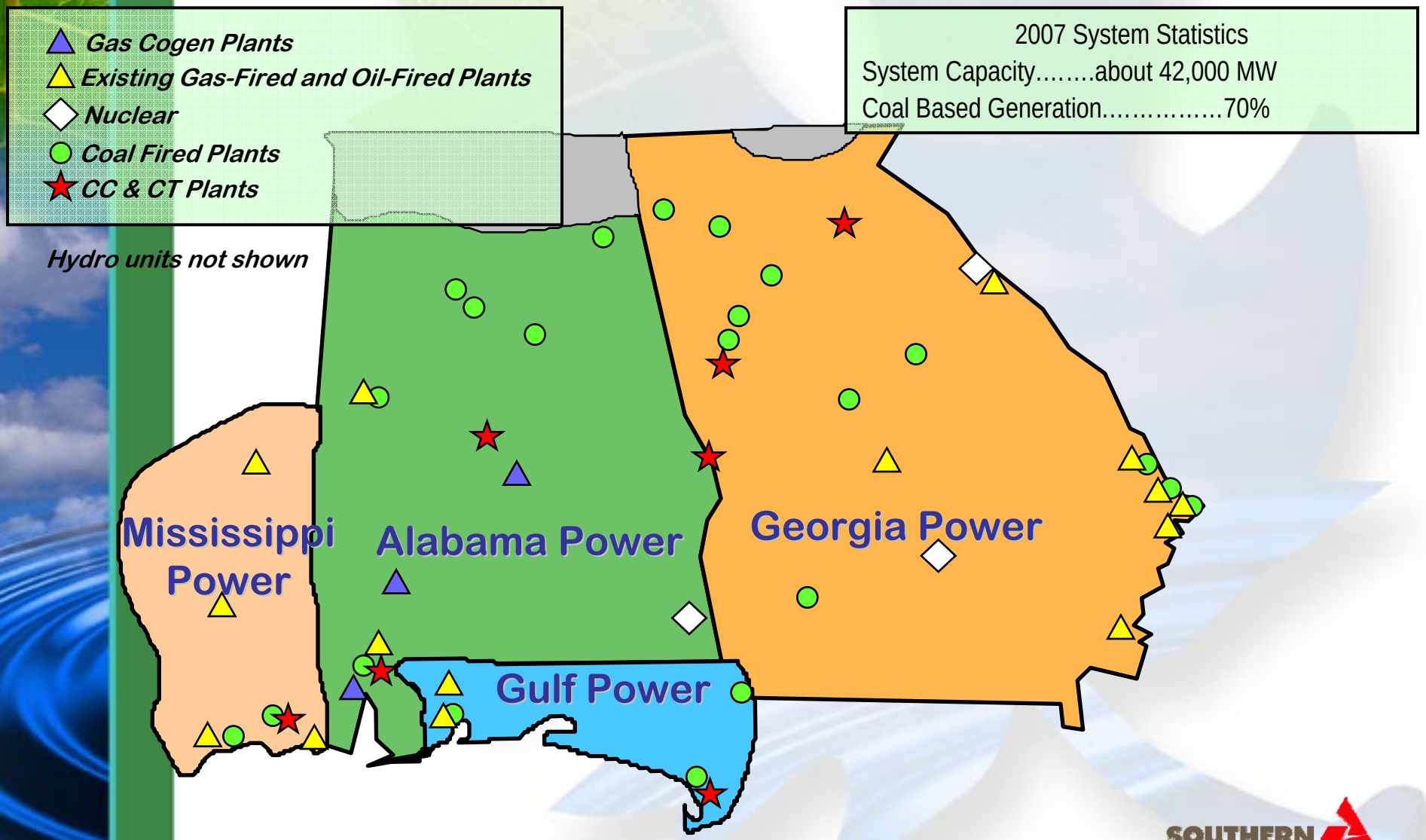
Southern Company



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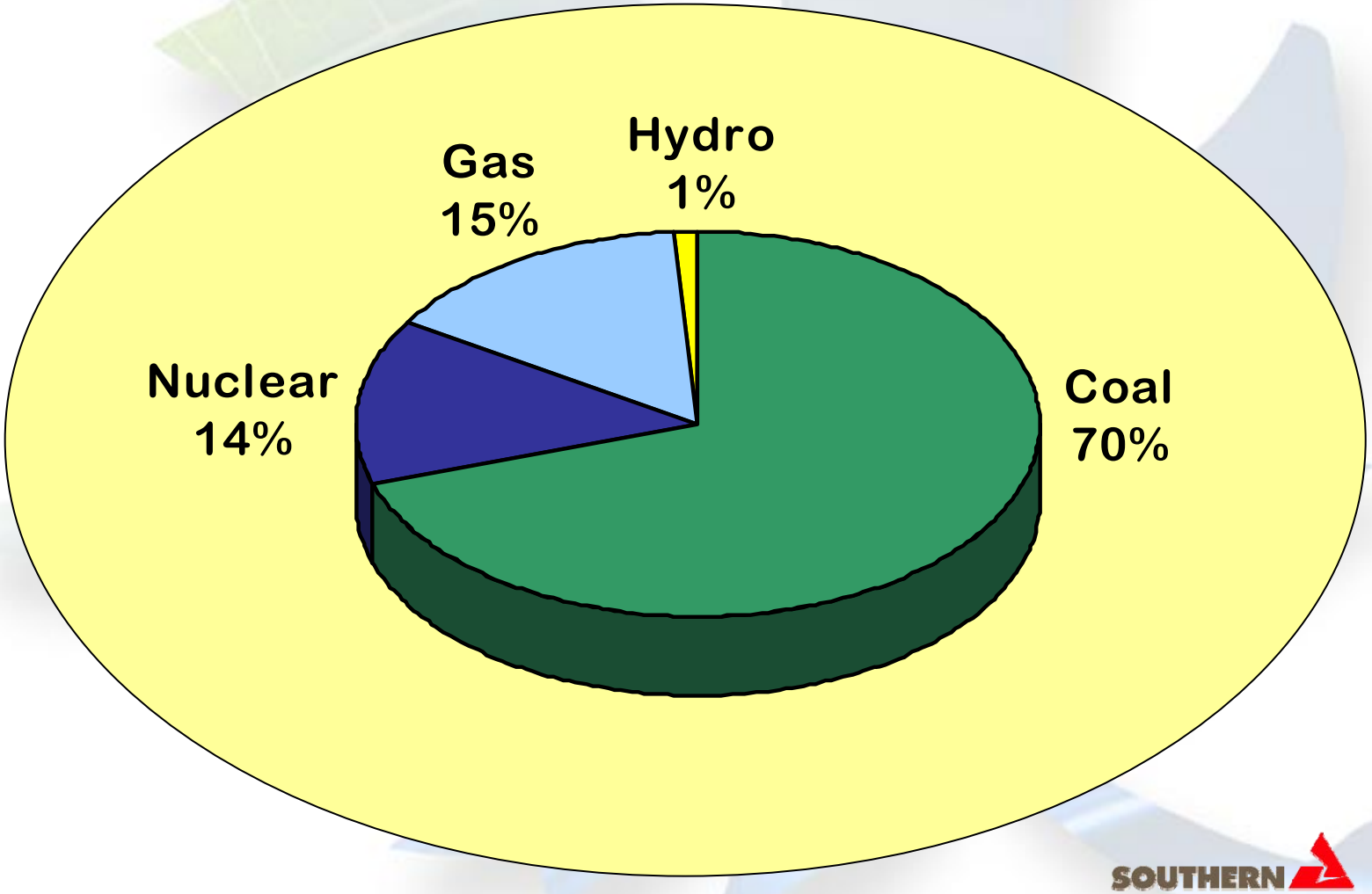
2007 Generation Mix (energy basis)



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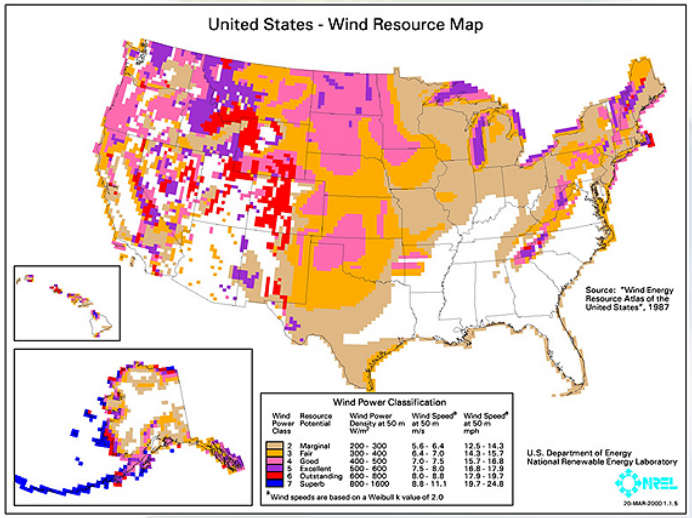
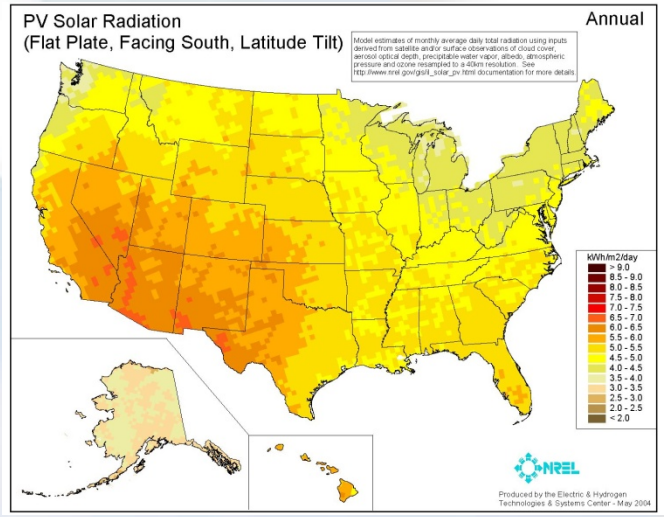
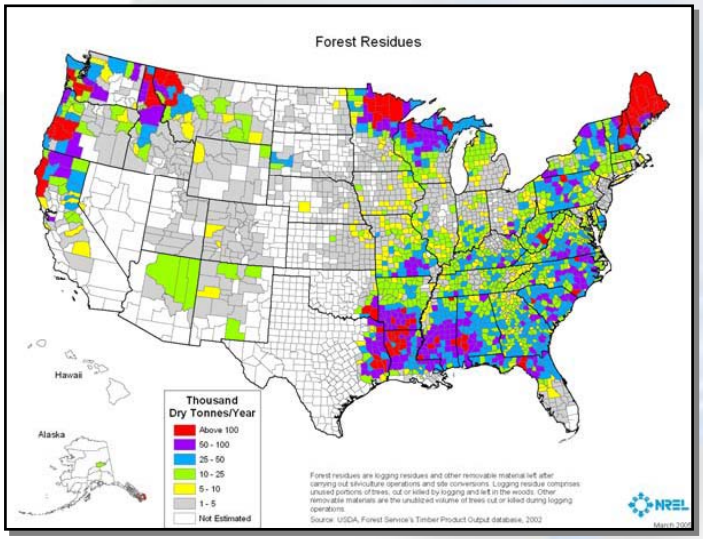
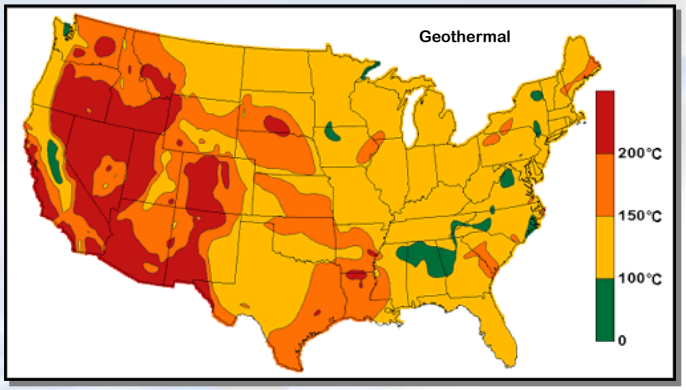
Renewable Power Generation

Resource Potential









Source: National Renewable Energy Laboratory

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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*

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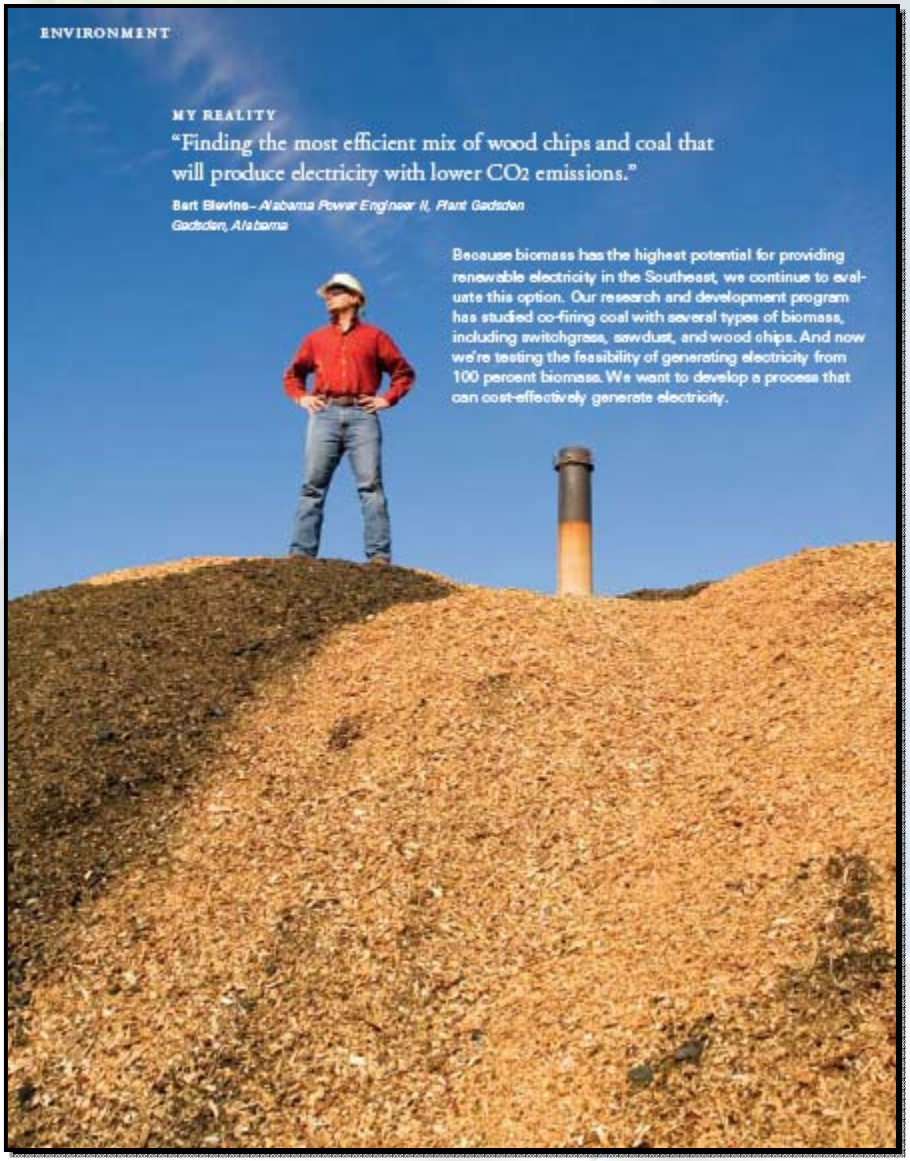
Biomass Co-firing



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Advantages

Biomass Co-firing

- Lower capital cost
- Emissions reductions
- Customer

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Disadvantages

Biomass Co-firing

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

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Biomass Co-firing

Fuel Types Tested

- Ground switchgrass
- Sawdust
- Wood chips (nominally 1 inch plus)
- “Small” wood chips (nominally ½ inch or less)

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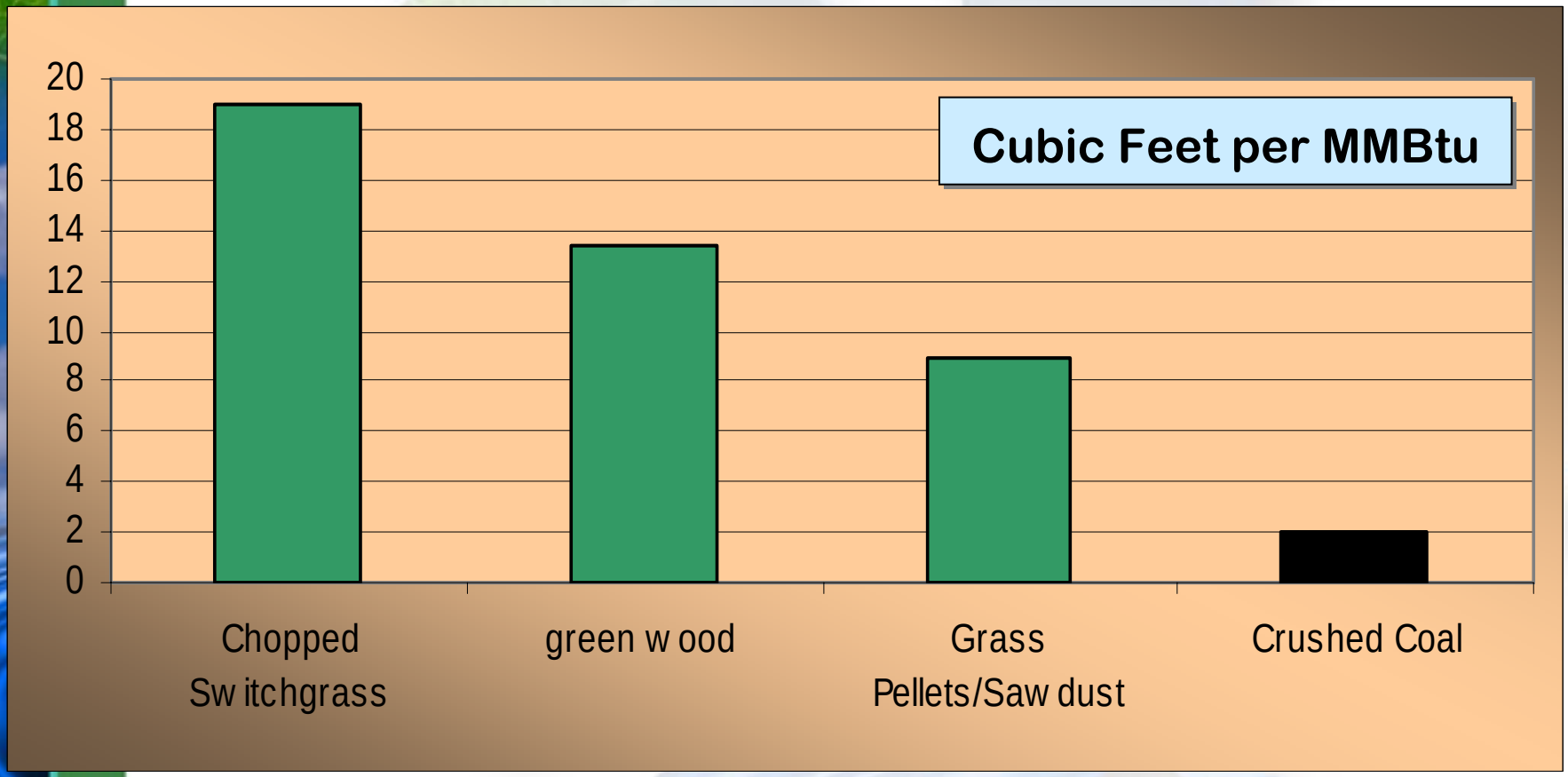
Low Volumetric Energy Density for Biomass Increases Handling and Transport Costs



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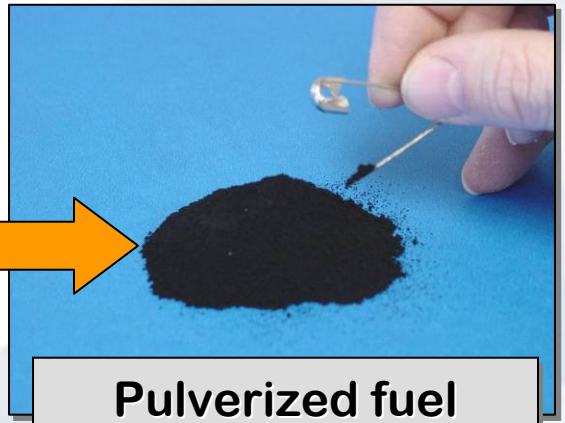
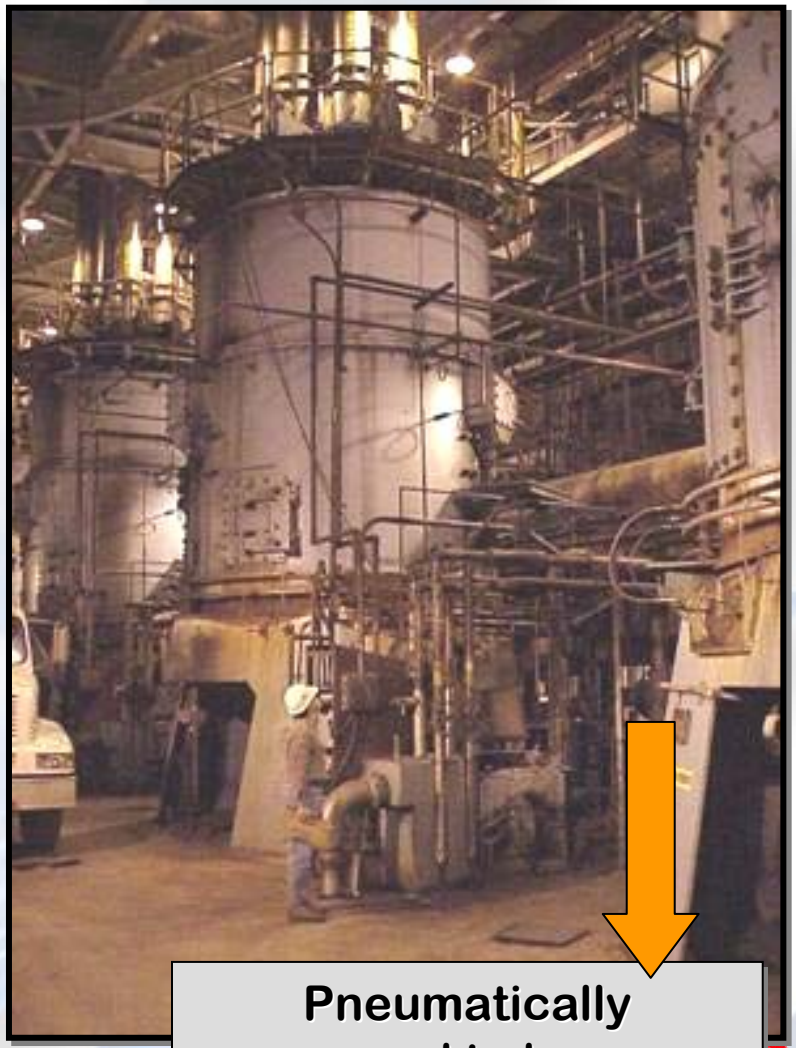
Biomass versus Coal

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

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%)

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Switchgrass

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

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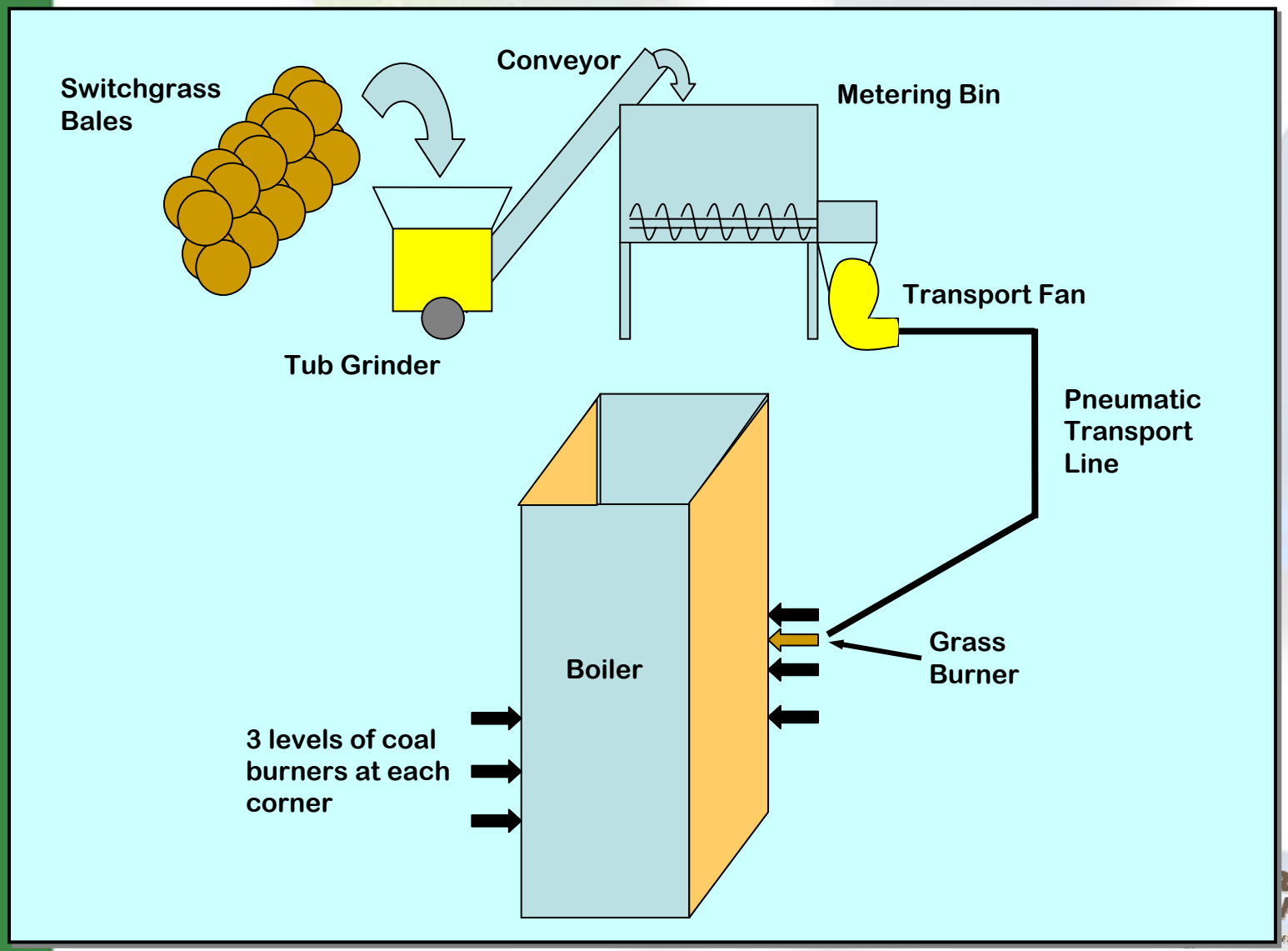
Switchgrass Direct Injection

Simplified Schematic



Switchgrass Grinding Facility

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Switchgrass Grinding Facility

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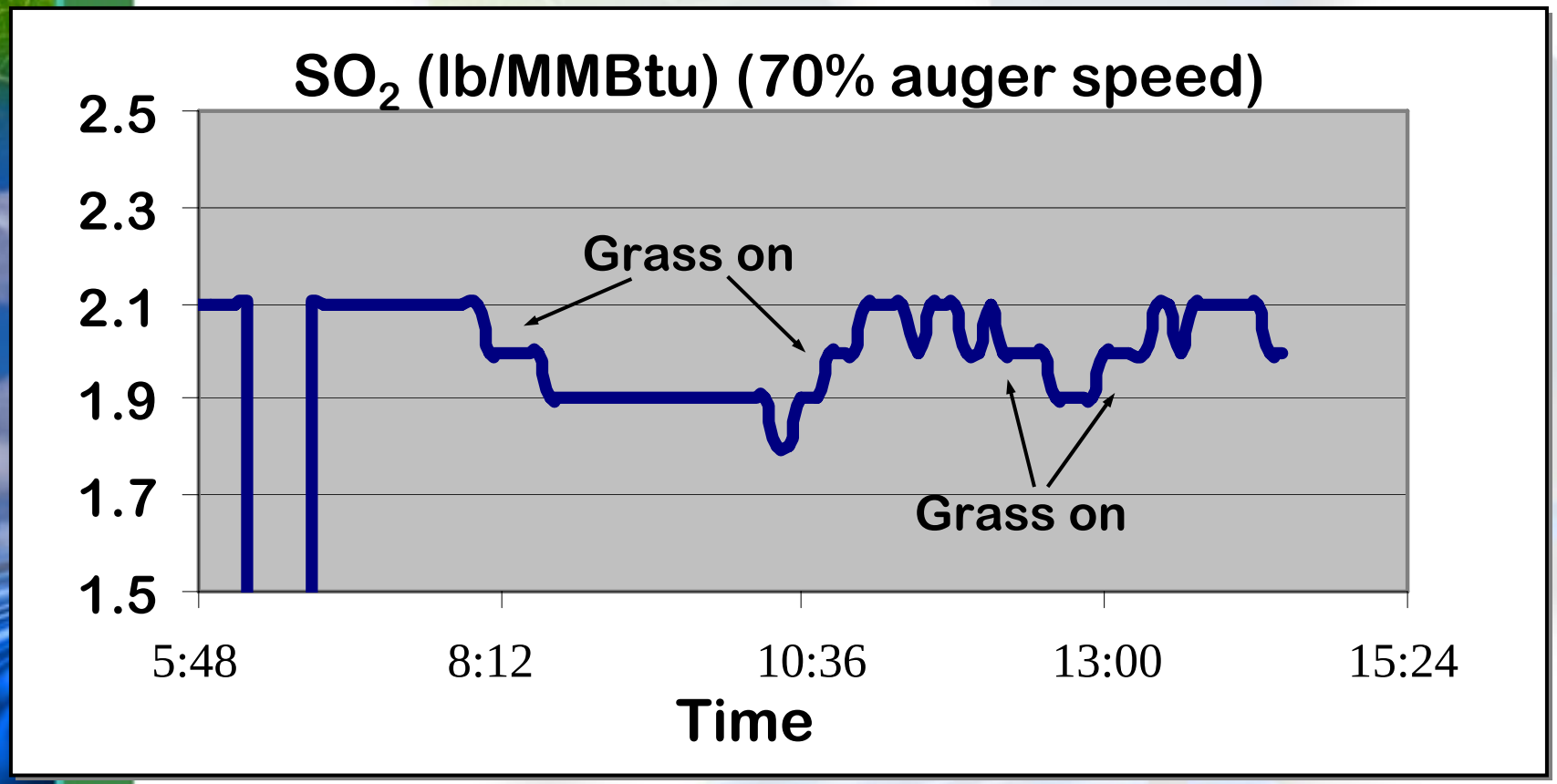
SO_2 Reductions



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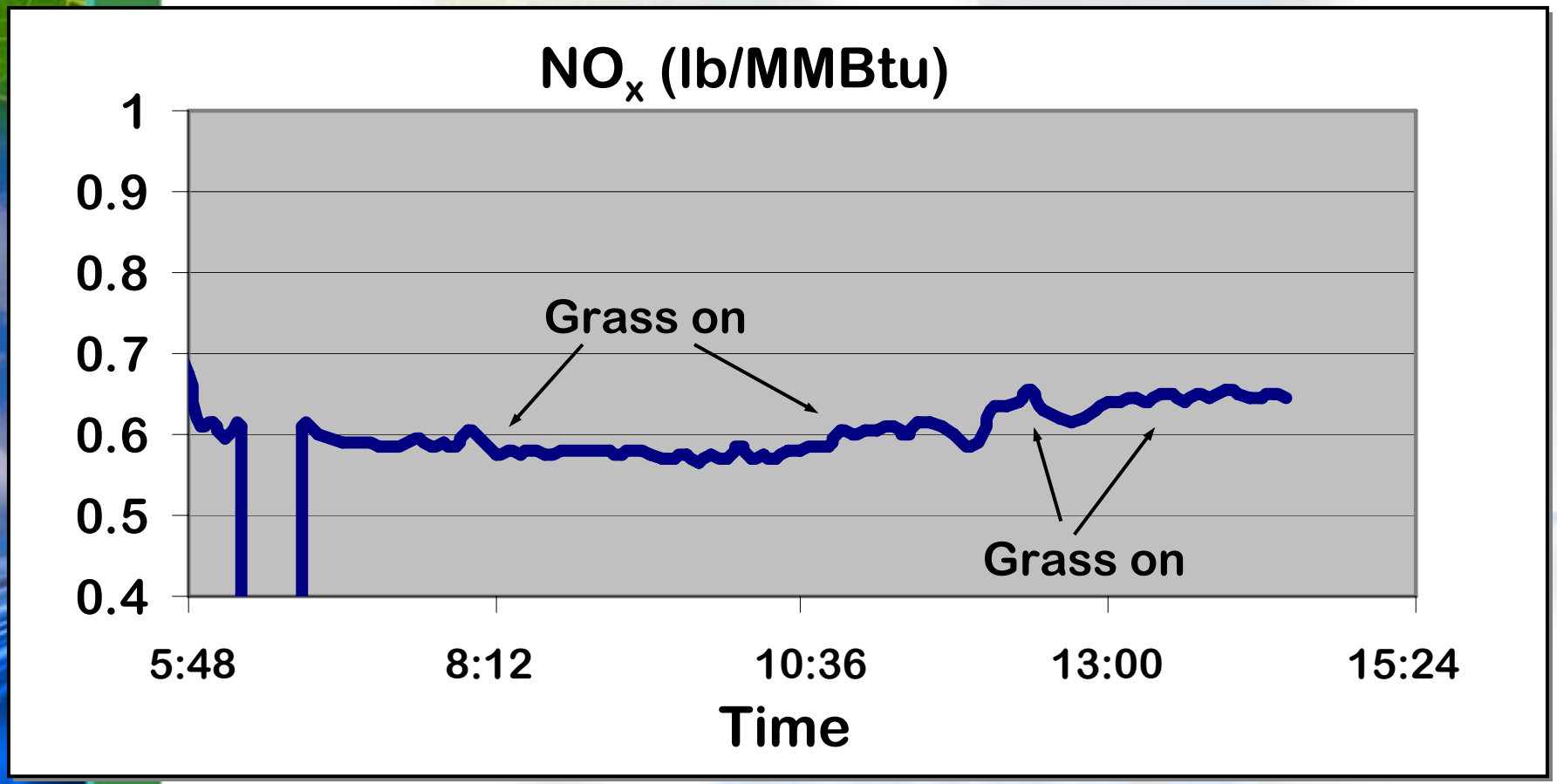
NO_x Reductions???



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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_2 emissions
- About 500 tons of switchgrass per year (200 hours --- 1st shift)