

Electric Utility Investigation of Biopower Applications

Biomass 2010

Plenary Session – Creating Power from Biomass

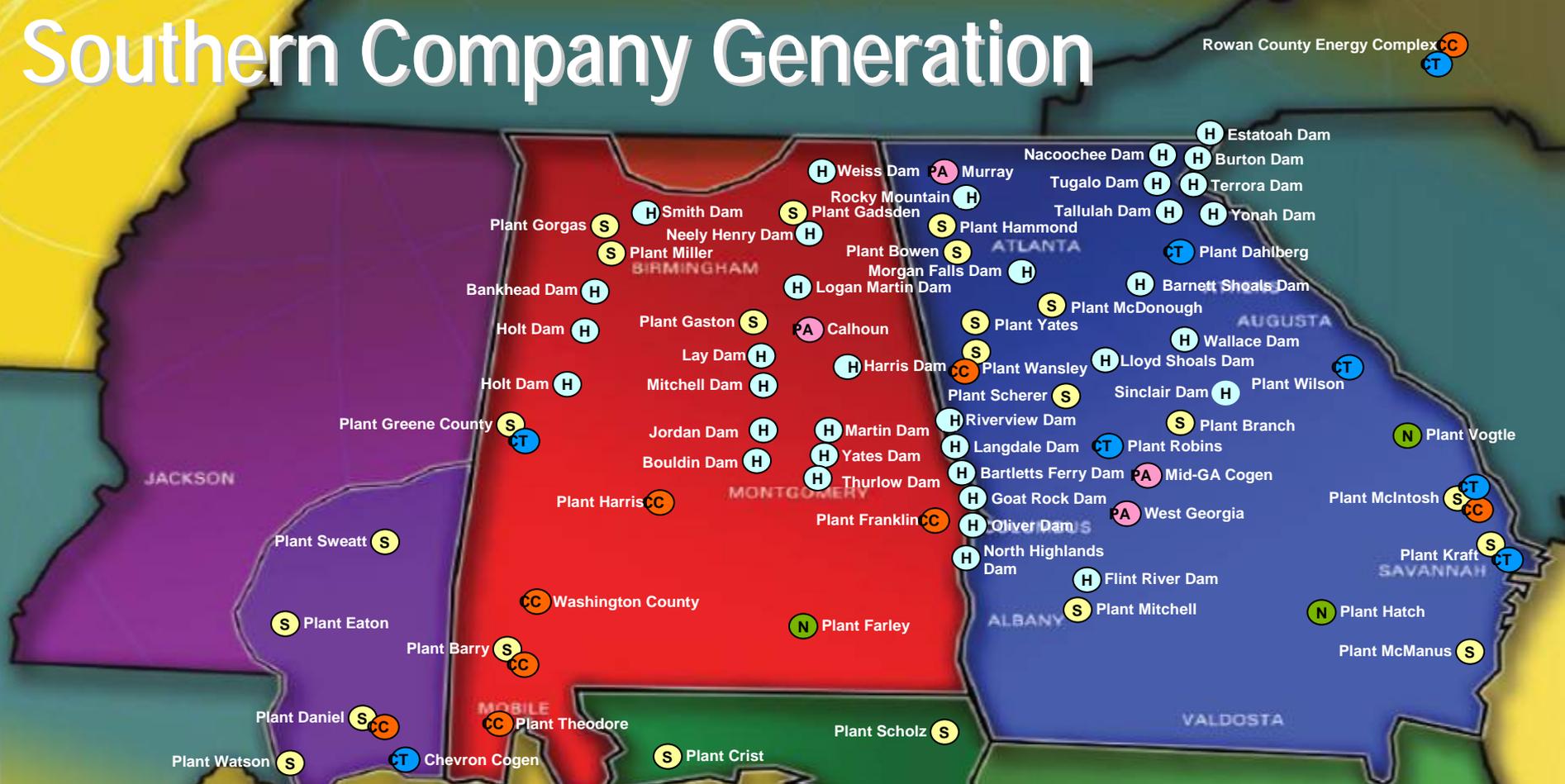
Tom Johnson

twjohnso@southernco.com

3/31/2010



Southern Company Generation



OPCO

- APC**
- GPC**
- GULF**
- MPC**
- SPC**

Plant Type

- N** Nuclear (3,759 MW)
- S** Steam (21,587 MW)
- CC** Combined Cycle (8,359 MW)
- CT** Combustion Turbine (3,992 MW)
- H** Hydro (2,815 MW)
- PA** Power Purchase Agreements (2,002 MW)

Total 42, 514 MW

Rowan County Energy Complex **CC**

DeSoto County Energy Complex **CT**

Stanton Generating Facility **CC**

Plant Oleander **CT**

Plant McManus **S**

Plant Hatch **N**

Plant Kraft **S**

Plant McIntosh **S**

Plant Vogtle **N**

Plant Wilson **CT**

Wallace Dam **H**

Barnett Shoals Dam **H**

Plant Dahlberg **CT**

Yonah Dam **H**

Estatoah Dam **H**

Nacoochee Dam **H**

Burton Dam **H**

Terrora Dam **H**

Tugalo Dam **H**

Murray **PA**

Rocky Mountain **H**

Plant Gadsden **S**

Plant Hammond **S**

Weiss Dam **H**

Plant Bowen **S**

Morgan Falls Dam **H**

Logan Martin Dam **H**

Smith Dam **H**

Neely Henry Dam **H**

Plant Miller **S**

Plant Gorgas **S**

Plant Gaston **S**

Calhoun **PA**

Harris Dam **H**

Lay Dam **H**

Holt Dam **H**

Mitchell Dam **H**

Jordan Dam **H**

Bouldin Dam **H**

Plant Harris **CC**

Martin Dam **H**

Yates Dam **H**

Thurlow Dam **H**

Plant Greene County **S**

Plant Franklin **CC**

Oliver Dam **S**

North Highlands Dam **H**

Plant Sweett **S**

Plant Wansley **S**

Plant Scherer **S**

Riverview Dam **H**

Plant Eaton **S**

Plant Wansley **S**

Langdale Dam **H**

Bartlett's Ferry Dam **H**

Plant Barry **S**

Plant Scholz **S**

Plant Mitchell **S**

Plant Daniel **S**

Plant Watson **S**

Plant Theodore **CC**

Plant Farley **N**

Plant Crist **S**

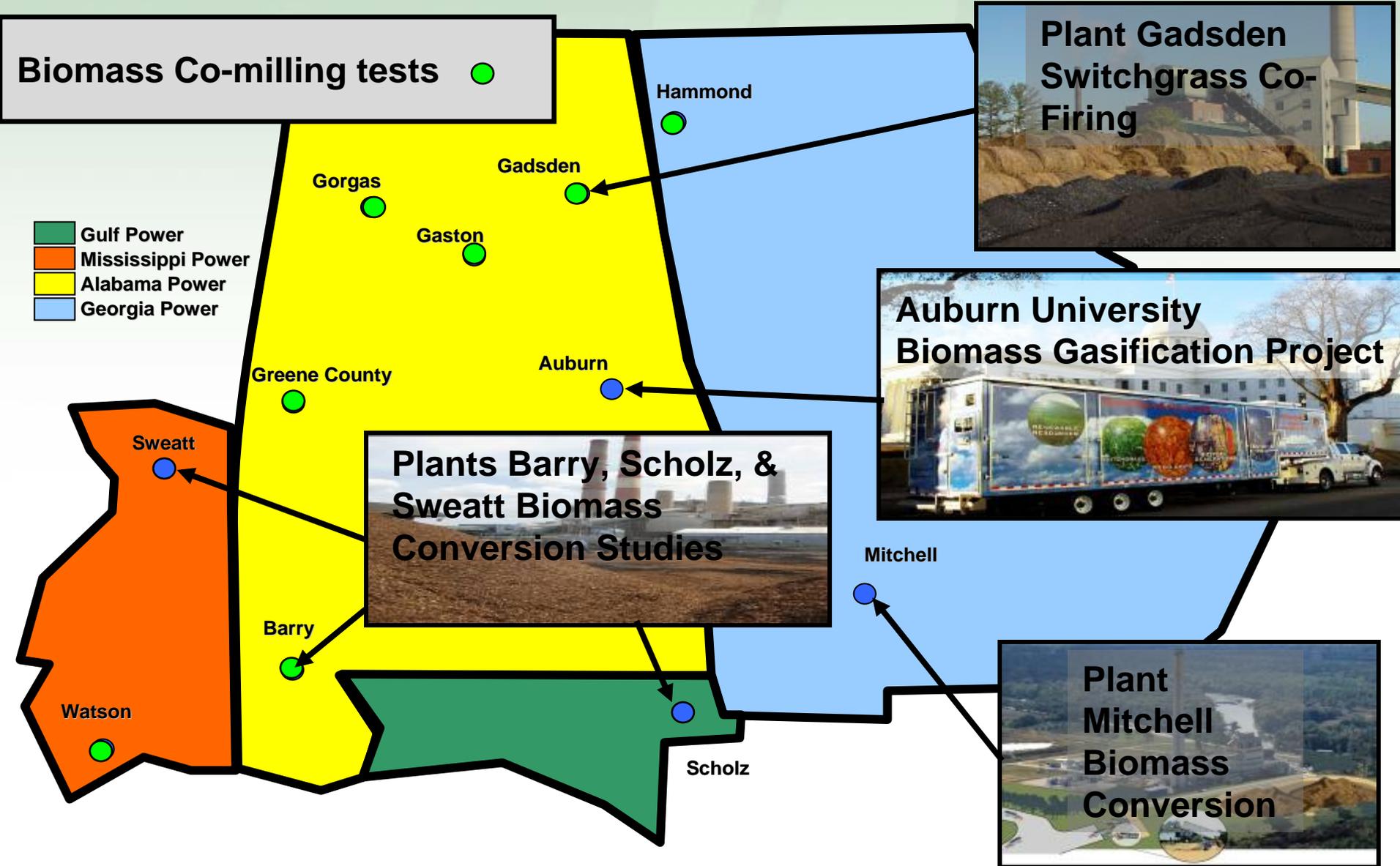
Chevron Cogen **CT**

Plant Smith **S**

Washington County **CC**

Plant Smith **CC**

Biomass-to-Power Demonstrations



Biomass Co-milling

- **Biomass co-milling involves creation of a fuel mix of biomass with coal and sending this mix to the existing fuel handling system**
- **Advantages**
 - Little or no capital investment
 - Quick implementation
 - Low cost fuel
- **Disadvantages**
 - Low co-firing %
 - Fuel handling
 - Extra pulverizer O&M?
 - Ash sales



Fuels Tested in Co-milling

- Pulp & paper size chips – **encountered feed system problems**
- 1/2” minus whole tree chips
 - Pine thinnings
 - Mixed hardwoods
- Sawdust
- Urban wood waste
- Peanut hulls



Various Fuels Used in Co-milling

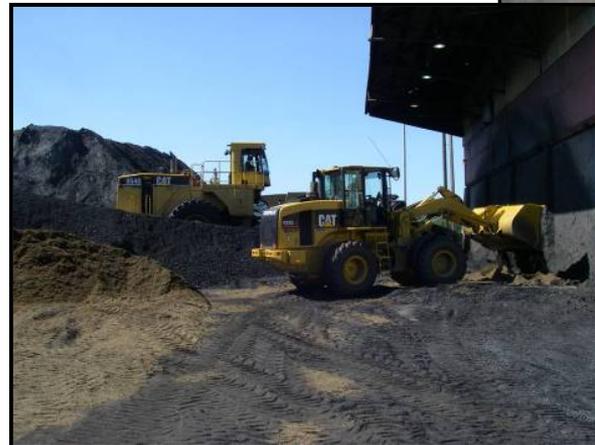
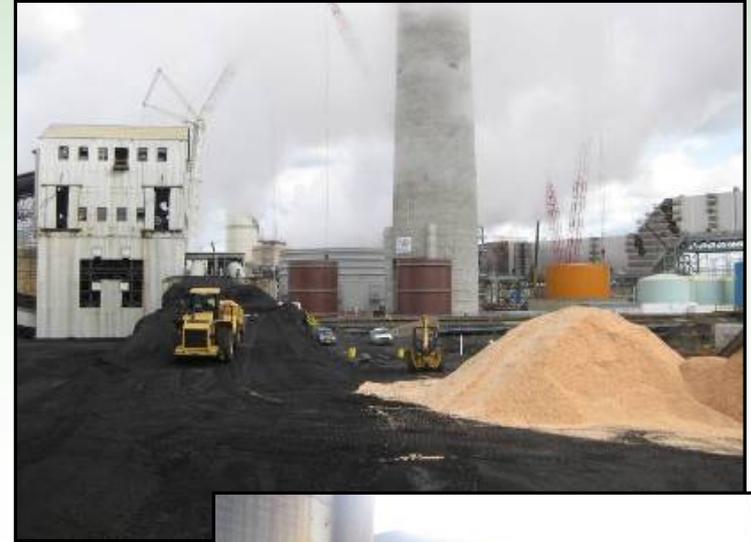


Biomass Co-milling



Co-Milling Test Results

- **Smaller % by energy (1%–3%)**
- **Co-milling limitations are mainly pulverizer related**
 - Amount of spare capacity
 - Wood vs. coal
 - Pulverizer condition
 - Moisture
- **Some added operational expense**
- **Emissions were unchanged or slightly lower**
- **Tested 11 Units**
 - Barry 2 & 4
 - Gadsden 1 & 2
 - Gorgas 6
 - Green Co. 1 & 2
 - EC Gaston 3
 - Hammond 1
 - Watson 4 & 5



Barry 4 Wood Pellet Co-Milling

Results

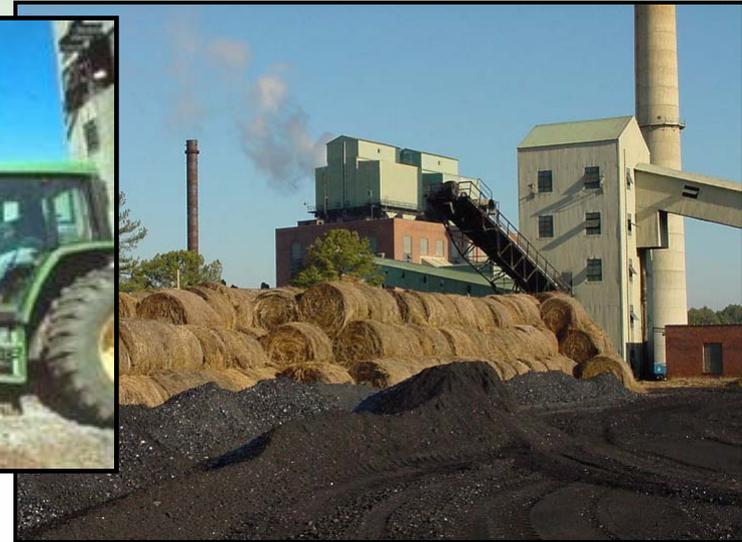
- Achieved 7.2% by energy co-milling at near full load (350 MW)
- New record for Southern Company renewable energy generation at 25 MW

Pellet Disadvantages

- Price \$10 – 12/MMBtu
- Must keep dry
- Added capital would be required for material handling and storage



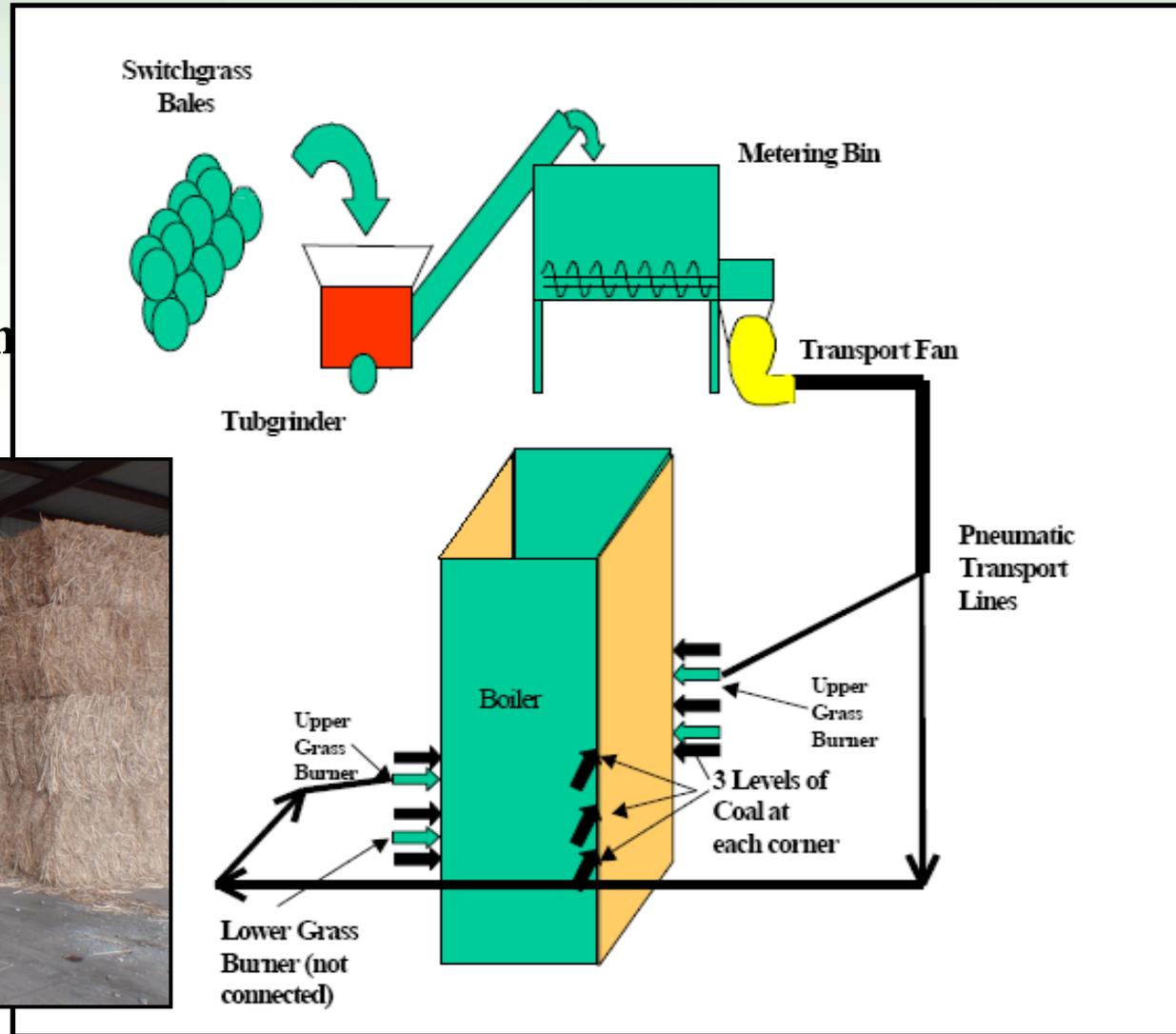
Plant Gadsden Direct Injection System



- **Alabama Power Renewable Energy Rate**
 - \$2.25 for 50 kWh block
- **Research system – limited to 7,000 lb/hr**
- **Two 1,000-pound bales of switchgrass generate 1,150 kilowatt-hours of electricity – enough to power an average home for nearly a month**

Plant Gadsden Direct Injection System

- Can co-fire up to 10% by energy at low loads, 5% at high loads
- ~ 3.5 MW
- Recently tested Giant Miscanthus



Biomass Repowering

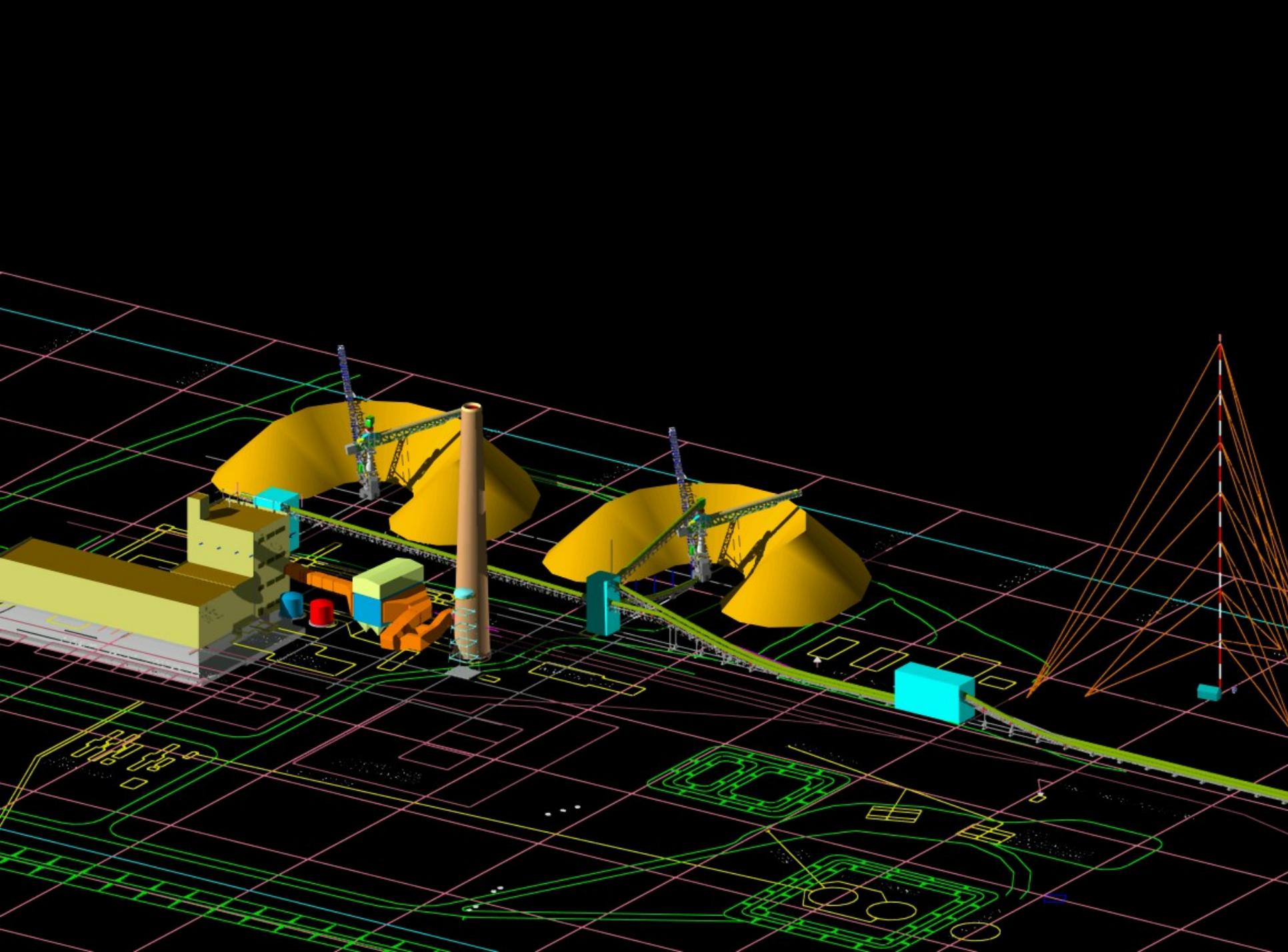
- Biomass plants can be dispatched
- Repowering is more cost competitive (makes use of existing plant equipment)
- Direct replacement for coal generation capacity (some unit capacity de-rate *may* occur)
- Economic transport radius of biomass supplies may limit repowered unit size

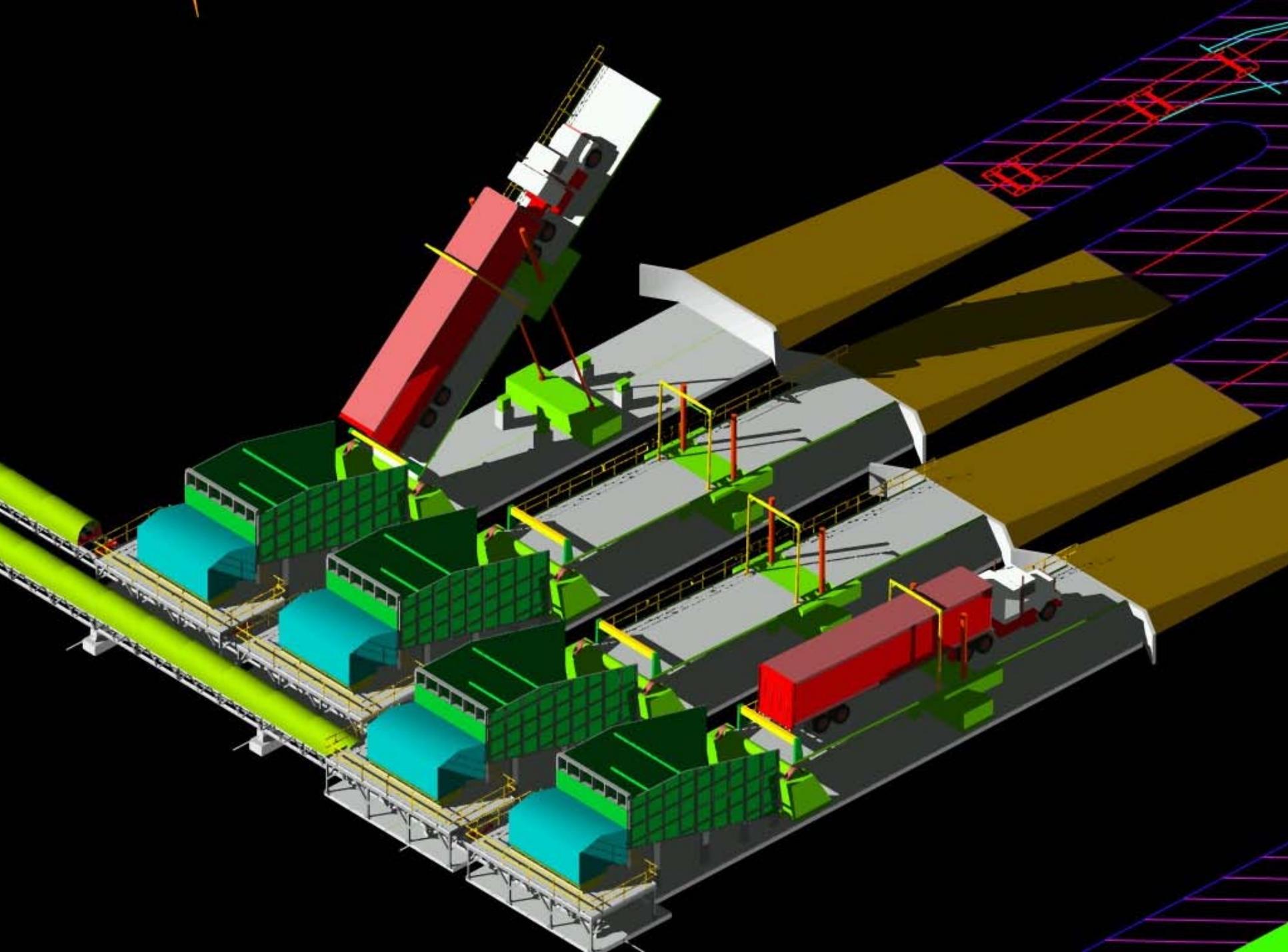


Plant Mitchell Repowering

- **Current plant**
 - 164 MW gross (155 MW net) coal facility
- **Capacity: 96 MW net w/ new stoker grate & suspension firing**
 - Approx. \$1,400/kW
- **Net heat rate at full load: 12,400 Btu/kWh**
- **Approx. 1.1 million ton/yr biomass use**
 - Around 170 trucks per day
- **Emissions**
 - SO₂, NO_x, & Hg emissions lower
 - 96% net reduction in fossil fuel CO₂







Technology Implementation Rank



Biomass Gasification

- **Auburn small scale gasifiers**
 - 25 kW distributed gasification trailer
 - Pressurized (150 psi) gasification bench scale unit (based on GTI technology)
- **UND EERC gasification**
 - Collaboration with EPRI
 - Transport Reactor Development Unit (pressurized)
- **PSDF pilot plant Transport Reactor research in pressurized biomass gasification**
 - Tested wood pellet feeding 1Q 2009
 - Gasification test of 20% by energy in 4Q 2009



Summary & Next Steps

Questions?

- **Biomass is currently the most economical option for Southern Company**
 - **Co-milling (lower % due to existing coal plant feed systems)**
 - **Direct injection on large units to get higher % (SCR catalyst deactivation & ash sales?)**
 - **Higher volumetric energy density fuels to get higher %?**
 - **Repowering (Industrial Boiler MACT impacts on technology selection?)**
- **Pressurized biomass gasification must be developed & demonstrated to increase efficiency via interface with higher efficiency combined cycle plants (say, 20 to 100 MW+)**
- **Feedstock Research**
 - **Fuel sustainability**
 - **Energy crops**
 - **Torrefied wood**
 - **Algae**