

Southern Company Biomass to Electricity Research

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Southern Company Research & Environmental Affairs
LSU Alternative Energy 2009
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Energy to Serve Your World[®]

Outline

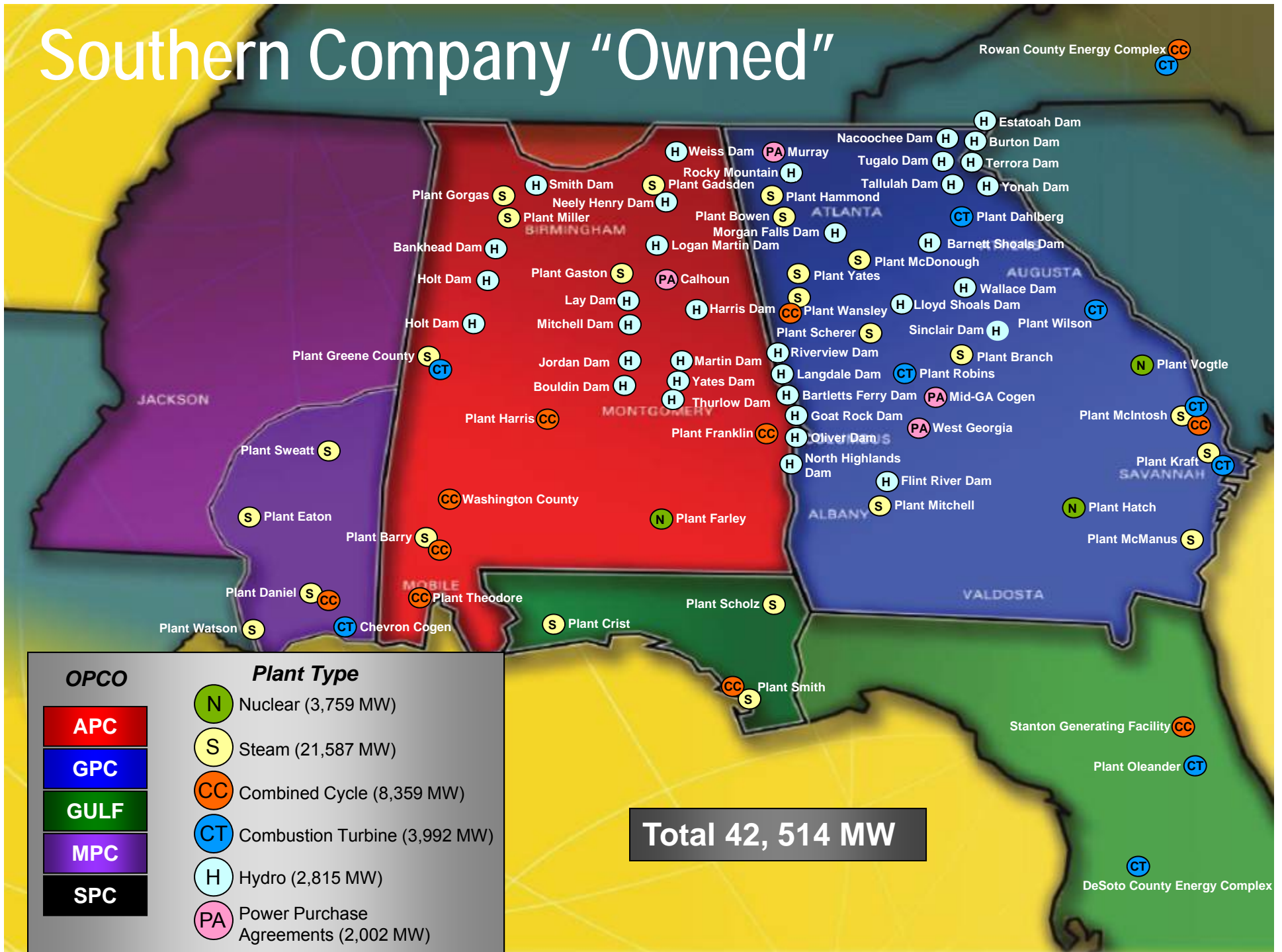
- Southern Company Introduction
- Renewable Portfolio Standards
- Renewable Options in the Southeast
- Biomass Co-Firing Research
- Plant Mitchell
- Questions

Southern Company

- Premier super-regional energy company in the Southeast U.S. and a leading U.S. producer of electricity
- Reputation for
 - excellent customer satisfaction
 - high reliability
 - retail electric prices that are 15% below national average
- Consistently highly ranked on Fortune magazine's list of "America's Most Admired Companies"
- 4.2 million customers, representing 12 million people
- 120,000 square miles of service territory
- 40,000+ MW of generating capacity



Southern Company "Owned"



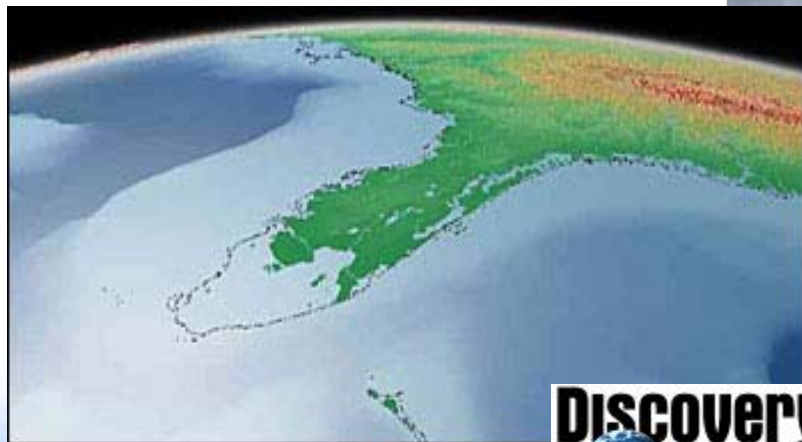
Total 42,514 MW

OPCO	Plant Type
APC	N Nuclear (3,759 MW)
GPC	S Steam (21,587 MW)
GULF	CC Combined Cycle (8,359 MW)
MPC	CT Combustion Turbine (3,992 MW)
SPC	H Hydro (2,815 MW)
	PA Power Purchase Agreements (2,002 MW)

Renewable Drivers

- Current renewable power drivers:
 - The political and societal movements toward capping CO2 emissions from power plants to curtail global warming
 - State and Federal Renewable Portfolio Standards
 - Cost and dependence on imported fuels
 - Current Administration's Agenda

Climate Change



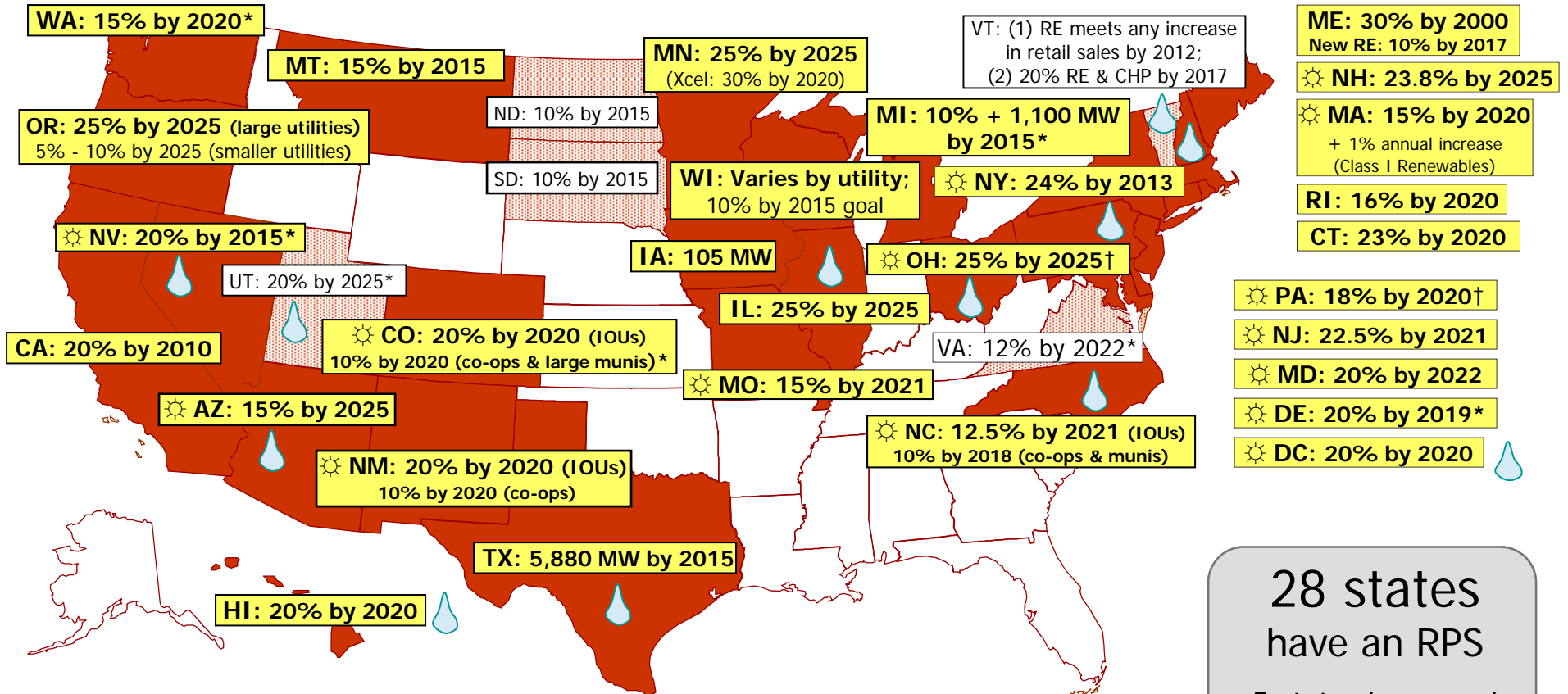
Energy

Renewable Portfolio Standards (RPS) or Renewable Electricity Standard (RES)


- Currently 28 of the 50 US states and the District of Columbia have adopted a RPS.
 - RPSs range from 105 MW in Iowa to 25% by 2025 in Oregon.
- Nationally there are multiple proposed bills:
 - Binghamman – 20% by 2020, Efficiency up to 5%, 5M MWh and up.
 - Markey – 25% by 2025, no EE, 1M MWh and up.




Renewable Portfolio Standards

www.dsireusa.org / April 2009



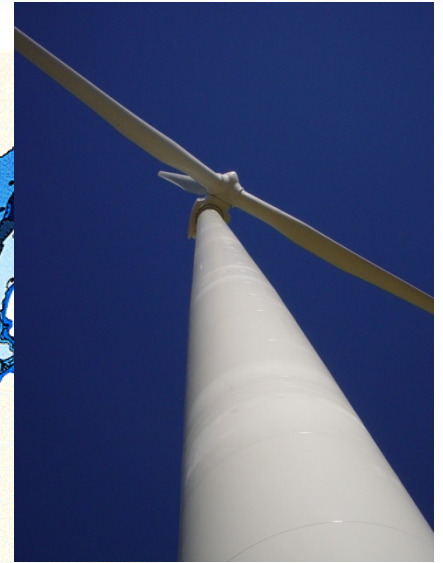
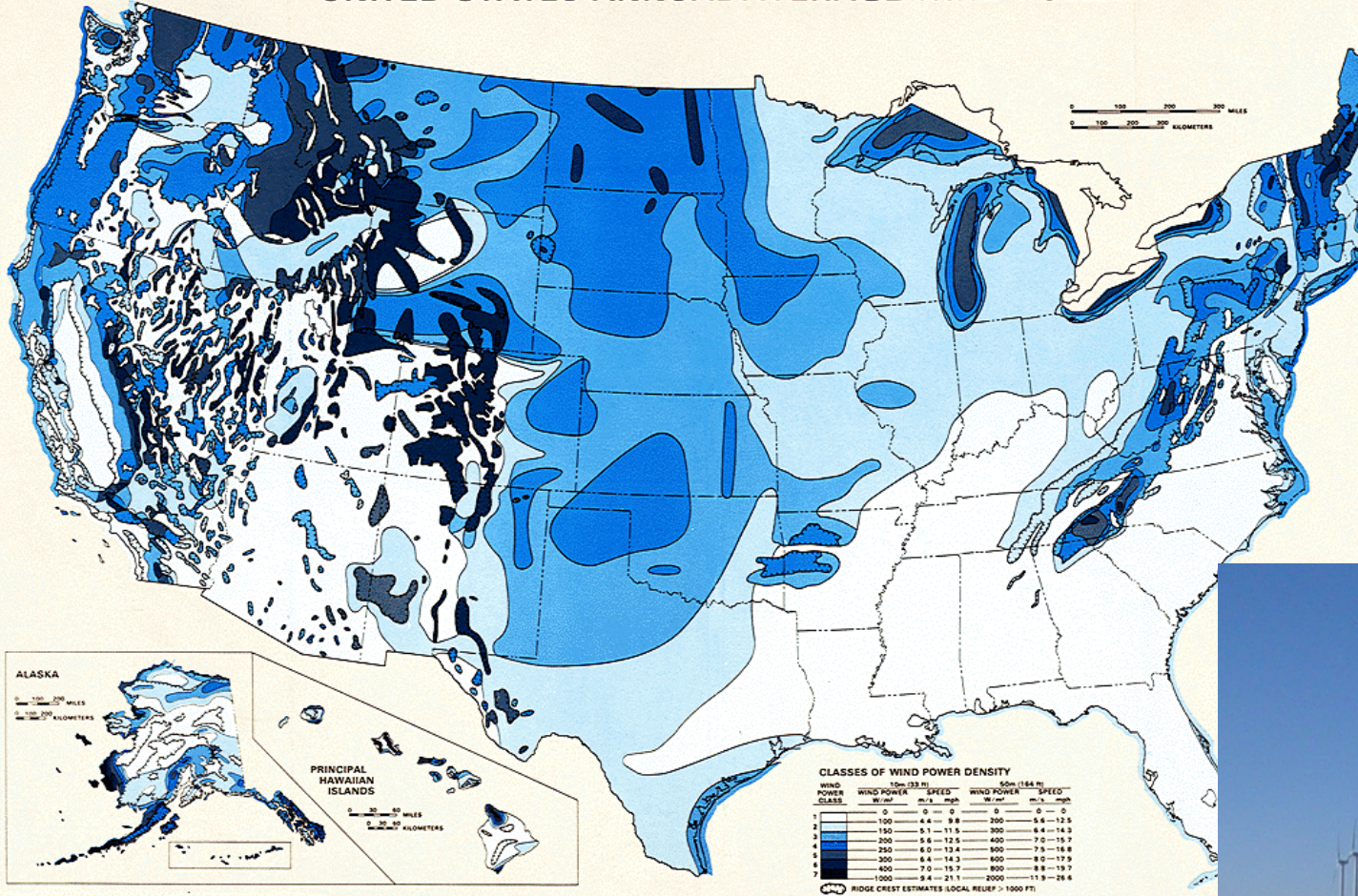
28 states have an RPS
5 states have goals

 State renewable portfolio standard
 State renewable portfolio goal
 Solar water heating eligible
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 Minimum solar or customer-sited requirement
 Extra credit for solar or customer-sited renewables
 Includes separate tier of non-renewable alternative resources

US Wind Resources

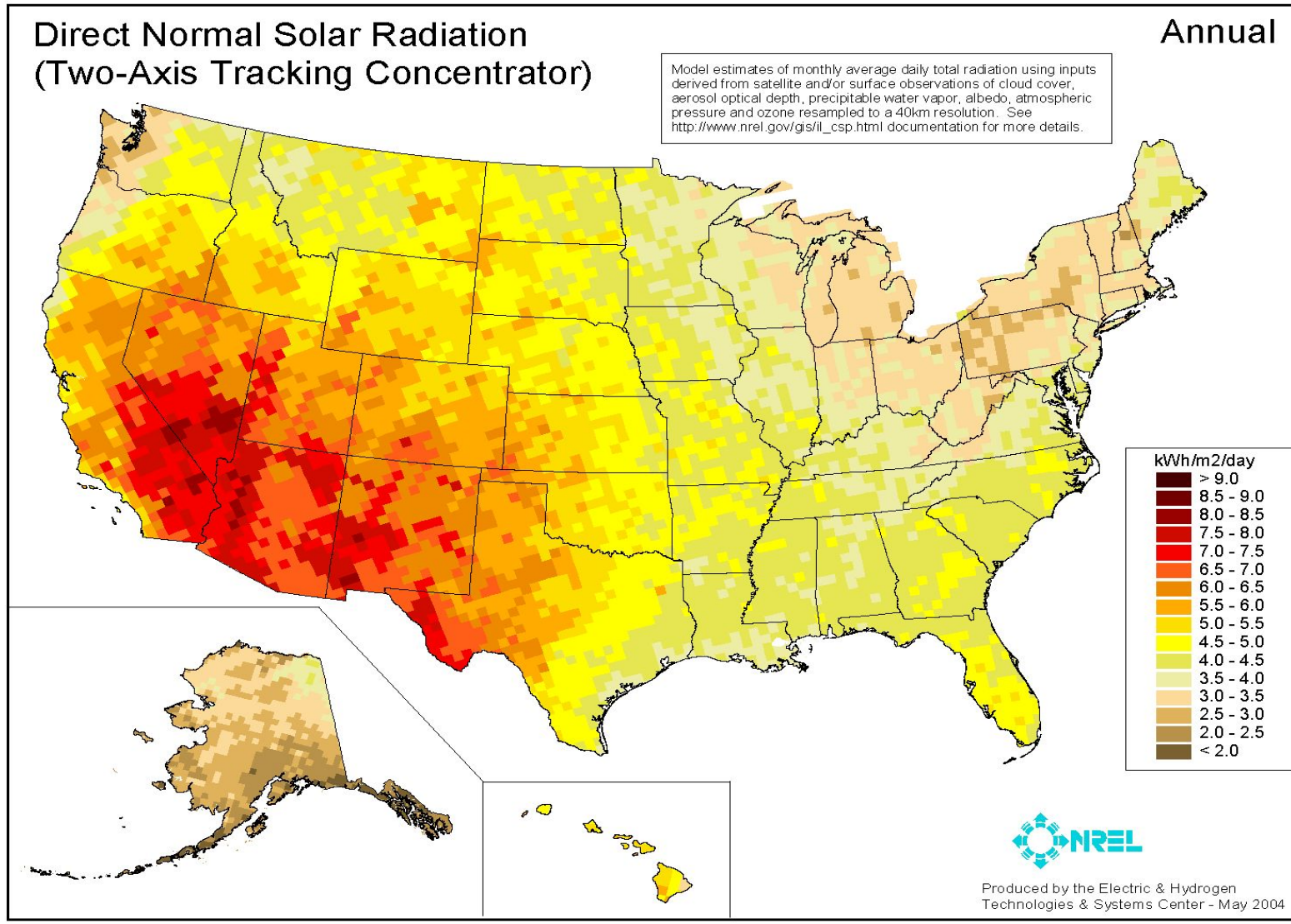
UNITED STATES ANNUAL AVERAGE WIND POWER



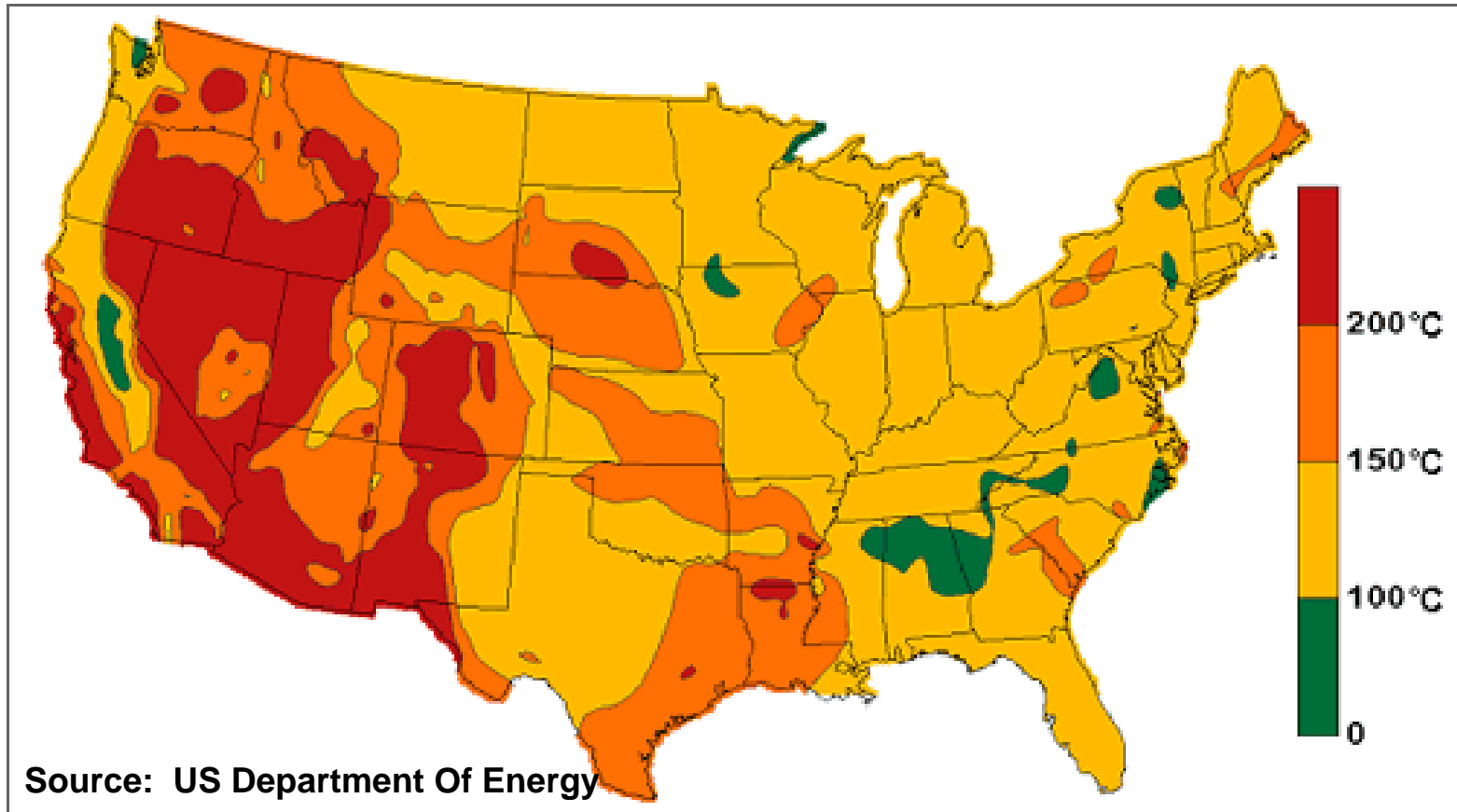
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Source: *Wind Energy Atlas of the United States* (NREL)

Solar Intensity: United States



US Geothermal Resources



- An economic resource however limited based upon geology

Bioenergy

- Energy derived from Biomass
- Biomass is defined by Ralph Sims as “recent organic matter originally derived from plants as a result of the photosynthetic conversion process, or from animals, and which is destined to be utilized as a store of chemical energy to provide heat, electricity, or transport fuels”
- Biomass is an abundant resource in the Southeast.
- 21,000 MW worldwide (8,300 MW US) - 2005

Biomass to Electricity Options

- Co-firing
 - Co-Milling
 - Direct Injection (DI)
- Dedicated Biomass Plants
 - Biomass Repowering of an existing unit
 - Brownfield or Greenfield sites
- Biomass Gasification - DI, CT, CC
- Biodiesel Co-firing in CT's or boilers

Co-Milling Project Objectives

- Determine the costs and benefits of co-firing whole tree green wood chips on:
 - power plant fuel handling
 - combustion efficiency
 - and air emissions
- Determine cost and feasibility of harvesting trees for co-firing fuel in an existing coal fired boiler.



Small Wood Chips Co-milling

- Mix biomass with coal and introduce into the boiler through coal handling system
 - Little or no capital investment
 - Low co-firing percentages (1 to 5% by energy input)
 - Tested at Plant Gadsden 1 & 2 - Fall 2007, Spring 2008
 - Plant Greene 1& 2 County - Fall 2008
 - Spring 2009 – Barry 2
 - Watson 4 & 5
 - Gaston 3, Gorgas 6



Cutting & Chipping Trees

Talladega National Forest

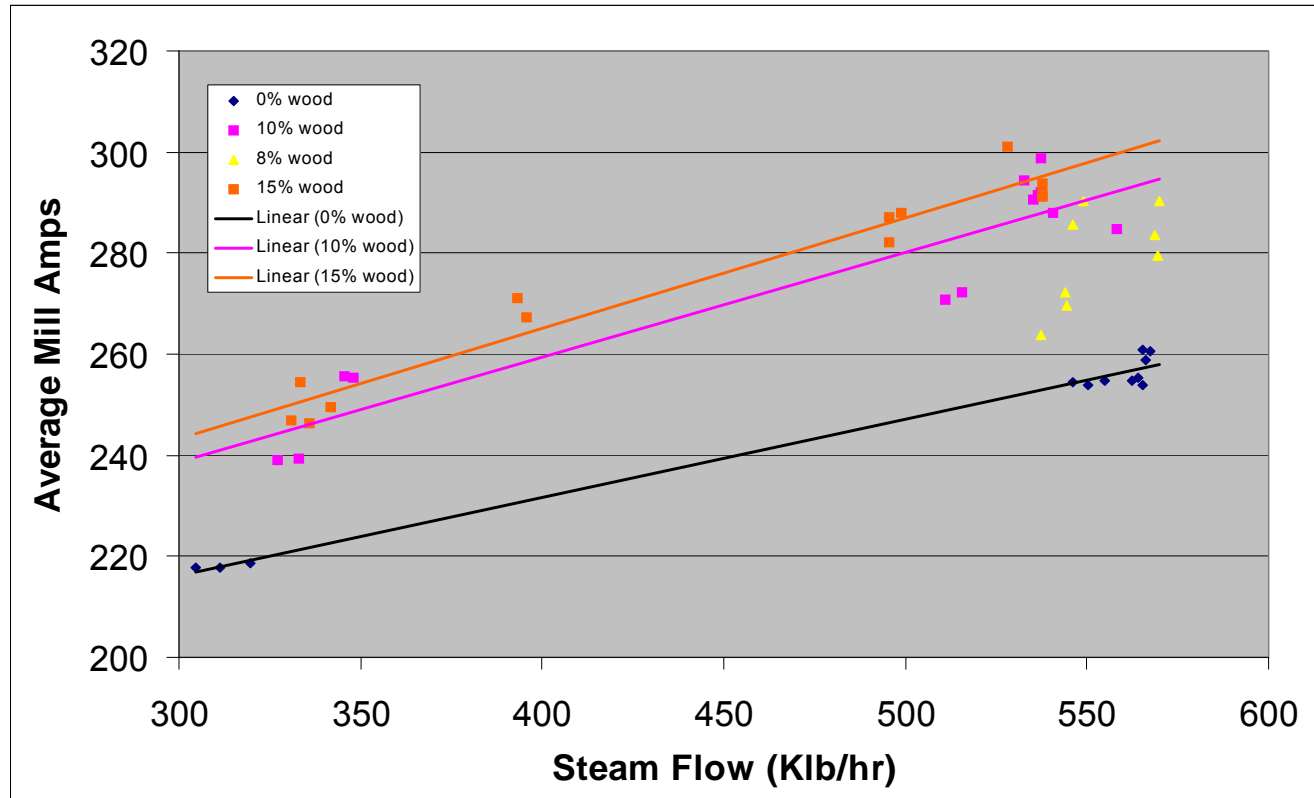
Precision Husky Modified
Drum Chipper



Small Wood Chips Co-milling



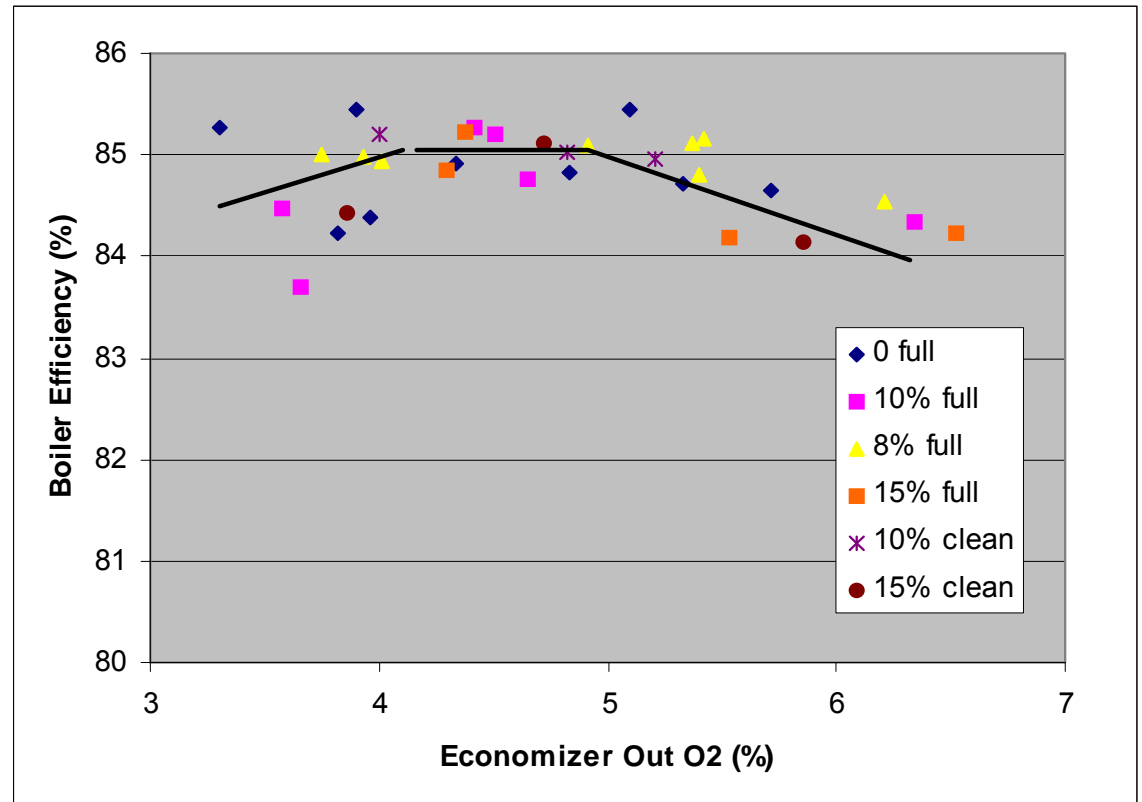
Results – Mill Amps



- Mill Amps increased 10 – 15% with wood addition
- Mill motors require spare capacity to carry higher amps

Boiler Efficiency Results

- Reduced dry gas loss offsets increased moisture losses with wood.
- 10% wood Co-firing about the same efficiency as coal
- 15% wood Co-firing between 0.0 - 0.7 % lower than coal



Small Wood Chips Co-milling

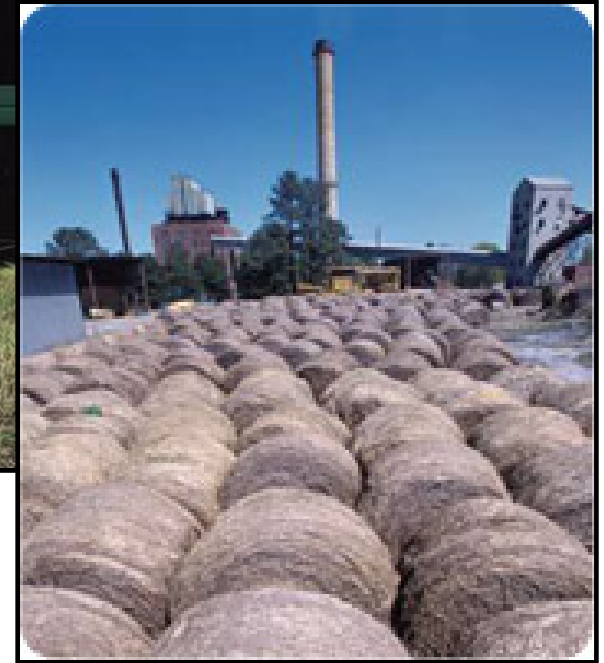
Summary of Results from Plant Gadsden

- Small wood chips successfully co-fired at 3 to 5% energy input
- Emissions were unchanged (NOX and CO) or reduced (CO₂, SO₂, Hg)
- Boiler efficiency unaffected at 3%, slightly lower at 5% co-firing



Plant Gadsden Direct Injection System

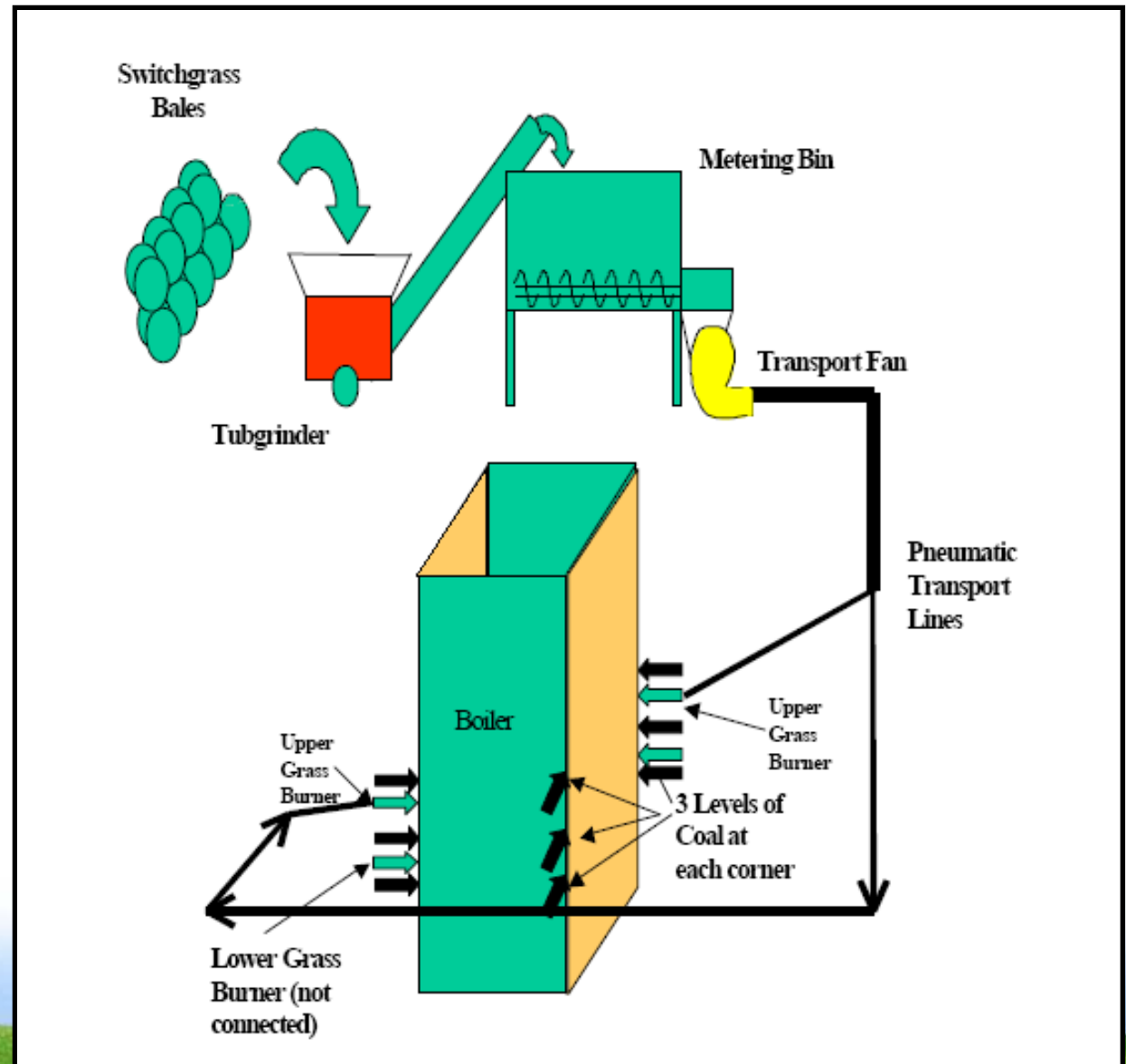
PRODUCT SNAPSHOT: SWITCHGRASS



- Alabama Power Renewable Energy Rate
 - 2.25 cents for 50 kwh block
 - Customers sign up for X blocks for 12 months
 - Two 1,000-pound bales of switchgrass generate 1,000 kilowatt-hours of electricity - enough to power an average home for a month.

Plant Gadsden Direct Injection System

- Can co-fire up to 10% by energy.
- Research system – limited to 7,000 lb/hr.



Biomass Repowering

- Proven at other sites
 - Plant Schiller 50 MW conversion
- Biomass plants have the advantage of being able to be dispatched like typical fossil fuel plants
- Accepted as CO₂ neutral
- More cost competitive than Greenfield sites
 - \$1400 – 2000 /kW vs. \$4000 / kW
- Direct replacement for coal generation capacity

Plant Mitchell



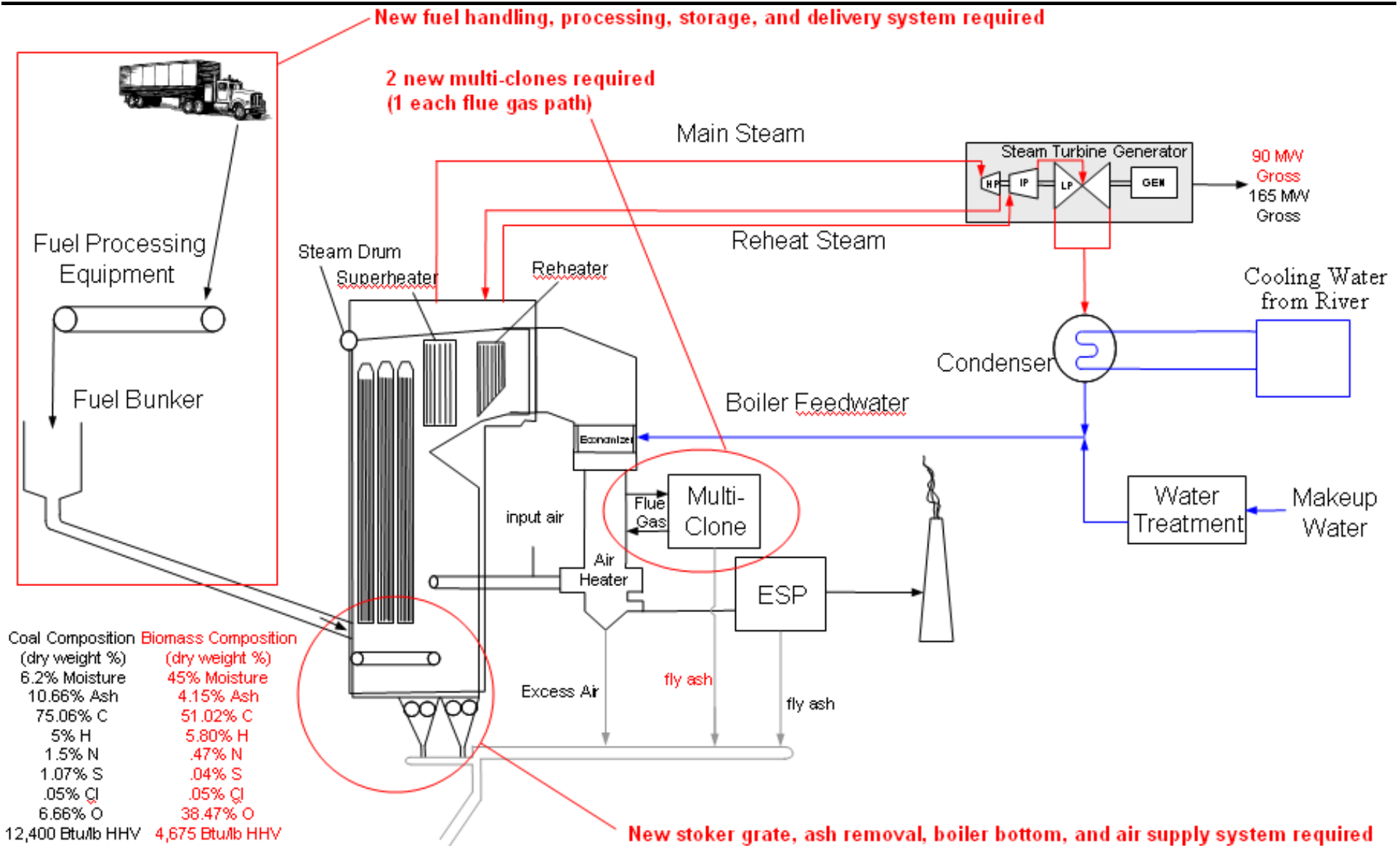
<http://www.youtube.com/user/GeorgiaPowerChannel>

Mitchell Biomass Re-powering Study

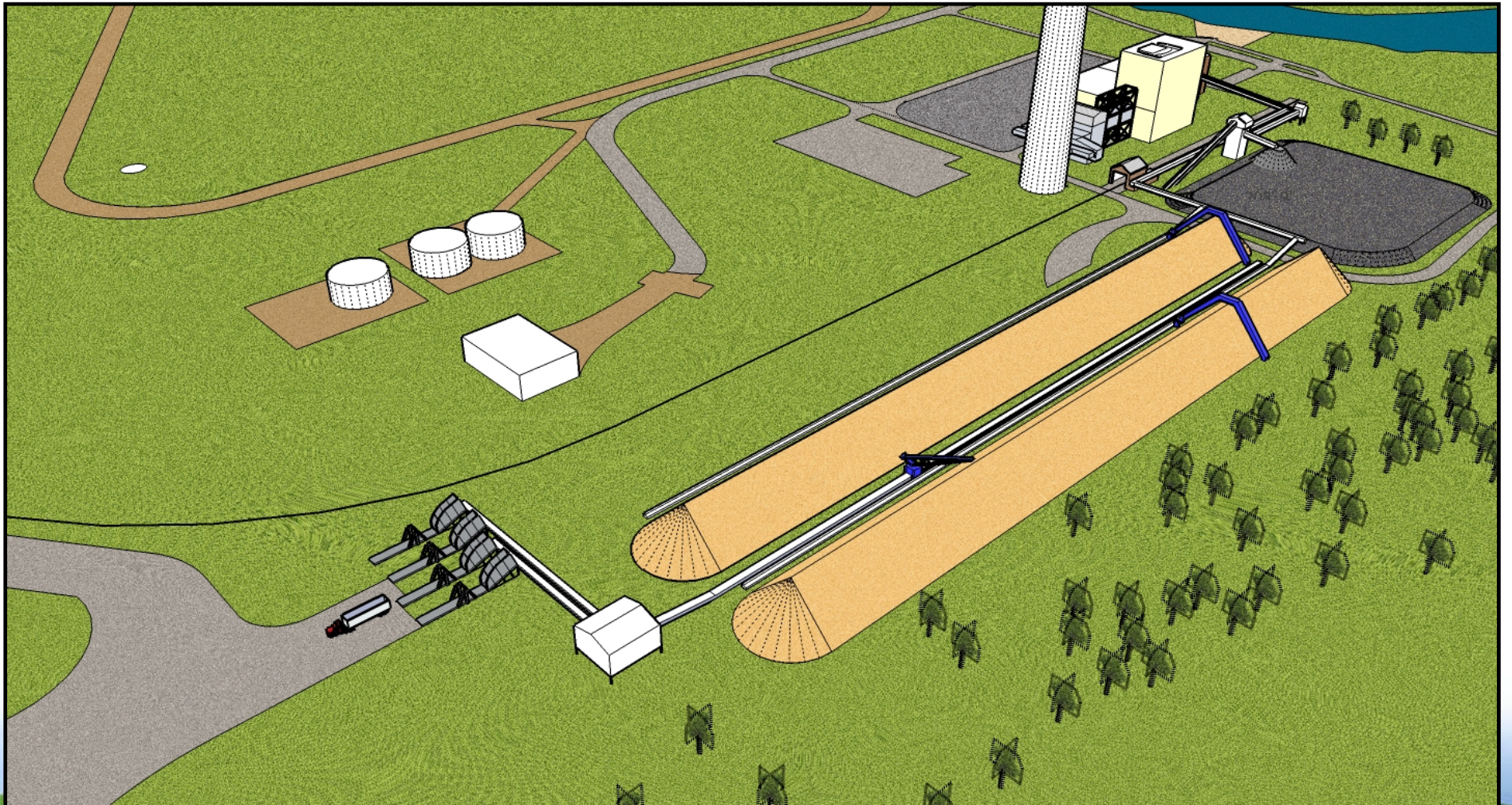
- T-fired PC Boiler (CE), built in 1962, Single Reheat
 - 165 MW gross, 156 MW net
 - Full Load Coal Flow: 60 ton/hr
 - 40 ft x 26 ft boiler plan area – limiting parameter
 - 1875 psig, 1000°F, 1,075,000 lb/hr
 - Coal Bunker Capacity:
 - 1630 tons, 27 hours
 - 30+ day On-site Coal Supply
 - Existing emissions controls
 - ESP, 1% S coal



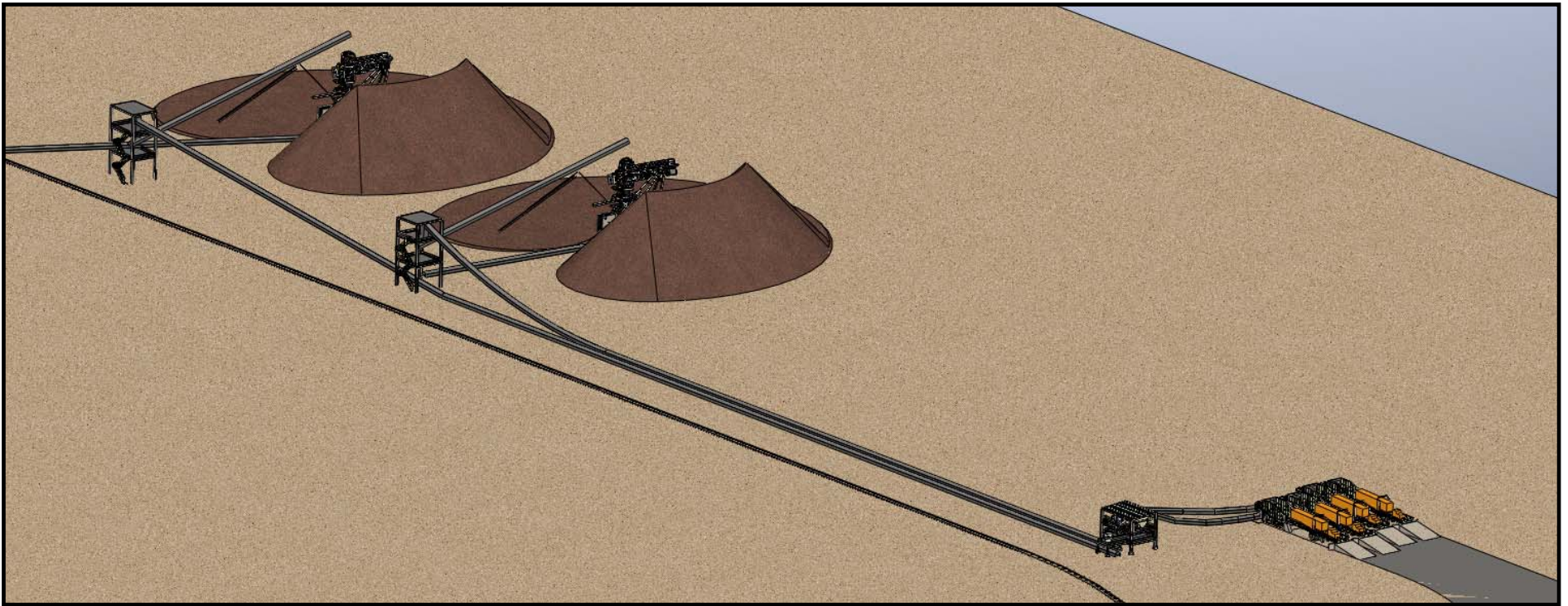
Plant Layout



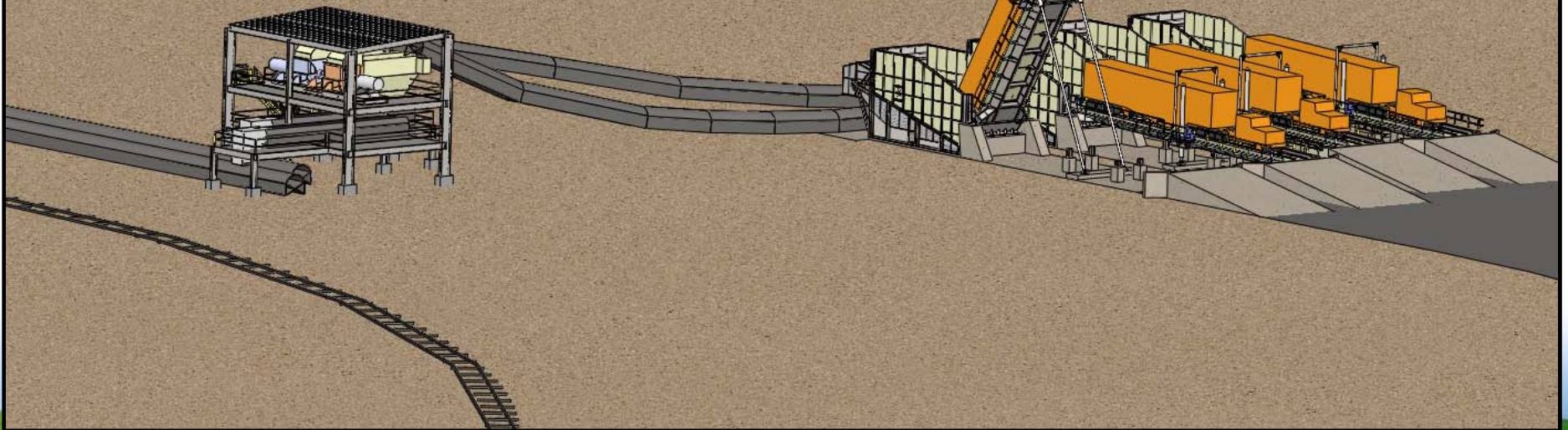
Mitchell Woodyard Concept #1 – Linear Piles



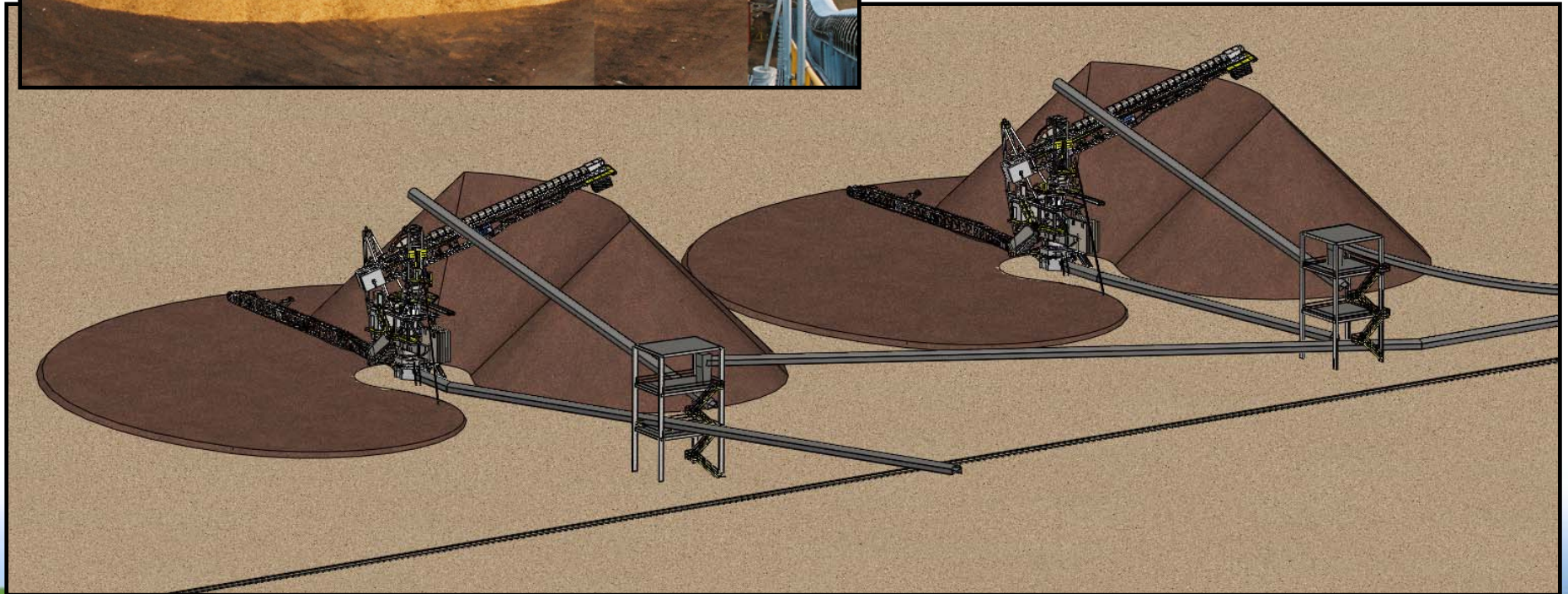
Mitchell Woodyard Concept #2 – Circular Piles



4 Truck Tippers 2 Screens and Hogs



Stacker / Reclaimer

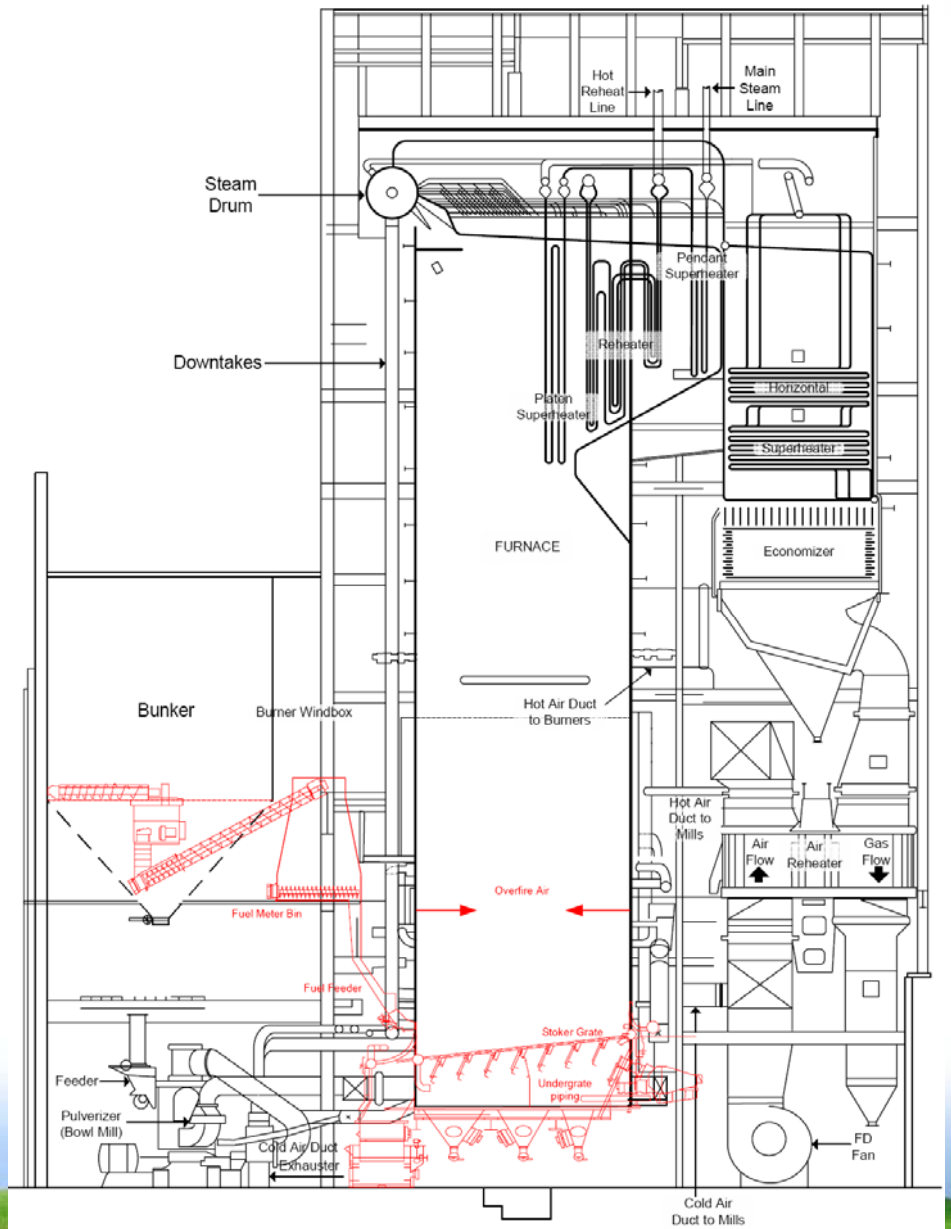
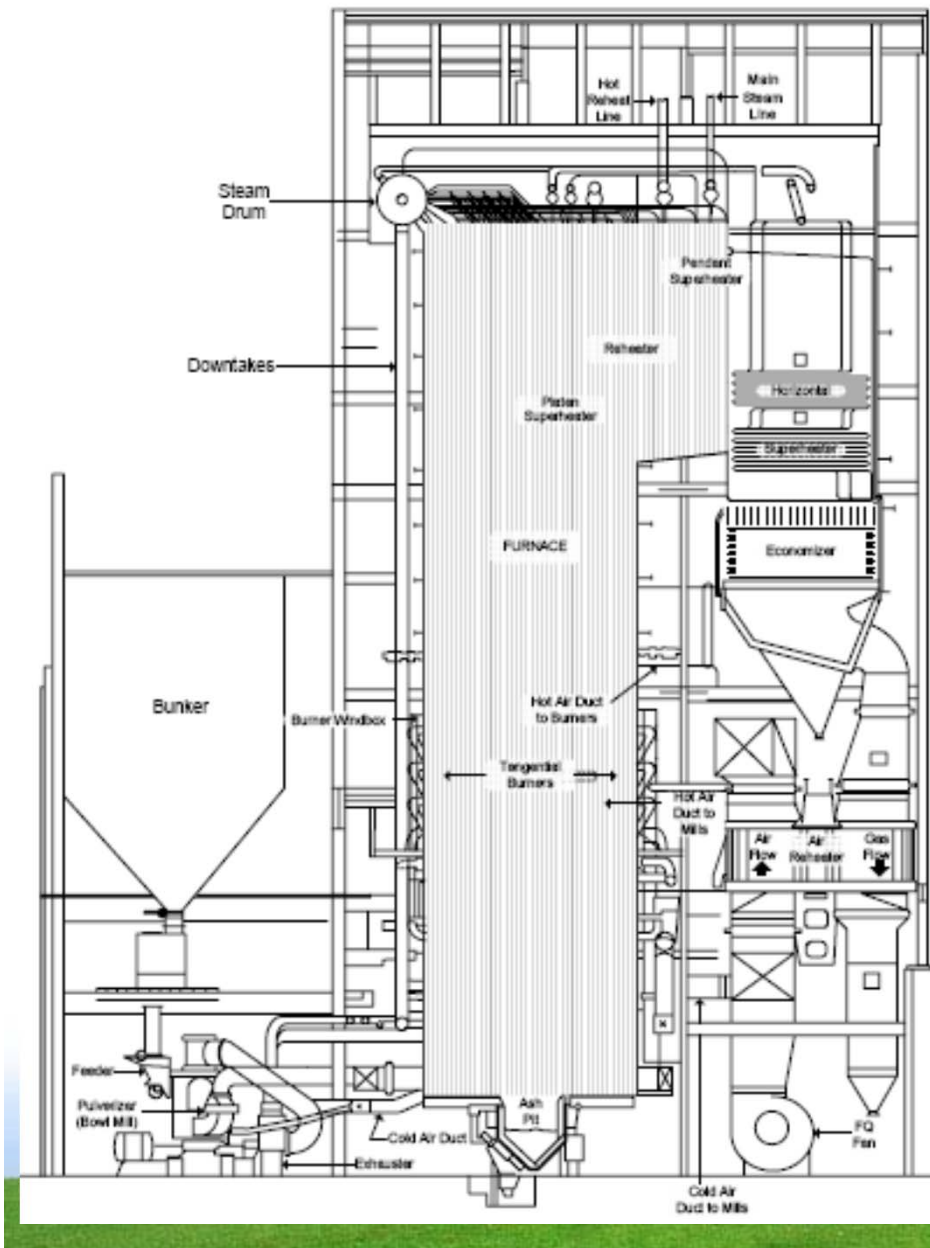


Boiler House Retrofit Requirements

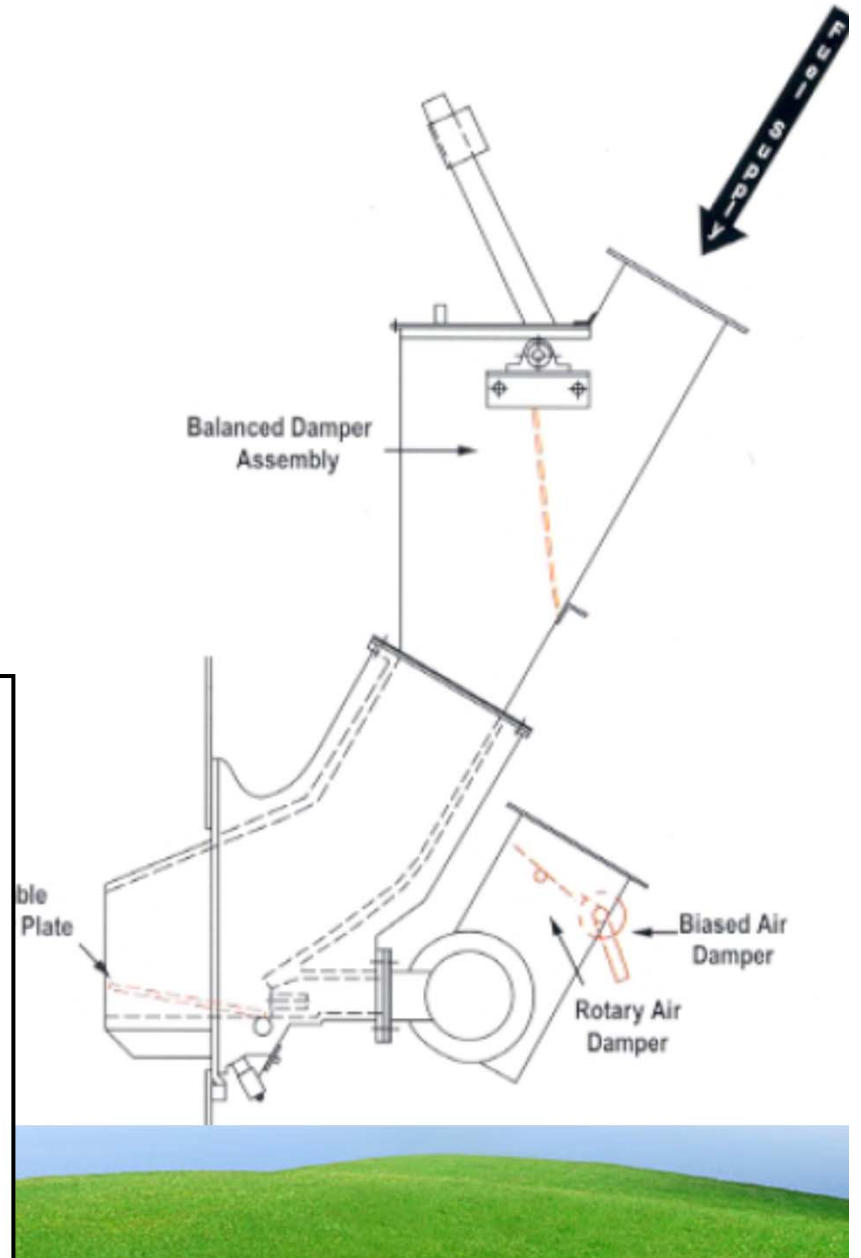
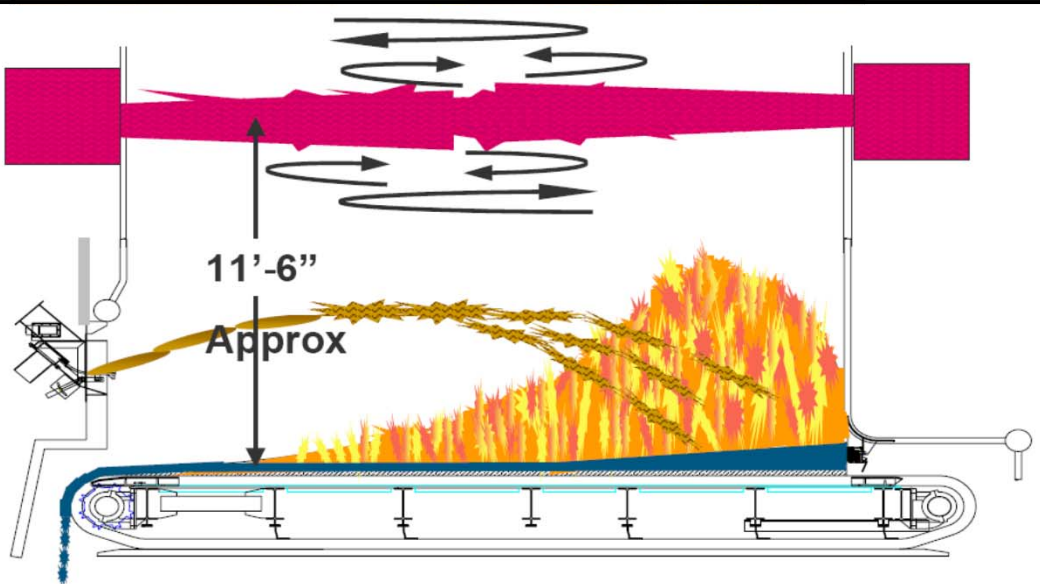
Install:

- Wood chip delivery system
- Stoker grate
- Air supply ductwork, including new booster fans for fuel distributors
- Replace furnace bottom, pressure parts, etc.
- Bottom ash collection system
- Grate cooling water supply
- Foundation upgrades
- Install multi-clone between economizer and air heater (1 ea. path)
- New retractable sootblowers for air heaters (1 each)
- Controls

Mitchell Unit 3 with DSC Vibrating Hydrograte

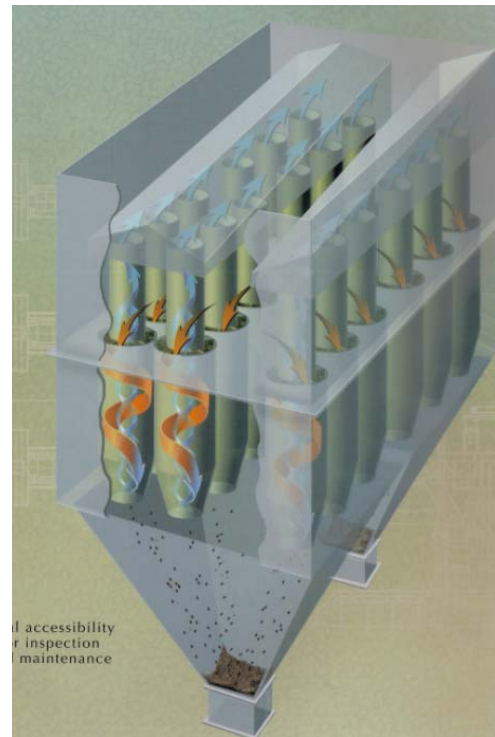


Air Swept Spouts for Biomass Fuels



Environmental Controls

- Existing ESP is adequate
- Multiclones would be added to remove large particulates and re-inject them for additional fuel burning
- Large reductions in NO_x, SO_x, Hg, CO₂ emissions



100% Biomass Operation

- Capacity:
 - 96 MW net w/ new Stoker Grate and Suspension Firing
 - Heat Rate ~ 12,500 Btu / Hr
- Approx. 1.1 million ton/yr biomass use
 - Biomass delivery would be on the order of 160 trucks per day for a 5.5 day delivery schedule.
- Timeline
 - August 22, 2008 Filed with GA PSC
 - December 2008 Air permit filed with EPD
 - March 17, 2009 PSC Unanimous Approval, 5 -0
 - March 2010 Final air permit expected
 - April 2011 Retrofit construction begins
 - June 2012 Begin operations

SE Renewable Energy Potential

- Wind has small capacity potential in the southeast
- Solar photovoltaics has very high cost and requires large land area
- Landfill methane can be cost competitive, but has small capacity potential
- Biomass has higher capacity potential in the southeast. Co-firing and converting an existing plant have lower costs than a new biomass facility.

Summary

- State and National RPS are more of a when than why.
- Biomass is the most economical option in the Southeast
- Southern Company must develop a comprehensive list of possible solutions which includes all forms of renewable generation.

Questions

If we knew what we were doing, it wouldn't be called research, would it?

- Albert Einstein

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