

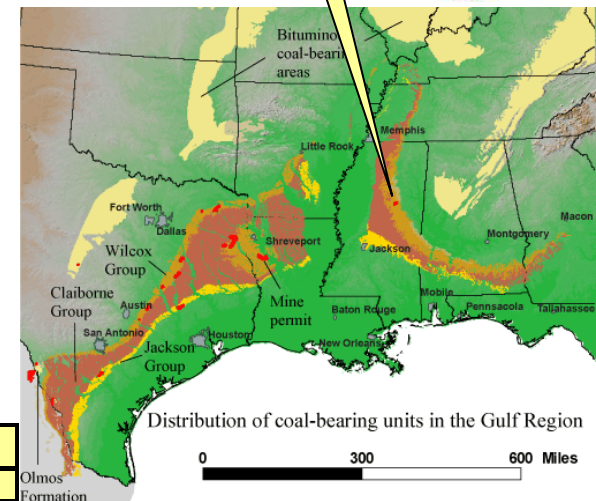
# CO<sub>2</sub> Capture at the Kemper County IGCC Project



2011 NETL CO<sub>2</sub> Capture Technology Meeting

# Kemper County IGCC Overview

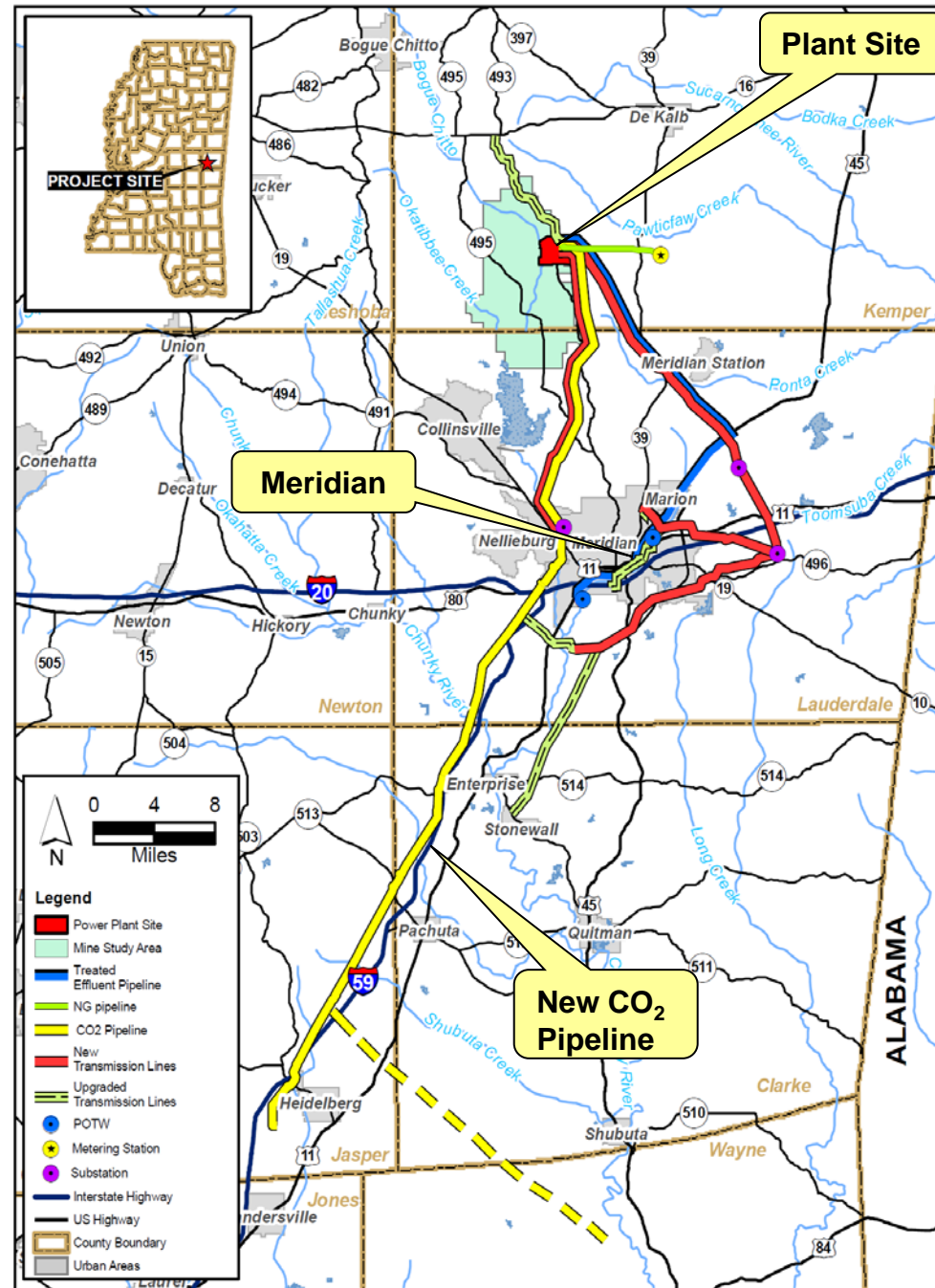
- 2x1 Integrated Gasification Combined Cycle (IGCC)
  - 2 TRansport Integrated Gasifiers (TRIG™)
  - 2 Siemens SGT6 - 5000F CTs
  - 1 Toshiba Steam Turbine (Tandem Compound Double Flow)
  - 582 MW peak and 524 MW on syngas
  - Heat Rate 11,708 Btu/kWh (29.5% HHV Efficiency w/ CO<sub>2</sub> control and 40+% moisture coal)
  - Selexol for H<sub>2</sub>S and CO<sub>2</sub> removal
  - 65+% CO<sub>2</sub> capture (~800 lb/MWh emission rate)
  - Mine Mouth Lignite
- Owner & Operator: Mississippi Power
- Over \$2 billion capital investment
- Commercial Operating Date: May 2014
- Use treated effluent from Meridian as makeup water
- By-Products (TPY)
  - ~3,000,000 - Carbon dioxide used for EOR
  - ~135,000 - Sulfuric acid
  - ~20,000 - Ammonia



Kemper Lignite Composition				
		Average	Min	Max
Heat Content	btu/lb	5,290	4,765	5,870
Moisture	%	45.5	42	50
Ash	%	12.0	8.6	17
Sulfur	%	1.0	0.35	1.7

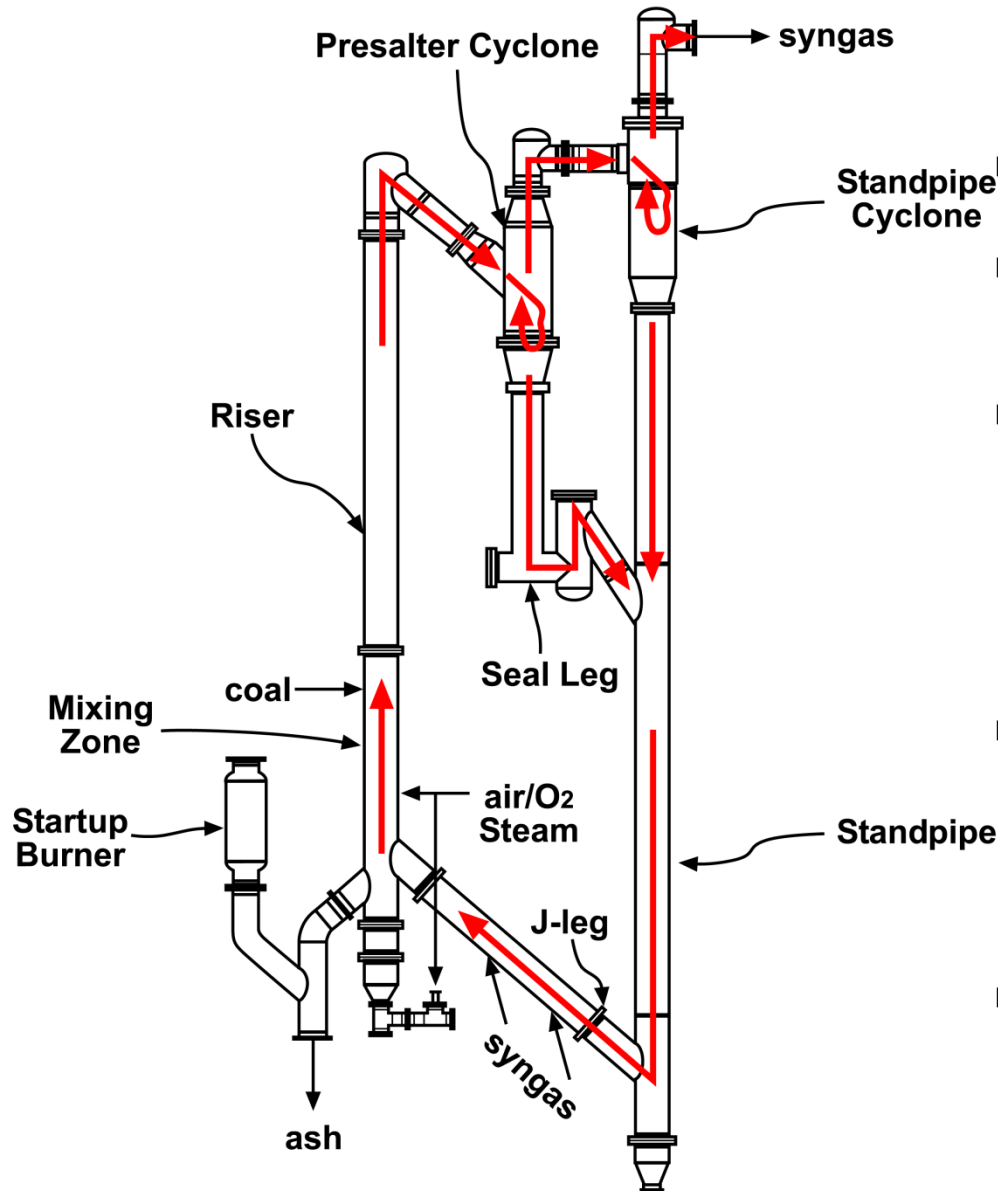
# Proposed Kemper County IGCC Project Map

- ~70 miles transmission
- ~ 60 miles CO<sub>2</sub> pipeline (for EOR)
- ~5 miles natural gas pipeline
- ~31,000 acre mine site
- ~2,900 acres plant site
- ~ 30 miles treated effluent line



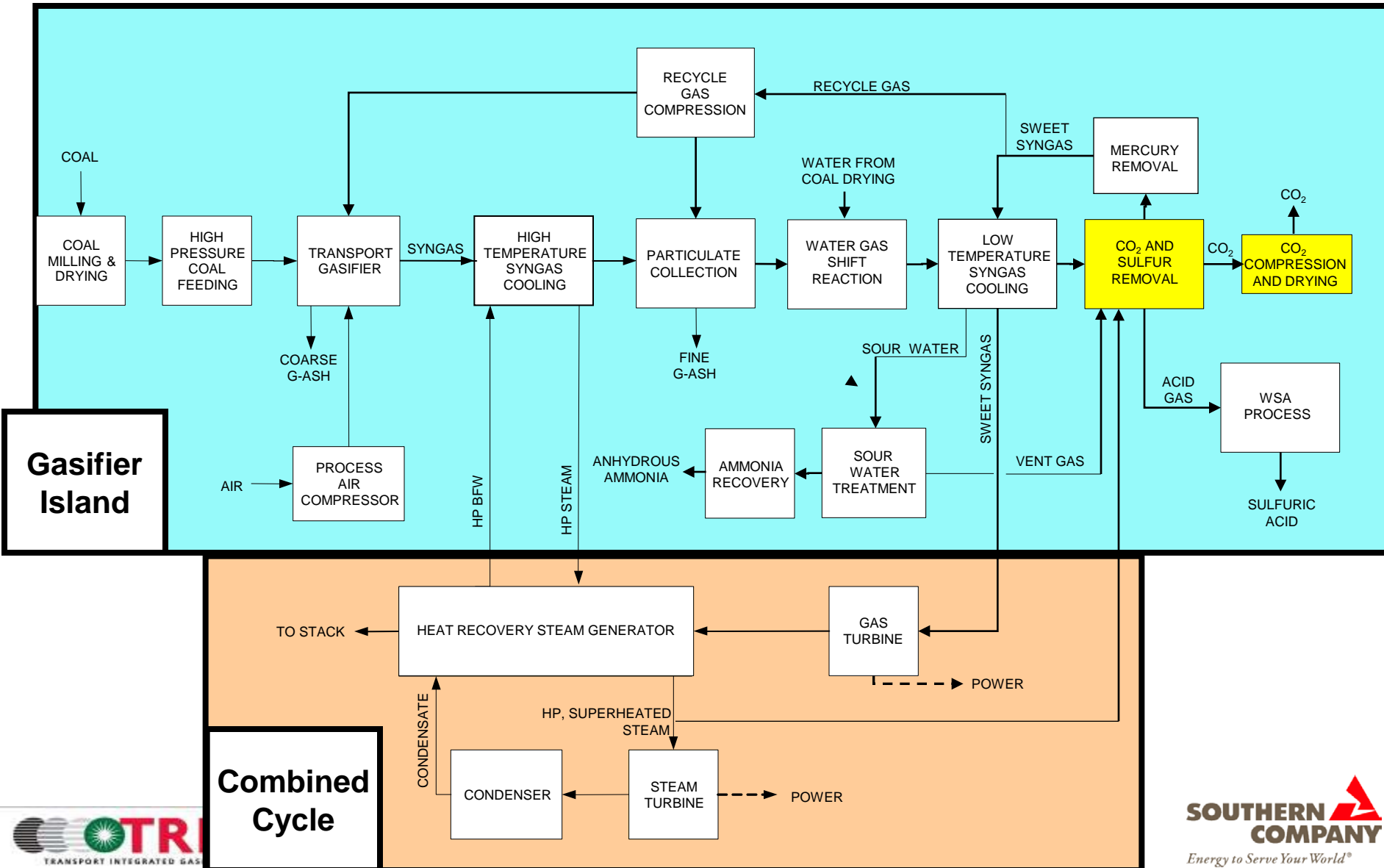
# TRIG™

## Attributes/Advantages



- Simple, well established design
  - Based on technology in use for 70 years
- Either Air- or Oxygen-blown
  - Air for power
  - Oxygen for liquid fuels and chemicals
- High Reliability Design
  - Non-slugging design:
    - Provides 10-20 year refractory life,
    - Eliminates black water system
    - Provides non-fouling syngas cooler operation
  - No burners to fail and be replaced
  - Dry dust removal eliminates gray water system
- Lower Fuel Costs
  - Coarse, dry coal feed allows:
    - Fewer, lower power pulverizers, and
    - Less drying than other dry-feed gasifiers
  - Cost-effective using high moisture, high-ash, low rank coals (PRB and lignite).
- Excellent Environmental Performance
  - Lower water use compared to pulverized coal (PC)
  - Excellent emissions performance
  - Easier to permit compared to PC
  - Lower cost carbon capture compared to PC

# Summary Flow Diagram



# Evolution of Acid Gas Removal at Kemper County IGCC

- Originally, no CO<sub>2</sub> removal. H<sub>2</sub>S removed with amine.
- With CO<sub>2</sub> removal added to scope, design team explored three main options based on a physical solvent:
  - 25% CO<sub>2</sub> removal (1,500 lb CO<sub>2</sub>/MWh).
    - Case 1: No WGS, Selexol for sulfur removal, amine for CO<sub>2</sub>
    - Case 1A: One stage of WGS, with Selexol for all acid gas removal.
  - 50% CO<sub>2</sub> removal (1,000 lb CO<sub>2</sub>/MWh).
    - Case 2: One Stage WGS with steam injection with Selexol for AGR.
    - Case 2A: Case 1A retrofitted to Case 2 in 2020
    - Case 2B: Case 1 retrofitted to Case 2 in 2020.
  - 65% CO<sub>2</sub> removal (800 lb CO<sub>2</sub>/MWh).
    - Case 3: Two stages WGS with steam injection and Selexol for AGR.

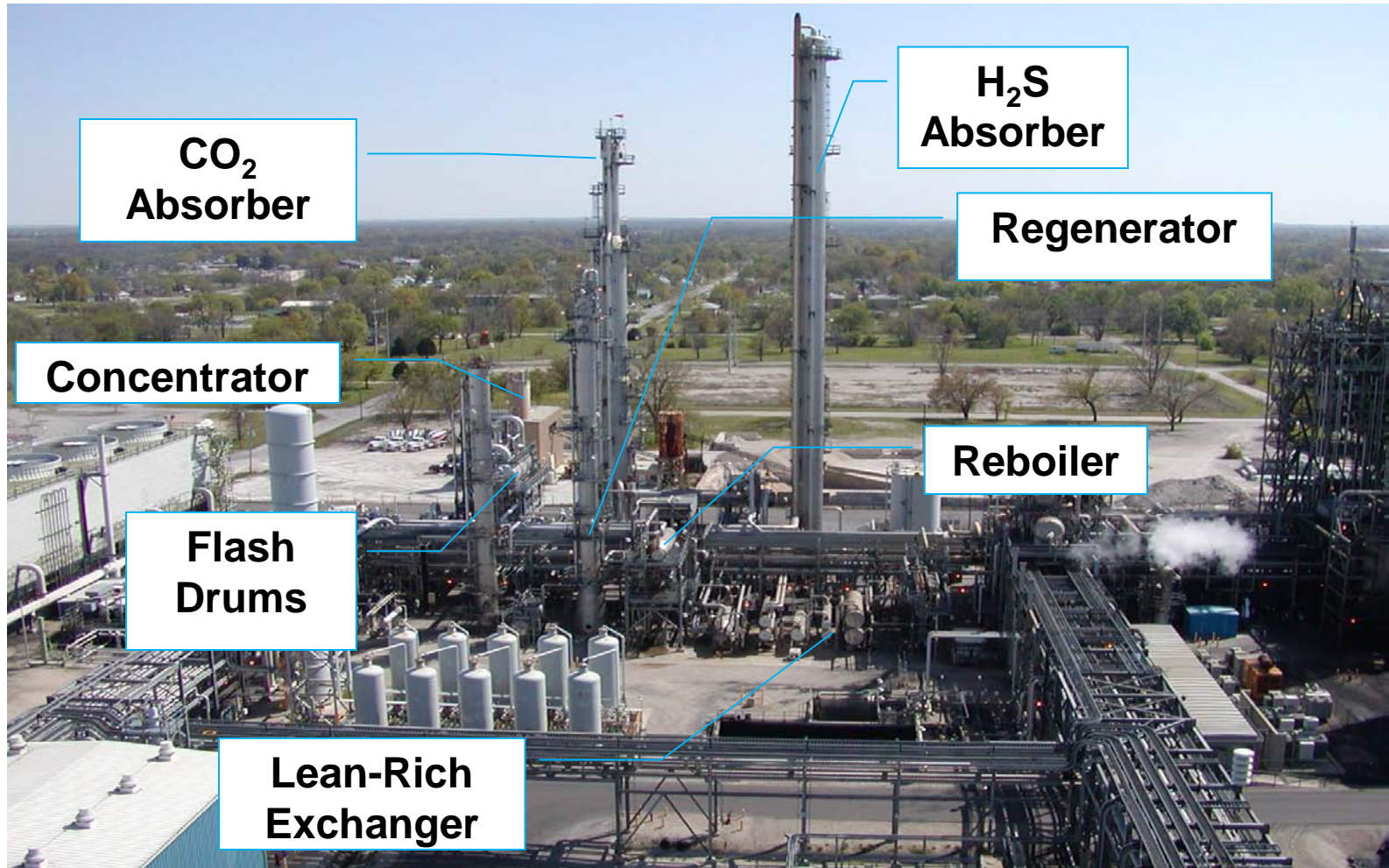
# Physical Solvent Selection

The operating costs for an amine were too expensive, due to high steam usage for regeneration. Therefore, a physical solvent was selected.

	Selexol	Rectisol
Volatility	Low	High
Solvent Price	High	Low
Emissions Concern	No	Yes

Both good options, but Selexol was chosen.

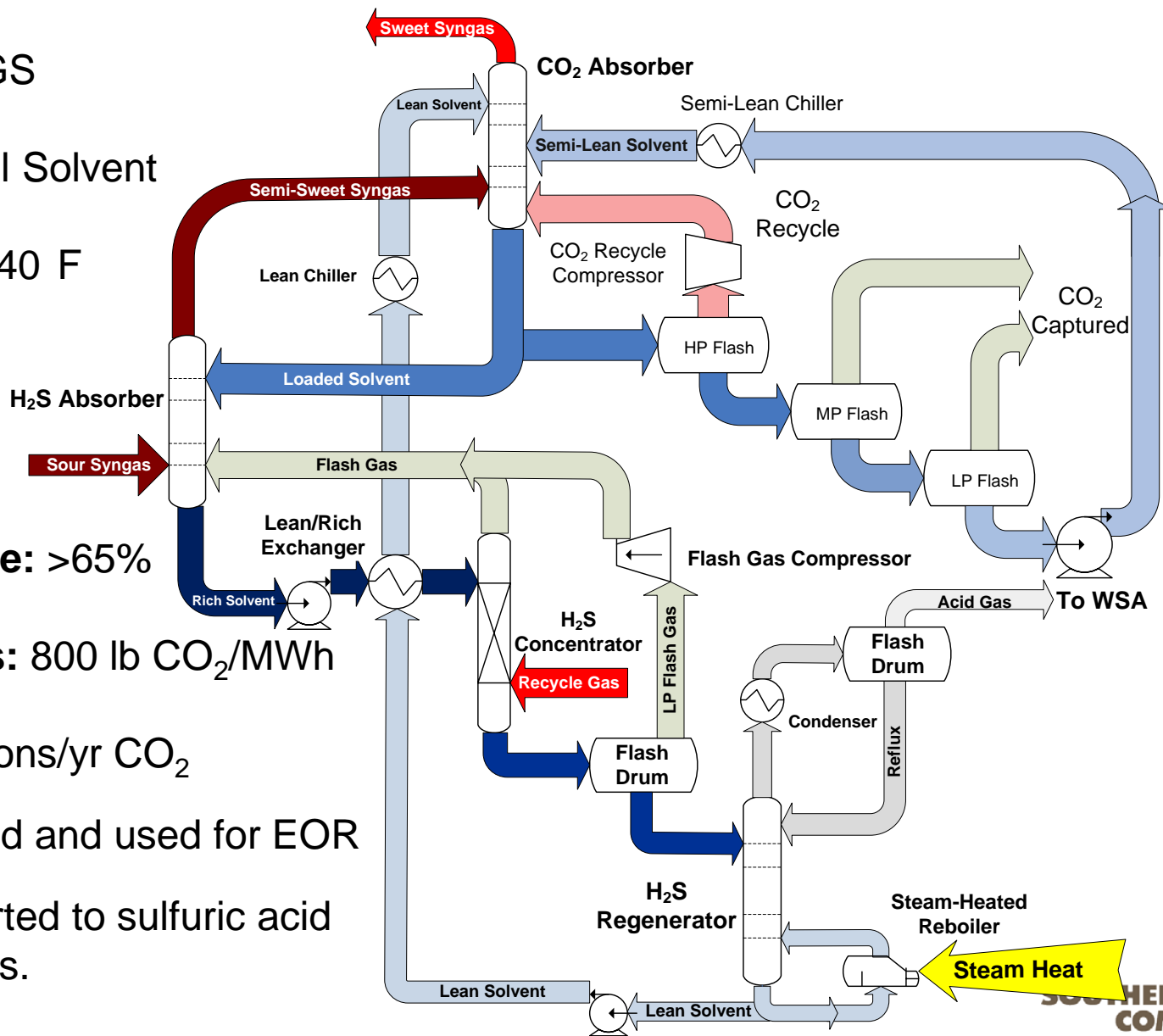
# Commercial Selexol Plant



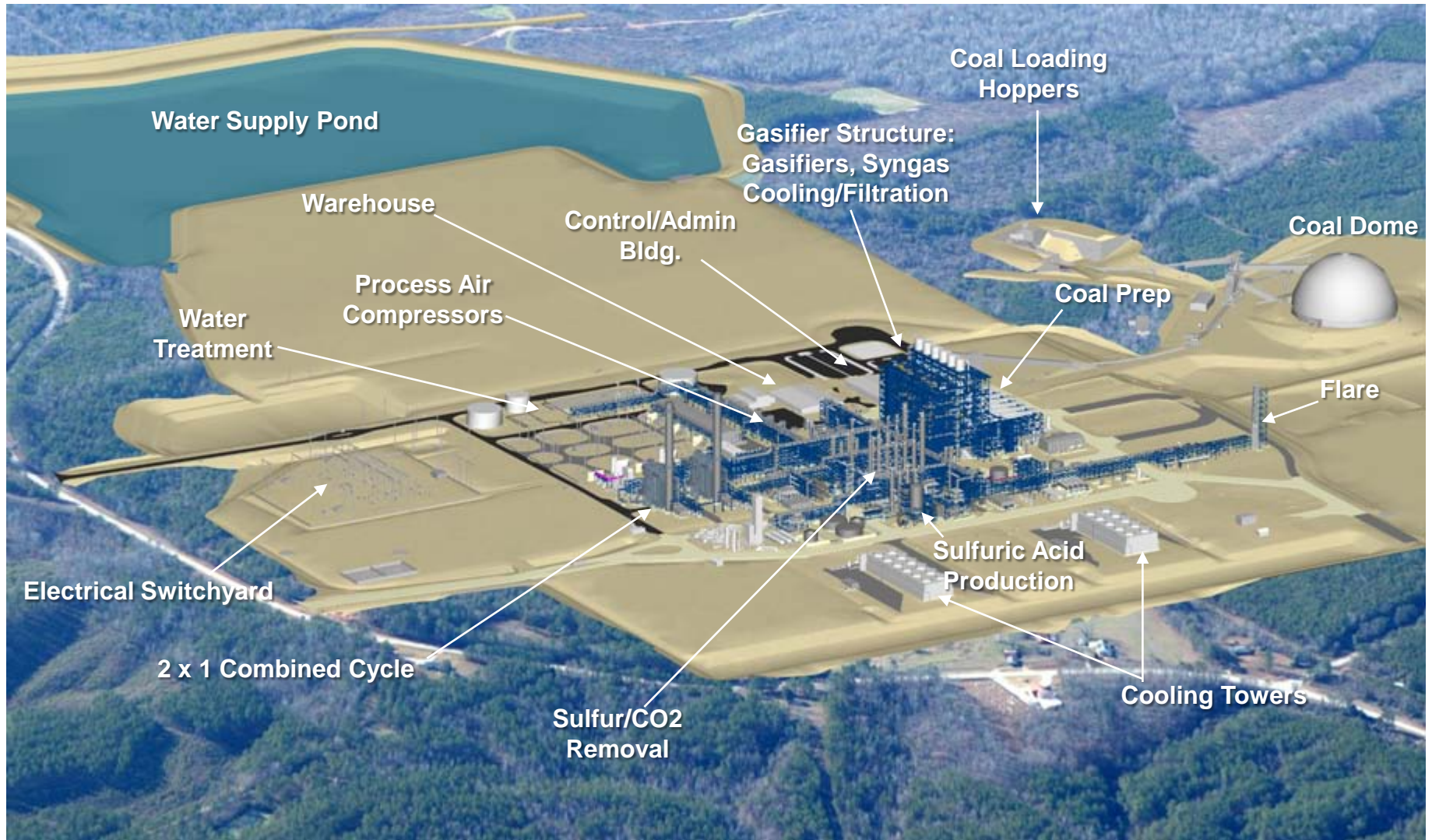


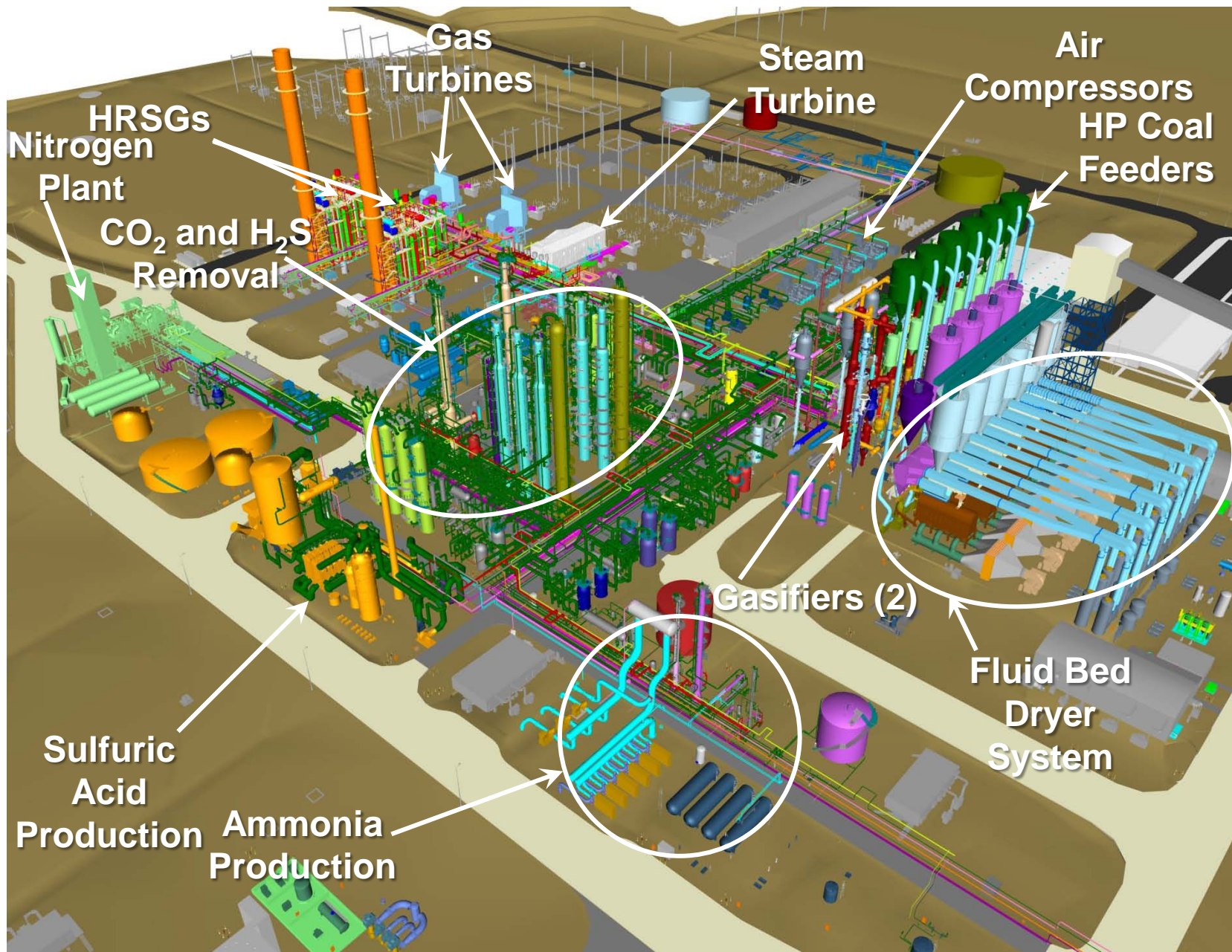
# CO<sub>2</sub> Capture Scheme for 800 lb/MWh

- Two Stages WGS
- Selexol Physical Solvent
- Refrigerated to 40 F
- Carbon Capture: >65%
- CO<sub>2</sub> Emissions: 800 lb CO<sub>2</sub>/MWh
- Yield: >3 MM Tons/yr CO<sub>2</sub>
- CO<sub>2</sub> compressed and used for EOR
- Acid gas converted to sulfuric acid via WSA process.



# Kemper County IGCC







# Project Status

- On June 3, 2010, the Mississippi Public Service Commission certified the project.
- Mississippi Power has entered into CO2 offtake agreements with Denbury Onshore and Treetop Midstream Services, LLC
- MDEQ issued the final PSD permit on March 9, 2010.
- Procurement: All major equipment awarded.  
Equipment fabrication underway.  
First major pieces arriving on site.
- Construction: Site cleared and graded.  
Foundation and pedestal work underway.  
Sumps, duct banks, underground piping being installed.



# Kemper Procurement Update

## 2<sup>nd</sup> Quarter - 2011



Top of CO<sub>2</sub> Absorber



Base of CO<sub>2</sub> Absorber



Base of Concentrator



Lean/Rich Exchanger Plates

# Kemper County IGCC Construction Update

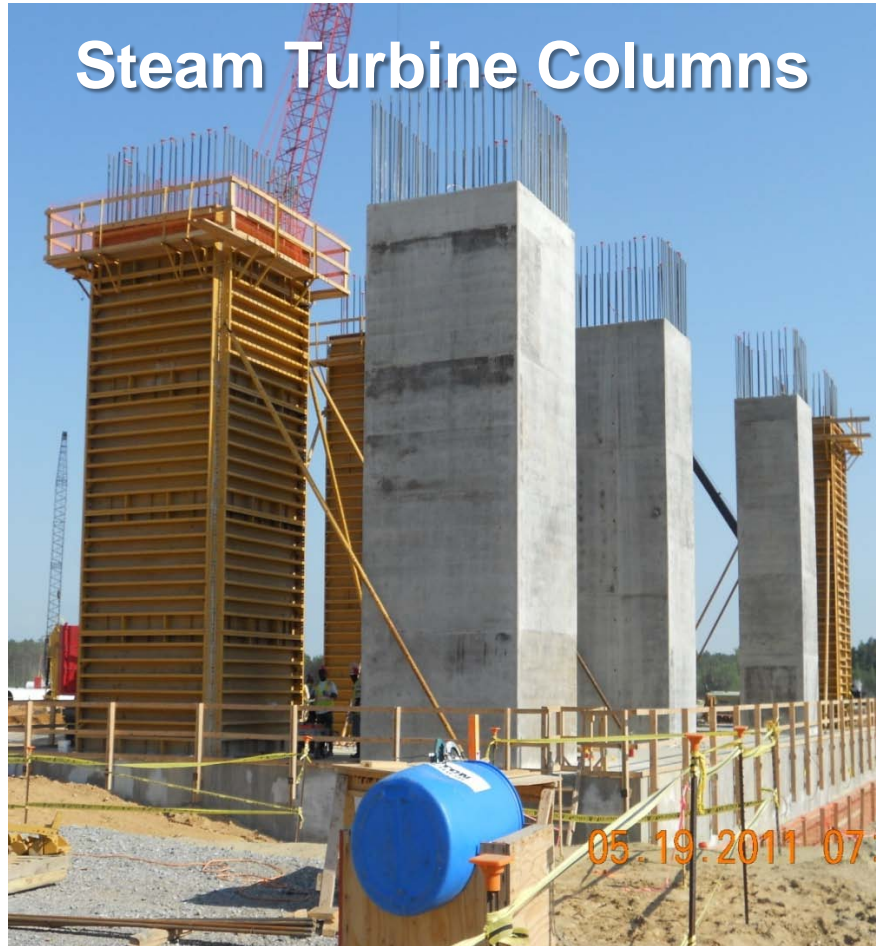
## 1<sup>st</sup> Quarter - 2011



Began Installation of Underground Electrical and Mechanical Systems

# Kemper County IGCC Construction Update

## 2<sup>nd</sup> Quarter - 2011



Deep Foundations/ Major Equipment Foundation Installation/U/G Utilities



# Kemper County IGCC Construction Update

## End of 2<sup>nd</sup> Quarter - 2011



Steam Turbine Operating Deck



Circulating Water Pipe



Plant Site as of July 2011



Gasifier Pile Caps/  
Deep Foundation Installation

# Summary

- Physical solvents were selected for the Kemper design due to reduced steam usage.
- The facility will use Selexol coupled with two stages of water-gas-shift, resulting in a CO<sub>2</sub> emission rate of 800 lb/MWh (a nominal 65% reduction).
- 3 million tons/year of CO<sub>2</sub> captured at the Kemper site will be used for EOR, and will meet offtaker specifications.
- Commercial operations are expected in May 2014.