Southern Company: SO

- **Headquarters:** Atlanta, Georgia
- **2010 revenues:** $17.45 Billion
- **2010 net income:** $1.97 Billion
- **2010 total assets:** $55.0 Billion
- **Electric generating capacity:** 42,962 MW
- **Four regulated electric utilities:** APC, GPC, Gulf, MPC
- **One wholesale generator:** SPC
Diversified Energy Sources

Energy Sources 2010

- Coal: 58%
- Gas: 25%
- Nuclear: 15%
- Hydro: 2%
**CO₂ Capture and Storage Technology**

**Capture**
- Pure CO₂ captured from plant flue gas

**Compression**
- Compressed to ~100-150 atm (~1500-2250 psi)

**Pipeline Transport**
- Transported to injection site via underground pipeline

**Underground Injection**
- Injected into deep geologic formations and sequestered for thousands of years
Carbon Capture Process
Southern Company CCS Research

- CO₂ Well bore leakage mitigation study Montana State - ZERT
- CCS training program & cap rock integrity lab; UAB
- Coal seam pilot injection El Paso CBM Filed
- Kemper County IGCC Mississippi Power
- CO₂ EOR pilot injection Denbury Citronelle Filed
- Saline reservoir pilot injection Mississippi Power Plant Daniel
- Sensitivity analysis of CO₂ sequestration potential and pore space requirement
- EPRI USDW test Mississippi Power Plant Daniel
- Valuation of damages from CCS; IEC & AJW
- Geological Suitable Study Alabama Power Plant Gorgas
- MHI pilot Plant Yates
- National Carbon Capture Center Wilsonville, AL
- 1 MW ADA Solid Sorbent Pilot, Plant Miller
- CCS demo 25 MW Alabama Power Plant Barry
- E.ON Greenland test
- NRG Energy test
- Diamond Energy test
- Southern Power test
- Mitsubishi Heavy Industries pilot Plant Yates
- GE Pilot Plant Yates
- National Carbon Capture Centre Wilsonville, AL
- EPRI USDW test
- Mississippi Power Plant Daniel
25 MW Integrated CCS Demo – APC Plant Barry

- **CO₂ Capture and Compression**
  - SCS/MHI collaboration with partners
  - KM-CDR capture technology (500 TPD)

- **Transportation and Sequestration**
  - DOE SECARB Phase III “Anthropogenic Test”
  - 150k tpy for up to 4 years into saline geology
  - ~15 mile CO₂ pipeline to Citronelle Field

- **Objectives/Goals**
  - Advance saline sequestration technology through large field test
  - Characterize operations to support full scale deployment
  - Continue outreach and education to insure seamless deployment
**Capture Project**
- SO collaborating with MHI
- Location: APC’s Plant Barry
- Execution and contracting: SO

**Sequestration Project**
- Project: DOE’s SECARB Phase III
- Prime contractors: SSEB and EPRI
- CO₂: SO supplying
- Sequestration location: Denbury’s Citronelle Oil Field

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**Plant Barry (APC)**

<table>
<thead>
<tr>
<th>Flue Gas / Utilities</th>
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**Capture Plant (SCS)**

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<th>CO₂ Pipeline</th>
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**Sequestration Plant**

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<th>Others</th>
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**Alabama Power Company**

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<th>Denbury Resources</th>
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**Pore Space**
25 MW CCS Demo: Execution

2010

Design

Construction

Foundation-Startup: < ½ est time

$35 million construction execution: staff < 10

2011

1Q
2Q
3Q
4Q
1Q
2Q
3Q
4Q

Pipeline cons

Startup

Operation

Man hours: 303,283
Safety: 1 recordable
2011 Update - Plant Barry

• Started up on June 2\textsuperscript{nd} 2011
  – Steam Optimization and Parametric Testing
  – Compressor commissioning
• Unit 5 on reserve shutdown has been an issue
  – Capacity Factor ~ 38%
• Illinois basin coal test burn on unit 5 at Barry (October 7-October 22)
• 42,730 tons of CO\textsubscript{2} captured thru October 21
• World’s largest start to finish CCS project on coal fired power plant
Results

The diagram illustrates the CO$_2$ captured (tons) and the Power Plant Unit Load over time. The blue line represents CO$_2$ captured (tons), and the red line represents the Power Plant Unit Load. The data is segmented into periods: May 18 to July 7, July 8 to August 26, August 27 to October 15, and October 16 to December 4.
Results

[Graph showing CO2 capture efficiency and CO2 captured over time from 18-May to 25-Oct.]

- CO2 capture Efficiency
- CO2 Captured (tons/day)
Results

Heat Duty (Btu/lb CO₂) vs. CO₂ Captured (tons/day)

- **Date**
  - 18-May
  - 7-Jun
  - 27-Jun
  - 17-Jul
  - 6-Aug
  - 26-Aug
  - 15-Sep
  - 5-Oct
  - 25-Oct

**Heat Duty (Btu/lb CO₂)**

**CO₂ Captured (tons/day)**

0.00 - 1000.00

0 - 1800
2012 Outlook

- Barry unit 5 (host unit) capacity factor increased to approximately 65%
- Pipeline in service April-May 2012
- Goals
  - 100 K tons CO$_2$ down the pipeline
  - Heat rate improvements
  - Robustness of plant with high impurities
  - Minimize amine emissions and KS-1 make-up requirement
- Test plans
  - Emissions testing
  - CO$_2$ compressor performance
  - Long-term parametric testing
  - Dynamic operation (load following testing)
  - Long term operability and reliability
Questions?