Southern Company

Southern Company R&D Program Review: Strategy and Reasons for Future Optimism with CCS

Southeast Regional Carbon Sequestration Partnership
13th Annual Stakeholders Briefing, February 7, 2018

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America's Premier Energy Company

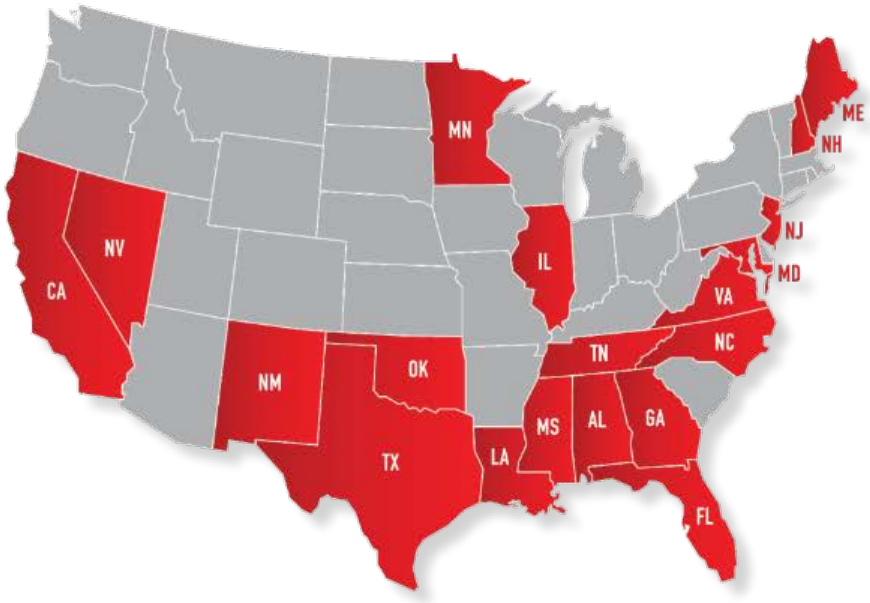
Southern Company

Approximately
46,000 mw
of Generating Capacity

Nearly
200,000
Miles of Power lines

More than
80,000
Miles of Natural Gas Pipelines

190 Bcf
of Natural Gas
Storage Capacity



Operations in
19 States

11
Electric & Natural Gas Utilities

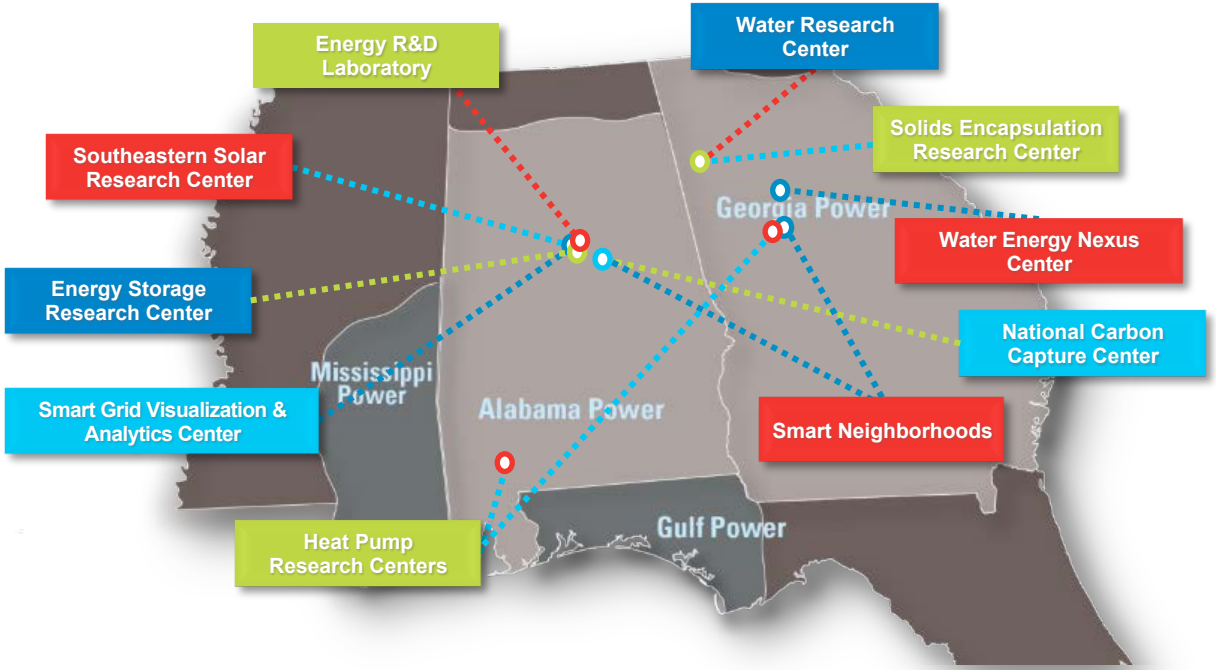
32,500
Total Employees

9 Million
Utility Customers

More than
1 Million
Retail Customers

Southern Company Research and Development

- Revolutionizing the future of energy
- Technology development for the **production**, **delivery** and **end-use** of energy
- Diverse research portfolio
- Collaboration with governments, utilities, universities and technology developers
- Innovative solutions to meet customers' current and future energy needs



Southern Company R&D Centers

CCUS R&D Technology Research Drivers

Are these drivers valid/or and moving targets?

- GHG environmental regulations
- Voluntary carbon footprint reduction
- Abundant domestic fossil-fuel resources coupled with stable fuel pricing
- Depreciated fossil-fuel generation assets with state-of-the-art environmental controls
- Maintain a balanced fuels portfolio
- Energy independence on the national level
- Challenging regional renewable portfolio in the Southeast, USA
- World class storage geology with demand for CO_2-EOR
- Federal & State incentives

Pre-Act 45Q Projects v. Post-Act 45Q Projects

	Pre-Act Projects	Post-Act Projects
Non-EOR	• $20/T + inflation • 75 million ton limit for EOR and • non-EOR combined* • All projects	• $22.66/T → $50/T over 10 years** + inflation after 10 year period • 12-year credit
EOR	• $10/T + inflation • 75 million ton limit for EOR and non-EOR combined*	• $12.83/T → $35/T over 10 years** + inflation after 10 year period • 12-year credit • Applies to: EOR, EGR, photosynthesis, chemosynthesis, chemical conversion, & other commercial use

*Credit expires when 75 million total load claimed **10 year linear progression from 2017 to 2026

Overview of New 45Q Tax Credit

- **Limitations -** New Credit includes the following limitations:
  - Small facilities - If emitting ≤ 500,000 tpy COx, must capture ≥ 25,000 tpy.
  - Electric generating facilities - Must capture ≥ 500,000 tpy.
  - Direct air capture facilities - Must capture ≥ 100,000 tpy.
  - NOTE: No apparent limit for other facilities (e.g., gas processing, refining).

- **Definition -** Secretary of Treasury required to define "secure geological storage" in consultation with EPA, DOE, and DOI.
  - This is already in the current law, but provides a new impetus for Treasury to act. It implicates UU v. RR GHG reporting issue.

- **Recapture -** Treasury must issue regulations regarding recapture of stored credit for COx that is reused.

Overview of New 45Q Tax Credit

- **Carbon oxide -** Covers carbon oxide (hereinafter "COx") sequestered, not just CO_2.

- **Incremental capacity increases -** New higher credit applies to COx captured beyond pre-Act capacity. Credit ramps up over time from $22.66 (2018) and caps at $50 (2026) with rate of inflation added each year after that. If starting in 2017, it would average at around $37 over the 12 years.

- **Otherwise released -** Applies to COx that "would otherwise be released into the atmosphere as industrial emission."

- **Deadline -** Facility must be under construction before January 1, 2024 and either
  - (1) the carbon capture equipment must also be under construction; or
  - (2) the original planning and design of facility must include carbon capture equipment.

- **Qualifying Facilities -** Includes industrial facilities and direct air capture facilities.

Is the new tax credit a driver for CCS deployment?

- By Federal law, tax credits can only offset tax liability by 75%.
- With our tax rate decrease to 21% from 35%, there is a potential “reduced value” of 45Q going forward.
- Interest deduction is now limited to 30% of earnings before interest, taxes and amortization (EBITA) (for most companies). However, there is a “Carve-out” for the regulated business. Many questions yet to be answered by the IRS regarding what gets “Carved-out” as part of the regulated business.
- Accelerated tax depreciation will be allowed but no bonus depreciation. On the non-regulated side of the business, capital investments can be expensed immediately.
- Future net operating income could increase appetite for projects with 45Q tax credits, but it is difficult to predict without passed regulations. Models are being built to evaluate the various impacts of tax reform.
- High capital investments should have stand alone ROI and not depend on tax credits?
- Tax credits will spur technology advancement with R&D!

National Carbon Capture Center

- **Sponsors:** U.S. Department of Energy and its National Energy Technology Laboratory
- **Partners:** Electric Power Research Institute, power and energy industry leaders
- **Managed and operated by:** Southern Company
- **Location:** Wilsonville, Alabama

U.S. DEPARTMENT OF ENERGY

NATIONAL ENERGY TECHNOLOGY LABORATORY

Southern Company

EPRI ELECTRIC POWER RESEARCH INSTITUTE

AMERICAN ELECTRIC POWER BOUNDLESS ENERGY

CLOUD PEAK ENERGY

DUKE ENERGY

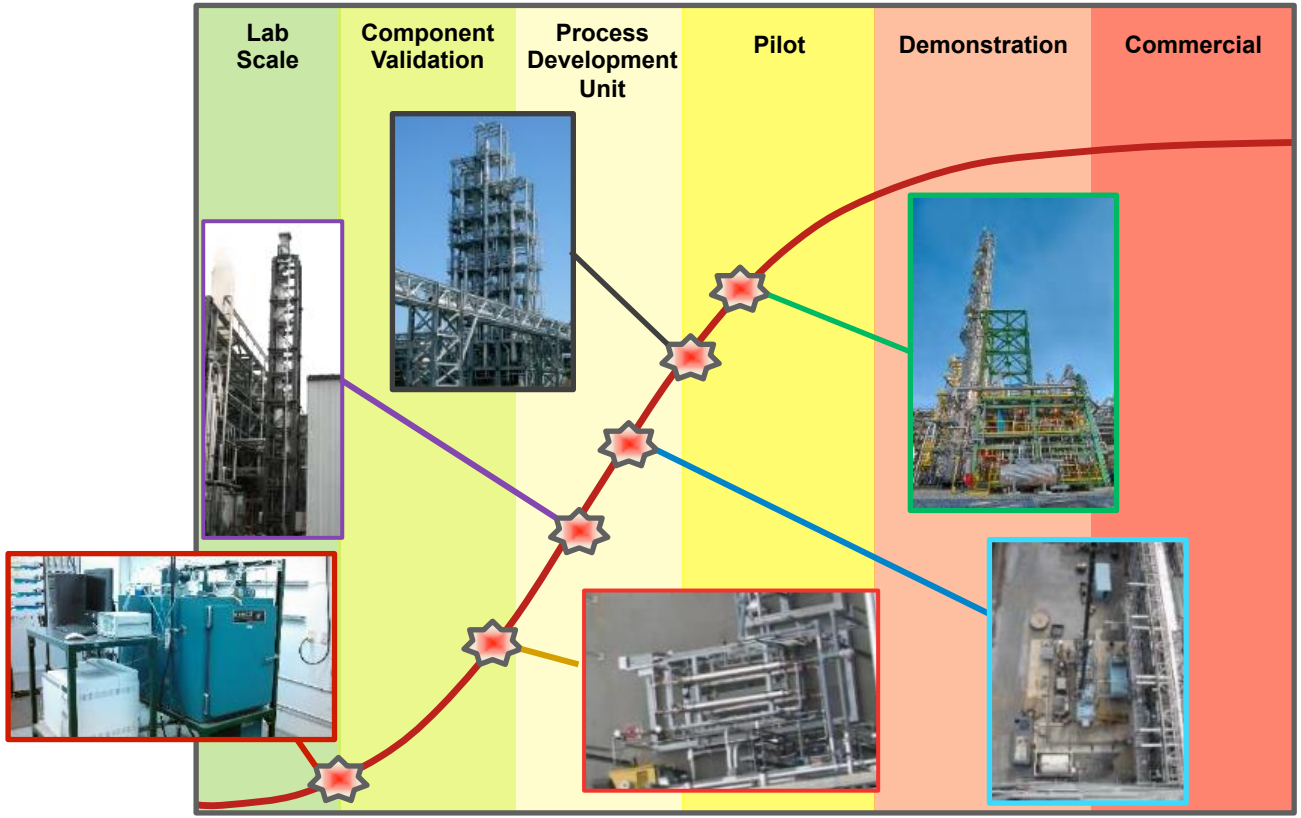
CLEARPATH

Mission and Values

A **world-class neutral** test facility and highly specialized staff to **accelerate the commercialization** of advanced technologies and enable fossil fuel-based power plants to achieve **near-zero emissions (low-cost CO_2)**

Safety First
Unquestionable Trust
Superior Performance
Total Commitment

Successful Testing and Partnerships



Technology Development Process

Evaluate and Screen Technology

Define Scope of Work with Developer

Design and Construct

Operate According to Test Matrix

Analyze Data and Report

Major Accomplishments

- More than 100,000 test hours for post- and pre-combustion carbon capture and gasification projects
- Post-combustion operation about 50,000 hours and over 6,000 hours under natural gas conditions
- 30+ post-combustion projects: enzymes, membranes, sorbents, solvents and associated systems
- Supported commercial developers to scale-up and DOE's Carbon Capture Simulation Initiative
- Technology developers from the U.S. and six countries

Carbon Storage Initiatives

Site Certification for Commercial Storage

Geologic resource assessment in saline reservoirs

- Plant Gorgas stratigraphic test well
- Plant Daniel CO_2 pilot injection study
- Plant Barry CO_2 injection demonstration
- Kemper County CarbonSAFE storage complex feasibility study

CO_2 Capture, Transportation and Storage Demonstration

Integrated CCS at 25-MW scale

- 12-mile pipeline to injection site
- 250,000+ metric tons captured
- 115,000+ metric tons transported and injected into 9,400-foot deep formation
- Site characterization, permitting, injection, monitoring and closure

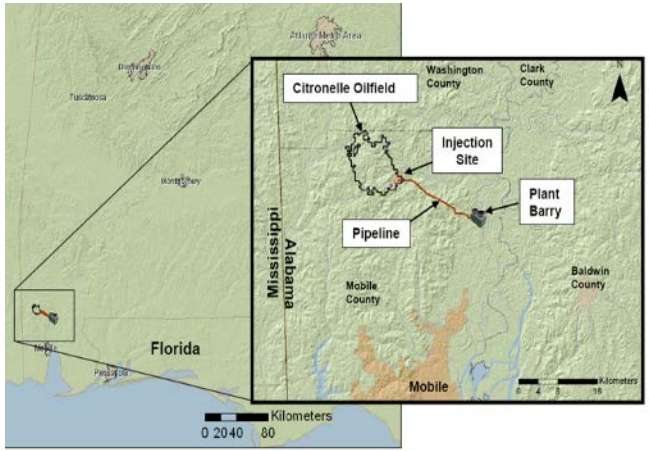
Brine Extraction and Storage Test (BEST)

Test wells at Plant Smith in Florida Panhandle

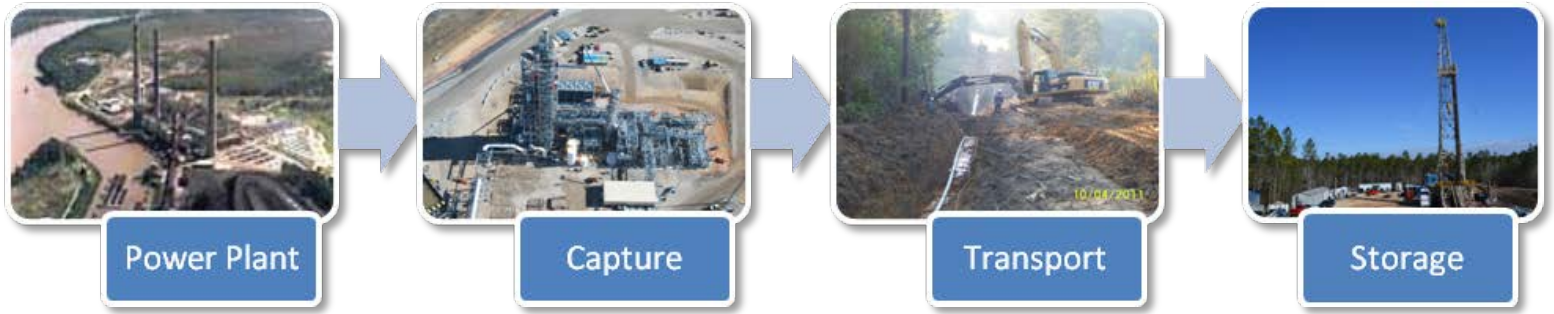
- Focused on managing CO_2 subsurface injection pressures to facilitate commercial storage
- Includes beneficial reuse of extracted brine associated with commercial-scale CO_2 injection operations

CCS Demonstration at Alabama Power's Plant Barry

Integrated CO_2 capture, transportation and storage at a fossil-fueled power plant

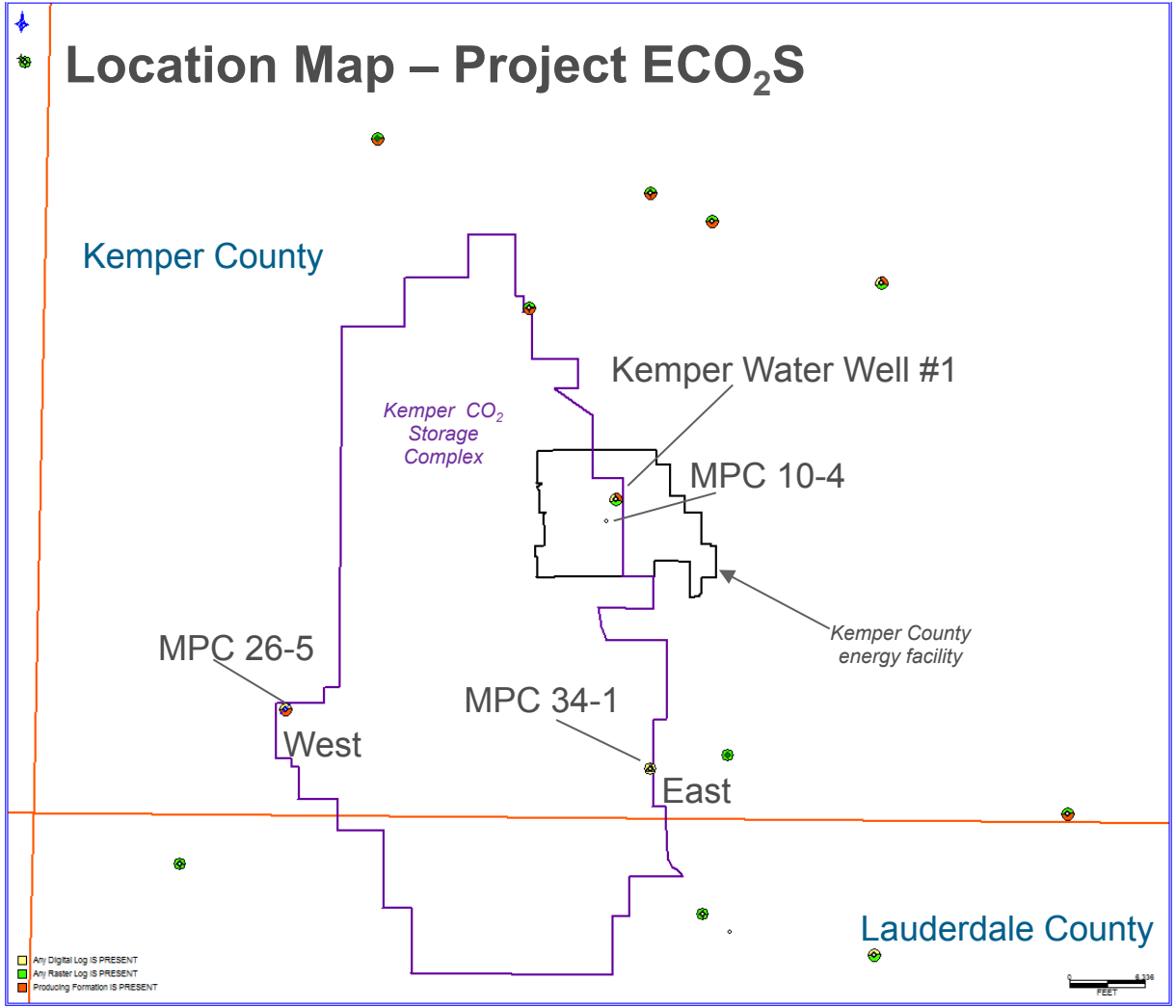


- CO_2 capture equivalent to 25-megawatts
- 12-mile pipeline linking captured CO_2 with injection site in Citronelle Dome
- 211,000 metric tons CO_2 captured with115,000 metric tons injected into ~9,400-foot deep saline formation
- Site characterization, UIC permitting, injection and monitoring of CO_2 for geologic storage, and closure



Kemper County Energy Facility

Location Map – Project ECO$_2$S



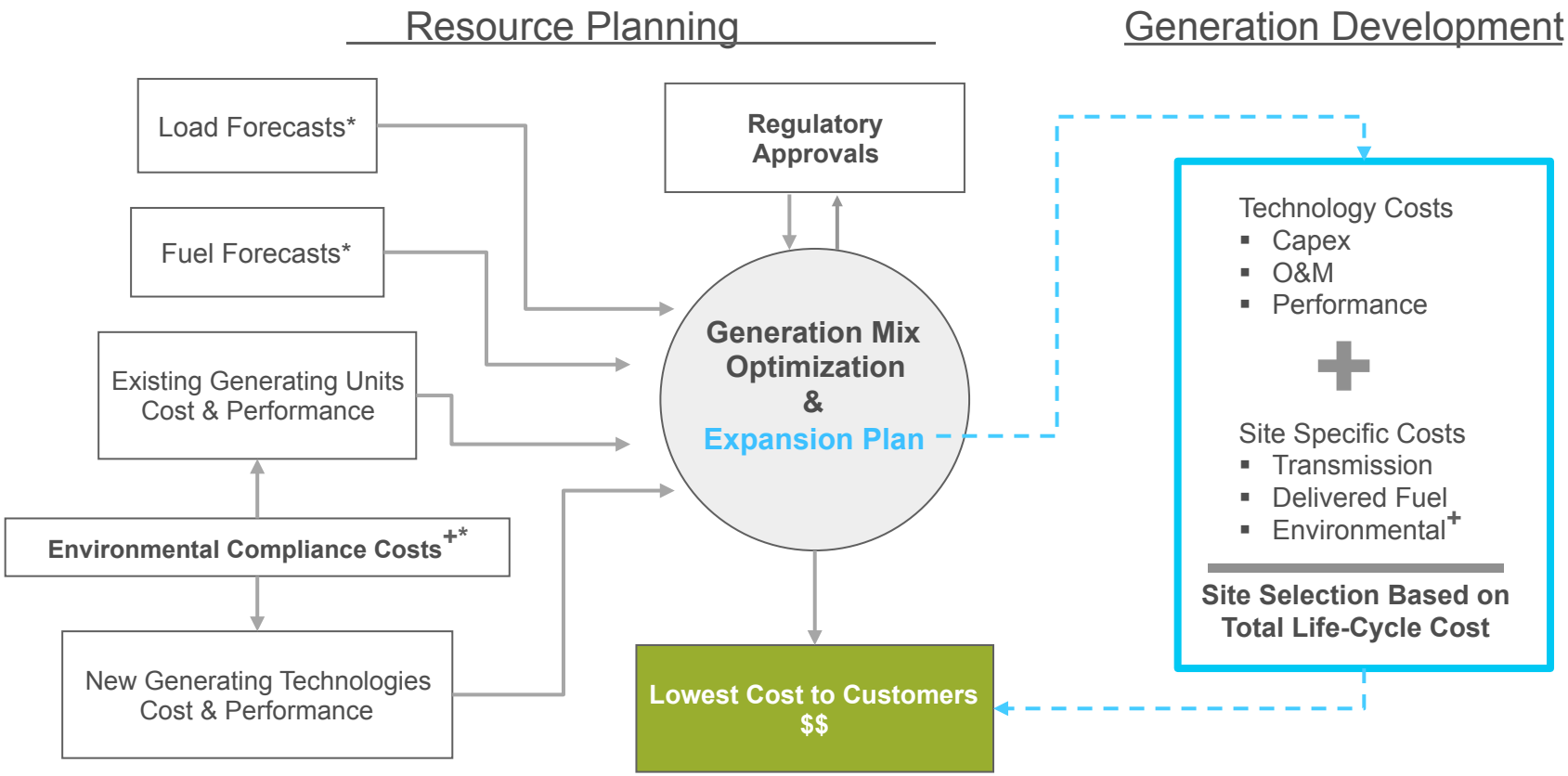
- Project ECO$_2$S is a storage complex "feasibility study" of $11.2 million DOE funds / $3.6 million industry cost-share for a total of $14.8 million total budget awarded for work at the Kemper County Energy Facility
- Scope is to perform detailed site-characterization of a storage complex having high potential for commercial storage (50+ million tonnes CO_2)
- Three deep wells have drilled in 2017 for site characterization

MPC-25-6 CarbonSAFE Project ECO$_2$S

DOE Coal, CCS & Power Systems Budgets

Coal, CCS & Power Systems (All figures in $ Thousands)	FY 17 Omnibus	FY18 Request		FY18 House	FY18 Senate	FY19 Request
Carbon Capture	101,000	16,000		95,000	93,930	0
Carbon Storage	95,300	15,000		89,073	88,269	0
Advanced Energy Systems	105,000	46,000		103,000	97,650	58,000
Cross-Cutting Research	45,500	37,800		51,550	42,315	36,000
Supercritical CO2 Technology (STEP) Program	24,000	0		24,000	19,530	0
Transformational Pilot Plant Solicitation				25,000		0
Carbon Capture, Utilization and Storage						23,000
Subtotal Before NETL R&D	370,800	114,800		387,623	341,694	117,000
NETL R&D	53,000	68,100		53,000	72,663	35,000
CCS & Power Systems R&D Subtotal	423,800	114,800		440,623	341,694	117,000
Transformational Pilot Plant Solicitation	50,000					
Natural Gas Advanced Power Systems R&D						
Total for FE R&D Programs	473,800	182,900		440,623	414,357	152,000

Generation Planning and CCS



- varies by scenario + may include CCS

For Illustration Only

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Thank You!