2021 Carbon Management and Oil & Gas Research Project Review Meeting: CCUS Infrastructure

Richard A. Esposito, Ph.D., P.G. Program Manager, Geosciences and Carbon Management Southern Company R&D - Net Zero Technologies August 3, 2021



Research & Development

Southern Company System Footprint



Current CCUS R&D Programs and Projects

National Carbon Capture Center

- 115,000+ test hours; 60+ technologies; cost reduction of ~40%
- Expanded scope: CO₂ capture for NG; CO₂ utilization; direct air capture (DAC)
- FEED Study of CO₂ Capture on Natural Gas (DE-FE00031847)
 - Linde-BASF system at Mississippi Power's Plant Daniel
- Black & Veatch DAC FEED Study (DE-FOA-0002402)
 - Scale-up of Global Thermostat's DAC system coupled with CHP turbine
- Southern States Energy Board DAC RECO₂UP (DE-FE0031961)
 - Field-test solid-amine CO₂ adsorption-desorption contactor technology at NCCC
- DOE/NETL CarbonSAFE in Kemper County, MS
 - Phase II completed: confirmed geologic potential as a regional storage hub (3 wells)
 - Phase III ongoing: 3 additional wells, Class VI UIC and NEPA permitting, seismic profiling, pre-feasibility capture studies, transportation studies, etc.
- CO₂ Storage Borehole Site Characterization in Cassville, GA *

* No current DOE co-funding



Energy Transition Requires Massive Infrastructure Investment

- Dramatic reduction of emissions, while maintaining electric reliability, will require broad CCUS deployment at baseload dispatch facilities like natural gas
- With CCUS massive infrastructure will be required for utilities to decarbonize
- Deployment will require an extensive CO₂ pipeline network that will look like the current natural gas pipeline network

Current CO ₂ Pipelines	Future CO ₂ Pipelines	Current NG Pipelines
5,000 miles	50,000 miles (?)	320,000 miles

- DOE Hydrogen Energy Earth shot (announced June 7): reduce cost of hydrogen 80% to \$1 per 1 kg in 1 decade (1-1-1)
- Fossil fuels to H₂ produces CO₂ requiring transport and storage. H₂ production will develop where CO₂ transport and storage infrastructure exists
- Large-scale carbon utilization also will require CO₂ transport

Infrastructure with Natural Gas and e-Transmission Snapshot



Gas pipelines

- Southern Natural Gas
- Southern Company Gas
- Pipeline projects



US Transmission Grid. Source: FEMA



CO₂ Infrastructure and the Electricity Sector

- Market structure affects generation investment:
 - Traditional state regulation: cost-plus regulation comes with imperatives of affordability and reliability
 - Restructured markets: no regulatory assurance of return on generation investments
- Utilities are challenged by an evolving source-sink matching perspective
 - A power plant's operating future determines whether CCUS investments can be viable
 - Operators look to maximize utilization, minimize costs to customers, maintain reliability, minimize emissions
 - Generation portfolio decisions shift based on market assumptions, fuel costs, environmental regulations, cost and viability of other technologies
 - Volumes of CO_2 required to be stored and at what time will CO_2 be required

Three Key CO₂ Pipeline Issues

	Cost	Property Rights	Permitting
Issues	 \$1-3 million per mile, depending on diameter, location, land features, other A 150-mile pipeline could approach the cost of the capture facility 	 Difficulty in obtaining landowner approval Eminent domain authority – may depend on who is asking/public purpose 	 Linear infra-structure difficult to permit: NEPA, ESA, EJ, wetlands, MBTA, NHPA, other
Potential Solutions	 Financial incentives (e.g., SCALE Act) Enhanced 45Q 	 Clarify eminent domain availability for CO₂ pipeline projects with public benefit 	 Robust USE IT Act implementation Corridor designations on federal/State lands

Selected Key CCUS Infrastructure Recommendations

Labor Energy Partnership – Building to Net Zero (July 2021)

- Establish priority regional storage hubs
- Set national target of 1 GTPase infrastructure capacity by 2050
- Provide clear authority for siting and permitting CO₂ pipelines, possibly including eminent domain authority
- Increase capacity for UIC Class VI permitting (EPA funding)
- Strengthen federal financial incentives, including enhancing 45Q tax credit
- Address long-term storage liability
- Assure workforce capacity

National Petroleum Council – Meeting the Dual Challenge (December 2019)

- Streamline pipeline permitting (achieved through USE IT Act)
- Clarify pore space access
- Provide clear authority for siting and permitting CO₂ pipelines, including eminent domain authority
- Increase capacity for UIC Class VI permitting (state primacy)
- Strengthen federal financial incentives, including enhancing 45Q tax credit
- Address long-term storage liability
- Assure workforce capacity

Beliefs About a Net-Zero Future

- CCUS is critical to delivery of a net-zero future that maintains clean, safe, reliable and affordable energy for our customers
- CCUS can integrate well with other net-zero approaches (e.g., SMR w/CCS, BECCS) and provide a pathway for industrial decarbonization
- Class VI CO₂ geologic storage will provide the primary means for permanent sequestration – significant storage capacity exists but source-sink matching and infrastructure will determine economics
- Widespread CCUS deployment requires substantial investment in RDD&D
- Low-carbon infrastructure investment is an engine for economic growth, innovation and global competitiveness
- Infrastructure legislation should prioritize investments that can accelerate the transition to a resilient, net-zero economy





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