DOE’s CCUS Program and Expectations of CDR Study

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John Litynski
Acting Division Director for Carbon Capture and Storage
Advanced Fossil Technology Systems

**Major Demonstrations**
First Generation fossil energy technology systems built to validate first-of-a-kind fully integrated projects at full scale for the power and industrial sectors.

**Advanced Energy Systems**
Technologies that greatly improve plant efficiencies, reduce costs, increase plant availability, and maintain the highest environmental standards.

**Carbon Capture**
R&D and scale-up technologies for capturing CO₂ from new and existing industrial and power-producing plants.

**Carbon Storage**
Safe, cost-effective, and permanent geologic storage of CO₂ in depleted oil and gas fields and other formations.

**Cross Cutting Research**
Materials, sensors, and advanced computer systems for future power plants and energy systems.
Carbon Capture R&D Pathways

Pre-Combustion
- Solvents
- Sorbents
- Membranes
- Hybrid processes
- Water-gas shift reactor

Advanced Compression
- Intra-stage cooling
- Cryogenic pumping
- Supersonic shock wave compression

Post-Combustion
- Solvents
- Sorbents
- Membranes
- Hybrid processes
Accelerating the Rate of RD&D - Transformational

Partnership between national labs, academia, and industry

Accelerate deployment by 50% in TRL 2-5 range

Parallel paths for materials discovery – synthesis – process design

Leverage advanced computing

Robotics for rapid synthesis and analytical capabilities

“Transformational Technology Development”

Non-aqueous and phase change solvents

Molecular Design

Advanced Manufacturing
Storage Infrastructure – Addressing Large Scale Challenges

Regional Carbon Sequestration Partnerships

Brine Extraction Storage Tests (BEST)

Unconventional EOR

Offshore Storage

Carbon SAFE
Carbon Dioxide Removal Technologies – Air Capture

**Carbon Engineering** ($1.5M)
- Active Pilot Plant – Squamish BC
- CaCO₃ to CaO loop
- TRL 5-6
- Cost TBD

**Ohio State University** ($1.25M)
- Facilitated transport membrane
- Dramatic increase in flux and selectivity
- TRL 2-3
- Cost >$300/tonne CO₂ captured

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**National Academies of Science Study**

*Developing a Research Agenda for Carbon Dioxide Removal and Reliable Sequestration*

- DOE Contribution - $250K based on FY16 appropriations guidance – Assess commercial viability of CDR technology
- 6 Boards Collaborating on Study
- Study Period - 2016-2018
DOE’s Expectation for Study

What would DOE like the panel to address:

✓ Assess the current status of global progress and achievements of direct air capture from dilute sources since the publication of the American Physical Society report on the subject
✓ Assess the level of current research efforts in air capture that are best positioned to lead to the commercialization of the technology at a significant scale.
✓ Assess the gaps in applied research and development that should be addressed to support the scaling up and commercialization of the technology

Measures of Success - The report would:

✓ Discuss the unique benefits of distributed air capture and availability of captured carbon dioxide at various scales
✓ Discuss the economics associated with air capture technologies, the markets for utilization of distributed CO₂, and greenhouse life cycle implications that should be considered
✓ Articulate the major challenges and applied research and development necessary to aid in the technology development, increase the scale, reduce the cost of capture, and commercialize the technology.
Carbon Use and Reuse Technologies

FY2015 Activities - $2M
- Focus: *Integration of Algae system with power plants*
- 2 Projects (Univ of KY and Micro Bio Engineering)

FY2016 Activities - $10M
- 7 projects supported (~$1M each)
- National Academies Study
- NETL and University Alliance R&D
- Integration of Algae system with power plant
- Mineralization of CO$_2$ into products
- Conversion of CO$_2$ to chemicals/fuels

Complements Advanced Gasification Program

National Academies of Science Study
*Developing a Research Agenda for Utilization of Carbon Waste Streams*
- Multiple DOE Program Effort
  - Fossil Energy - $250K
  - EERE BETO - $200K
  - Office of Science - $200K
- 2 Boards Collaborating on Study
- Study Period - 2016-2017