THE COMMITTEE ON ENERGY AND COMMERCE

MEMORANDUM

February 7, 2014

TO: Members, Subcommittee on Oversight and Investigations

FROM: Committee Majority Staff

RE: Hearing on "Department of Energy Oversight: Status of Clean Coal Programs"

On Tuesday, February 11, 2014, at 10:00 a.m. in 2123 Rayburn House Office Building, the Subcommittee on Oversight and Investigations will hold a hearing entitled "Department of Energy Oversight: Status of Clean Coal Programs." The hearing will review the status of the Department of Energy's clean coal programs. In particular, the Committee will examine the research, development, demonstrations, and timeframes to support the advancement of carbon capture and sequestration technologies for potential future commercial deployment at coal-based power plants.

I. WITNESSES

S. Julio Friedmann, Ph.D
Deputy Assistant Secretary for Clean Coal
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Scott Klara
Acting Director
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II. BACKGROUND

The Department of Energy (DOE) plays a key role in seeking to accelerate the commercial availability of technologies to reduce carbon dioxide (CO_2) emissions from coal power plants. DOE's Office of Fossil Energy oversees research on these technologies through its coal research, development, and demonstration (RD&D) program. The program is implemented through DOE's National Energy Technology Laboratory (NETL), which conducts basic R&D and manages cost-sharing and collaborative work with universities, private entities, and demonstration projects.

With regard to coal power generation, carbon capture and sequestration (or storage), also known as CCS, involves the separation of carbon dioxide from coal-based power plant flue gas

or syngas and either using it – in enhanced oil recovery (EOR) for example – or storing it before it can be released into the atmosphere.

Deployment of CCS includes four primary steps: CO_2 capture, compression, transport, and storage. According to DOE, the three general categories of CO_2 capture that can be applied to coal-based power plants are pre-combustion, post-combustion, and oxy-combustion. Pre-combustion capture is applicable to integrated gasification combined cycle (IGCC) power plants, while post- and oxy-combustion capture can be applied to conventional pulverized-coal (PC) power plants. In the predominant approach to CCS, the captured CO_2 is transported via pipeline to a permanent storage site or used for enhanced oil recovery. CO_2 may be stored permanently underground in geologic formations, such as depleted oil and gas fields, un-mineable coal seams, and saline formations.[1]

Commercially available so-called first-generation CO_2 capture technologies are used in various industrial applications. However, according to NETL, these technologies are not ready in their current state of development for implementation on commercial coal-based power plants because they have not been demonstrated at appropriate scale, require approximately one-third of the plant's steam and power to operate, and are cost prohibitive.[2] The *2010 Report on the Interagency Task Force on Carbon Capture and Storage* notes that existing CO_2 capture technologies for coal-based power plants "are not ready for widespread implementation primarily because they have not been demonstrated at the scale necessary to establish confidence for power plant application."[3]

To answer the technical questions and develop confidence in the commercial application of CCS, DOE has supported the development and evaluation necessary to demonstrate effective integration of first generation CCS technologies at coal power plants. However, even with successful demonstration, economic barriers to commercial deployment will remain. In its 2014 Budget Request, DOE explains that "these demonstrations focus on first generation CCS technologies and seek to demonstrate that CCS can be integrated at commercial scale while maintaining reliable, predictable and safe plant operations. However, in the case of electricity generation, first generation CCS technology cost is not expected to be low enough to achieve widespread deployment in the near term."[4]

From FY 2005 through FY 2014, DOE has been appropriated more than $7.6 billion to support advancement of CCS technologies for eventual commercialization.[5] Of this amount, about $4.45 billion has been allotted to demonstrate first generation CCS technologies, through the Clean Coal Power Initiative (CCPI), and FutureGen 2.0 and the Industrial Carbon Capture and Storage (ICCS) programs.

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[1] *See* DOE/NETL Carbon Dioxide Capture and Storage RD&D Roadmap, December 2010. *For additional background, see* Carbon Capture and Sequestration: Research, Development, and Demonstration at the U.S. Department of Energy, Congressional Research Service, September 30, 2013. R42496.

[2] See NETL at http://netl.doe.gov/research/coal/carbon-capture.

[3] *See* 2010 Report on the Interagency Task Force on Carbon Capture and Storage, August 2010, at 50.

[4] *See* Department of Energy FY 2014 Congressional Budget Request, Volume 3, April 2013, *at FE-5.*

[5] This sum includes about $4.2 billion in annual appropriations since 2005 and $3.4 billion in the 2009 American Recovery and Reinvestment Act (ARRA). DOE has been co-funding large-scale demonstrations of emerging clean coal technologies to hasten their adoption since 1985. It has been funding R&D for sequestration since about 1997.

At present, DOE is pursuing eight major demonstration projects under these three programs.[6] The demonstrations cover power generation at the five facilities associated with coal power generation, ranging from 240 megawatts (MW) power output to around 580 MW. Six of the eight projects use the captured CO_2 for enhanced oil recovery; two seek demonstrations of sequestration in saline formations. (See attachment.) Only one of the coal power facilities, the Kemper County IGCC project, is presently under construction. According to current schedules, the evaluation and reporting on "lessons learned" from the demonstrations associated with coal power – including the Kemper County facility – will be completed over the period of 2020 through around 2023.

In the meantime, DOE is pursuing and supporting research to seek advances in various integrated power and capture technologies that may achieve substantial cost reductions. Of funding appropriated since FY 2005, more than $3 billion has been committed to pursuing these second generation technologies and so-called transformational technologies, processes, and tools that will result in lower costs for CCS implemented on coal power plants.

The agency's January 2011 plan for developing and advancing second generation CCS technologies established four program goals: (1) develop technologies that can separate, capture, transport, and store CO_2 using either direct or indirect systems that result in a less than 10 percent increase in the cost of energy by 2015; (2) develop technologies that will support industries' ability to predict CO_2 storage capacity in geologic formations to within ±30 percent by 2015; (3) develop technologies to demonstrate that 99 percent of injected CO_2 remains in the injection zones by 2015; (4) complete Best Practices Manuals for sequestration site selection, characterization, site operations, and closure practices by 2020.[7]

DOE and NETL have set an "aggressive timeline" for second generation and transformational technologies moving from the laboratory to pilot testing through actual demonstration that ranges from the mid-2020s timeframe to the mid-2030s, respectively – depending on private industry funding.[8] Whether these goals will be realized, of course, has a substantial degree of uncertainty given the risks of failure inherent in technological research. DOE goals and timetables for development and demonstration appear to have slipped since 2010. For example, at present only one of the first-generation CCS demonstration projects is meeting the start-up date estimated in DOE's CCS research, development, and demonstration roadmap issued in December 2010[9] – other coal-based projects are two to four years behind schedule. The goal to develop systems that result in less than a 10 percent increase in the cost of energy by 2015, according to current assessments, appears to be still at concept stage.[10]

This past October, in light of the funding authorized, and recent regulatory proposals by EPA that assert the "adequate demonstration" and commercial viability of CCS on coal power plants, the Committee wrote DOE to examine the extent to which DOE programs have

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[6] *See* Major Demonstration Programs: Program Update 2013, DOE/FE-0565, September 2013.
[7] *See* Carbon Sequestration Program: Technology Program Plan, February 2011, at 10.
[8] *See* Clean Coal Research Program: Carbon Capture Technology Program Plan, January 2013 at *31*.
[9] *See* DOE/NETL Carbon Dioxide Capture and Storage RD&D Roadmap, December 2010.
[10] *See* 2012 Technology Readiness Assessment—Clean Coal Research Program, DOE/NETL, December 2012.

contributed to advancements with respect to research, development, and demonstration of CCS technologies. The inquiry also sought information on what DOE's work has accomplished in terms of reducing the cost and related deployment barriers for carbon capture and storage technologies.[11] This hearing will continue to inform this inquiry.

III. ISSUES

The following issues may be examined at the hearing:

- What is the status and timeline of major demonstration projects?
- What is the status and timeline of second generation and transformational CCS technologies?
- What technical and economic barriers must be overcome to advance future commercial deployment of clean coal technologies and CCS?
- What challenges confront cost-effective deployment of CO_2 storage and sequestration programs?

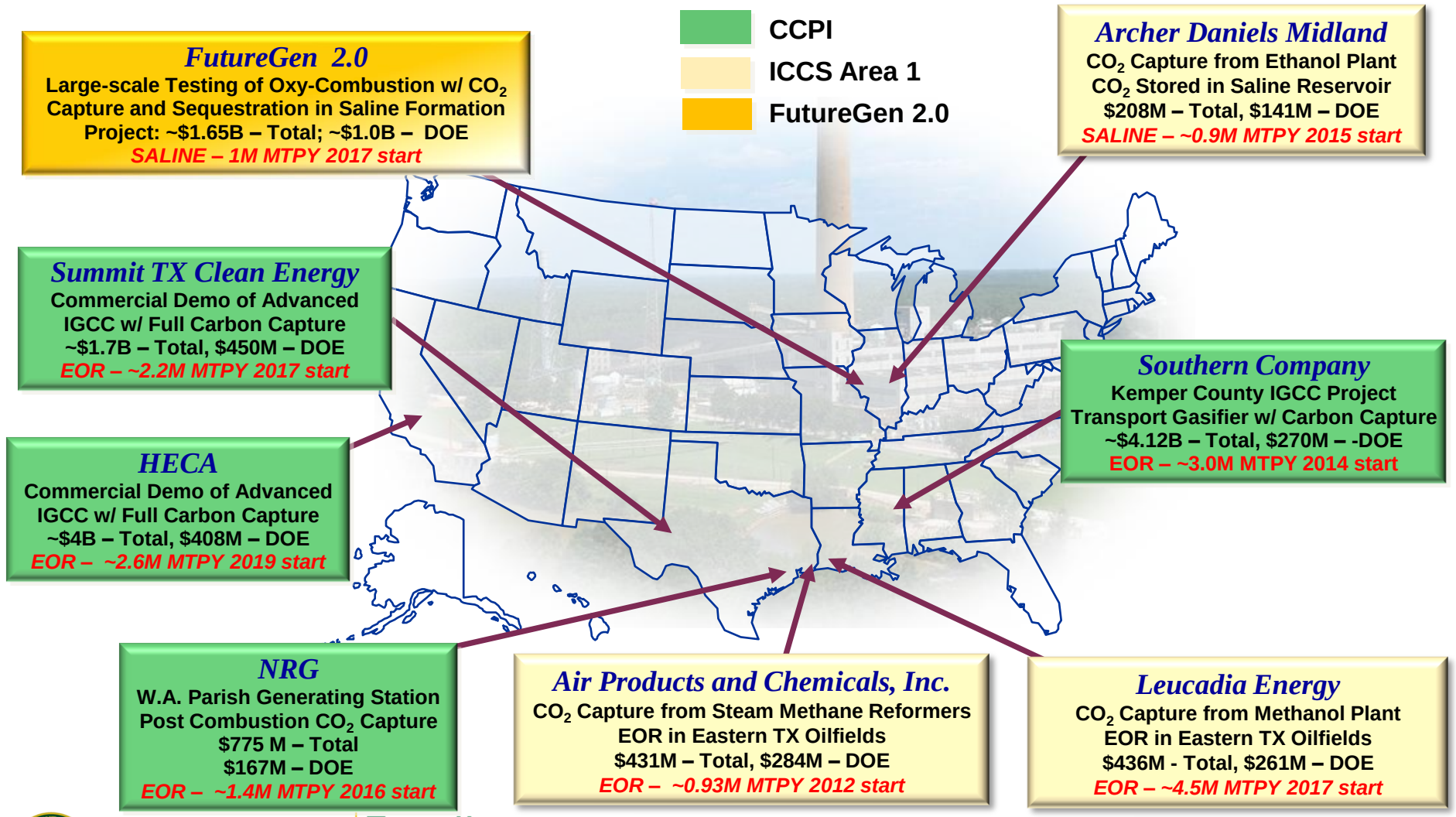
IV. STAFF CONTACTS

If you have any questions regarding this hearing, please contact Peter Spencer or Sam Spector of the Committee staff at (202) 225-2927.

[11] See Committee Web site.

Major CCS Demonstration Projects

Project Locations & Cost Share



FutureGen 2.0
Large-scale Testing of Oxy-Combustion w/ CO_2 Capture and Sequestration in Saline Formation
Project: ~$1.65B – Total; ~$1.0B – DOE
SALINE – 1M MTPY 2017 start

Archer Daniels Midland
CO_2 Capture from Ethanol Plant
CO_2 Stored in Saline Reservoir
$208M – Total, $141M – DOE
SALINE – ~0.9M MTPY 2015 start

Summit TX Clean Energy
Commercial Demo of Advanced IGCC w/ Full Carbon Capture
~$1.7B – Total, $450M – DOE
EOR – ~2.2M MTPY 2017 start

Southern Company
Kemper County IGCC Project
Transport Gasifier w/ Carbon Capture
~$4.12B – Total, $270M – -DOE
EOR – ~3.0M MTPY 2014 start

HECA
Commercial Demo of Advanced IGCC w/ Full Carbon Capture
~$4B – Total, $408M – DOE
EOR – ~2.6M MTPY 2019 start

NRG
W.A. Parish Generating Station
Post Combustion CO_2 Capture
$775 M – Total
$167M – DOE
EOR – ~1.4M MTPY 2016 start

Air Products and Chemicals, Inc.
CO_2 Capture from Steam Methane Reformers
EOR in Eastern TX Oilfields
$431M – Total, $284M – DOE
EOR – ~0.93M MTPY 2012 start

Leucadia Energy
CO_2 Capture from Methanol Plant
EOR in Eastern TX Oilfields
$436M - Total, $261M – DOE
EOR – ~4.5M MTPY 2017 start

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