Amended Written Statement of Ben Yamagata
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Coal Utilization Research Council (CURC)

Before the

United States Senate
Committee on Energy and Natural Resources
April 20, 2010

I. Introduction:

On behalf of the membership of the Coal Utilization Research Council (CURC) I thank the Committee for this opportunity to testify on Title II of draft legislation distributed by Senator Jay Rockefeller and Senator George Voinovich on March 20.

The CURC is an organization of major U.S. coal producers, electric utilities that rely upon coal to generate electricity, major equipment manufacturers, state governments and academic institutions. A membership list is attached (See: Attachment 1).

Title II of the Senators' draft would authorize the establishment of a twenty gigawatt demonstration and early commercial deployment program focused upon carbon capture and sequestration (CCS) technology. CURC supports the concepts in this proposed legislation and we look forward to working with the Senators and also with this Committee and others to refine this draft proposal prior to introduction.

As requested by Committee staff, this testimony focuses specifically upon title II of the draft legislation related to incentives for a 20 gigawatts CCS "pioneer plants" program.

II. Summary of the important points in this written statement:

- Four key elements of CURC's testimony:
    1. To insure that CCS technology is effective and affordable and to achieve these goals within the mid-century timeframe being discussed for CO_2 reductions we must begin the Rockefeller/Voinovich title II program NOW.
    2. The scope of the proposed title II program is broad (20 GWs) and will be expensive (as much as $40 billion over a 20+ year period). The National Academy of Sciences, the Senator Byron Dorgan "Pathways" initiative comprised of a large and diverse cross-section of interests, including NGOs, industry, academia, as well as the International Energy Agency and many others have concluded that a large-scale CCS demonstration-deployment program is essential to the rapid commercialization of CCS. More importantly the IEA has concluded that the successful deployment of CCS could reduce overall costs of reductions by up to 97%!

3. CURC supports the concepts of title II of the draft legislation and recommends several modifications to the draft including:
    - Consideration of an electric utility industry-led accelerated CCS demonstration program similar in scope and administration to the "wires charge" authorization included as section 114 of H.R. 2454 in lieu of the 10 GW special funding program proposed in the Senators' draft. While the approaches to a fee on electricity consumption to finance a CCS demonstration program differ and CURC's electric utility members, in particular, have agreed upon the program included in H.R. 2454, the CURC fully endorses the concept of such a fee-based program to support the demonstration of CCS particularly if the program insures that there will be a diversity of CCS technologies demonstrated. This diversity of options will provide industry with the ability to choose which option is most favorable to a particular circumstance.
    - The draft legislation sets forth eligibility criteria based, in part, upon the size of demonstration projects. As currently drafted this criterion would eliminate from eligibility certain CCS projects now under consideration. The size limitation must be adjusted. CURC has offered a different size of project criteria which we believe retains the objectives of the proposed program while still insuring that large-scale demonstration projects will qualify. We urge the substitution of this modified size standard.
    - Clarification of language in the draft proposal to insure that all of the proposed financial incentives are available to a specific project (e.g. project should be eligible for investment as well as production tax credits) and also to include subsidized bond financing and or tax grant options for not-for-profit public power and electric cooperative utilities not otherwise eligible for the proposed tax incentives.
4. Finally, Congress is encouraged to adopt the "comprehensive" carbon management program for coal as reflected in the Rockefeller/Voinovich discussion draft. Each title of the Senators' discussion draft is vitally important, in the judgment of CURC members, to successful widespread commercial deployment of CCS.

III. Why Coal and CCS technology?

Coal is an important contributor to the U.S. and global energy mixes. In the U.S., coal provided 23% of total energy consumption in 2008, according to the DOE Energy Information Administration. About 90% of coal in the U.S. goes to electric power generation, and that coal generates about half of our electricity. Globally, coal is about 27% of total energy consumption and 40% of electricity generation. Coal use in the U.S. has been relatively constant for several years, and is expected to remain so in the future, but globally coal has been the fastest growing

fuel form for the past decade, in total Btu's. EIA projects that 94% of growth in global coal use between 2006 and 2030 will be in non-OECD countries. Much of that growth will be in China, which currently uses about three times as much coal as the U.S. and is building approximately one new coal-based power station every week of the year.

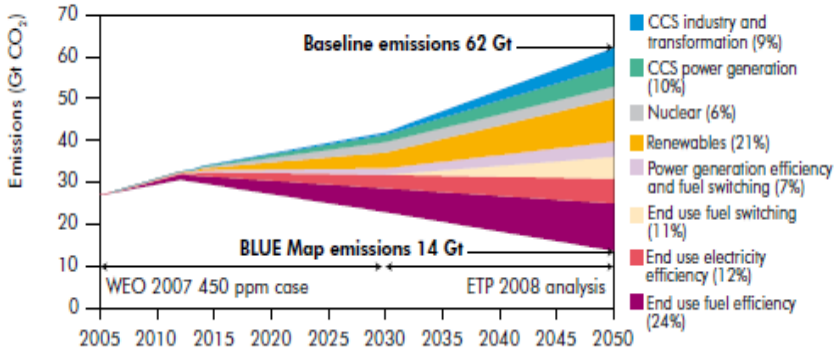
Coal provides, and will continue to provide, reliable and low cost energy and power to billions of people around the world. But, to address the continued and growing need for coal we must address the carbon dioxide emissions that result from coal use. CURC is absolutely confident that given sufficient time and financial assistance technology will be available to address the CO_2 emissions resulting from the use of all carbon-based fuels, including coal and natural gas.

In the U.S., coal contributes about 31% of total emissions of greenhouse gases, according to EPA's latest inventory. That figure is exceeded only by petroleum (35%). Without a significant reduction in emissions from all fossil fuels, including coal, we have no chance of meeting those legislative goals demanded by some like an 83% reduction in GHG emissions by 2050. For coal, the only practical ways of achieving such results are to either not use it, or to apply CCS technology. Given the economic and energy security contributions of using coal, and the clear certainty that the developing nations will continue and expand their use of coal, CCS appears to be the more realistic choice. Others have reached this same conclusion. You may recall the oft-quoted statement by former U.K. Prime Minister Tony Blair: *"The vast majority of new power stations in China and India will be coal-fired. Not 'may be coal-fired'; will be. So developing carbon capture and storage technology is not optional, it is literally of the essence."* In the International Energy Agency's analysis of GHG mitigation options (Energy Technology Perspectives, 2008) the IEA concluded that a scenario including the assumption that CCS was available and effective was **97% cheaper than a scenario without CCS**. IEA has concluded that: *"CO_2 capture and storage for power generation and industry is the most important single new technology …."*

The importance of CCS might best be explained when described in the context of the various paths that must be pursued to achieve what the Intergovernmental Panel on Climate Change (the IPCC) has concluded as necessary reductions in global greenhouse gas (GHG) emissions of 50-85% below current rates by 2050 in order to limit warming to 2-2.4°C. In 2008, the International Energy Agency published its analysis of measures needed to achieve a 50% decrease below current GHG emission rates by 2050.[1] Figure ES.2 (below), taken from that report, summarizes the report's findings.

[1] Energy Technology Perspectives, 2008, International Energy Agency, OECD, 2008.

Figure ES.2 ▶ Comparison of the *World Energy Outlook 2007* 450 ppm case and the BLUE Map scenario, 2005-2050



The figure shows that the major opportunities for achieving such a reduction are comprised of the following components:

- End-use efficiency improvements: 36% of total reduction
- Renewable energy use 21%
- CCS on industry and power sectors 19%
- Nuclear power expansion 6%
- All other approaches combined 18%

Among its summary findings for research, development, and demonstration needs, the IEA stated, **"There is an urgent need for the full-scale demonstration of coal plants with CCS."** (emphasis in original).

IV. What is the Current Status of CCS?

Most of the major components needed for CCS have been used commercially. They have not, however, ever been combined on a commercial scale power plant anywhere in the world. With respect to storage technology, we have extensive experience in the U.S. with enhanced oil recovery, which retains a large portion of the CO_2 injected to produce additional crude oil, but there are only a handful of projects globally that are injecting large quantities of CO_2 into the largest potential "sink" for CO_2: deep saline geological formations (essentially porous rocks saturated with brackish water, a mile below the earth's surface). The USDOE has two relevant demonstration programs underway – the Regional CO_2 Sequestration Partnerships program, focused on storage of CO_2; and, the Clean Coal Power Initiative (CCPI), focused on integrated power plant capture and storage projects. In addition, the FutureGen project, an integrated gasification combined cycle (IGCC) equipped with carbon capture and storage technologies, hopefully, will be fully underway with completion of construction and initial operation by 2015. This first-of-a-kind project will capture and sequester one and one-half million tons of CO_2 annually.

It is important to note that if all the ongoing projects go forward, and that is always an uncertainty, in 2016 we will have experience with two saline storage projects and four, or more other power plant and industrial projects that have the goal of CO_2 capture and storage in EOR formations, and they are important, especially for deploying CCS in the near-term -- but they will not give us needed experience with saline storage which is necessary for unlocking the greater potential of CO_2 storage in deep geologic formations.

My point is not one of complaint about the current demonstration program – it is the most advanced and aggressive in the world. My point is that this is not enough to launch a program critical to the world's future in the time frames discussed by the President and in proposed legislation. This level of undertaking is further explained and amplified by others including the following:

1. America's Energy Future, a recent report by the National Research Council, concluded that 15-20 CCS projects totaling 10 gigawatts (GW) of capacity were needed in the next decade, in order to accommodate broad deployment of CCS in the time thereafter. The NRC report said*, "A failure to demonstrate the viability of these technologies* [both CCS and advanced nuclear systems] *during the next decade would greatly restrict options to reduce the electricity sector's CO_2 emissions over succeeding decades.* ***The urgency of getting started on these demonstrations to clarify future deployment options cannot be overstated."*** [emphasis added]

2. The total number of projects and scope of demonstrations recommended by the National Research Council study is generally consistent with the conclusions drawn by CURC. Our members have carefully examined the need for a variety of CCS demonstrations to address both technical and financial issues of uncertainty and concluded that it will be necessary to support as much as 15 gigawatts of CCS-related capacity. Importantly, this does not need to be electricity generation only. Indeed, many of the early, commercial-scale projects utilizing coal or petroleum coke will convert those fossil fuels to a useful energy product like substitute natural gas (SNG). And, these projects will also capture CO_2 emissions. However, at least five gigawatts-equivalent of the CCS projects must have as a part of the demonstration the storage of captured CO_2 into deep geologic formations. We cannot emphasize enough the importance of gaining the handling, storage, verification and monitoring experience that will come with this type of permanent storage.

3. Finally, over the period of several months last year a group of environmental organizations, industry organizations, experts from academia and technology providers convened under the auspices of Senator Byron Dorgan (known as the Dorgan "Pathways" initiative) to determine if they could agree upon the need for and amounts of financial support required to encourage the rapid development and deployment of CCS technology. That diverse group of interests was able to achieve some agreement over the need to support CCS deployment and most important, agreed that large amounts of government assistance was essential to early success of CCS (a brief

description of the "Pathways" project and conclusions are attached to this written statement as Attachment 2). Much of the financial requirements and timing for CCS development contemplated by the "Pathways" participants are reflected in two titles of the draft proposal of Senators Rockefeller and Voinovich.

These analyses suggest a much more aggressive target than that set by the Obama Administration, and greatly exceeds activity now underway. It is important to recognize that time is of the essence on moving forward with this work.

V. What is our Analysis of the Draft Rockefeller and Voinovich Legislation?

Committee staff suggested that I focus my remarks on Title II of draft legislation released for comment by Senators Rockefeller and Voinovich on March 20, 2010. The primary obstacle to more activity demonstrating CCS technology is money. Title II of the Senators' draft proposes to address this issue by taking the money from two sources. Under Subtitle A of Title II, the first 10 gigawatts of CCS-equipped capacity would be funded by utilities which use fossil energy to produce electricity. A small fee placed on those utilities, and based on their total generation by each fossil fuel, would provide a pool of about $2 billion per year for 10 years, or $20 billion altogether. The second 10 gigawatts of CCS-equipped capacity are governed by Subtitle B and would be eligible for a production tax credit for captured and stored CO_2, loan guarantees, and an investment tax credit funded from general tax revenues. Hence, Title II proposes a practical solution to the greatest problem in getting more demonstration units built in the near term. It has identified a source of funds. In CURC's activities in this area, it has become clear that industry will support the general concept of a "wires charge" to pay for the initial demonstration program, and to pay the private sector share of both that program and the taxpayer-assisted program. Finally, if the IEA's cost projections are even close to correct, electricity consumer and taxpayer support of these Pioneer projects will be rewarded with electric power which is much less expensive than it would otherwise be, if and when a climate program reaches its more aggressive stages.

The Subtitle A funds would be administered by DOE and used to pay a production subsidy, in dollars per ton of CO_2 captured and stored (or converted). Projects with higher %-capture, or earlier in time, would get a higher rate per ton. The details of how much the subsidy would be for specific projects or overall are not prescribed in the draft. The goal of the program is to provide incentives for at least 10 GW of CCS-equipped capacity.

Subtitle B of Title II provides for amendment of the internal revenue code to:

- Extend the current Section 45Q production tax credit to any eligible unit placed in service prior to January 1, 2017. The credit amounts to either $10/ton or $20/ton of CO_2 captured and stored, with the amount depending on whether the storage in associated with EOR or saline formations, for the first 10 years of unit operation with CCS.
- Provide $20 billion dollars in loan guarantees for up to 10 gigawatts of new and retrofit units with CCS is authorized by an amendment to Section 1704 of EPACT-2005.

- Provide that units eligible under Section 1704 may also elect to receive a 30% Investment Tax Credit for the incremental cost of the CCS systems (but not for the basic power plant or industrial process unit).

Key Issues of Concern to CURC:

We applaud Senators Rockefeller and Voinovich for taking a leadership position on the advancement of this critical technology. In my view, this is the most constructive legislative package supporting CCS yet offered, in terms of its ability to generate additional demonstration facilities NOW. However, there are several issues that require modifications prior to introduction (See: attachment 3 for a comparison of the provisions proposed in the draft legislation by Senators Rockefeller and Voinovich and recommendations, very similar to section 114 of H.R. 2454, that CURC has previously provided).

The first, and foremost, is the structure of the section 201 program, the "Carbon Capture and Sequestration Early and Effective Deployment Fund Act of 2010" which includes the assessment of a fee on electricity consumption by certain customers. [2] Simply stated, we believe that the program initially considered and adopted in the House-passed climate bill related to an industry-funded demonstration program, the so-called "Boucher wires charge" more clearly reflects a suitable structure. I have taken the liberty of attaching a CURC-prepared document that compares the provisions of the draft legislation to provisions that CURC supports. There are immense possibilities in the Senators' draft legislation to address our concerns and CURC and our members stand ready to offer further, detailed views in this regard.

It is significant that electric utilities, both regulated and non-regulated, as well as the association of state utility regulators (NARUC) have agreed upon the level of fees to be assessed on all utility customers as well as the administration of the demonstration program. That agreement was reflected in the CCS demonstration program included in H.R. 2454, section 114. The Rockefeller-Voinovich discussion draft substantially alters critical elements of section 114. In addition to conforming the amount of fees to be levied and the customer base that would be asked to provide funds for the demonstration program to H.R. 2454, the Committee and Senators Rockefeller and Voinovich must retain a mechanism that will ensure that the funds collected for the program be available only to the program and that they not be subject to an annual appropriations process that immediately draws into question whether funds will be available from one appropriations cycle to the next.

[2] A structural issue which has been raised regarding the Draft Discussion is the exclusion of residential electricity users from the lines charge assessment. These customers constitute about one-third of electricity use, so their exclusion raises the fee significantly for the remaining customers (commercial and residential electricity users). Under this construction, the fee could reach burdensome levels, particularly for the manufacturing sector, which is struggling to survive in the current recession. The basic principle of minimizing the fee per payer by having a large base of inclusion is defeated if a large segment of the potential payers are excused from the assessment. I would urge the authors of the draft proposal and this Committee carefully reconsider the issue of "who pays" in order the spread the cost impacts across all electricity ratepayers.

Second, we are very concerned that the eligibility requirements to participate in either the 10 gigawatt demonstration program, funded by the assessments on electricity consumption, or the 10 gigawatt pioneer plant or "first mover" program that provides a variety of tax and other financial incentives to early commercial scale projects, are overly restrictive. Indeed, several of our members currently engaged in first of a kind CCS-related projects have reported that their project will not qualify for the proposed programs. We assume that is not the intent of the senators to exclude these projects that will pioneer the needed experience with CCS technology.

Specifically, section 205 (i) and section 252 (c) of the draft set forth two different size criteria for CCS projects to be eligible for the Title II programs. We urge that these criteria be identical and that qualifying criteria be premised upon the assumption that the size of the project, once successfully completed, will enable that technology to thereafter be replicated at commercial scale in some instances or scaled-up in other instances to thereafter operate at full commercial scale. This size standard will be different based upon the technology involved but industry and the Department of Energy, we believe, could easily determine standards to define commercial scale and also determine if a given project will demonstrate a technology that can be subsequently constructed at full commercial scale. To account for a variety of circumstances and technologies CURC has recommended that the size standard include an absolute size of at least 200 MWs or equivalent of nameplate capacity to account for CCS retrofits for a portion of very large power plants or at least 20 percent of the total nameplate generating capacity to encompass smaller projects. Again, the goal of the Title II program should be to focus on the pioneer plants that constitute the first generation of CCS projects that will operate in commercial settings. Also with respect to eligibility it is important that all electric utilities, those that are regulated and those operating in deregulated markets, have opportunities to access the variety of financial incentives. Equally true, CURC supports changes to Title II that will insure that public power entities are also eligible for funding under the programs.

In addition, subtitle III of the draft bill provides a tax credit under new section 45R of the Internal Revenue Code for 62 GWs of capacity that are installed with CCS systems. Although very supportive of this provision, we have one major concern with an ambiguity with the eligibility requirement. Specifically, the requirement can be read to require the capture and sequestration of at least 65% of the total CO_2 emissions from the entire unit. For the same reasons already noted above, the application of capture levels to the entire will be infeasible at the larger-sized existing coal-fired units and, in such cases, only a portion of the flue gas will be treated by CCS technology. For this reason, CURC recommends that the 65% capture level be measured based on the capture levels achieved by the treated portion of the flue gas, instead of all of the flue gas from the unit. This approach is consistent with how the CCS bonus allowance program is administered under the Kerry-Boxer bill.

VI. The Need for a Comprehensive Carbon Management Program for Coal

The CURC strongly supports the comprehensive nature of the draft legislation proposed by Senator Rockefeller and Senator Voinovich. While we have not commented upon other elements of their proposal we note the importance of their initiative in seeking to address the issues that our membership considers of upmost importance to the successful development and, thereafter, widespread commercial deployment of CCS.

Finally, while we have not commented, in this written statement upon the other titles of the draft legislation proposed by Senator Rockefeller and Senator Voinovich, CURC wishes to state its support for these important titles, as well. There are modifications that we would recommend and we look forward to working with those senators, as well as this and other jurisdictional committees of the Congress to modify this important proposal. We thank you for the opportunity to provide this statement.

Attachment #1

CURC
COAL UTILIZATION RESEARCH COUNCILSM

Air Products and Chemicals
Alliant Energy
Alpha Natural Resources**
Alstom Power, Inc.
American Coal Council
American Coalition for Clean Coal Electricity (ACCCE)
American Electric Power*
Arch Coal, Inc.
The Babcock & Wilcox Company
Battelle
ConocoPhillips
CONSOL Energy, Inc.
Duke Energy Services*
Eastman Gasification Services Company
Edison Electric Institute (EEI)
Electric Power Research Institute (EPRI)
Energy Industries of Ohio
E. On US LLC
Foster Wheeler
FutureGen Industrial Alliance
General Electric Company
The Global CCS Institute
Illinois Department of Commerce & Community Affairs
Jamestown Board of Public Utilities
Kentucky Office of Energy Policy
Lehigh University
National Mining Association (NMA)
National Rural Electric Cooperative Association (NRECA)
New York Power Authority
NRG Energy
Ohio University
Peabody Energy
Praxair, Inc.
Penn State University
Purdue University
Rio Tinto Energy America Services
Salt River Project
Schlumberger Carbon Services
Shell US Gas & Power
Siemens Power Generation
Southern Company
Southern Illinois University
State of Ohio, Air Quality Development Authority
Tenaska, Inc.
Tennessee Valley Authority (TVA)
Tri-State Generation & Transmission Association
United Mine Workers of America
University of Kentucky
University of Texas at Austin
University of Utah
University of Wyoming
West Virginia Coal Association
West Virginia University
Western Research Institute

*** CURC 2010 Co-chairs**
**** CURC 2010 Vice-Chair**

Senator Dorgan CCS Pathways Initiative
Response to Question #1: Funding Levels and Timelines

Question #1: How much funding for clean coal and Carbon Capture and Storage (CCS) is required to ensure that technology is ready for broad deployment and what are the appropriate timelines for such funding?

Introduction

Background

The U.S. has large coal resources that seem likely to be utilized well into the future to provide electricity and other forms of energy supplies in the U.S. To continue providing electricity in a carbon constrained world, coal-fired electricity generation and industrial uses of coal, along with other fossil fuels, must be paired with the successful and widespread adoption of carbon capture and storage (CCS). To achieve this, we must address the technological, legal, and economic hurdles that stand in the way of developing and deploying CCS technology.

CCS technology development and deployment was a vital component of Senate climate change legislation[1] that was debated in the U.S. Senate in 2008 but, during that debate, several competing and differing views on the critical needs for the development of CCS technology emerged. Ultimately, the bill failed to pass, but consideration of another Senate bill is likely for the 111th Congress, and action on climate legislation is already under way in the House. In order to be prepared for this debate, Senator Byron Dorgan (D-ND) in late 2008 requested several groups (see list attached) interested in coal and CCS technology to respond to a set of questions related to CCS technology development and deployment. Called the "CCS Pathways Initiative", this effort is an attempt to bring parties to the table to better define and narrow diverging views over cost, funding needs and deployment barriers of CCS technology. Through the group's collaborative effort, Senator Dorgan's initiative has allowed perspectives to be provided from industry, technology interests, labor, academia, environmental groups, and States, and more clearly defines the scope of the various interests in response to specific questions.

Scope and Organization of Response

Question 1 (Q1) of Senator Dorgan's CCS Pathways Initiative relates to the total cost required to ensure broad CCS deployment and when that cost will be incurred over time. Question 2 (Q2) relates to the financial mechanisms or drivers needed to cover those costs and ensure broad deployment. In effect, Questions 1 and 2, taken together, ask "What will it cost to achieve broad CCS deployment, when will the money be needed, who should pay for it, and how will this be disbursed." To answer this, we deal with the elements of costs and timing (how much and when?) in the response to Question 1. Some of us who have worked on the response to Question 1 deal with the elements of how to pay these costs (by what means and how disbursed?) in our response to Question 2. The two answers must be read together because the development and deployment of CCS and the funding options to achieve it clearly are interdependent.

To develop a response to Q1, the organizations participating in Senator Dorgan's CCS Pathways Initiative gathered the range of cost estimates put forward by participating organizations as well as several well-respected, non-participating organizations. In many cases, these are not estimates

[1] S.A. 4845 to S. 3036 (Boxer), 2nd Manager's Substitute Amendment, the "Climate Security Act of 2008".

of the total cost of CCS, but are estimates or proposals for a federal share of the cost and are noted as such in the table. The group reviewed these numbers, discussed how best to present the results, and agreed to provide the estimated costs for CCS without focusing on the specific policies believed necessary to generate a funding source to cover those costs. Nonetheless we recognize that policy will have an impact on timelines as well as funding levels and mechanisms, and these considerations are captured in the assumptions put forward by some of the participants, discussed below. The result is a three-part response that includes the current summary memo, a spreadsheet that describes a range of the proposed CCS cost-related estimates provided by a set of the organizations participating in the response to Q1, and a memo to further clarify the concepts relating to technology development cycles. Importantly, all three of these documents must be reviewed collectively as one response to Q1; if viewed individually, the information provided could be misinterpreted or taken out of context.

Some of the organizations that participated in preparing this response do not, necessarily, endorse the entire range of, or particular, funding levels and timelines identified by the various groups. It is therefore important to recognize the response to Q1 does not represent a consensus; rather, it is intended to identify a range of options, some of which are preferred by particular participating organizations and others not, but are included to illustrate the views of each of the participants in the group.

Summary of Response to Q1

The response to Q1 is based on the following three points:

1. CCS facilities have higher operating and capital costs and will require some level of incentive to build and run these facilities before they reach a point where they can sustain themselves in the marketplace and be deployed widely. The group response to Q1 presents a range of estimates for the incremental CCS costs that various organizations have set forth as the costs that need to be covered to bring CCS to the point of widespread deployment. The cost estimates suggest that some level of federal financial assistance is needed initially to offset part or all of those costs.

2. While potential regulations or policies regarding CO_2 limits may impact the level or nature of the funding needs for CCS facilities, the policies and their potential impacts on CCS facilities are intentionally not discussed in the response to Q1, but are addressed in response to Question #2.

3. Funding to help support the identified range of CCS costs needs to be structured so as to encourage development of fully integrated projects, as well as some component projects (e.g., capture only for new technology demonstrations or stand-alone anthropogenic storage demonstrations where appropriate). Decoupling CO_2 capture development from CO_2 storage site characterization and development could be pursued in proving out geologic CO_2 storage sites; however, fully integrated projects are essential, complemented by component projects where they make sense.

Concepts Relating to Technology Development Cycles

The "Concepts" memo describes the stages of CCS technology development and deployment, starting with continued research & development (R&D), moving to pioneer plants (demonstrations and first movers), and ending with early adopters before widespread CCS deployment as a competitive climate mitigation technology. The purpose of the "Concepts" memo is to ensure a common understanding of the parameters upon which the funding levels and timelines have been assigned for each of the technology phases.

The CCS development process can be conceptualized through phases characterized by the reduction, or improved confidence, in the level of technical and financial risk of technology implementation. In practice, these phases are likely to overlap rather than occur sequentially. With respect to CO_2 capture, the R&D program will deliver technologies for both new-build and retrofit applications and also support "step-change" breakthroughs in innovation to lower the cost and improve the performance of implementing CCS technologies. There is a general consensus that some number of "pioneer plants" (as defined in the attached "Concepts" memo) will be important to help a greater number of potential investors deem the technology manageable from a technical risk perspective. These pioneer plants may not achieve the level of performance and/or reduced cost that would be expected at a later, more mature technology stage. However, these plants will help to facilitate the transition to the "early adopter" phase. In the early adopter phase, the technical risk of CO_2 capture is deemed more widely manageable, but during the initial years of a CO_2 regulatory program there will still be a need for financial incentives as costs to operate a fully integrated coal-fueled facility with CCS will likely exceed the costs of allowances (or the costs of emitting CO_2). This will lead into a period of capacity addition (widespread deployment), wherein CO_2 capture equipped plants (new or retrofit) are built based on cost, demand, market, and regulatory incentives and conditions. Cost will be reduced and performance improved over time by a learning and experience factor as the technology is replicated, and by more discrete and distinct step-change improvements in the technology brought on by continued R&D, pilot testing and scale-up. A path of cost reduction and performance improvement is also expected for CO_2 storage.

CCS Costs and Timelines Matrix

Attached is a chart that reflects the range of CCS cost estimates and timelines set forth by several of the participating organizations. Because the costs presented by each of the stakeholder groups are tied to different assumptions about what is needed in terms of CCS demonstrations or early deployment projects that will facilitate a move towards deployment, the group agreed to present the range of CCS costs put forward by each of the stakeholder groups instead of attempting to develop a consolidated cost recommendation.

It is important to understand that the costs in the attached chart are not all based on the same assumptions and are noted in the chart (and below) as such. For example, some groups estimated total incremental costs for CCS, including capital recovery and operating and maintenance (O&M) costs for the life of a CCS facility. Others included only incremental capital costs, and some included incremental capital costs and O&M costs for less than the full life of the CCS facility. Finally, some presented only the estimates or proposals for funding from the public sector (i.e., the financial incentive), and excluded the private sector contribution to incremental CCS costs.

While there are differences in the overall costs recommended by the various stakeholders, it is important to note that there is still some consistency on the order of magnitude of the proposed costs and timelines, which should serve as a useful starting point for policymakers to determine the appropriate level of federal support that should be provided, and over what period of time, to successfully deploy CCS.

Below is a summary of the methodology used by each stakeholder in developing their cost estimates of what is needed to successfully deploy CCS.

- **Clean Air Task Force (CATF)/National Commission on Energy Policy (NCEP).** The program cost estimate is expressed in cumulative nominal dollars over the years in which the incentive payments would be made, assuming 10 GW of new IGCC with CCS and 10 GW of retrofitted post combustion capture (PCC) with CCS were deployed, and that projects received incentive payments over the first 10 years of their operating life. The level of incentives is equal to the after-tax payments that each technology's investors would require to be economic relative to competing sources of generation over the life of the investment, taking into account incremental capital, operating, and commodity costs. These costs include fuel and replacement power costs, project financing costs, and carbon allowance costs (beginning at $12/ton and escalating 7% annually). The costs of carbon dioxide transportation and geologic sequestration are not included. Potential revenue received for selling CO_2 for use in enhanced oil recovery (EOR) is not factored into the economics of a project.

- **Coal Utilization Research Council (CURC).**

  1. **CURC-EPRI Roadmap.** The CURC-EPRI roadmap identifies a set of technology steps necessary to achieve a suite of first of a kind demonstrations of coal fueled power generation technologies, including the capture and storage of CO_2, that are needed to initiate early deployment of CCS technology. The roadmap includes both an R&D and demonstration program for gasification systems, advanced combustion systems, advanced turbine concepts, carbon storage, and for existing plants focused on CCS retrofits. Only the Roadmap R&D estimates are included in the attached chart. The CURC-EPRI Roadmap estimates of demonstration plant needs have been folded into the more recent CURC CCS Timeline estimates and are discussed below.

  2. **CURC CCS Timeline/Vision for Coal w/CCS.** The CURC timeline cost estimates reflect the incremental cost (levelized cost of electricity in 2007 dollars) of incremental CCS technology costs compared to a new supercritical pulverized coal unit without CCS. The total incremental CCS costs include capital recovery and O&M costs (i.e. levelized cost of electricity) over 30 years (financing life of a plant), and an estimate of CO_2 transport, injection, measurement, and monitoring cost of $10/metric ton of CO_2. The "federal share" reflects those total incremental costs less an estimated value for allowances and less an estimated value of CO_2 sold for use in EOR. The CURC timeline results in 60 GW of CCS-equipped electricity generating capacity being put in operation by the 2030-2035 time

period and assumes that additional CCS capacity would be added on a routine commercial basis from that time forward.

- Pioneer Plants. Of the total of 15 GW of Pioneer Plants with CCS, the CURC plan anticipates that at least 5 GW will sequester CO_2 into deep geologic formations, and an additional 10 GW of capacity will capture and utilize CO_2 for EOR ("first movers"). For the total 15 GW of capacity, CURC assumed capture rates between 50 – 90%. The CURC CCS cost totals for the 15 GW are distributed over 15 year period.
- Early Adopters. A subsequent 45 GW ("early adopters") would be supported, and for purposes of this analysis, the capture level is assumed to be between 60 – 90%. The CURC CCS cost totals for the 45 GW are distributed over a 20 year period.
- Funding Distribution. It is recognized that this measure of funding distribution is arbitrary because the various incentives, in whatever form, would be available for varying amounts of time.

- **EPRI Prism Analysis.** As part of EPRI's assessment of RD&D funding needs necessary to support the development of a full portfolio of advanced electricity technologies, EPRI estimated additional RD&D funding needs for advanced coal with CCS to range from $700 million - $1.0 billion/year for 25 years (2005 to 2032). The EPRI estimates are over and above the funding provided for CCS in the current DOE programs and does not include incentives or funding needed to encourage deployment. The EPRI estimates were high level, and do not include assumptions with respect to how much of the $1.0 billion should be directed to R&D vs. demonstrations, or how many demonstrations are needed. The annual costs provided by EPRI do not include annual operating costs, or costs to transport and store CO_2.

- **Lignite Energy Council (LEC).**

1. LEC Demonstration Program - $10 billion.

- Retrofits. The LEC program proposed 5 retrofit demonstration projects coupled with storage, for a total of $10 billion. The retrofit projects costs range from $500 million to $1+ billion per project depending on the size of the demonstration, which could be a slipstream (100 MWs or larger) or a total unit conversion (250 MWs or larger). The incremental capital costs for the 5 retrofit projects are estimated to cost $2.5 billion to $5 billion. Pipeline transportation, CO_2 injection and O&M costs are not included.
- New Plant Projects. The LEC proposes 5 greenfield demonstration projects with storage which could operate a variety of technologies like oxy-fuel, supercritical or ultra-supercritical with carbon capture or integrated gasification combined cycle. Incremental capital costs will ultimately be dependent on the size of the plant (250 MWs or larger) and are expected to exceed $1.5 billion per plant, which includes storage costs (will vary with each project depending on the length of the pipeline, size of compressor needed and what type of storage is available - Enhanced Oil Recovery (EOR) or geological formations) and pipeline cost, which are estimated at approximately $1 – $1.5 million per mile and will be dependent on the location of the storage reservoir and relation to the location of the plant. Including storage costs in the demonstration project costs will add approximately

$100 – $500 million per project (reflected in the $1.5 billion per project cost). Therefore, 5 new projects with geologic storage would cost approximately $7.6 billion – $8 billion. O&M costs are not included in this estimate.

2. LEC First Mover Integrated Projects with Storage – $33.6 to 38 billion.

- The LEC proposes 7 integrated CCS projects with storage beyond the demonstration phase. These would be new units with carbon capture (600 MWs or larger). Incremental capital costs, including transport and injection, are estimated to range between $8,000 – 9,000 kW, or approximately $4.8 billion – $5.4 billion per plant. Seven integrated plants would range from $33.6 billion – $38 billion. O&M costs are not included in this estimate.

- **Massachusetts Institute of Technology.** The MIT *Future of Coal* report, published in early 2007, recommends a federally supported coal RD&D program based on enabling large scale coal use in a carbon constrained world. MIT's cost recommendations for an $850 million/year, 10 year RD&D program that also assumes 3 to 5 storage projects injecting 1 MTPY of CO_2 annually and 5 integrated first of a kind CCS demonstration projects. The $850 million/year figure reflects the federal contribution to those programs, and does not include annual operating costs, or costs to transport and store CO_2.

- **Pew Center on Global Climate Change**. The cost estimate provided by the Pew Center is the "high-side" cost estimate from the Pew Center's paper, "A Program to Accelerate the Deployment of CO_2 Capture and Storage". This "high-side" cost estimate calculates the capital costs of CCS based on a 2006 EPRI study of PC and IGCC plant retrofits with CCS using low-rank coal, and represents the Pew Center estimate for a total federal subsidy (funding need) to facilitate CCS deployment. The incremental capital costs estimated by Pew also include a "reimbursement cost" for lost generating capacity due to the CCS energy penalty. The Pew Center's total cost estimate includes the following costs for 30 coal-fueled electric power plants totaling 12 GW in capacity plus 10 non-utility industrial CCS projects:
  - the incremental capital cost of CO_2 capture (61% of the total cost represented in the attached chart);
  - incremental operating costs for the first five years of operation (15% of the total cost represented);
  - the capital and operating costs of CO_2 transport and storage for the first five years of operation (17% of the total cost represented);
  - the cost of 10 industrial CCS projects (3% of the total cost); and
  - the cost of 10 years of program operation and management, including geologic storage assessment, front-end feasibility studies, and in-depth performance assessments of the CCS projects (4% of total reported costs).

- **Natural Resources Defense Council (NRDC) Feed In Subsidy**. NRDC has outlined a performance-based subsidy program to deploy CCS technology to scale using revenue from a greenhouse gas cap and trade program. The proposal formed the basis for the relevant U.S. Climate Action Partnerships (USCAP) recommendations on "Complementary Measures for Coal Technology", as part of a larger set of recommendations to cap and substantially reduce greenhouse gas

emissions through comprehensive federal climate legislation (USCAP Blueprint for Legislative Action of January 2009). Under a CCS fixed feed-in program, an entity would receive a 10 year stream of direct cash payments based on the amount of CO_2 that a facility sequesters on an annual basis. The subsidy would start at $90/ton for the first 3 GW of CCS power plants, assuming an 85-90% capture rate, with scaled back incentives given to lower rates. This dollar per ton payment would gradually decline over time (annual decline of $5/ton) as the technology build-out reaches a target of 55 GW. The $90 per ton figure reflects the costs needed to cover the following:

- Incremental capital and O&M costs (incremental costs are assumed using an IGCC with CCS relative to a PC facility) over 20 years, discounted to 10 years.
- Pipeline transportation costs up to 50 miles.
- CO_2 storage costs at $12/ton of CO_2.
- Assumes an increasing carbon price that contemplates covering the projects' increase in operating and maintenance costs.
- 10 year subsidy costs on a per project basis.
- Reimbursement of construction costs.
- Additional costs for permitting, plant siting, insurance, compliance with environmental and other statutes and regulations.

Deployment of CCS may result in some additional incremental costs that are not included in some cost ranges documented in the response to Q1, but included in others. These costs may also need to be covered at least through the early deployment stages. Specifically, the cost ranges presented by the Lignite Energy Council, EPRI, CURC, CATF/NCEP, and MIT do not include the following:

(1) Property rights acquisition for CO_2 storage sites and/or siting pipelines;
(2) Personnel and staffing needs to permit CO_2 injection sites; and
(3) Financial risk management instruments including, potentially, financial assurance mechanisms, insurance, and other instruments for managing long-term responsibility and post-closure site costs, including measurement, monitoring and verification of the injection site, and/or transfer of long-term stewardship obligations.

The differences in the assumptions outlined above should be helpful in determining whether, for the costs represented in the attached chart, the government share of this funding will either cover the total incremental costs (in the early stages of the program when costs are expected to be much higher) or be some percentage of the total incremental cost. In either case, there was debate within the group on what those funding levels ought to be, because it is difficult to estimate CCS costs and the opportunity cost of emitted CO_2 (e.g., allowance prices) over future decades with a high level of confidence. Our joint message is, however, that with a sufficient level of funding to cover the incremental costs, CCS plants can begin planning, development and construction today, and a significant amount of CCS capacity can be in operation by the 2025-2030 and beyond timeframe.

While most of the participants acknowledge the magnitude of the estimated funding needs presented in the attached chart, there was some debate as to whether or not providing funding alone would, or should, move the technology to a point of commercial deployment. Some

argued that the need for funding cannot be separated from the need for a regulatory policy driver. Discussions on this issue focused on the following points:

- Some expressed the opinion that a greenhouse gas (GHG) regulatory program that caps and places a price on emissions also needs to be implemented as a prerequisite for their support of broad CCS incentives at the scale described in this memo and for the technology to be successfully deployed and pay for its operating costs when incentives expire[2].
- Others put forward the argument that unless or until the funding gap is filled, CCS will not be deployed, particularly if a GHG regulatory program is implemented. The concern is that a regulatory program in advance of technology development would simply force electricity generators to utilize alternative conventional fuel sources such as natural gas.

This group was not specifically asked to determine whether or not a GHG regulatory program is needed in order to create a market for the technology. However, for some participants the issue is inextricably linked.[3] Therefore, the group offers the attached chart which identifies a range of incremental costs that are needed to reach a point of technical maturity under the differing assumptions listed above, but does not provide a consensus recommendation for who should fund those costs. It is assumed that this is a function of the policy regime and that industry and government will partner in sharing those costs. How those costs could be funded and what mechanism could be used for the federal government to provide such funding is identified in the group response to Question #2.

While our response to Q1 is not intended to define the criteria to qualify for funding for particular programs, at least one participant[4] believed that a higher government cost share should be provided for a demonstration program, provided that design standards be used as a guide for qualifying for demonstration funding. Further, it was suggested that funding mechanisms be designed to ensure the development of technologies that work with all ranks of coal.

The timeframes identified in the attached chart reflects the timeframes when part of the funding for CCS costs will be needed in order to be available and committed to projects up front and prior to construction, but are not intended to suggest that all of the funding allocated will result in installed CCS capacity within that exact timeframe. While part of the funding commitment must be made up front in order to finance and initiate projects, the actual project may not begin operation and construction for another 2 to 5 years (after engineering, permitting and planning has taken place).

How to Measure Success?

One way in which to measure success would be to examine whether any federal funding provided to cover the incremental cost estimates identified in the attached chart has resulted in the operation, construction or development of CCS capacity that had been suggested as possible. The range of CCS capacity estimates is not intended to be a precise number, and some deviation

[2] Parties that subscribe to this view include NRDC and EDF.
[3] Those participants include NRDC, EDF and Pew.
[4] Lignite Energy Council.

should be expected. Therefore, it might be prudent to review these estimates every five (5) years to update as necessary. Additionally, while policymakers must have some benchmark upon which to measure success, we must reiterate that funding to cover the estimated incremental CCS costs must be provided and an appropriate regulatory regime governing the permitting of CCS plants and storage facilities must be in place in order for the CCS capacity goals to be achievable.

Organizations that Participated in Response to Question 1

American Coalition for Clean Coal Electricity (ACCCE)
American Public Power Association (APPA)
Clean Air Task Force (CATF)
Coal Utilization Research Council (CURC)
Edison Electric Institute (EEI)
Electric Power Research Institute (EPRI)
Electric Power Supply Association (EPSA)
Environmental Defense Fund (EDF)
Generators for Clean Air
Large Public Power Council (LPPC)
Lignite Energy Council (LEC)
National Commission on Energy Policy (NCEP)
National Mining Association (NMA)
Natural Resources Defense Council (NRDC)
Nicholas Institute for Environmental Policy Solutions, Duke University (Duke)
Pew Center for Global Climate Change (Pew)
Princeton Environmental Institute
United Mine Workers of America (UMWA)
World Resources Institute (WRI)
Wyoming Infrastructure Authority

Attachment #2
Summary of Responses to Question #1: Funding Levels and Timelines
Senator Dorgan CCS Pathways Initiative

CCS Costs and Timelines Matrix

R&D Program	**Organization**	**2005-2009**	**2010**	**2011**	**2012**	**2013**	**2014**	**2015**	**2016**	**2017**	**2018**	**2019**	**2020**	**2021**	**2022**	**2023**	**2024**	**2025**	**2026**	**2027**	**2028**	**2029**	**2030**	**2031**	**2032**	**2033**	**2034**	**2035**	**Total**
10 year program (Federal Costs)	NRDC		$600	$600	$600	$600	$600	$600	$600	$600	$600	$600	$600																$6,600
10 year program			$475	$475	$475	$475	$475	$475	$475	$475	$475	$475																	$4,750
Sequestration Costs (subset of total R&D costs)	MIT		$100	$400	$400	$400	$400	$400	$100	$100	$100	$100																	$2,500
25 year program (2005 to 2030)	EPRI		See costs in demonstration line below																										
18 year program (2008 to 2025)*		$400	$500	$500	$500	$500	$400	$400	$150	$150	$150	$150	$150	$100	$100	$100	$100	$100											$4,850
Sequestration Costs (subset of total R&D costs)	CURC/EPRI		$25	$25	$25	$25	$25	$25	$25	$25	$25	$25	$25																$275

Demonstration Program	**Organization**	**2005-2009**	**2010**	**2011**	**2012**	**2013**	**2014**	**2015**	**2016**	**2017**	**2018**	**2019**	**2020**	**2021**	**2022**	**2023**	**2024**	**2025**	**2026**	**2027**	**2028**	**2029**	**2030**	**2031**	**2032**	**2033**	**2034**	**2035**	**Total**
Minimum of 7 integrated demos; 10 year program	NRDC		$2,100	$2,100	$2,100	$2,100	$2,100	$2,100	$2,100	$2,100	$2,100	$2,100	$2,100																$23,100
5 integrated CCS demos; 10 year program. Costs shown **reflect federal costs for program only.**			$400	$400	$400	$400	$400	$400	$400	$400	$400	$400																	$4,000
Sequestration Demos Costs (subset of total demo costs)	MIT		$100	$100	$100	$100	$100	$100	$100	$100	$100	$100																	$1,000
Includes R&D and demonstration funding (2005 to 2030)	EPRI	$830	$800	$800	$800	$800	$800	$800	$800	$800	$800	$800	$800	$620	$620	$620	$620	$620	$400	$400	$400	$400	$400						$18,050
5 retrofit projects and 5 greenfield demos w/storage (10 total), 10 year program Costs reflect incremental capital costs only.	LEC			$1,000	$1,000	$1,000	$1,000	$1,000	$1,000	$1,000	$1,000	$1,000	$1,000																$10,000
4 GW of demos and 5 storage demos. Costs include CCS captical cost difference plus incremental opearting costs for first 5 years of operation. Costs shown **reflect federal costs for program only.**	PEW		$1,000	$1,000	$1,000	$1,000	$1,000	$1,000	$1,000	$1,000	$1,000	$1,000	$1,000																$11,000
CCS Timeline and Coal w/CCS Program 5 GW of demonstration/pre-commercial CCS capacity - see pioneer plants line below	CURC																												

Pioneer Plants - First Movers	**Organization**	**2005-2009**	**2010**	**2011**	**2012**	**2013**	**2014**	**2015**	**2016**	**2017**	**2018**	**2019**	**2020**	**2021**	**2022**	**2023**	**2024**	**2025**	**2026**	**2027**	**2028**	**2029**	**2030**	**2031**	**2032**	**2033**	**2034**	**2035**	**Total**
20 GW of first mover/early adopter new and retrofit CCS capacity - see early adopter line below.	CATF/NCEP																												
8 GW and 5 storage projects; costs reflect CCS captical cost difference plus incremental operating costs for first 5 years of operation. Costs shown **reflect federal costs for program only.**	PEW		$2,000	$2,000	$2,000	$2,000	$2,000	$2,000	$2,000	$2,000	$2,000	$2,000																	$20,000
7 integrated projects (600 MW or more), 10 year program. Costs reflect incremental capital costs only (no O&M costs included)	LEC			$3,800	$3,800	$3,800	$3,800	$3,800	$3,800	$3,800	$3,800	$3,800	$3,800																$38,000
CCS Timeline and Coal w/CCS Program 5 GW of demonstration/pre-commercial CCS capacity. Costs include incremental levelized CCS capital recovery and O&M costs (ove a 30 year plant life) averaged over 15 year Pioneer Plant program.	CURC																												
- Costs shown reflect **total incremental costs** for 5 GW			$2,500	$2,500	$2,500	$2,500	$2,500	$2,500	$2,500	$2,500	$2,500	$2,500	$2,500	$2,500	$2,500	$2,500	$2,500												$37,500
- Costs shown reflect federal costs for 5 GW.			$1,700	$1,700	$1,700	$1,700	$1,700	$1,700	$1,700	$1,700	$1,700	$1,700	$1,700	$1,700	$1,700	$1,700	$1,700												$25,500
CCS Timeline and Coal w/CCS Program 10 GW of first mover CCS capacity. Costs include incremental levelized CCS capital recovery and O&M costs (over a 30 year plant life) averaged over 15 year first mover program.	CURC																												
- Costs shown reflect **total incremental costs** for 10 GW			$4,500	$4,500	$4,500	$4,500	$4,500	$4,500	$4,500	$4,500	$4,500	$4,500	$4,500	$4,500	$4,500	$4,500	$4,500												$67,500
- Costs shown reflect federal costs for 10 GW.			$1,600	$1,600	$1,600	$1,600	$1,600	$1,600	$1,600	$1,600	$1,600	$1,600	$1,600	$1,600	$1,600	$1,600	$1,600												$24,000

Early Adopter	**Organization**	**2005-2009**	**2010**	**2011**	**2012**	**2013**	**2014**	**2015**	**2016**	**2017**	**2018**	**2019**	**2020**	**2021**	**2022**	**2023**	**2024**	**2025**	**2026**	**2027**	**2028**	**2029**	**2030**	**2031**	**2032**	**2033**	**2034**	**2035**	**Total**
20 GW of CCS capacity. Costs are averaged and annualized over a 10 year period and include incremental capital and O&M costs. Costs shown **reflect federal costs for program only**.	CATF/NCEP						$8,000	$8,000	$8,000	$8,000	$8,000	$8,000	$8,000	$8,000	$8,000	$8,000													$80,000
55 GW of CCS capacity. Costs are averaged and annualized over a 14 year period and include incremental capital and 10 years of O&M costs. Cost shown **reflect federal costs for program only.**	NRDC**				$7,790	$7,790	$7,790	$7,790	$7,790	$7,790	$7,790	$7,790	$7,790	$7,790	$7,790	$7,790	$7,790	$7,790											$109,060
CCS Timeline and Coal w/CCS Program 45 GW of CCS capacity. Costs include incremental levelized CCS capital recovery and O&M costs (over a 30 year life of plant) averaged over 20 year early adopter program.	CURC																												
- Cost shown reflect **total incremental costs** for 45 GW									$17,300	$17,300	$17,300	$17,300	$17,300	$17,300	$17,300	$17,300	$17,300	$17,300	$17,300	$17,300	$17,300	$17,300	$17,300	$17,300	$17,300	$17,300	$17,300	$346,000
- Cost shown reflect federal costs for 45 GW									$6,800	$6,800	$6,800	$6,800	$6,800	$6,800	$6,800	$6,800	$6,800	$6,800	$6,800	$6,800	$6,800	$6,800	$6,800	$6,800	$6,800	$6,800	$6,800	$136,000

* The CURC-EPRI roadmap funding dates back to FY 2008
** NRDC's proposal formed the basis for the relevant USCAP recommendation (see Summary Memo)

NOTES:
1. All $ dollars reflected in U.S. millions and in constant 2007 dollars
2. Unless noted, all costs reflect combined federal/private commitment
3. All costs reflect average annual commitment of costs needed during that timeframe
4. MIT was not a participant in the CCS Pathways Initiative

Organizations:
CATF - Clean Air Task Force
CURC - Coal Utilization Research Council
CURC/EPRI - CURC/EPRI 2006 Clean Coal Technology Roadmap
EPRI - Electric Power Research Institute, 2007 Prism Analysis
LEC - Lignite Energy Council
MIT - Massachussetts Institute of Technology "Future of Coal" Report, 2007
NCEP - National Commission on Energy Policy
NRDC - Natural Resources Defense Council
PEW - Pew Center on Global Climate Change

CURC
COAL UTILIZATION RESEARCH COUNCIL[SM]

Items of major concern in the Rockefeller-Voinovich proposal are highlighted in yellow

Monday, April 19, 2010

Comparison of CURC 5-Point *Coal w/ CCS Program* to Rockefeller-Voinovich 'Carbon Capture and Sequestration Deployment Act of 2010'

Point/Title	CURC 5-Point *Coal w/ CCS Program*	Rockefeller-Voinovich 'Carbon Capture and Sequestration Deployment Act of 2010'	Comparison of Major Changes from CURC 5-Point *Coal w/ CCS Program to* Rockefeller-Voinovich Discussion Draft
			◆
Title II: Pioneer Plant Program	Initiates a near-term (through 2020) 15 GW commercial-scale demonstration and near-term deployment program to install CO_2 capture systems on utility and industrial facilities and to also support the transportation and storage (sequestration) of captured CO_2 into a variety of geologic formations in order to achieve permanent storage or for use in hydrocarbon recovery to be permanently stored into geologic formations after hydrocarbon recovery is concluded. **SEC.201 – GRANT PROGRAM FOR 5 GW OF CAPACITY** Provide up to 50-50 cost-share grants to support up to 5 GW of treated generation capacity (new or retrofit commercial-scale electric generating facilities using coal, petcoke or other fossil fuels would be eligible) that utilizes CCS technology. Such projects will capture ≥ 80% CO_2 of the treated fuel gas or flue gas stream (at least 200 MWs or 20% of the nameplate generating capacity of the unit) and cause such CO_2 to be transported and permanently stored in saline or other deep geologic storage structures (includes EOR and subsequent permanent storage). **SEC. 202 – FUNDING FOR 5 GW OF TREATED GENERATING CAPACITY** $1.0 billion would be made available annually for each of ten years for large-scale demonstrations of the selected CCS projects (funding acquired through a "wires charge" which is an assessment on electric utility rates – this provision is known as the "Boucher wires charge" enacted in House-passed legislation) o Establishes The Carbon Capture and Sequestration Corporation if approved by 2/3rds of qualifying fossil fuel generation utilities and not disapproved by 40% or more state PUCs that regulate electric rates o The Carbon Capture and Sequestration Corporation, (a majority of the Board to be representatives of distribution utilities subject to assessments) is authorized to administer the funding distribution program. Composition of the Corporation includes members from the following – ▪ Investor-owned utilities ▪ Municipal utilities ▪ Rural electric cooperatives ▪ Fossil fuel producers ▪ Independent generator or wholesale power producers ▪ NETL o Assessments per kwh charged to electric utilities =	**SUBTITLE A** **SEC. 201-203 – The Carbon Capture and Sequestration Early and Effective Deployment Funding Act of 2010** o Within 180 days of enactment , Secretary of DOE establishes a "Special Funding Program" for the development and deployment of carbon capture, sequestration, and conversion technologies, on the condition that at least 30 state PUCs submit written approval to DOE; if approved the program can be established within one year of enactment. The special funding program gives the Secretary the authority to collect assessments for 10 yrs after enactment of the program; funding awards made under this assessment must be made within 15 yrs of program's establishment **SEC. 204 – CARBON CAPTURE AND SEQUESTRATION PROGRAM PARTNERSHIP COUNCIL** Directs the Secretary to establish the 'The Carbon Capture and Sequestration Program Partnership Council'. o Council Composition – The Council is composed of no more than 15 voting members, appointed by the Secretary, including at least 1 representative from the following: ◆ Investor-owned utilities ◆ Municipal utilities ◆ Rural electric cooperatives ◆ Fossil fuel producers ◆ Nonprofit organizations ◆ Independent generator or wholesale power producers ◆ Consumer groups ◆ Employee organizations (as defined by ERISA) o The majority of voting members must be fossil-fuel based electric utilities o The Secretary is to appoint electric utility Council members from candidates offered by EEI, APPA and NRECA o Council members must recuse themselves from voting on their own projects o The Council will also consist of the following non-voting members: ◆ The Under Secretary for Science ◆ The Assistant Secretary of Fossil Energy ◆ 2 PUC representatives, recommended by NARUC	◆ The CURC 5 point plan is very similar in content to the program authorized in H.R. 2454, section 114 (the "wires charge") and therefore the comparison is made in this table to the draft legislation and the originally suggested provisions of the CURC 5 point plan. ◆ The Rockefeller -Voinovich bill calls for a 'near-term' program through 2025 v. 2020 in 5-point program. ◆ Affirmative approval by 30 PUCs rather than disapproval by 40% of regulatory authorities is contrary to agreement of state regulators already obtained in H.R. 2454. (MAJOR ISSUE) ◆ The 5-point program authorizes a separate Corporation whereas the Council established in Rockefeller-Voinovich acts through the Department of Energy. ◆ NETL is not a member of the Council/Corporation under the Rockefeller-Voinovich bill (is a member under CURC proposal) ◆ 5-point program raises $1.0 billion available via wires charge; Rockefeller-Voinovich raises $2.0 billion; both over a 10 yr period. The draft legislation must clarify that public utilities, both regulation and non-regulated are eligible for the programs as well as provide financial incentives for public power utilities. ◆ The assessments collected by the Corporation are more than triple the rates proposed in the 5-point bill and not all utility customers (residential customers) are included in the assessment of the fee. (MAJOR ISSUE) ◆ For the "wires charge" program the 5 point plan is limited to 5 GWs and Rockefeller-Voinovich is 10 GWs. Under the 5-point plan a project must be equipped with CCS technology on 200 MWs or 20% of the unit's nameplate capacity in the case of electric generating units or industrial units that emit 500,000 tons/year of CO_2 and capable of capturing 80% of the CO_2 from the flue or fuel gas stream of the treated capacity and use the CO_2 for hydrocarbon recovery or store the captured CO_2 into deep saline or other geologic formations. Under the Rockefeller-Voinovich bill units <100 MWs are not eligible to

Comparison of CURC 5-Point *Coal w/ CCS Program* to Rockefeller-Voinovich 'Carbon Capture and Sequestration Deployment Act of 2010'

	▪ Coal $0.00043 ▪ Natural Gas $0.00022 ▪ Oil $0.00032 ▪ Assessments are deposited in a "CCS Trust Fund" and available only to make grants under the program o Selected demonstration projects would include -- ◆ the use of various ranks of coal or pet coke; ◆ siting of projects to achieve geographic distribution; or ◆ demonstration of a variety of CO_2 capture technologies.	o Staggered terms of office, compensation established o Council Duties – o for the purpose of advising, assisting, consulting with, and making recommendations to the Secretary and the Program Director (see below) on funding program activities, including: ▪ review of applications for grants, contracts, cooperative agreements and other actions required of the Council ▪ vote on whether to favorably recommend the applications; ▪ review and make recommendations on IP policies; ▪ collect information on projects being carried out by other CCS development and deployment programs; ▪ approve an overall plan for the program and projects carried out under the program and submit this plan to Congress, PUCs and Secretary. o The Secretary, in consultation with the Council, is authorized to appoint a Program Director to manage the special funding program o A group of senior program managers and a technical advisory committee are also established, by the Secretary, to assists in advising the council on special funding program activities o Establishes a Technical Advisory Committee to provide independent scientific review of applications and other transactions funded under the program o Composed of 7 members from - ▪ academia ▪ national labs ▪ independent research organizations ▪ NETL ▪ Other qualified institutions o Review and make recommendations to Council on application for funding o May make recommendation on other technical issues related to the program **SEC. 205 – FUCTIONS AND ADMINISTRATION OF THE SPECIAL FUNDING PROGRAM** Directs the special funding program to support – to the maximum extend possible – commercial scale demonstration projects that will	participate and only 20% of collected assessments can be used to support projects of 100 to 300 MWs in size. (MAJOR ISSUE) ◆ For purposes of defining GW equivalency under the 10 GW program, the 5-point plan defines 6 million tpy of captured and sequestered CO_2 emissions from industrial units as equivalent to 1 GW of treated capacity. The Rockefeller-Voinovich bill states an industrial unit with uncontrolled CO_2 emissions is equal to the uncontrolled CO_2 emissions of a 500 MW EGU as equal to the installed capacity of a 500 MW unit.

		accelerate the commercial availability of CCS and conversion technologies with the goal to capture emissions from the generation of at least 10 GW. (b) Project approval process – Program Director shall make awards if award is: ▪ recommended to the Council by the technical advisory committee ▪ approved by the voting members of the Council ▪ must be carried out in the U.S. ▪ prioritized by projects in regions of the country with a high probability of CCS development and deployment potential (c) Specific Purposes-- Program Director to give funding priority to projects that include cost sharing and projects that – ▪ Are capable of advancing the technologies to commercial readiness ▪ Use different coal types ▪ Are geographically diverse ▪ Involve diverse sequestration media ▪ Employ CCS or conversion technologies potentially suitable for new or retrofit applications (d) Eligible entities for funding include: ▪ Electric utilities selling fossil fuel based electricity to electric consumers ▪ Universities ▪ National Laboratories ▪ Federal research agencies ▪ State research agencies ▪ Nonprofit organizations ▪ Consortiums of 2 or more of the entities described above (e) The funds may be used to purchase CO_2 for the purpose of sequestering CO_2 and testing carbon sequestration sites **(f) – ORGANIZATION OF FUNDING INTO TRANCHES** The Program Director, with approval from the Council, can choose to distribute funds in a series of tranches. Funds under this tranche system are distributed as such - ▪ As a payment per ton of CO_2 captured and sequestered or converted; ▪ Based on a sliding scale; more money is provided for higher capture and sequestration or conversion;	This section authorizes a separate mechanism by which funds could be distributed focusing upon the CO2 captured rather than providing the necessary funds to support construction as provided in the alternative funding mechanisms of the draft. (MAJOR ISSUE)

		▪ Taking into account the cost of electricity ▪ Decreases with successive tranches ▪ Taking into account the reasonable incremental capital and operating costs for CCS (g) Funding is subject to Davis-Bacon wage rate assurances (i) Restrictions on funding: ▪ Projects < 100 MW are not eligible ▪ Projects between 100-300 MW may only receive 20% of funds (j) Funds can only be used for CCS projects; up to 5% for administration **SEC. 206 – ASSESSMENTS AND FUNDING** Assessments are charged to electric utilities based on CO_2 emission rate of fossil fuel-based electricity sold to electric consumers with the goal of collecting $2 billion per year for 10 years. (a) Assessments per kwh = ▪ Coal $0.00145 ▪ Natural Gas $0.00074 ▪ Oil $0.00108 o The Secretary may not collect assessments from individual residential consumers. (b) The funds collected may only be used to carry out activities of the special funding program and are to remain available until expended; funds are available only to the extent provided in advance in an appropriation Act. (c) Secretary may vest fee title to property from a project to any entity. (d) Protection is provided, for 5 years after funds are provided, against the dissemination of information on demonstration activities that would be a trade secret or commercial or financial information that is privileged and confidential (e) Fees reimbursed to utilities if after 7 years after creation of the Council at least 75% of funds have not been obligated for CCS projects. **SEC.207 – ERCOT** Provides special provisions for levying charges against ERCOT **SEC.208 – DETERMINATION OF FOSSIL FUEL-BASED ELECTRICITY**	Already noted, the level of assessments, the customer base from which the assessment is levied and the size criteria for eligibility are major issues with the proposed legislation. ♦ The available funds under this program would be subject to annual appropriations which immediately calls into question whether funding will be available from one appropriations cycle to the next. (MAJOR ISSUE)

Comparison of CURC 5-Point *Coal w/ CCS Program* to Rockefeller-Voinovich 'Carbon Capture and Sequestration Deployment Act of 2010'

		DELIVERIES A system is established whereby the DOE will determine how to calculate and apportion fossil fuel-based electricity assessments. Such determination is to be, by regulation after notice and comment, finalized within 180 days from enactment. An electric utility subject to assessments may seek judicial review of determination made about electricity generated by fossil fuel upon which assessment is levied. **SEC.209 – COMPLIANCE WITH ASSESSMENTS** The Secretary may bring an action in US court to compel compliance with assessment payment **SEC. 210 - MIDCOURSE REVIEW** 5 years after establishment of the special funding program, a report is to be submitted to Congress evaluating the activities of the program. **SEC.211 – RECOVERY OF COSTS** Electric utility subject to rate regulation and upon which assessments are levied may not be denied opportunity to recover costs associated with compliance with this program	
	SEC.203 – FEDERAL FINANCIAL INCENTIVE FOR ADDITIONAL 10 GW OF CAPACITY Provide federal financial incentives to support up to 10 GWs (or equivalent energy) of commercial-scale coal or pet coke (or a combination of both) projects equipped with CCS technology on 200 MWs or 20% of the unit's nameplate capacity in the case of electric generating units or industrial units that emit 500,000 tons/year of CO_2 and capable of capturing 80% of the CO_2 from the flue or fuel gas stream of the treated capacity and use or store the CO_2 for hydrocarbon recovery or to store the captured CO_2 into deep saline or other geologic formations. Industrial units are not eligible for more than 5 GWs of support. o Federal incentives would be in the form of: ♦ An additional authorization of up to **$40 billion** in authority would be made available through the DOE loan guarantee program (Title XVII of EPAct 2005) to support qualifying projects as well as associated CO_2 transmission pipelines needed to carry CO_2 to storage or hydrocarbon recovery sites. ♦ A combination of a 30% investment tax credit (authorizes a new s **subsection 48D** for costs of the energy production facility that are above costs associated with a comparable supercritical PC unit, or	**SUBTITLE B – FEDERAL FINANCIAL INCENTIVES FOR ADDITIONAL 10 GW OF CAPACITY** Provides federal financial incentives to support up to 10 GWs (or equivalent energy) of commercial-scale coal or pet coke (or a combination of both) projects equipped with CCS technology. No more than 5 GWs may be industrial entities. For purposes of determining equivalency, an industrial unit with uncontrolled CO_2 emissions equal to the uncontrolled CO_2 emissions of a 500 MW EGU shall be treated as having installed capacity equivalent to such 500 MW unit Federal incentives would be in the form of: **SEC. 251 -** Amends IRS §45Q, the carbon sequestration tax credit. A 10 yr tax credit is available to the person who uses CO_2 in EOR or disposes of CO_2 and places carbon capture equipment into service by January 1, 2017. o Recipients of §48A and §48B investment tax credits are not excluded from receiving §45Q sequestration credit **SEC. 252 -** An additional authorization of **$20 billion** in authority would be made available through the DOE loan guarantee program (Title XVII of EPAct 2005) to support new or retrofit projects equipped with CCS as well as associated CO_2 transmission pipelines needed to carry CO_2	♦ As previously explained, the size criteria for the enumerated financial incentives is a major issue. ♦ The 5-point plan seeks $40 billion in additional loan guarantee authority. Rockefeller-Voinovich authorizes $20 billion in additional authority through the DOE loan guarantee program. ♦ No changes to 30% ITC

Comparison of CURC 5-Point *Coal w/ CCS Program* to Rockefeller-Voinovich 'Carbon Capture and Sequestration Deployment Act of 2010'

	cost of CO_2 capture equipment on an existing facility (electricity or industrial) as well as ten years of CO_2 sequestration tax credits to help defray the incremental costs of CCS. (Note: CURC has also proposed that a comparable program of incentives would be authorized for electric generating utilities owned by non-taxable public utility entities). Credits under this section available from 1/1/2010 to 1/1/2025. **SEC. 204 -** Amends IRS §45Q, the carbon sequestration tax credit. A tax credit for every metric ton of CO_2 captured and either used in EOR or sequestered in secure geologic storage or converted to a stable form. The credit is available to the owner of the facility that captures CO_2 and such taxpayer may transfer the credit to another taxpayer who sequesters or uses the CO_2. o Recipients of §48A and §48B investment tax credits can receive §45Q sequestration credit o The current 75 million ton cap is lifted o Credit available for a 10 year period for property placed in service by December 31, 2018.	to storage or hydrocarbon recovery sites Eligible units: o Capture 25% of the emission from the unit and capture at least 50% of those emissions o Coal or petcoke used for at least 75% of the fuel used by the unit o Provides for permanent storage directly or after use for hydrocarbon recovery **SEC. 48D -** A combination of a 30% investment tax credit for costs of the energy production facility that are above costs associated with a comparable supercritical PC unit, or cost of CO_2 capture equipment on an existing facility (electricity or industrial) as well as 10 yrs of CO_2 sequestration tax credits to help defray the incremental costs of CCS. o Projects that have received a 48A or 48B tax credit, or funds from the special funding program, are not eligible to receive the 30% ITC o Applies to new facilities placed in service after December 31, 2010 and before January 1, 2025 and retrofits that commence operation after December 31, 2010 and before January 1, 2025.	◆ In the 5-point plan, the owner of the facility that captures CO_2 and physically or contractually ensures the use of CO_2 in EOR or disposes of CO_2 may claim the section 45Q carbon sequestration tax credit. Under Rockefeller-Voinovich, the taxpayer who uses the CO_2 in EOR or disposes of CO_2 is eligible to claim the tax credit. Additionally, the placed in service date for the 5-point plan is December 31, 2018 but January 1, 2017 for Rockefeller-Voinovich. The entity that captures or causes the capture of the CO2 should be the only party eligible for the tax credit and that party should be authorized to transfer the credit to other entities that would then enable financing of the project.