Coal Initiative Reports

White Paper Series

A Trust Fund Approach to Accelerating Deployment of CCS: Options and Considerations

Naomi Peña, *Pew Center on Global Climate Change*
Edward S. Rubin, *Carnegie Mellon University*

January 2008

PEW CENTER ON Global CLIMATE CHANGE

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Abstract

This paper discusses one possible avenue to accelerate deployment of carbon dioxide capture and sequestration (CCS) technologies: use of a special-purpose CCS Trust Fund. Trust funds can be an attractive policy option because, if properly designed, they can raise significant amounts of funds from non-governmental sources and can ensure that those paying into the fund benefit from the program. A CCS Trust Fund financed, for example, through fees on coal-based or fossil fuel-based electricity generation may have a role in reducing CO_2 emissions from power plants because it could:

- Raise funds at the scale needed to support a significant number—e.g., 10 to 30—of commercial-scale CCS projects
- Ensure that the funds raised would be used to demonstrate CCS at commercial scale for a full range of systems applicable to U.S. power plants
- Establish the true costs, reliability, and operability of power plants with CCS
- Utilize private-sector business standards for project selection and management to ensure program cost-effectiveness
- Significantly reduce CCS costs within 10 to 15 years by supporting approximately 30 demonstrations, yielding substantial national economic benefits as CCS becomes widely deployed.

The United States has considerable experience with trust funds. While no single existing fund illustrates all the features that might be desirable for a CCS Trust Fund, lessons from prior U.S. experience can be used to design an effective, efficient mechanism for advancing commercial-scale deployment of CCS. In particular, experience has indicated the importance of financial self-sufficiency, private-sector management standards, insulation from the annual Congressional appropriations process, and termination upon completion of objectives. Carefully crafted enabling legislation and, most likely, use of a quasi-public or private entity to manage a CCS Trust Fund will be needed to incorporate these and other desirable features.

Background

The use of coal to generate electricity in the United States currently results in some 1.9 billion tons of carbon dioxide (CO_2) emissions per year, about a third of total U.S. CO_2 emissions (USEPA 2006). To consider and evaluate policies that could be used to address emissions from coal use in the United States, China and India, the Pew Center on Global Climate Change has undertaken a Coal Initiative. A Consultative Group* composed of stakeholders and experts was formed to assist in this process. For the United States, the focus of the Coal Initiative is on policies to accelerate and support the widespread deployment of CO_2 capture and sequestration (CCS). This is because CCS is the only suite of technologies at, or near, commercial stage that holds promise for reducing CO_2 emissions from large point sources at the scale needed to address climate change (IPCC, 2005). Given this reality and the high costs of CCS systems, the Consultative Group requested the Pew Center to investigate a trust fund approach as one possible mechanism for accelerating CCS deployment at coal-fueled power plants. This paper is the result of that investigation.

The premise of the Coal Initiative, and of this and other papers written under its auspices, is that coal will continue to be a major energy source used to meet electricity demand in the United States, China and India for decades to come. This continued reliance on coal in the United States results from its abundance and relatively low, stable price compared to natural gas; from the hurdles facing a major scale-up in the use of alternatives such as renewable energy for baseload electric power; and from national security concerns favoring use of domestic energy resources. The increasingly urgent need to address climate change and reduce greenhouse gas (GHG) emissions suggests that application of CCS on a wide scale is needed at the earliest possible date. However, there are significant barriers to immediate and widespread deployment including: projected high costs and energy losses; lack of a policy driver or other incentives; lack of experience and proven reliability of CCS technologies in the electric utility industry; lack of a regulatory framework for permitting utility-scale sequestration projects; legal uncertainties related to liability and property rights; the need for agreements and coordination among different companies that may handle different facets of the operation (e.g., utility companies, pipeline operators, and storage site operators); and the need to build public understanding and acceptance of CCS as an option for mitigating climate change.

*Background on the Pew Center Coal Initiative and a list of Consultative Group members can be accessed through this link.

Objectives of a CCS Trust Fund

To address the barriers mentioned above, and thereby support widespread deployment of CCS, a significant number of commercial-scale demonstrations of CCS are needed. Such demonstrations will be sufficiently costly that new sources of funds will be needed. A companion paper (Kuuskraa, 2007) estimates total costs of approximately $10 billion to $30 billion over a 10 -15 year period for programs at scales of ten projects and thirty projects, respectively. The requisite sums potentially could be raised in a number of ways: for example, by direct government funding of a large RD&D program; by allowances auctioned under a cap-and-trade program; by a fee on electricity generated, or on coal purchased by utilities; or by sufficiently large tax credits. Except for tax credits, money raised by any of these means could be administered through a trust fund dedicated to early commercial-scale demonstrations of CCS at power plants.

This paper discusses desirable features of a dedicated CCS Trust Fund. A well-designed fund could serve to rapidly, efficiently, and cost-effectively meet two key objectives:

- Demonstrate the viability of key CCS options in commercial utility and industrial applications in the United States, and

- Begin to significantly reduce CCS costs and energy penalties.

If inaugurated in the immediate future, a dedicated CCS Trust Fund that succeeds in demonstrating the viability of CCS technology in utility applications, and in reducing its costs and energy penalties, could be an important adjunct or precursor to other policies needed to address global climate change. For example, although it is widely recognized that deep reductions in CO_2 emissions are required to stabilize atmospheric concentrations of greenhouse gases, it may be problematic to impose stringent CO_2 control requirements (e.g., generator performance standards, retailer mandates, or requirements to sequester CO_2) until the viability of CCS has been proven. Proving CCS requires gaining confidence in the use of CO_2 capture technology in full-scale utility applications; overcoming technological integration challenges; resolving issues related to property rights and long-term liabilities; and development of a U.S. regulatory framework and public acceptance for the safe and effective long-term geological storage of CO_2. Multiple large-scale demonstrations of deep geologic sequestration, including in saline formations, in conjunction with demonstrations of CCS at electric power plants are also needed to resolve these issues. The overriding objective of a CCS Trust Fund is to achieve these outcomes as quickly and economically as possible.

SCOPE AND OBJECTIVES OF THIS PAPER

The following sections of this paper first describe the basic elements of a CCS Trust Fund, then review prior U.S. experience with trust funds. Following this, the trust fund approach is evaluated against a set of criteria that can be used to assess alternative policy approaches to addressing emissions from power plants.

A companion paper (Kuuskraa, 2007) lays out key characteristics and costs of a proposed CCS deployment program that a CCS Trust Fund would support. That program would cover the incremental costs of deploying CCS at a limited number of commercial-scale coal-fueled power plants. Key program characteristics are technological neutrality (i.e., supporting demonstrations of all key technology-coal-location combinations); careful timing of demonstrations; and supplementing power plant CCS projects with a number of large-scale geological sequestration demonstrations using CO_2 from existing non-utility industrial sources. Other papers in the Pew Center's Coal Initiative examine other U.S federal policy options; options available to states; and appropriate actions in India and China. Other Pew Center initiatives focus on options for reducing GHG emissions in other sectors.

Basics of a CCS Trust Fund

The essence of a trust fund is to ensure that money is dispersed only for the purposes, and under the conditions, established for the fund. By providing guarantees on how funds will be used, a trust fund increases the chances of attaining specified goals and garnering needed support.

There are several critical differences between private and public-sector trust funds, including who owns the assets and how income and outlays can be modified. If fees are imposed by federal legislation, the revenue becomes government money, which has important implications for trust fund design. In the case of most federally-controlled trusts, the government owns the trust's income and assets and can unilaterally alter fund purposes and amounts entering or leaving the fund (White House, 2008). An alternative is for the federal legislation to establish rules under which fees can be imposed by the private sector. In this case since the revenues would not be government money, they could be handled by a non-governmental entity with federal oversight. In order for a CCS Trust Fund to operate effectively and efficiently, it would be important to avoid altering its purposes or curtailing any planned expenditures. Four key issues that determine whether a federally-established fund will operate in this way are discussed below. Other aspects of effective, efficient trust fund operation are discussed in subsequent sections.

TYPES OF FEDERALLY-ESTABLISHED FUNDS

Government funds in which money is earmarked for a specific purpose or to finance a specific program include special funds, trust funds, revolving funds, and deposit funds. Only in the case of deposit funds does the government act as a private fund trustee, making no decisions about the amount entering the fund or expenditures. In the case of special funds and most trust funds, money must be appropriated by Congress before it can be spent, thus exposing expenditures to the annual appropriations process. This is problematic because this process can restrict expenditures or divert money to purposes other than those originally intended. Revolving funds are used to conduct "continuing cycles of business-like activity" (White House, 2008). The advantage of revolving funds is that money received is automatically available for expenditure. A few special-purpose trust funds have been set up as revolving funds. With appropriate enabling legislation it might be possible to set up a CCS Trust Fund as a revolving fund.

EXPENDITURE CLASSIFICATIONS

Some expenditures of federal money are discretionary while others are mandatory. Mandatory spending programs include Medicare and veterans' pension payments. Expenditures are treated as mandatory when authorizing language entitles a specified class of beneficiaries to receive payment or otherwise obligates the federal government to make payments (GAO, 2005). The details of enabling legislative language would determine whether spending from a CCS Trust Fund (unless it qualified as a revolving fund) was discretionary or mandatory.

TYPES OF REVENUES

Revenues for a fund are classified as voluntary contributions, taxes, or fees. If money for a CCS Trust Fund were raised through voluntary contributions or self-imposed mandatory contributions resulting from an industry-wide referendum (as in being done by the coal industry in Australia and by the propane industry in the United States), the fund could operate independently of the federal budget processes. On the other hand, if revenues are generated by taxes, the proceeds would be deposited in the U.S. Treasury, expenditures from which are generally subject to the Congressional appropriations process. However, if a fee (rather than a tax) is imposed through federal legislation, the resulting proceeds may not have to be deposited in the U.S. Treasury. If proceeds are received and disbursed by a non-federal entity, they need not be subject to the annual Congressional appropriations process.

AFFILIATION OF THE OPERATING ENTITY

The entity designated to receive and disperse revenues could be (or be part of) a federal agency, a quasi-public organization, or a private entity. Quasi-public and private entities may offer important advantages, such as:

- Direct control by, and transparency to, stakeholders and independent experts
- Freedom to hire and retain the most qualified people
- Insulation from Congressional pressures
- Certainty in dispersing funds on a timely basis
- Ability to use private-sector best practices in decision-making.

To the extent that operating a fund through a federal agency impedes realizing these advantages, semi-independence would be an important factor for achieving cost-effectiveness and success of a CCS Trust Fund.

Existing Trust Funds: Examples and Lessons Learned

A number of federal trust funds were reviewed (see Appendix) to derive lessons useful for the design of a dedicated fund for CCS projects at U.S. power plants. Some of these federal trust funds have operated at the relevant scales and have served similar purposes. They have been successful in raising money to implement large-scale infrastructure upgrade programs, including infrastructure to address environmental problems.

Two trust funds that illustrate alternative funding and operational entity approaches which are particularly relevant to the design of a CCS Trust Fund are the Highway Trust Fund and the Propane Education & Research Council Fund. The 1956 Highway Revenue Act authorized a 13-year program to build the U.S. interstate highway system. The Act increased existing gasoline taxes and imposed new ones, while simultaneously creating the Highway Trust Fund to receive and disperse the monies collected. This approach succeeded in building a national highway system where previous approaches had achieved only very limited success (Jackson, 2006). Expenditures from the Highway Trust Fund were subject to annual appropriations acts and over time revenues were directed to a variety of other purposes. In addition, Congressional expenditure limits, imposed at times to address federal budget deficits, resulted in higher overall costs for funded highway projects and eroded overall program cost-effectiveness (Jackson, 2006; Hezir, 2007).

The more recent Propane Education and Research Act of 1996 represented a very different approach: it enabled a fund that operates outside of the federal budget process while subject to federal oversight. The act authorized the propane industry to conduct a referendum on whether to impose fees on propane producers and marketers in order to establish and operate a program with specified objectives. The objectives in this case were to improve safety, fund research, develop more efficient equipment, and expand public awareness of propane's uses and environmental advantages. The enabling legislation specified that the fee would become obligatory for all member companies if the referendum passed. It also set the maximum fee that could be charged. The funds raised go directly to, and are dispersed by, the non-governmental organization established under the Act, with funds remaining completely outside the annual Congressional appropriations process.

In addition to the two examples above, the U.S. Municipal Wastewater Treatment Program established under the Federal Water Pollution Act (Clean Water Act) also provides important lessons. Like the Highway Trust Fund, this program has been successful in upgrading a significant part of the national infrastructure, in this case installing and upgrading wastewater treatment facilities. The Clean Water Act offered federal grants to municipalities to assist them in meeting discharge regulations. However, the program's cost-effectiveness was seriously compromised due to the tendency of potential grant recipients to propose plants larger than needed and with more features than necessary. In order to reduce federal government financial exposure, the grant approach was later supplanted by a revolving loan program. However, a similar loan approach would not be an option for CCS until future conditions (such as a price on carbon) enabled some or all of the costs of CCS to

be recovered. Nonetheless, the "take home" messages from this program are both simple and critical:

- Federal grant program grants encourage project proposals that often are not cost-effective, and
- Expensive programs must be self-supporting

In general, the review of prior U.S. trust funds yielded the following lessons applicable to the design of a CCS Trust Fund:

Things to Avoid:

- Subjecting fund outlays to the annual federal appropriations process
- Not specifying a termination date, goal, or condition for ending the program (e.g., total amount of funds to be collected or number of projects to be funded)

Things to Promote:

- Flexibility to engage the most qualified management personnel
- A broad spectrum of stakeholders and technical and scientific experts to oversee, manage, and operate the fund
- Secure funding and financial discipline

Further information on these and other trust funds is provided in the Appendix. The review of these funds underlies the rationale and desirable characteristics recommended for a CCS Trust Fund to implement the large-scale demonstration programs discussed earlier.

Rationale for a Quasi-Independent, Fee-Based CCS Trust Fund

Here we outline the rationale for a quasi-independent trust fund supported by a fee on coal-fueled power plants[1] to provide monies that would be dedicated to commercial-scale CCS demonstrations. This approach has the potential to:

- Raise the funds required to pay the cost of a sufficient number of CCS demonstrations to overcome, as quickly as possible, the technical and other barriers to widespread deployment noted earlier
- Cost-effectively disperse funds solely for this purpose
- Establish, and then begin to substantially reduce, the costs and energy penalties for key CCS technologies across the United States in an efficient manner.

Cost-effective dispersal of funds is most likely to be achieved if the fund is managed following a private sector business model; however, this may be difficult to achieve if the fund is managed by a federal agency. That conclusion also was reached in a recent MIT study, which recommended a quasi-governmental corporation to manage a CCS demonstration program, stating that it was critical to maintain "…sufficient fidelity to commercial practice, so that both the government and the private sector can gain credible information on which to base future public and private investment decisions" (MIT, 2007). That report goes on to note that the federal government's "deep pockets" and often limited experience with commercial practice can make it difficult to protect against poor project designs proposed by private companies seeking government funding.

A significant advantage of a well-managed quasi-independent trust fund is that it could select and implement the types of demonstrations and the timing of projects that would most efficiently establish the viability of CCS options and begin to lower costs across all needed options.

CONSIDERATIONS IN PROGRAM DESIGN

To achieve emission reductions at the scale needed while retaining coal as a central energy source for electricity, CCS will be needed at coal-fueled power plants throughout the United States. This will require demonstrations of a variety of CCS technologies (e.g., at both combustion-based and gasification-based power plants), in both new-build and retrofit situations; across a variety of U.S. coal types used in different regions of the country (including differing elevations), and with CO_2 sequestered in different types of

1 Alternatively such a fee potentially could be imposed on all fossil-fuel based electric generation units, or on generating units of all types. It could also be extended to other large industrial emitters of CO_2. However, coal-based units are likely to need CCS to meet requirements under climate change legislation before other types of plants, and are the most likely to benefit from early availability of CCS technologies.

geological formations. A companion paper (Kuuskraa, 2007), for example, suggests that a minimum of ten demonstrations, with one to three projects in each of six categories, is needed to test a full range of combinations. That paper also points out that in order to reduce energy reduce costs and energy penalties in the most cost-effect manner, careful staging of projects is needed to enable lessons learned from one set of projects to be incorporated into the design of subsequent demonstrations. If carefully staged, a recent study estimated that approximately 30 CCS projects could bring costs down by up to 40 percent within 10 to 15 years (Kuuskraa, 2007).

Whether funded through fees or other mechanisms, a well-managed CCS Trust Fund would best be able to rapidly, efficiently, and cost-effectively achieve the key objectives of establishing the viability and bringing down the costs of key CCS technologies. Fees offer the advantage of providing a regular and predictable income stream to support CCS projects. A carefully structured loan program also might be able to achieve these objectives. Tax credit approaches lack the programmatic oversight needed to select and stage projects to achieve cost and energy penalty reductions along the most rapid and cost-efficient path. Similarly, direct allocation of allowances to individual companies under a cap-and-trade program may not result in optimal project staging. This is a critical issue because early, rapid cost and energy penalty reductions can bring both economic and environmental benefits.

A dedicated CCS Trust Fund also could start operating in the immediate future as soon as known sums are at its disposal. A fee on electricity generation or coal purchases would accomplish this objective. However, a funding stream linked to a climate change policy is likely to be much less predictable. The high current cost of CCS means that a modest GHG cap alone is unlikely to result in adoption of CCS by coal-fired plants. Modeling studies indicate that an effective carbon price of at least \$30/ton CO_2 is needed before CCS becomes a viable option for GHG reductions, with some studies suggesting much higher prices would be necessary. Policies that impose lower effective carbon prices are thus unlikely to result in any significant deployment of CCS (Wise, et al., 2006). The Bingaman-Specter cap-and-trade bill, for example, imposes a price cap starting at \$12 per ton CO_2, rising at a rate of 5 percent per year. Under such a scenario, without additional incentives, it would be unlikely that CCS would be adopted at either new or existing power plants anytime soon.

ALTERNATIVE FUNDING MECHANISMS

Both the Bingaman-Specter and Lieberman-Warner cap-and-trade bills offered in 2007 address the problem of low initial carbon prices by providing bonus allowances for sequestered carbon dioxide and an advanced coal and sequestration technologies program funded by the sale of allowances. Assuming the price of allowances is at least \$10 per ton, bill provisions allowing four or more bonus allowances per ton of CO_2 sequestered should enable CCS projects to move forward. Moreover, at this price the advanced coal technology programs would also receive sufficient funds through the bills' auction provisions to support a number of CCS deployment projects. In the case of the Lieberman-Warner bill, the advanced coal technology program funds would be dispersed by a non-profit, non-federal government corporation, with the corporation using the funds to support selected projects. This bill thus provides a management structure of the type proposed for the CCS Trust Fund described in this paper. The key question regarding the approach taken in these bills is how soon the programs would materialize and be adequately funded.

Tax credits are another alternative to a CCS Trust Fund approach. In general, tax credits do not provide the ability to selectively choose and stage projects, and also suffer from an inability to provide consistent funding over time frames of importance to investors and project sponsors. Tax credits are typically authorized for short periods of time, such as three years (Hezir, 2007). For example, the Renewable Energy Tax Credit, which provided support for wind, solar, and biomass energy projects, expired three times between 1999 and 2004. Considerable effort was required to prevent its expiration on two other occasions (Union of Concerned Scientists, 2007). This stop-and-go availability of funding has posed serious problems for development of wind-generation facilities. A trust fund with a secure source of revenue over a longer time frame is a more promising solution to the need for on-time, reliable financing of the full range of commercial CCS demonstrations that are needed. Finally, under current federal budget constraints, tax credits are likely to require an offsetting source of revenue to render them revenue-neutral. Similarly, loan guarantees are unlikely to be a useful approach for financing deployment of CCS unless conditions enabled utilities to recover their higher production costs through higher tariffs for electricity or by some other means.

Evaluating the CCS Trust Fund Approach

Every approach to achieving widespread deployment of CCS has pros and cons. Since one objective of the Pew Center Initiative is to help determine which policy approaches are likely to be most successful and viable, advice was sought from the Coal Initiative's Consultative Group at its September 26, 2006 meeting. The Consultative Group suggested the following criteria be used to evaluate proposed approaches: [2]

- Familiarity
- Effectiveness in reducing emissions
- Cost-effectiveness
- Equity (fairness) in regard to: regional impacts, company size, regulated versus non-regulated utilities, technology options
- Ease of implementation: ease of monitoring and enforcement, and avoidance of complexity
- Linkage: to other policies in utility sector, and to policies outside of utility sector
- Timing: achieving action in the near term, operating across administrations, clarity of time for adoption, not rewarding pre-program construction of coal plants without CCS
- Allowing coal to continue to play a significant role in electricity generation
- Use of trading and market mechanisms

Potentially, a trust fund dedicated to CCS demonstrations could have any number of objectives. The selected objectives would impact many aspects of the fund's design, as well as how the fund would rate against the criteria listed above. For example, a dedicated CCS Trust Fund might be designed to support the cost of 10 to 30 CCS demonstrations across a variety of power generation capture and storage options; to use a variety of coals in different regional settings; and to terminate upon completion of the pre-determined set of projects. Alternatively, a fund might operate until a desired fraction of CO_2 emissions from coal-fired (or all fossil-fuel

2 These criteria were considered desirable by most of the stakeholders in the Consultative Group. However, stakeholders were more likely to vary in preferences for the following additional criteria:

- Reliance on incentives versus regulations
- Whether cost burden falls on the consumer or utilities, and if on utilities whether it falls equally on all generating units or primarily on new, existing, or fully amortized plants
- Whether the program covers all fossil-fuel plants or only coal-fired units
- Whether the program supports other clean air objectives or addresses only GHG emissions.

based) electric generation is captured and sequestered or (as would occur under the Lieberman-Warner bill) until funds are exhausted. Yet another fund option might be to repower and equip with CCS only fully amortized plants of a specified age or efficiency. Such decisions on scope will impact the time over which the program would operate; how much money would be needed; the effectiveness in reducing emissions; which entities would be assessed fees; and overall cost-benefit ratios. Consequently, the choice of program objectives would affect the evaluation of a CCS Trust Fund on almost all of the listed criteria listed above.

A "STRAW-MAN" TRUST FUND PROGRAM

The Pew Center Coal Initiative white paper, A Program to Accelerate Deployment of CO_2 Capture and Storage (Kuuskraa, 2007), describes a program designed to achieve deployment of CCS at the earliest possible date (over the next 10 to 15 years) by covering the incremental costs of CCS at 10 to 30 commercial-scale (400 MW net with CCS) coal-fueled electric generation units plus five to ten large non-utility industrial emitters. In the following discussion, a CCS Trust Fund dedicated to carrying out this program is evaluated against the suggested criteria listed above.

While trust funds have been used previously to build infrastructure (for example, the interstate highway system as noted earlier), use of a semi-independent or private entity to operate a trust fund is less familiar. However, this option is becoming more familiar through recent programs such as the Research Partnership to Secure Energy for America (RPSEA) and the Propane Education and Research Council (PERC) (see Appendix).

In terms of effectiveness, the larger program scale (30 plants) would be effective in reducing emissions, due both to the CO_2 captured at the supported plants, as well as to the more rapid deployment of CCS that could result from significant decreases in cost and energy penalties.

As suggested earlier, the cost-effectiveness of a trust fund could be affected by the type of fund and the management entity. A privately-managed fund, a federally-established revolving fund, or a fund subject to mandatory rather than discretionary spending and managed by a semi-independent or private entity could all be very cost-effective. Under either private or semi-independent management, the federal government would provide oversight and approval of the strategic and operating plans. It would be more difficult to operate a fund cost-effectively if expenditures were subject to the annual authorization process or managed directly by a federal agency. Program size is also a factor in cost-effectiveness, particularly in the case of a federally-established fund. The upfront costs would be relatively high if only ten demonstrations were to be supported, making the 30-project program more cost-effective than the smaller-scale program.

In terms of equity, the program described in Kuuskraa (2007) provides for a broad range of demonstrations across geographic regions, generation technologies, and coal types. At the 30-project scale, the program is also designed to reduce costs and energy penalties as quickly as feasible. At either scale, a fund dedicated to carrying out this program would ensure technological and regional equity.

The primary implementation hurdle for this approach is garnering political support to impose the necessary fees. Once established, a trust fund dedicated to supporting demonstrations is unlikely to encounter

monitoring or enforcement difficulties. Although reaching agreement on certain issues such as fees, criteria for project selection, and a fund dispersal mechanism will involve many considerations and some negotiation, clear outcomes are available in each case.

In terms of timing and linkages, a fund dedicated to the program described above would result in the first set of CCS demonstrations at coal-fueled plants within five years, and several subsequent sets within 10 to 15 years (depending on program scope). Thus, it would achieve results quickly on a clear schedule and could serve as a precursor to or catalyst for any national policy that might require or incentivize deployment of CCS at power plants. As explained earlier, it could also operate in conjunction with national carbon constraint policies, such as the Lieberman-Warner bill, although compatibility with such policies will depend on program and policy details. If future legislation resulted in a market value for sequestered CO_2, entities that received assistance from a CCS Trust Fund could be required to reimburse the fund for the revenues received, or could be denied credits for sequestered carbon while receiving assistance from the fund.

Table 1 summarizes how a trust fund designed to carry out the program in Kuuskraa (2007) rates against the criteria listed earlier. Trust funds with other objectives might rate differently, particularly on effectiveness and equity. For example, a trust fund focused on repowering with more efficient boilers the least efficient, fully amortized coal plants in the current U.S. fleet might or might not be technologically equitable, depending on the repowering choices made and which plants were subject to charges. However, such a program might have cost and environmental advantages.

Table 1: Evaluation of a CCS Trust Fund for the Program in Kuuskraa (2007)

Criterion	Conditions resulting in a high rating	Conditions resulting in a low rating
Familiarity	Trusts used in coal mining & other sectors of the economy	Trusts not previously used in the electric power sector
Effectiveness in addressing emissions	Larger scale	Smaller scale
Economic effectiveness	Larger scale, private-sector type management, funds not subject to annual appropriations	Smaller scale and management subject to normal federal restrictions and budget process
Equity	Either scale	Poor project selection
Ease of Implementation	Coal industry favors approach	Coal industry does not deem necessary
Linkage	Precursor to mandatory carbon limits	Concurrent linkage depends on program details
Timing: near-term action	Either scale	None
Coal remains significant in mix	Support for 30 or more plants may be needed	10 or fewer plants may not achieve this objective

DRAWBACKS AND LIMITATIONS OF A TRUST FUND APPROACH

Although a dedicated CCS Trust Fund shows promise for accelerating deployment of CCS, the approach also has important limitations and would have to overcome significant hurdles. Perhaps the biggest hurdle is the need to raise relatively large sums of money, which is likely to meet resistance from affected companies, whether done through federal action or voluntary contributions. In addition, Congress would likely be reluctant to impose fees solely to support CCS. Instead, it could be argued that any fees imposed should support a wider range of greenhouse gas emissions reduction options. This more comprehensive approach to addressing emissions is envisioned, for example, in the mission of ARPA-E (Energy Research Act, 2007). Thus if fees were imposed to support CCS, the program would quite possibly be part of a more comprehensive package, or accompanied by legislation, that also supported other greenhouse gas reduction technologies, both in the electricity and other sectors.

A second drawback of trust funds is that they are less familiar, particularly in the electric power sector. This lack of a well-tried model poses another barrier to the approach. Further, although this paper explains the advantages of insulating funds from the annual Congressional appropriations process, dispersal of funds by an entity established or enabled by federal legislation would still be subject to oversight by Congress. Finally, once trust funds are established, historically they often tended not to terminate. This can reduce cost-effectiveness when continued beyond completion of the original purpose. To avoid this, enabling legislation could include a clear termination point (such as a specified number of years, number of projects, or total revenue to be collected) as noted earlier.

Finally, establishment of a dedicated trust fund might be more onerous to utilities than the more familiar loan guarantees or tax credit approaches.[3] However, a trust fund also could provide either grants or loan guarantees, so these approaches are not really incompatible, although a loan guarantee program could be instituted without recourse to a trust fund and the attendant need to establish a management entity. An advantage of a direct loan guarantee is that its budgetary impact is limited to the estimated present value of expected defaults. Further, this budgetary impact can be "neutralized" by requiring loan recipients to pay fees to cover the present value of any expected defaults—in effect a type of insurance that defaults will not result in budget losses. But as noted earlier, this approach cannot guarantee the outcomes sought by a dedicated CCS Trust Fund.

3 Bardin (2007) has suggested use of a commodity tax credit to subsidize deployment of CCS. Under this approach, utilities would receive tax credits on a "per ton of CO_2 sequestered" basis. To render the program revenue neutral, funds would be raised through a combination of fees on imported oil, liquid transportation fuel consumed, and electricity from fossil fuels delivered to the grid. The program is envisioned as operating through the U.S. Department of Treasury, and would not be a trust fund approach although similar in imposing fees and dispersing benefits for a specified purpose.

Design and Management of a CCS Trust Fund

As noted earlier, one of the compelling reasons to consider a CCS Trust Fund is its potential to assure that monies raised will be used for purposes that have merit in the eyes of key stakeholders. This requires, as is common to all trust funds, that documents establishing the fund specify the eligible uses of trust fund revenues. If government-imposed fees are used to raise the money, it will also require careful crafting of enabling legislation to protect the fund from diversion to other purposes and interference with timely expenditure.

Some of the most basic design options for a dedicated fund to accelerate deployment of CCS will be whether or not fund dispersal is:

- Managed by a federal agency, or by an entity at arms length from federal agencies
- Subject to the annual Congressional appropriations process

Ensuring that the fund remains dedicated to supporting commercial-scale demonstrations of CCS will require that the enabling legislation carefully defines: the type of fund and its budget status; the mechanism used to raise money; the purposes on which the money is to be spent; the entity charged with managing the funds; and the relationship between a non-federal agency (if one is used) and federal oversight.

The fund's authorizing language will determine whether or not disbursement of revenues is subject to the appropriations process or not. Avoiding that process is important to increase stakeholders' confidence that the proceeds will be used for the intended purposes and will be distributed in a timely manner. Important design elements that influence this determination include whether the charge on affected utilities is designated as a tax or a fee; whether it is imposed directly by the federal government, or enabled by the federal government but imposed by the industry itself; and whether, if the charge is imposed by the government, the proceeds qualify as "offsetting collections" (GAO, 2005).

Proceeds from taxes generally must go to the U.S. Treasury and be subject to the federal budgetary process, including annual appropriations. However, proceeds from fees[4]—particularly proceeds from charges that qualify as "offsetting collections"—can be routed directly to the account of the entity collecting the money and be "available for obligation to meet the account's purpose without further legislative action" (GAO, 2005; Schick, 2000).

If authorization language provides for a quasi-public or private institution to manage a dedicated fund, Congress would most likely specify the structure and basic operating rules for the entity, program objectives,

4 Structuring charges so that they qualify as fees rather than taxes is a legal and policy art (Hezir, 2007). If the goal is to set up a trust fund not subject to the annual federal appropriations process, experts would have to be engaged to ensure that charges qualified as fees. For example, one charge that might qualify as a fee would be a charge on electricity generated from coal to compensate for damages to the environment.

federal members of an oversight committee, and criteria for fund directors and non-federal members of the oversight committee.

REVENUE-RAISING OPTIONS

Experience from programs like the Municipal Wastewater Treatment program described earlier, as well as current federal budget rules (which require any new legislation involving expenditures to be offset by new revenues), indicates that financial self-sufficiency is likely to be one of the most important features of a program to support large-scale demonstrations of CCS. Money for a CCS Trust Fund could be raised in a number of ways as discussed earlier; for example, through an auction of allowances under a cap-and-trade program, via user charges on coal consumption, or via a fee on electricity generated. If the latter option is used, decisions on three issues will be needed:

(a) Which entities should be subject to the fee (e.g., coal-based units only, or a larger set of facilities)

(b) Whether the fee should be the same for all affected units, or whether it should depend on other factors (such as the plant CO_2 emission rate per kWh)

(c) The level(s) of the fees.

Regardless of decisions on these issues, trust fund establishment documents should state when, or the conditions under which, such fees will terminate.

For any given scale of program, widening the base from which revenue is collected has the obvious advantage of lower average fees per entity. Estimates of the fees needed to support a deployment program of 10 to 30 projects were developed in Kuuskraa (2007) assuming a uniform fee per kWh of net generation was imposed only on current coal-fired facilities. The estimated average fee per kWh needed to cover the full incremental capital and operating costs was $0.0012 per kWh for the 30-plant program and $0.0004 per kWh for the 10-plant program. With expected future growth in coal-based generation, average fees would be lower than these estimated values. For comparison, the average price of electricity in the United States for residential consumers in 2007 was $0.1065 per kWh (EIA, 2007). The fees cited above range from 0.4 percent to 1.1 percent of this amount. Decisions regarding the basis of a fee also would depend strongly on program objectives. For example, fees could remain flat at some pre-determined level, or rise or decline over time. They could be based on the amount of electricity generated, or could depend on plant age, plant efficiency, or some combination of factors.

FUND DISPERSAL OPTIONS

As noted earlier, a number of mechanisms are available for dispersing revenues raised to fund CCS projects, including grants, loans, tax credits, and individual industry use of proceeds sale of bonus allowances under a cap-and-trade program. Tax credits and bonus allocations to industry would be alternatives to a CCS Trust Fund approach. However, a trust fund could disperse either grants or loans. Proceeds from the sale of

allowances set aside for that purpose could be also placed into a fund and dispersed through an Advanced Coal and Sequestration Technologies Program.

For either grants or loans, a "reverse auction" procedure could be used to seek the most cost-effective projects. Thus, applicants to a CCS Trust Fund could be required to submit bids stating the amount of CO_2 that would be sequestered per loan or grant dollar, with support going to applicants judged to have the most cost-effectiveness projects (subject to technical evaluations and possible side conditions such as a minimum CO_2 capture efficiency and operating hours per year). Multiple CCS project categories also could be established to provide auctions in all desired options to be demonstrated—though there would no assurance that bids would be offered in all categories.

In selecting trust fund dispersal options, issues of technological and regional equity, as well as relevant categories of grant (or loan) recipients, also must be addressed. Specifications for these program design features can be embedded in legislative language and other documents establishing the fund (Kuuskraa, 2007).

In all cases, economic efficiency, as well as environmental effectiveness, will be supported by fund dispersal mechanisms that encourage:

- A high rate of CO_2 avoidance (low CO_2 emissions per net kWh generated);
- High amounts of total CO_2 avoided via sequestration; and
- Cost-effective projects (low cost per ton of CO_2 emissions avoided).

However, to achieve the goal of demonstrating a variety of CCS options, different cost-effectiveness criteria might be required for different combinations of power generation technologies, capture technologies, coal types and geographic or geological characteristics.

Other equity issues in fund dispersal decisions include equity between large and small companies, between regulated and non-regulated utilities, and between projects that have opportunities to recover some costs (e.g., through enhanced oil recovery) versus projects that do not have such opportunities. The entity designated to manage a CCS Trust Fund should be charged with incorporating relevant equity considerations when selecting projects to be supported.

Finally, several additional program design features could be instrumental in accelerating CCS deployment in the near term, including:

- An aggressive schedule of support for commercial-scale demonstrations, consistent with the overall program scope and objectives
- Reducing the level of payments available for new CCS projects over time
- Clear rules for terminating the program after a specified period (i.e., the opportunity to obtain support is "now or never").

Conclusions

The premise of this paper is that coal-based power plants will continue to provide the major share of U.S. electricity demand for decades to come, and that significant reductions in the CO_2 emissions from such plants are urgently needed as part of a national effort to address global climate change. The suite of technologies for CO_2 capture and sequestration offers the only known path to achieving reductions in coal plant emissions at the necessary scale. At the present time, however, CCS remains expensive and not yet demonstrated in full-scale utility operations. A government-enabled program to accelerate the demonstration and deployment of CCS in a variety of applications, and to drive down the cost of CCS through learning-by-doing and related measures, can bring significant economic as well as environmental benefits to the nation, while also fostering domestic energy security.

A CCS Trust Fund can serve a useful role in this regard because it would:

- Support needed demonstrations of integrated CCS at commercial-scale coal-based power plants to establish its costs and viability—the likely pre-conditions for any future policy requiring the use of CCS
- More quickly and directly achieve significant cost reductions in CCS technologies than approaches that depend solely on sufficiently stringent CO_2 emission limits
- Bring substantial national economic as well as environmental benefits by reducing the future costs of achieving significant CO_2 emission reductions from coal-based electric power plants
- Foster energy security goals by enabling domestic coal to provide electricity as well as (potentially) transportation fuels (e.g., in the form or electricity or hydrogen) in a carbon-constrained environment.

Advantages of a CCS Trust Fund approach include its ability to:

- Raise the required amounts of money from non-governmental sources
- Ensure that those who pay into the fund also benefit from the program
- Ensure multi-year financial self-sufficiency of a CCS deployment program
- Ensure that demonstrations are conducted for a range of power generation facilities, CCS technologies, coal types, and geographical regions
- Get started rapidly and maintain a well-defined revenue stream.

The requisite features of such a fund have been successfully employed in past federal programs where trust funds have proven to be an important mechanism for improving other aspects of the nation's environment and infrastructure. This is also the ultimate goal of an initiative to significantly reduce CO_2 emissions from the nation's use of coal to generate electricity. If a trust fund approach is used to accelerate deployment of CCS at power plants, desirable design features of that program should include provisions to ensure that:

- Trust fund revenues are insulated from the federal annual appropriations process
- Fund management is in accordance with private-sector decision-making standards
- Clear termination guidelines or requirements are specified.

A companion paper (Kuuskraa, 2007) elaborates on the costs and objectives of a CCS demonstration program of the sort a CCS Trust Fund would support. Other policy options to achieve reductions in CO_2 emissions from the use of coal to provide electricity are explored in other Pew Center Coal Initiative reports.

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Additional perspectives on federal programs were gained through personal communications with:

David Beecy, U.S. Department of Energy
Kevin Bliss, Interstate Oil and Gas Commission
Claudia Copeland, Congressional Research Service
David Greene, Oak Ridge National Laboratory
Joseph Hezir, EOP Group
Roger Noll, University of California
Alan Pisarski, Independent Consultant
Dale Simbeck, SFA Pacific
Tom Stanton, Johns Hopkins University

Appendix: Selected Trust Fund Descriptions

THE HIGHWAY TRUST FUND

As noted earlier, the Highway Trust Fund, authorized by the Federal Aid Highway Act of 1956, established perhaps the best known and most successful trust fund in U.S. history. The Highway Revenue Act formed Title II of the Federal Aid Act, with Section 205 imposing new taxes and raising others[5] in order to render the interstate highway program self-financing. Section 209 established the Highway Trust Fund and dedicated 100 percent of the federal gasoline tax receipts to the fund (Jackson, 2006). The idea for an interstate highway system dated to Franklin Roosevelt, but the lack of sufficient funding resulted in only 6,000 miles of roads by the time Eisenhower became President. By ensuring (via establishment of the Trust Fund) that the money raised from road users would be used for road building, the 1956 Federal Aid Act succeed in imposing the taxes and fees needed for this extensive infrastructure project. It was anticipated that approximately $38 billion would enter the trust fund as a result of the taxes over the 16-year period 1956-1972—an amount sufficient to cover expected expenditures.

In its early years, the Highway Trust Fund remained inviolable, with funds going solely to building roads. Subsequently however, particularly after completion of the primary interstate highways, significant portions of receipts went to states with relatively light road usage and funds began to be allocated for other related purposes. Cost-effectiveness of the program also became compromised because annual spending was capped during the appropriations process in order to address federal budget deficits, and the spending limits increased project costs.

THE U.S. MUNICIPAL WASTEWATER TREATMENT PROGRAM

Two important lessons come from a federal program whose objectives resemble those of a deployment program for CCS. The Federal Water Pollution Act (Clean Water Act) provides support for installation of water treatment technology at the nation's waste water treatment plants. Like the Highway Trust Fund, this program has been successful in upgrading a very significant part of the national infrastructure. The "take home" messages from this program are both simple and critical:

- Expensive programs must be self-supporting
- Federal program grants encourage project proposals that are not cost-effective.

5 The pre-existing gasoline tax was raised from two to three cents per gallon. Other taxes, percentages of which went into the trust fund, included taxes on tires, inner tubes, tread rubber, trucks, and buses.

The Clean Water Act offered federal grants to municipalities to assist them in meeting discharge regulations. However, the program's cost-effectiveness was seriously compromised due to the tendency on the part of potential grant recipients to propose plants larger and with more features than necessary. In an effort to limit the federal government's financial exposure and to impose financial discipline on municipalities, the grant approach was supplanted by a revolving loan program. The intention was to render the program self-financing (Copeland, 2004). A loan approach of this type would not be an option for CCS, however, because such units would not earn enough to pay loans back, at least until federal mandates created conditions that rendered power plants with CCS competitive with units without CCS. The difficulty of ensuring the cost-effectiveness of federal grants has also characterized the history of R&D support of coal technologies (Simbeck, 2007).

TWO VOLUNTARY INDUSTRIAL TRUST FUNDS

The Propane Education and Research Act, passed in October 1996, provided for establishment of a Propane Education and Research Council to fund research and development of new and more efficient propane equipment and to expand public awareness of propane, its uses, and environmental advantages. The Propane Education & Research Council is a private organization authorized to impose fees up to a maximum amount. The legislation stipulated that it would be established if approved by a two-thirds majority vote in an industry referendum.[6] The referendum passed in early 1998, the Council was established and fees were collected that year, and the first contracts were let early in 1999. The Act specifies the number, representation, and terms of Council members; establishes the Council's purposes and functions; provides for monthly collection of fees adequate to cover planned expenditures; and requires public and federal review of the annual budget (Propane Education and Research Council, 2007). In 2007, the Council collected five-tenths of one cent per gallon of propane, with projected revenues of $45.1 million dollars. By passing the referendum, the propane industry committed itself to a multi-year, multi-million dollar effort, with collection and dispersal of funds handled by the Council, whose members the industry selects subject to rules set in the enabling legislation. The rapidity with which the Propane Education and Research Council was established and initiated projects suggests that this model can provide a fast-track approach for the power industry to gain experience with commercial, integrated CCS technologies.

In Australia, coal stakeholders have undertaken a voluntary approach to CCS demonstrations in response to government interest in promoting the use of CCS in that country. COAL21 is a voluntary partnership between Australian coal and electricity industries, unions, federal and state governments and the research community. Its objectives include the facilitation of demonstration, early uptake, and commercialization of technologies that can provide near-zero emission electricity. The voluntary fees are expected to result in $1 billion dollars within the coming decade. The management and operating structure of COAL21 suggest a number of components for a U.S. CCS Fund. COAL21 has a Steering Committee broadly representative of the participants and an Advisory Committee comprised of technical and scientific experts. Sub-groups of the Advisory Committee are formed as required or requested for specific projects. A Communications Group provides for information exchange, and roundtable meetings involving all participants are held twice a year providing opportunities for networking, information sharing, and strategic decision-making. Conference calls open to all participants are held every two months (Coal21, 2007).

6 Voting rights were based on volume of propane produced or sold, giving larger players a greater voice.

FEDERAL PROGRAMS NOT SUBJECT TO ANNUAL APPROPRIATIONS

A number of federal funds are insulated from the annual appropriations process including a research fund established under the Energy Policy Act of 2005, the Metropolitan Washington Airports Authority, the Tobacco Master Settlement Agreement (TMSA) and, due to a recent change in law, the Abandoned Mine Land program (AML). As elaborated below, the first two utilize a quasi-public approach to administration of a trust fund, the third operates via a private entity, and the last is run by a federal agency.

The Energy Policy Act of 2005 (EPACT) Title X, Subtitle J

Subtitle J of EPACT provides one model of a fund supported by federal revenues but managed by a non-federal agency with spending independent of the federal annual appropriations process. Title X, Subtitle J, Ultra-Deepwater and Unconventional Natural Gas and Other Petroleum Resources, directs the Department of Energy (DOE) to contract with a non-governmental consortium to administer the subtitle's activities and manage the funds awarded under the subtitle. The subtitle establishes a special fund to finance the program, with $50 million annually from federal oil and gas lease payment earmarked to the fund and available for expenditure without the need for further appropriations[7].

In 2006 the Research Partnership to Secure Energy for America (RPSEA) was selected to administer the fund. RPSEA is a non-profit corporation composed of a consortium of U.S. energy entities. The Secretary of Energy has oversight on all aspects of the program, and Subtitle J establishes an Unconventional Resources Technology Advisory Committee responsible for advising the Secretary. Thus, while RPSEA itself is a non-governmental entity, its management of Subtitle J funds is subject to oversight by a committee selected through government solicitation and by the Secretary of Energy (USDOE, 2007). RPSEA thus exemplifies important features of an organization that would be established to manage a CCS Trust Fund if the fund were created by federally-imposed charges. Fund management is in the hands of private sector stakeholders and experts, with DOE (and possibly other federal agencies) exercising oversight functions.

The Metropolitan Washington Airports Authority

The Metropolitan Washington Airports Authority (MWAA) is a non-federal entity that both collects and administers fees under federal oversight. The Airports Authority, which is responsible for capital improvements at Washington's airports, was established by the U.S. Congress but is an independent, non-federal public body. It is self-supporting, using aircraft landing fees, rents, and revenues from airport concessions to fund operating expenses, and has a 13-member Board of Directors, three members of which are appointed by the President of the United States (MWAA, 2007). Important features of the MWAA include its ability to float bonds, and to make contracting and hiring decisions unconstrained by restrictions on such activities that apply to federal agencies. Such freedom from federal contracting and hiring constraints also has been considered an important element in the success of DARPA. Hiring constraints are included in the list of "peculiarities of government administered projects" that the recent study (MIT, 2007) suggests should be removed from any program used to support timely deployment of CCS.

7 An additional $100 million annually, which is subject to annual appropriations process, is authorized for the fund from the U.S. Treasury general fund.

The Tobacco Master Settlement Agreement

The Tobacco Master Settlement Agreement (TMSA) illustrates a program that follows a different paradigm, creating a fund which operates without federal legislation and is administered by a private association. In 1998, stemming from a series of lawsuits, a schedule of fees to be paid by cigarette companies was established through a contractual agreement between states and the tobacco industry. The National Association of Attorneys General manages the TMSA on behalf of the states. The agreement obligates cigarette companies to make payments to states totaling more than $40 billion over its first 25 years of operation (Redhead, 1998). In this case, however, the TMSA does not restrict how states use the money they receive under the Agreement. Nonetheless, the sums raised and distributed by the TMSA are similar in magnitude to those needed to fund the incremental costs of CCS at 30 commercial-scale coal-fueled units (Kuuskraa, 2007).

The Abandoned Mine Reclamation Fund

The Abandoned Mine Reclamation Fund, established by the Surface Mining Control and Reclamation Act of 1977 (SMCRA), is administered by the U.S. Department of Interior's Office of Surface Mining. Although this Fund originally operated under discretionary spending rules, in 2006 the program was converted to a system under which Abandoned Mine Land reclamation grants are mandatory (OMB, 2008). This change is designed to end the situation in which Congress, via the annual appropriations process, prevented much of the money collected from being spent. Annual proceeds are in the $0.3 billion range, with over $7.4 billion collected since 1978 (Noto, 2006), with over $2 billion unspent at the time the change to a mandatory spending program was made.

Attributes of Selected Federal Programs

Attribute	CWA	FHA	UDW & UNG	PERC	TMSA	AML	MWAA
Purpose of program	**Assistance in meeting standards**	**Build infrastructure**	**Commercialize & deploy new technologies**	**Research, Development and Education**	**Compensate victims**	**Remediate damage to environment**	**Infrastructure and operation**
Self-financing	no	yes	yes	yes	yes	yes	yes
Taxes/fees	taxes	taxes	fees	fees	fees	fees	fees
Trust Fund	no	yes	yes	fund	yes	yes	no
Administering Body	EPA	IRS	DOE and RPSEA	Private Council	NAAG	Interior	WMAA
Targets infrastructure	yes	yes	yes	no	no	yes	yes
Loan/grant/ credit	grants & loans	grant	grant	NA	NA		NA
$5 billion or more	yes	yes	no	no	yes	yes	unknown
Support to private entities	no	no	yes	yes	no		yes

CWA = Clean Water Act

FHA = Federal Highway Act

UDW & UNG = Ultra-Deepwater and Unconventional Natural Gas and Other Petroleum Research Fund

PERC = Propane Education and Research Council

RPSEA = Research Partnership to Secure Energy for America

TMSA = Tobacco Master Settlement Agreement

NAAG = National Association of Attorneys General

AML = Abandoned Mine Land Fund

MWAA = Metropolitan Washington Airports Authority

This paper describes key elements of an administrative structure that could efficiently and effectively manage a program to accelerate deployment of carbon capture and storage at coal-fueled electric power plants. It is part of a Pew Center on Global Climate Change Coal Initiative, a series of reports examining and identifying policy options for reducing coal-related GHG emissions. The Pew Center brings a cooperative approach and critical scientific, economic, technological, business and policy expertise to the global climate change debate at the state, federal and international levels.

Pew Center on Global Climate Change
2101 Wilson Boulevard, Suite 550
Arlington, VA 22201

Phone (703) 516-4146

www.pewclimate.org