



HARVARD Kennedy School
JOHN F. KENNEDY SCHOOL OF GOVERNMENT

Proposed Roadmap For Overcoming Legal and Financial Obstacles to Carbon Capture and Sequestration

WENDY B. JACOBS
LEAH COHEN
LEAH KOSTAKIDIS-LIANOS
SARA RUNDELL

Discussion Paper 2009-04
March 2009

**PROPOSED ROADMAP
FOR OVERCOMING LEGAL AND FINANCIAL OBSTACLES TO
CARBON CAPTURE AND SEQUESTRATION**

Wendy B. Jacobs^{*}

Leah Cohen[†]

Lara Kostakidis-Lianos[†]

Sara Rundell[†]

Discussion Paper 2009-04

March 2009

^{*} Director, Harvard Environmental Law and Policy Clinic

[†] Students, Harvard Law School

Citation

This paper may be cited as: Jacobs, Wendy B., Leah Cohen, Lara Kostakidis-Lianos and Sara Rundell, “Proposed Roadmap For Overcoming Legal and Financial Obstacles to Carbon Capture and Sequestration” Discussion paper 2009-04, Cambridge, Mass.: Belfer Center for Science and International Affairs, March 2009.

Comments are welcome and may be directed to Wendy Jacobs at wjacobs@law.harvard.edu.

The views expressed within this paper are the authors’ and do not necessarily reflect those of the organizations they are affiliated with. This paper is available at www.belfercenter.org/energy.

Acknowledgement

The Energy Technology Innovation Policy (ETIP) research group, in the Harvard Kennedy School’s Belfer Center for Science and International Affairs, supported research on which this paper is based. ETIP receives funding from: the Doris Duke Charitable Foundation; the Energy Foundation; the David and Lucile Packard Foundation; the William and Flora Hewlett Foundation; the U.S. Environmental Protection Agency; the Pew Center for Global Climate Change; BP International, Ltd.; BP Alternative Energy Holdings, Ltd.; and Shell.

Energy Technology Innovation Policy (ETIP)

The overarching objective of the Energy Technology and Innovation Policy (ETIP) research group is to determine and then seek to promote adoption of effective strategies for developing and deploying cleaner and more efficient energy technologies, primarily in three of the biggest energy-consuming nations in the world: the United States, China and India. These three countries have enormous influence on local, regional, and global environmental conditions through their energy production and consumption.

ETIP researchers seek to identify and promote strategies that these countries can pursue, separately and collaboratively, for accelerating the development and deployment of advanced energy options that can reduce conventional air pollution, minimize future greenhouse-gas emissions, reduce dependence on oil, facilitate poverty alleviation, and promote economic development. ETIP's focus on three crucial countries rather than only one not only multiplies directly our leverage on the world scale and facilitates the pursuit of cooperative efforts, but also allows for the development of new insights from comparisons and contrasts among conditions and strategies in the three cases.

**HARVARD LAW SCHOOL ENVIRONMENTAL LAW & POLICY CLINIC'S
PROPOSED ROADMAP
FOR OVERCOMING LEGAL AND FINANCIAL OBSTACLES TO
CARBON CAPTURE AND SEQUESTRATION**

PREPARED FOR
MARCH 30, 2009
WORKSHOP

The Harvard Environmental Law and Policy Clinic¹ supports the development of carbon capture and geological sequestration² (CCGS) as part of a larger national effort to address climate change and promote economic growth. President Obama's commitment to reduce greenhouse gas emissions and to deploy CCGS as one mechanism for achieving emissions reductions provides impetus for realizing this goal.³ The urgency posed by climate change combined with the time needed for obtaining project financing and permits and for demonstration of large scale CCGS projects⁴ requires that the United States develop the necessary support structure for CCGS immediately.

Given the urgent need to slow climate change, it is not appropriate to wait for national restrictions to be imposed on emissions of carbon dioxide (CO₂) or for the establishment of a national cap-and-trade system, or national CCGS legislation before proceeding to demonstrate the technology necessary for commercial deployment.⁵ Apart from reducing CO₂ emissions, the development of CCGS technology in the United States also has the potential to provide large economic and energy security benefits by creating high quality jobs and reducing reliance on foreign imports of fossil fuels.⁶

Despite both the need and the emerging political will, few specific proposals for achieving the rapid development of CCGS have been put forward to date. Many existing proposals either lack sufficient concreteness to make CCGS operational or fail to focus on a comprehensive, long term framework for its regulation, thus failing to account adequately for the urgency of the issue, the need to develop immediate experience with large scale demonstration projects, or the financial and other incentives required to launch early demonstration projects.⁷ We aim to help fill this void by proposing a roadmap to commercial deployment of CCGS in the United States.⁸ The proposed roadmap is a work in progress, and we look forward to receiving your feedback.

This roadmap focuses on the legal and financial incentives necessary for rapid demonstration of geological sequestration⁹ in the absence of national restrictions on CO₂ emissions. It weaves together existing federal programs and financing opportunities into a set of recommendations for achieving commercial viability of geological sequestration.

Part I provides a brief summary of the obstacles and disincentives to large scale deployment of CCGS and an overview of our recommended solutions. Part II presents the principles underlying this proposed roadmap. Part III includes a more detailed discussion of key milestones under the roadmap and the related rationales.

I. Obstacles to Commercial Deployment of Geological Sequestration

“The most challenging aspect of developing [CCGS] for the utility industry is sequestration.”¹⁰

A. Summary of obstacles and disincentives

According to industry experts and environmental advocates alike, the chief obstacles and disincentives to commercial deployment of geological sequestration are:

- Lack of a tax, national limits or other restrictions on CO₂;
- High costs for early demonstration projects and retrofits and lack of sufficient financial incentives to compensate early movers for costs and risks;
- Absence of a large, reliable, readily-accessible captured CO₂ stream or demonstrated large scale capture capability; and
- Uncertainty surrounding responsibility for the risks of large scale geological sequestration projects, due to the absence of a liability and permitting regime and the absence of in-the-ground performance experience.¹¹

The absence of demonstrated risk profiles for large scale geological sequestration activities and the length of time for which sequestered CO₂ must remain in place understandably contribute to concerns regarding long term liability for closed geological sequestration sites and hinder the creation of a private financial assurance market or risk pooling mechanisms to address operational liability for early projects. The current lack of a liability regime for large scale geological sequestration and the fragmented permitting process for capture, transport and geological sequestration together create a lack of predictability, resulting in impediments to project financing and implementation. Finally, uncertainty surrounds ownership of pore space and deep saline aquifers and the potential that CCGS might trigger liability and requirements under existing environmental protection statutes, such as the Resource Conservation and Recovery Act (RCRA), the Comprehensive Environmental Response, Compensation and Liability Act (CERCLA), and the Clean Air Act (CAA).

B. Overview of recommendations

1. Demonstrating CCGS: the first five geological sequestration projects

We propose to address these obstacles and disincentives in the short term by identifying the fewest federal legislative actions necessary to quickly launch large scale geological sequestration demonstration projects. These actions are presented based on the order of project implementation and include the following:

- Tailoring existing federal grants, tax credits, loan guarantees and tax exempt bonds to better target the immediate needs of CCGS projects;
- Siting early geological sequestration demonstration projects on federal and state lands;
- Issuing permits for geological sequestration demonstration projects under the existing Underground Injection Control (UIC) Program administered by the Environmental Protection Agency (EPA);
- Providing amnesty to up to five existing coal-fired power plants that are out of compliance with the Clean Air Act and waiving New Source Review (NSR) and Prevention of Significant Deterioration (PSD) permit requirements in exchange for commitments to retrofit plants to capture and treat large volumes of CO₂ for use in capture and sequestration demonstration projects;
- Instituting a limited cap on operational liability for injectors of CO₂;
- Encouraging states to legislatively clarify ownership of pore space and limit actions in trespass and ejection; and
- Transferring long term stewardship (responsibility for monitoring, measuring, and verification (MMV) activities, corrective and remedial actions and damages) for geological sequestration sites to a national Post Closure Fund upon certification by a federal agency (or delegated state agency) of proper site closure and performance.

2. Transitioning to commercial deployment of CCGS

Over the next several years, as geological sequestration is demonstrated to be commercially viable, comprehensive legislation for CCGS can be enacted to include the following:

- Implementing restrictions and/or a tax on CO₂ emissions;
- Requiring existing coal plants to capture a significant portion of their CO₂ emissions;
- Shifting financial incentives from demonstration projects to commercial deployment;
- Providing a federal power of eminent domain over pore space to deal with individual holdouts;

- Establishing federal ownership of deep saline aquifers;
- Establishing a comprehensive permitting regime that streamlines permitting for capture, transport, and geological sequestration to replace the patchwork of regulations that might be applied now;
- Imposing financial assurance and risk pooling requirements on industry in order to manage operational liability;
- Continuing the practice of transferring long term responsibility for sequestration sites to a Post Closure Fund upon certification.

II. Guiding Principles

This section describes the principles that underlie this proposed roadmap.

A. CCGS is a mechanism to address climate change

There is a broad consensus in the scientific and business communities that CCGS is an important technology for reducing CO₂ emissions throughout the world. It may be impossible to achieve significant emissions reductions, in the United States and abroad, without the use of CCGS. As is the case in many other countries, the United States has large coal reserves, coal-generated electricity is less expensive than other energy sources and about half of domestic energy supply is currently generated from coal.¹² In addition, middle income and developing countries, such as China and India, also rely heavily on the use of coal-generated electricity and are likely to increase their reliance on coal as their economies grow in the future. Hence, coal is expected to remain a major energy source for decades to come.¹³ Technologies such as CCGS are needed to address coal-generated CO₂ emissions because “coal use and climate protection are on a collision course. Without rapid deployment of [CCGS] systems, that collision will occur quickly and with spectacularly bad results.”¹⁴ Development of CCGS will also enable the United States to take a leading role in helping other countries, particularly India and China, to address climate change and may help lay the groundwork for the next international climate agreement.

B. CCGS can be a tool for economic growth and energy security

Development of CCGS technology provides the opportunity to establish U.S. leadership in an area of growing international market demand and to create high quality domestic jobs in the clean technology, manufacturing and construction industries. “The U.S. needs to start fast in the race to competitively develop this technology and we need to win it, so that America will be selling it [in other countries], rather than buying it there.”¹⁵ CCGS also has the potential to enhance energy security by reducing U.S. reliance on fossil fuel imports. It will allow continued use of the abundant supply of coal in the United States, and the creation of an accessible

stream of captured CO₂ will support continued domestic production of oil and gas through enhanced oil and gas recovery (EOR/ EGR).¹⁶

C. Existing opportunities and expertise should be used to jumpstart early large scale demonstration projects

Experts estimate that it could require as long as 7 to 15 years to develop geological sequestration technology for commercial deployment.¹⁷ Policymakers should jumpstart early large scale demonstration projects as soon as possible in ways that minimize the need for new legislation and legislative amendments and that take advantage of existing regulatory opportunities and financial incentives.

D. Expediting the development of capture technology for existing coal plants is critical

Thousands of coal-fired power plants across the world and hundreds in the U.S. will continue to operate for decades to come. It is not realistic to expect them to be replaced with integrated gasification combined cycle (IGCC) plants, or other state-of-the-art facilities in the near term. Moreover, in order to effectively test geological sequestration of CO₂, a significant and readily-accessible captured stream of anthropogenic CO₂ is needed. Existing plants should be targeted for this task. Given the high costs of retrofitting in terms of capital, permitting and the associated energy penalty, a combination of financial and other incentives should be designed to facilitate and expedite the retrofit of existing coal plants with CO₂ capture equipment.

E. Demonstration projects should include cost-sharing

Financial incentives such as grants, tax credits and loan guarantees should be designed to ensure that private companies investing in early capture of CO₂ and geological sequestration demonstration projects share the costs of these demonstration projects with taxpayers. Companies engaged in geological sequestration should shoulder a significant share of the costs, not only because they are expected to be the same companies that benefit from CO₂ emitting activities and from early development of technical expertise, but also to help ensure that the projects for which financial incentives are granted are properly sited and managed.¹⁸ At the same time, taxpayers are expected to benefit significantly from demonstration projects, both because technological advances and data from the early projects can then be applied to later projects and because the demonstration projects and later projects that build on them will decrease harmful emissions of CO₂. Thus, cost-sharing is an equitable approach to addressing the high costs of early geological sequestration projects. More substantial public support is likely to be necessary to foster capture technology. Over time, as limits or taxes on CO₂ emissions are implemented, risks are more accurately identified and costs for capture and geological sequestration decline, the private sector should assume a greater share of the project costs.

F. Climate impacts should be balanced with other environmental goals

CCGS policies should balance the technology's climate change benefits with its impacts on other environmental goals. Both siting and liability for geological sequestration should take into account factors such as environmental justice, impacts on natural resources and protected areas and the risks of groundwater contamination, in order to ensure that geological sequestration is carried out in an environmentally and socially responsible manner.

G. The permitting framework for CCGS should capitalize on federal and state expertise

The permitting framework for CCGS should follow the model of existing federal environmental protection statutes by establishing a floor for performance standards at the federal level and providing the option for program delegation to and primary enforcement by the states. We believe that this approach will:

- Prevent a “race to the bottom” resulting from competition among states to attract geological sequestration projects and related investment;¹⁹
- Provide a mechanism for addressing potential sub-surface migration of CO₂ across state boundaries;
- Provide regulatory capacity and resources for states which lack them;
- Constitute an effective vehicle for addressing interaction with other federal statutes, including RCRA, CERCLA, and the CAA;²⁰
- Allow early mover states to build on their expertise in regulating the injection and storage of oil and gas, in defining pore space ownership and sub-surface property rights (particularly in the short term) and in responding to environmental justice and other concerns at the community and state levels;²¹ and
- Provide states with additional flexibility for tailoring other aspects of CCGS regulation to the individual conditions of their state.

H. Liability for geological sequestration sites should be addressed at the national level

Establishing indemnities, liability caps, risk pooling mechanism, and a Post Closure Fund at the national level will allow the pooling of sufficient resources and promote a more equitable distribution of costs between states, given that certain states lack suitable sites for geological sequestration but will reap the benefits of reduced CO₂ emissions.

I. Renewable sources of power and energy efficiency measures should also receive federal support

It is important that any policies to promote CCGS do not favor continued reliance on coal over other efforts to mitigate climate change. “[T]he conventional coal fuel cycle is among the most environmentally destructive activities on earth.”²² For that reason, the Harvard Environmental Law and Policy Clinic (ELPC) supports the reduction of coal-generated electricity and the increased use of energy efficiency measures and investment in renewable sources of energy. Recommendations on those issues are beyond the scope of this paper.

Roadmap to commercial viability of CCGS

1 Secure financial incentives, set up liability framework

- Secure more federal funding (Rec 1-4)
- Provide limited CAA amnesty to generate large captured CO₂ stream (Rec 4b)
- Provide loan guarantees and tax exempt bonds (Rec 5,6)
- Facilitate access to federal land (Rec 8)
- Clarify pore space ownership (States) (Rec 9a, 14a)
- Issue permits under existing regulations (Rec 11)
- Streamline NEPA review (Rec 11b)
- Authorize fixed indemnities and liability caps for earliest projects (Rec 13a)
- Create National Post Closure Fund (Rec 13b-c)

2 Flesh out the details

- Declare national ownership of deep saline aquifers (Rec 9c)
- Consider national legislation on pore space (Rec 9b, 14b)
- Create federal power of eminent domain (Rec 10)
- Collect contributions to Post Closure Fund (Rec 15a)
- Adjust national liability legislation (Rec 13)

3 Establish long term framework

- Target incentives to commercial deployment (Rec 7)
- Establish standalone permit regime for CCGS (Rec 12a-b)
- Shift operational liability to private sector (Rec 16, 17a)
- Establish Post Closure Fund claims architecture (Rec 15b)

12 -18 months

3-4 years

Transition to commercial deployment

III. How do we get there from here quickly and efficiently?

This proposed roadmap focuses on government actions and incentives required to expedite deployment of at least five large scale demonstration projects and transition to commercial deployment of CCGS. Incentives are needed to spur geological sequestration specifically and also to ensure that sufficient CO₂ is captured to enable these projects. Additional work is required to develop the specific incentives necessary to move beyond these demonstration projects and achieve rapid commercial deployment of CCGS once the technology is proven.

Our approach utilizes existing appropriations and legal structures in the immediate future, minimizing the need for new legislation while recognizing that more complex and time consuming changes are required over the longer term. Recommendations are set out thematically, in order of the immediacy with which they should be addressed. The attached Figure shows how we envision implementation of these recommendations and provides a roadmap to commercial viability of CCGS in three stages.

Our recommendations require coordinated development of the permitting regime, liability framework, and financial incentives, and will therefore require substantial inter-agency coordination. We recommend that enabling legislation assign clear federal agency leads to each task and that DOE be given the role of facilitating co-operation across agencies. One option to consider is a task force comprised of EPA, DOE, DOI, Treasury and state representatives to provide advice and facilitate cooperation. The primary function of this group would not be to sign off on developments under the enabling legislation but rather to ensure that the relevant expertise from each agency and the states is brought to bear.

We anticipate that:

- EPA will lead
 - Process for issuance of permits and operational requirements for demonstration projects (Rec 11) and the development of a comprehensive standalone CCGS regulatory regime (Rec 12)
 - Development of the Post Closure Fund claims architecture (Rec 15b)
- Treasury will manage the Post Closure Fund (Rec 13c) and collect fund contributions (Rec 15a)
- DOE will effectively act as project manager and
 - Lead the selection and management of demonstration projects
 - Monitor the financial incentives package and competitive bidding process
 - Think ahead to incentives needed to spur and support commercial deployment

- DOI will be responsible for setting appropriate fees and leasing arrangements for use of federal property (surface and subsurface) and for use of deep saline aquifers.

A. Financial incentives

Carbon capture and geological sequestration projects are projected to cost hundreds of millions—or even billions—of dollars.²³ In the absence of national restrictions on CO₂ emissions, making CCGS demonstration projects economically viable will require cost sharing between industry and government, with significant investment from both.²⁴ While a number of small pilot projects have been funded, moving to large scale demonstration projects requires much larger investments. The recent commitment in the American Recovery and Reinvestment Act of 2009 (ARRA) of \$3.4 billion for fossil energy research provides some new funding. It is not clear yet how much of those funds will be available for CCGS. Regardless of the precise allocation of these funds, however, more investment will likely be needed.²⁵

This paper identifies gaps in the existing funding pools that need to be plugged²⁶ in order to:

- launch large scale (1Mt/yr)²⁷ demonstration projects;
- secure sufficient quantities of captured CO₂ for such projects to be viable, which requires investment in a range of capture technologies; and
- encourage existing key players (e.g. EOR/EGR operators, existing coal-fired power plants) to participate in demonstration projects.

The financial incentives outlined below should be distributed by DOE (and other authorized agencies) on a competitive basis²⁸ and in consultation with the EPA to ensure that the first five demonstration projects are sufficiently diverse (geologically, technologically and otherwise) and have undergone appropriate risk and site assessments.

Over the next 12-18 months, existing programs and appropriations should be clarified and modified to maximize use of the substantial funds made available by ARRA. Additional appropriations may be required in specific areas. Work to secure such appropriations should start immediately so that funds will be available on a timely basis.

Funding of CCGS could be partially offset by a reduction in existing tax credits available to the coal industry, thus reducing the need for new appropriations in difficult economic times and spreading some of the cost of demonstration projects across the broader industries that stand to benefit most from early deployment of CCGS.²⁹ Further work is required to assess the feasibility of this approach and quantify both the ideal amount of reduction and the impact of such an offset.

1. Clarify the funds available for capture projects under ARRA and request additional appropriations if necessary to support a diverse portfolio of capture demonstration projects

Of the \$3.4 billion provided for fossil energy research under ARRA, DOE has allocated \$800 million to the Clean Coal Power Initiative (CCPI) Round III (in addition to the \$440 million previously provided),³⁰ and \$1.52 billion of the ARRA funds to “industrial carbon capture *and* energy efficiency improvement projects, including a small allocation for innovative concepts for beneficial reuse of carbon dioxide.” It is not clear how much will go directly to capture projects or whether the currently available federal funding will be sufficient to stimulate investment in a diverse portfolio of capture demonstration projects that will result in the capture of sufficient amounts of CO₂ to support five large scale geological sequestration demonstration projects.

It is beyond ELPC’s capability to model the necessary direct federal investment in light of other available or proposed financial incentives.³¹ We recommend that DOE use such modeling to allocate the \$1.52 billion between carbon capture and energy efficiency projects and move quickly to request additional appropriations if the analysis confirms that the available funds are unlikely to be sufficient to stimulate or fund the required demonstration projects.

2. Secure additional funds to provide substantial federal grants for at least five large scale capture and geological sequestration demonstration projects

DOE has previously awarded substantial grants under its Regional Carbon Sequestration Partnership Program for projects that will capture CO₂ at “pilot” levels.³² Large scale demonstration projects are, however, necessary to confirm the commercial viability of CCGS.³³ Substantial additional funding will be required to support these demonstration projects. DOE should undertake or arrange for an economic analysis of how much additional funding is needed and quickly move to request additional appropriations.

3. Amend I.R.C. § 45Q to improve its effectiveness

Existing oil and gas operators are logical early movers in CCGS.³⁴ Using captured CO₂ is only economically attractive to them, however, when the price of oil is high.³⁵ Operators faced with volatile oil prices cannot be certain of recovering on their investment in carbon capture. A volatile oil price discourages investment in CO₂ capture for the purpose of EOR/EGR.

I.R.C. § 45Q provides a tax credit of \$10 per ton for operators that capture CO₂ which is used in EOR/EGR and then sequestered.³⁶ When oil is priced below a certain dollar point, the tax credit is not sufficient to provide an effective incentive. (There is anecdotal information that the current credit provides a viable incentive when the price of oil is at least \$75/barrel.) We suggest amending § 45Q to create a variable incentive which moves in an inverse relation to the price of oil (and cuts out when oil prices are high enough to make using captured CO₂ independently attractive).³⁷ The threshold oil price and a maximum credit level should be set

based on economic modeling. A variable credit, whilst more administratively complex, provides a targeted incentive for EOR/EGR operators by reducing their exposure to oil price volatility while ensuring that tax credits are not given away when they are not necessary to make using captured CO₂ economically attractive.³⁸ (A simpler but less precise alternative approach would be to increase the amount of the credit per ton for an interim period in order to stimulate large and early capture projects.)

Section 45Q also provides a tax credit of \$20 per ton to operators who capture and dispose of CO₂ in “secure geological storage” (independent of EOR/EGR activities).³⁹ Given the projected costs of capture, it is not anticipated that this will be a meaningful standalone incentive for capture projects, but may be used by operators in tandem with other incentives and thus should not be removed from the Code.⁴⁰

Credits are available under § 45Q until the end of the year in which 75 million tons of CO₂ have been captured and stored.⁴¹ While this cap is likely sufficient for demonstration projects, the cap should be increased if it becomes apparent that it will expire before demonstration projects can benefit from the credit. To address this potential risk, the structure could be modified to provide for award of credits to demonstration projects that apply for an allocation, thereby ensuring that the credits will be available to those projects and will not be exhausted earlier by other entities.

4. Target financial incentives to encourage retrofits of existing plants

To maximize the potential benefits of CCGS, existing power plants will need to be retrofitted with capture technology. As such, it is imperative to include both new and existing plants in demonstrations of capture technology. The expense of retrofitting, in terms of obtaining capital for new technology, obtaining permits and addressing the energy penalty, is prohibitive at present. Significant financial support from the federal government will be required.

a. Create an investment tax credit for retrofits with capture technology

Investment tax credits for those who capture and sequester CO₂ are currently available under I.R.C. § 48A but are conditioned on the use of IGCC or other “advanced coal-based generation technology.”⁴² Although we support the focus of § 48A on promoting energy efficiency, given that many existing plants will continue to operate for decades to come, there is also a benefit to retrofitting existing power plants with capture technology even if they do not achieve increased efficiency in electricity generation. We recommend creating a new investment tax credit for existing plant operators who retrofit with capture technology and capture a substantial percentage of CO₂ emissions. The credit could initially target demonstration projects, and, if successful, it could be extended later to encourage wide scale retrofitting with capture technology.

- b. Use enforcement discretion to provide amnesty to a limited number of existing power plants that retrofit with capture technology and participate in demonstration projects and, if necessary, legislate to allow EPA to waive New Source Review (NSR) and Prevention of Significant Deterioration (PSD) requirements**

We propose that EPA, in consultation with DOE and the U.S. Department of Justice, select up to five coal-fired power plants that are (1) situated in geographically and geologically diverse locations; (2) in proximity to potential sequestration sites and available pipelines; and, (3) believed to be in violation of the CAA. Each plant would receive amnesty for prior NSR/PSD violations in exchange for shouldering the expense of retrofits to capture a minimum of one million tons of CO₂ per year for use in a demonstration of large scale capture and sequestration.⁴³ If use of the capture technology would result in additional emissions of regulated pollutants above the thresholds for NSR/PSD permitting, then Congress should authorize EPA to waive or minimize NSR/PSD permitting in order to facilitate and streamline installation of capture technology at these five locations. Precedent for this approach exists already in CAA Section 415, 42 U.S.C.A. § 7651n (clean coal technology regulatory incentives). Another option would be for Congress to grant explicit authorization for EPA to exclude these retrofits from the CAA definition of “modification” so that NSR/PSD requirements are not triggered.

This approach allows the federal government to provide a substantial additional financial incentive for existing power plants to participate in CCGS projects without requiring additional appropriations.⁴⁴ The amnesty for prior violations of NSR/PSD, in particular, would be attractive for some plants that are at risk of expensive prosecutions.

More information about the relationship between retrofits and the associated energy penalty is needed to evaluate the quantity of additional emissions of currently-regulated pollutants that plants would emit if they were allowed to offset the energy penalty and to what extent such offsetting should be allowed. EPA does not presently have the authority to issue such a waiver under the CAA, so legislation would be required to implement this change.⁴⁵ Any such legislation should be limited to a specific number of projects and conditioned upon specific performance standards.⁴⁶

5. Adjust existing programs to provide loan guarantees for CCGS projects

Given the current global credit crisis, loan guarantees may be particularly useful for companies seeking to secure financing for CCGS projects. DOE has included CCGS projects in the third round of applications under the Innovative Technology Loan Guarantee Program, but no loans have yet been issued under the program. While the ARRA directed additional money toward energy loan guarantees, CCGS was excluded from this allocation. Our recommendations focus on revisions to provide access to loan guarantees for CCGS projects.

a. Adjust DOE's loan criteria

It is unclear why no loan guarantees have yet been granted. However, last month, Secretary Chu announced a plan for streamlining and expediting the DOE review process.⁴⁷ While DOE has explicitly solicited CCGS applications under this program, the funding criteria, which require that eligible technologies have the potential for replicability in other commercial projects, must have a reasonable prospect of repayment, must be mature enough to assure dependable commercial operations and sufficient revenues, and are "likely to be available in the United States" in connection with specific advanced coal applications may be too narrow for CCGS demonstrations projects to qualify.⁴⁸ We recommend that DOE consider relaxing the loan criteria to support CCGS technology demonstrations where supported by large operators or partnerships that help reduce the capital risk to government.

b. Amend the ARRA to include CCGS in the energy loan guarantee program

The ARRA created a new, temporary loan guarantee program for renewable energy, electric transmission and biofuel projects that begin construction by 2011. Although an amendment was proposed to make loan guarantees available for CCGS projects as well, it was not adopted in the final bill. We recommend that future stimulus legislation revisit this proposal and amend Section 1705 of the ARRA to include CCGS projects. Additional loan guarantees for CCGS--on top of what is available under the ITLGP--would offer significant near-term benefits for the national economy: they would attract large private investments; create jobs in mining, manufacturing and construction; and stimulate markets in commodities such as steel and concrete.⁴⁹

6. Amend I.R.C. § 141, et. seq. to make tax exempt bonds available for CCGS projects

Tax exempt bonds may help CCGS project operators gain access to capital. We suggest amending existing I.R.C. § 141, et seq. to include CCGS demonstration projects under the purposes of the existing private activity bonds (PABs). (PABs are tax-exempt bonds issued by a state or local government the proceeds of which are used by an entity other than the government issuer for qualified purposes, including furnishing local electrical energy or gas and environmental enhancements of hydro-electric generating facilities).⁵⁰ Using the existing statutory framework will expedite the process and reduce associated transaction costs, providing quick access to an additional capital-raising option for project operators.

Tax exempt bonds may not be as attractive in an economic downturn such as the world is currently experiencing. The ARRA has created a new type of bond, called Build America Bonds, designed to combat the economic crisis by offering a temporary choice of federal tax credits to the holder or cash to the issuer in lieu of the traditional tax exemption on interest.⁵¹ Due to the current credit crunch and the need for CCGS capital, future federal legislation should expand the use of tax credit bonds (with or without the cash option) to include CCGS projects.

7. Shift financial incentives to target scale up as CCGS becomes commercially viable

We anticipate that experience from the demonstration projects and the eventual (expected) implementation of national restrictions on CO₂ emissions will substantially improve the economics of CCGS. As CCGS becomes commercially viable, the incentives outlined above should be phased out and financial responsibility for the costs of CCGS should shift to private parties. Transitional incentives may be appropriate depending on the specific CO₂ restrictions implemented and the pace of development and cost reductions in CCGS technology. These incentives should focus on encouraging rapid commercial deployment of CCGS⁵² and again be limited to encourage early and rapid up-take.

B. Siting

8. Pass legislation confirming DOI/Bureau of Land Management (BLM) authority to allow use of federal properties for CCGS

BLM has broad authority to manage federal lands.⁵³ Specific legislation could (and should) quickly be passed to confirm BLM's authority to lease pore space under federal land for geological sequestration purposes. Such legislation would simply parallel BLM's existing authority to lease pore space for sub-surface oil and gas storage.⁵⁴ Such clarifying legislation would allow CCGS project operators access (in appropriate cases) to federal land, thereby eliminating the delays, transaction costs and liability issues associated with negotiating with multiple landowners for the use of private pore space and provide operators access to surface land needed for monitoring and corrective action.

In addition, as will be discussed below, we recommend that Congress delegate responsibility to BLM and EPA for management, leasing, and protection of deep saline aquifers, whether or not situated below federal lands.

9. Pass legislation to clarify ownership of pore space and deep saline aquifers

Some states have already passed legislation to clarify pore space ownership,⁵⁵ but in many states there is lingering uncertainty. There is also uncertainty about the ownership of deep saline aquifers. This uncertainty complicates siting decisions as it is not clear with whom project proponents should be negotiating. It also creates uncertainty about potential liability for third party property owners.

a. States should have the opportunity to clarify pore space ownership in first instance

Given that property rights are governed by state law and that states vary in their approaches, this is an issue best resolved by states. We recommend that states take responsibility for passing legislation to clarify pore space ownership in order to avoid the need for federal preemption and/or invocation of eminent domain. In the immediate term, it is most feasible to

site projects in states that have already passed, or are willing to quickly pass, clarifying legislation. Applications for both federal funding programs and geological sequestration permits should give preference to projects sited in states that have passed legislation to clarify pore space ownership.

b. Consider the need for federal legislation in light of state inaction

As CCGS moves towards commercial deployment, clarification of pore space ownership across the country will become more critical. The federal government should consider the need for federal legislation that would apply in states which have not yet acted.⁵⁶

c. Congress should enact legislation asserting federal ownership of deep saline aquifers.

While ownership of pore space can and should be addressed through state law, a strong argument can be made that deep saline aquifers should be considered a national resource under the dominion of the federal government. As water supplies diminish, it may become necessary for the nation to tap into deep saline aquifers for agricultural purposes and for drinking water. To avoid inter-state battles and to manage competing demands for this water supply, the federal government should assert ownership through legislation. An important collateral benefit of doing this now is that such legislation would clarify ownership of deep saline aquifers for purposes of sequestration. EPA should be assigned responsibility for setting standards for protection of this source of groundwater; BLM should be assigned responsibility for leases and charging fees for its use.

10. Pass legislation to provide a limited federal power of eminent domain

Where sequestration projects require use of or access to private land, a federal power of eminent domain may be necessary – as a last resort and in the absence of a state power of eminent domain – to ensure that CCGS projects move forward. The power would be used for:

- acquisition of pore space and the operation of facilities;
- access rights for operators and public entities to undertake monitoring and corrective action;

and should be granted only after:

- operators have demonstrated a good faith effort to negotiate;
- environmental justice issues and alternative sites have been considered.

While we anticipate geological sequestration demonstration projects will be predominantly sited on operator- or government-owned land, there may be a need to negotiate with private

landowners even in this early phase. If, however, the demonstration projects are sited such that they do not extend onto private land, legislation may not be required immediately.

C. Permitting

11. Use existing regulations to permit demonstration sequestration projects

a. Issue permits for early demonstration projects under existing UIC regulations

EPA has indicated that both existing small scale pilot geological sequestration projects and large scale demonstration projects (the focus of this paper) may qualify for permitting under existing UIC regulations.⁵⁷ While recognizing that regulation under the UIC program, which is limited to the protection of public sources of underground drinking water, is not ideal,⁵⁸ ELPC supports issuing permits for a limited number of demonstration projects under the existing UIC regulations. UIC provides an available regulatory framework and permitting under Class V allows EPA some flexibility.⁵⁹ We suggest not waiting for the finalization of the proposed Class VI rule, which will ultimately be subject to the same fundamental limitations as the existing regulations.

Legislative amendments to exempt geological sequestration demonstration projects from RCRA and CERCLA are not necessary at this time. Operators may avoid liability under these statutes by not accepting for injection CO₂ streams that could be classified as “hazardous” waste. This approach ensures operators are not burdened by remote risks while preserving their incentive to actively avoid those risks and has the advantage of not requiring legislative amendment.

b. Streamline NEPA review of capture and sequestration projects

We recommend that the Council on Environmental Quality (CEQ) work with EPA to issue guidance for the environmental review of the capture and sequestration aspects of CCGS projects. The guidance document should clarify the standards and procedures for conducting NEPA review for each aspect of the project, including:

- Designating a lead agency;
- Establishing a timeline for review; and
- Identifying the mitigation of climate change as a public benefit.

Such guidance will speed up NEPA review by establishing a uniform, predictable process and by eliminating additional time needed to designate a lead agency. The same approach could also be applied to NEPA review for CO₂ transportation pipelines, once a federal framework is created for them.

12. Establish a standalone permitting process for commercial deployment of CCGS

a. Pass new legislation on CCGS to permit commercial sequestration projects

To facilitate the eventual widespread commercialization of CCGS, we recommend developing a comprehensive legislative and regulatory framework for EPA to manage CCGS permitting rather than relying on a patchwork of regulations under the CAA, SDWA (UIC), RCRA and CERCLA. The permitting regime should build on the UIC regulations and EPA's experience with the pilot and demonstration projects but provide authority to consider additional factors, such as environmental justice considerations, protection of private drinking water supplies, and protection of deep saline aquifers, in addition to mitigation of climate impacts.

The legislation should:

- Provide that permitting under its auspices satisfies the requirements of both SDWA and RCRA (as the UIC program does under the existing RCRA regulations);⁶⁰
- Include authority for EPA to compel compliance with permits and require corrective action and remediation akin to RCRA §§ 3008 and 7003;⁶¹
- Define a level of CO₂ stream purity above which the stream would be exempt from regulation as a hazardous waste or substance under RCRA and CERCLA;
- Amend SDWA, RCRA, CERCLA, and the CAA as required to bring them into conformance with the new regime; and
- Require financial assurance sufficient to cover monitoring, maintenance and verification (MMV), corrective action, remediation, damages, and site closure costs until the operator is released from responsibility.

b. Pass legislation similar to the Natural Gas Act to provide a federal agency with permitting authority for transportation

State entities generally have authority for siting CO₂ transportation pipelines, while the BLM maintains authority for siting pipelines across federal lands. In the short term, this arrangement should be sufficient for the construction of any new CO₂ transportation pipelines needed for early large scale demonstration projects. In the long term, however, a national network of CO₂ pipelines will need to be constructed.⁶² While transportation is not a focus of this roadmap, the Natural Gas Act may provide a useful model for regulating CO₂ pipelines under which a federal agency could be allocated authority to permit the siting, construction, and operation of the network.

D. Liability

While EOR/EGR activities have provided several decades of experience with CO₂ injection, there is still considerable uncertainty about the risks posed by the long term sequestration of commercial volumes of CO₂ in a variety of geological settings. Any liability regime needs to address two distinct phases in the geological sequestration project life cycle: operational liability and long term (post-closure) liability.

We propose substantial limits on operational liability for earliest movers, with the federal government sharing the cost of liability in this early stage for two reasons: (1) because the public stands to benefit from proof of sequestration technology and (2) to send a clear message to the rest of the world that the United States is committed to achieving rapid reductions in CO₂ emissions. We recommend shifting responsibility to the private sector as CCGS becomes commercially viable. We recognize that there will be a transitional phase from demonstration to commercial deployment and that some limits on liability may continue to be appropriate for a select and limited group of projects in this phase.

We also propose that long term liability for all sequestration sites (both demonstration and commercial) shift to the federal government after wells and sites have been properly decommissioned, monitored and then certified as closed by an appropriate agency (likely to be EPA and delegated states), with the cost of long term liability for and stewardship of such sites covered by an industry funded Post Closure Fund.

Our recommendations for the demonstration period focus on a legislative package that allows Congress to establish a coherent framework for liability over the sequestration life-cycle from injection to post closure, providing certainty to early actors while allowing important and complex details to be filled in over time.

13. Pass federal enabling legislation to create operational and long term liability framework

a. Authorize DOE, DOI and others to set caps on operational liability and provide indemnities for a limited number of geologically-diverse sequestration demonstration projects

A cap on operational liability for operators of the first five or so geological sequestration demonstration projects is a relatively simple mechanism for cost sharing between industry and government and provides certainty for operators while preserving incentives for responsible project management. Total operator liability⁶³ (under all existing federal and state laws) for operational incidents could be capped at a fixed amount per project, with federal government agencies providing indemnities for an additional fixed amount. Operators of the demonstration projects should be required to obtain and demonstrate financial assurance to meet their liability cap.

We suggest that the federal government provide the indemnity in order to avoid undue burden on individual states, but expect that agreements may be struck between state and federal governments to share potential costs for particular projects.

Legislation is required to authorize federal agencies to provide indemnities.⁶⁴ The legislation should strictly limit indemnification authority to a fixed number of demonstration projects, provide a cap on total government exposure for each incident, and ensure that state punitive damages claims are preempted except in the case of gross negligence or intentional misconduct. A cap on the indemnity balances the need to provide critical financial support for demonstration projects with the need to limit public exposure. The indemnity would cover those who capture, transport and sequester CO₂ as well as third-party private property owners who make their land available. Federal indemnities should *not* apply in cases of gross negligence or intentional misconduct. Legislation establishing the Post Closure Fund should calculate industry fees and payments into the Fund at a level adequate to re-pay the fisc for any public funds expended to cover operational liability for the demonstration projects. In this way, the industries that benefit from CCGS will help to pay for its development.

For generators and transporters of CO₂, we expect that the primary risks within their control – the presence of contaminants in the CO₂ stream – will be dealt with contractually between the CCGS parties (generator, transporter, geological sequestration operator) in order to avoid pipeline corrosion and avoid triggering RCRA or CERCLA liability. A standalone CCGS regulatory scheme specifically exempting CO₂ of sufficient purity from RCRA and CERCLA will provide certainty for generators and transporters over the longer term. An indemnity for third party private property owners removes a potential obstacle to siting demonstration projects; we propose it on the presumption that such owners are not necessarily in the best position to undertake monitoring and corrective action in the context of experimental technology. This rationale may not apply to commercial projects.⁶⁵

b. Transfer responsibility of sequestration sites to the federal government post-certification

In order to provide certainty for operators and assurance to the public that provision has been made for long term stewardship of sequestration sites, many commentators, including ELPC, recommend that responsibility for MMV, corrective action and damages, as well as ownership of CO₂ and rights of access be transferred to the federal government after a post closure certification process to be established by regulation. Operators should remain liable, however, for their gross negligence and intentional misconduct. Post closure certification should be granted only after several decades of MMV and specific performance standards confirming site stability have been met. ELPC has previously provided comments to EPA on appropriate certification performance standards.⁶⁶ We suggest that EPA reconsider what period of time should elapse before certification is granted; the 50 year period slated in the proposed UIC Class VI wells rule may be too long to provide an effective incentive both to engage in geological sequestration and to responsibly manage projects up to certification.

Government costs post-certification should be covered by an industry funded Post Closure Fund as outlined below.

c. Establish a national Post Closure Fund

Initial legislation should create a Post Closure Fund, financed by fees paid by industry and to be managed by the U.S. Treasury Department. Fees should be set at a level adequate to pay for MMV, corrective action, remedial action, and damages. The legislation should limit recovery for remediation and damages under the Fund to certain capped claims as described below and to be defined in future regulations by EPA. We recommend creating a claims architecture that includes environmental, natural resource, property and tort claims; pre-empts existing federal and state law claims; and is accessible on a strict liability basis without time limitations. This approach is suggested in order to provide certainty for future claimants and allow for estimation of future costs while ensuring that the Fund will not be depleted by a single incident.

14. Pass legislation to limit trespass and ejection actions

We have recommended that early geological sequestration demonstration projects be sited on operator- or government-owned land to minimize the need for negotiations with multiple parties. Even under this approach, there remains the possibility that CO₂ will migrate onto privately owned land. In that event, operators could be subject to actions in trespass or ejection even in the absence of actual damage.⁶⁷ Concerns about such potential liability for trespass and ejection may deter and/or delay demonstration projects. The prospect of litigation in the absence of damage could further deter operators or severely curtail siting options, thereby hindering commercial deployment of CCGS. Given that these actions are governed by state property law, our recommendations follow our approach to the resolution of pore space issues.

a. States consider legislation in the first instance

We recommend that states take responsibility in the first instance and consider legislation to either prevent trespass and ejection actions in relation to CCGS or else limit them to cases where there is actual damage. Applications for both federal funding programs and geological sequestration permits should favor projects sited in states that have clarified these issues by legislation.

b. Consider the need for federal legislation in light of state inaction

As CCGS moves towards commercial deployment, the federal government should consider the need for federal legislation to apply in states which have not yet acted.

15. Establish rules for Post Closure Fund contributions and claims

a. Set contribution fees for the Post Closure Fund and start collecting as demonstration projects come online

We recommend a two-tiered approach to Fund contributions with:

- regular fees from CO₂ generators, transporters and geological sequestration operators as well as from a broader range of industries that benefit from CCGS; and
- balloon payments by geological sequestration operators at post-closure certification based on operator performance and particular site characteristics and risk. For example, where a deep saline aquifer has been used for sequestration, the cost of future treatment of the water to render it potable and/or safe for agricultural purposes should be calculated and paid into the Fund. Present valuing would produce a zero charge, so a different calculation will be needed.

Congress should set the initial fees based on long run cost estimates for MMV, corrective action, remediation and damages. The initial estimates will necessarily be rough so provision should be made for regular reassessment of fees based on revised cost forecasts, the number and risk profile of sequestration sites, inflation and the level of funds currently held.

b. Establish rules for Post Closure Fund claims

EPA should lead the development of the Post Closure Fund claims architecture through notice and comment rulemaking to ensure appropriate public input on the types of claims recoverable, caps on claims, and the claims process. Federal legislation will be needed to either completely pre-empt state law claims or else set caps on recovery under those claims. Designing the claims architecture is likely to be a lengthy process, but one for which there is sufficient time. Given that claims cannot be made on the Post Closure Fund until a site has received certification of proper closure, the claims architecture can be established after fees start being collected.⁶⁸

16. Shift financial responsibility for operational liability to the private sector as CCGS becomes commercially viable

As we move to commercial deployment of geological sequestration, it is expected that the cost of CCGS will drop and liability will be more predictable. At that point, it is appropriate that private operators should assume liability for operational risks. At an appropriate point, liability caps and indemnities should no longer be available.⁶⁹ Much of the current literature suggests that the private financial assurance market, building on EOR/EGR experience, can appropriately insure against operational risk.⁷⁰ Operators should be required to obtain and periodically demonstrate sufficient levels of robust financial assurance as a condition of permitting.⁷¹

a. Consider an industry risk pooling mechanism for operational incidents

If operators are unable to access sufficient financial assurance on commercially feasible terms, a risk-pooling model may be required to achieve rapid commercial deployment of geological sequestration. We suggest that a secondary insurance model, along the lines employed by the nuclear industry in the Price Anderson Act may be appropriate.⁷² Under this model:

- Operators are required to obtain insurance for a fixed amount, which is drawn on first in the event that they cause an incident;
- In the event of a major incident, every operator is liable up to a fixed amount, which is drawn on second;
- The amount available per incident is capped at total industry contributions;
- Access to funds is based on strict liability; there is no statute of limitations on claims; and
- State law punitive damages are barred, there are caps on individual claims

While we do not recommend caps on individual claims or punitive damages for reckless behavior or intentional misconduct, a form of cap may be necessary if an industry-wide risk pooling mechanism is employed in order to limit the exposure of operators who are not at fault. This would require explicit federal legislation to preempt state law claims and cap damages for individual state law claims.

Alternatively, access to funds could be governed by the claims architecture established for the Post Closure Fund recommended in 15b, above.

CONCLUSION

We present this roadmap to foster discussion. We recognize that some elements of the proposal may be controversial. We welcome feedback.

NOTES

¹ The Harvard Environmental Law and Policy Clinic (ELPC) is dedicated to addressing major environmental issues in the U.S. and abroad and to providing its students an opportunity to do meaningful, hands-on environmental legal and policy work. Students and clinic staff work on issues such as climate change, pollution reduction, water protection and smart growth. This paper is authored by Leah Cohen, Sunjung Kim, Lara Kostakidis-Lianos, and Sara Rundell (all clinic students), together with Wendy B. Jacobs, Esq., Clinic Director. We gratefully acknowledge comments and contributions from Victoria A. Judson, Esq. of Steptoe & Johnson, Shaun Goho, Clinic Staff Attorney, Nancy M. Wang, Esq., and from former clinic students Phillip Assmus, Alejandra Maupome Cagigal, Sharon Jacobs, Matthew Littleton, Mina Makarious, Eric Nguyen, and Emily Wack.

² This paper focuses on onshore geological sequestration only and does not address offshore sequestration.

³See, e.g., Office of Management and Budget, A New Era of Responsibility: Renewing America's Promise (Feb. 26, 2009), available at <http://www.gpoaccess.gov/usbudget/fy10/pdf/fy10-newera.pdf>.

⁴ "Large scale demonstration projects" refers to early projects that demonstrate the injection and sequestration of 1 million tons of CO₂ per year over multiple years in different types of geological environments. See section 702(3)(D) of the Dept. of Energy Carbon Capture and Sequestration Research, Development and Demonstration Act of 2007 for definition of "large-scale" (P.L. 110-140); Massachusetts Institute of Technology, "The Future of Coal: Options for a Carbon-Constrained World (2007)" for discussion of demonstration projects.

⁵ See, e.g., *The Future of Coal Under Climate Legislation: SubComm. on Energy and Environment of the H. Comm. on Energy and Commerce*, 111th Cong. (2009) ("House Testimony") (Testimony of Hawkins, at 13.)

⁶ *Supra* note 3 and Testimony of Hawkins, *supra* note 5 at 17.

⁷ We define "early" to include the first five large scale demonstration projects. The actual number of initial demonstration projects may be lower or higher, but should be sufficient to demonstrate the sequestration of at least one million tons per year over multiple years and in a diversity of geological environments. *Supra* note 4.

⁸ Our work builds on the work of many others, including: CCSReg Project, "Carbon Capture and Sequestration: Framing the Issues for Regulation, An Interim Report from the CCSReg Project," Department of Engineering and Public Policy, Carnegie Mellon University, December 2008; IPCC, "Carbon Dioxide Capture and Storage," Special Report (2005); Massachusetts Institute of Technology, *The Future of Coal: Options for a Carbon-Constrained World*;" Klass & Wilson, "Climate Change and Carbon Sequestration: Assessing a Liability Regime for Long-Term Storage of Carbon Dioxide," 58 Emory L.J. 103 (2008); Dooley, Trabucchi, & Patton, "Tipping Fees Can't Save us From the Tipping Point: The Need to Create Rational Approaches to Risk Management that Motivate Geologic CO₂ Storage Best Practices," GHGT-9, forthcoming; Trabucchi & Patton, "Storing Carbon: Options for Liability Risk Management, Financial Responsibility," BNA Daily Environment Report (2008); Patton & Joyce, "Hazardous Waste Financial Assurance: A Comparison of Third Party Risk Management Mechanisms – Suggestions for Reform," 39 Env't Rep. 1181 (2008); World Resources Institute, "CCS Guidelines," WRI (2008); USCAP, "A Blueprint for Legislative Action: Consensus Recommendations for U.S. Climate Protection Legislation," January 2009.

⁹ While many of the financial incentives apply equally to carbon capture, the roadmap focuses primarily on sequestration, not capture or transport.

¹⁰ See, e.g., House Testimony (statement of Larry S. Munroe, Southern Company at 4).

¹¹ See, e.g., House Testimony (statement of David Crane, NRG Energy, Inc.) at 2-3, (statement of Frank Alix, Powerspan Corp.) at 3, (statement of Larry Monroe); MIT, "Future of Coal," *Supra* note 4; WRI, *supra* note 8.

¹² See House Testimony (Opening Statement Rep. Waxman); (Statement of Hal Quinn, National Mining Association that "if the United States and every OECD nation completely stopped using coal, most of the world's CO₂ emissions would remain untouched.") at 1.

¹³ *Supra* note 5 at 6.

¹⁴ *Supra* note 5 at 17.

¹⁵ House Testimony (Statement of Crane) at 3.

¹⁶ EOR/ EGR using CO₂ is the process by which CO₂ is injected into oil or gas reservoirs to facilitate the recovery of residual oil or gas reserves (also referred to as tertiary recovery).

¹⁷ House Testimony (Statement of Monroe) at 5.

¹⁸ See Patton articles, *supra* note 8 and Klass & Wilson, *supra* note 8, at 34.

¹⁹ See Klass & Wilson, *supra* note 8 (discussing “race to the bottom” in connection with FutureGen) at 29-30.

²⁰ See Comments of Harvard Environmental Law and Policy Clinic to EPA regarding EPA’s proposed regulations for Class VI wells UIC wells, at 36-37.

²¹ See GAO report, “Deep Injection Wells: EPA Needs to Involve Communities Earlier and Ensure that Financial Assurance Requirements are Adequate,” (2003).

²² House Testimony (Hawkins Statement) *supra* note 5, at 4.

²³ Hearing Before the U.S. House of Representatives Science and Technology Subcommittee on Energy and the Environment: “FutureGen and the Department of Energy’s Advanced Coal Programs,” Testimony of Sarah M. Forbes, World Resources Institute (“Forbes Testimony”), at 3. See GAO Report, “Clean Coal: DOE’s Decision to Restructure FutureGen Should Be Based on a Comprehensive Analysis of Costs, Benefits and Risks” at 8.

²⁴ Even with restrictions on CO₂ emissions, significant investment will be necessary to get companies ‘down the experience curve’ and make CCGS economically viable. See e.g. (Statement of Quinn), *supra* note 11 at 3.

²⁵ See e.g., (Forbes Testimony), at 3; (Testimony of Quinn), *supra* note 11 at 2.

²⁶ Economic modeling is required to determine specific funding levels required given the suite of available and proposed financial incentives.

²⁷ *Supra* note 4.

²⁸ Competitive criteria should reflect recommendations 9b and 14a.

²⁹ *Supra* note 3 at 122-23 (proposing reductions of some tax credits). While PAYGO has been suspended in part for ARRA, President Obama has indicated support for reinstating PAYGO rules: The White House, The Agenda: Fiscal, available at <http://www.whitehouse.gov/agenda/fiscal>.

³⁰ While applications for Round III closed on January 20, 2009, DOE recently indicated its intention to reopen the round.

³¹ This modeling should factor in potential state contributions. Many states have begun studying and providing funding for CCGS activities. See e.g. Courtney Welch, National Conference of State Legislatures, “Memorandum Re: Carbon Capture and Sequestration Legislation, Mar. 28, 2008.”

³² DOE is supporting seven projects under Phase III of this Program. Most will, over a number of years inject a *total* of 1Mt, with one project injecting up to a total of 2Mt. We describe these projects as “pilot” to distinguish them from what we consider “demonstration” scale projects which inject 1Mt *per year* for a number of years.

³³ *Supra* note 4.

³⁴ EOR operators have the benefit of significant experience injecting CO₂, existing pipeline infrastructure and an independent economic incentive for injecting CO₂. See e.g. (Testimony of Duncan), *supra* note 11 at 4.

³⁵ DOE estimates that current technology will allow capture at a cost of \$150 per ton: see U.S. Department of Energy, Carbon Capture Research.

³⁶ I.R.C. § 45Q(a)(2). ARRA clarified that § 45Q requires EOR operators to inject and sequester CO₂ in order to qualify for the credit. See ARRA, Sec. 1131(a).

³⁷ Credits under § 45Q apply to the person who *captures* the CO₂, unless otherwise provided by regulations so these credits provide only an indirect incentive to EOR operators. See I.R.C. § 45Q(d)(5).

³⁸ Providing an increased \$/ton credit which cuts out when the price of oil rises above a fixed amount could be considered as an administratively simpler alternative.

³⁹ I.R.C. § 45Q(a)(1).

⁴⁰ We do not recommend increasing the credit available under § 45Q(a)(1) in a blanket fashion given the substantial public expense this would incur.

⁴¹ I.R.C. § 45Q(e).

⁴² I.R.C. § 48A currently provides a 10%-30% tax credit for investment in IGCC or other 'qualifying advanced coal projects.' Advanced coal-based generation technology includes IGCC or other advanced coal-based generation technology defined by energy efficiency (net heat rate) and emissions performance standards. I.R.C. § 48A(f).

⁴³ This would be a permissible use of EPA's enforcement discretion: It would achieve expedited reduction of CO₂ emissions, test new technologies, and gather data for eventual regulation of CO₂ emissions from power plants. See, e.g., Association of Irrigated Residents v. EPA, 494 F. 3d 1027 (D.C.Cir. 2007).

⁴⁴ CAA Section 415 requires a 20% federal investment. A determination would need to be made about whether to keep or eliminate this requirement.

⁴⁵ See New York v. EPA, 413 F. 3d 3 (D.C.Cir. 2005); EPA Fact Sheet, available at <http://www.epa.gov/nsr/fs20070605.html>

⁴⁶ Additional conditions may be appropriate.

⁴⁷ <http://www.energy.gov/news2009/6934.htm>

⁴⁸ DOE's final rule implementing the Innovative Technology Loan Guarantee Program states that eligible technologies must be beyond their pilot state, but there can be no more than three commercial projects applying this technology in the United States.

⁴⁹ (Testimony of Crane), *supra* note 11 at 1.

⁵⁰ See IRS Publication 4078.

⁵¹ Tax credit bonds provide a federal tax credit that offsets some or all of the interest that State or local governments would otherwise need to pay on the borrowing. See The American Recovery and Reinvestment Act

of 2009: Full Summary of the Provisions from Senate Finance, House Ways & Means Committee, at 10 (February 12, 2009) *See also* ARRA § 1531 (re Build America Bonds).

⁵² *See, e.g.*, encouraging retrofits, IGCC technology.

⁵³ *See, e.g.*, Section 302 of the Federal Land Policy Management Act of 1976, 43 U.S.C. § 1732 (providing BLM authority to issue “easements, permits, leases, licenses, published rules, or other instruments as the Secretary deems appropriate.”)

⁵⁴ *See, e.g.*, 30 U.S.C. § 226(m); 25 U.S.C. § 396g.

⁵⁵ *See, e.g.*, Proposed Wyoming HB 89 (2008).

⁵⁶ *See, e.g.*, Richard J. Lazarus, *Super Wicked Problems and Climate Change: Restraining the Present to Liberate the Future* (forthcoming in *Cornell Law Review*, vol. 94).

⁵⁷ *See* EPA, “Using the Class V Experimental Technology Well Classification for Pilot Geologic Sequestration Projects” (UIC Program Guidance No. 83), March 1, 2007 at 3.

⁵⁸ *See* note 20, *supra*.

⁵⁹ *See* generally UIC Program Guidance.

⁶⁰ 40 CFR § 257.1(9).

⁶¹ *See, e.g.*, 42 U.S.C. § 6928, 42 U.S.C. § 6973.

⁶² *See, e.g.*, CCSReg Project, *supra* note 8, at 25.

⁶³ We propose both a cap on liability per incident and a cap on total liability for each demonstration project, including CO₂ capture, transport and sequestration.

⁶⁴ *See* House Report 109-611, “Energy Research, Development, Demonstration, and Commercial Application Act of 2006” at 38. Texas and Illinois each passed legislation implementing an indemnity in their bids to attract FutureGen: see Texas HB 149 and Illinois SB 1704.

⁶⁵ Where property owners receive commercial rents in exchange for use of their property, it may be appropriate to impose monitoring obligations and liability.

⁶⁶ *Supra*, note 20, at 8-12.

⁶⁷ Trespass is a claim for money damages for someone or something being on one’s real property. Ejectment is an action to have the person or thing removed off of the real property. Proof of damage is typically not a required element for either action.

⁶⁸ This model would follow the approach to development of the Oil Spill Liability Trust Fund (OSLTF). Congress created the Fund in 1986, but did not pass legislation authorizing use of the Fund or collection of fees for the Fund until 1990 under the Oil Pollution Act. See http://www.uscg.mil/npfc/About_NPFC/osltf.asp.

⁶⁹ There may be the need for a transitional approach to liability as CCSG shifts from demonstration to commercial deployment.

⁷⁰ See, e.g., Trabucchi & Patton, Patton & Joyce, Dooley et al., *supra* note 8.

⁷¹ Decisions on types of financial assurance mechanisms that are acceptable should take into account the effectiveness of each mechanism in providing robust assurance in cases where operators encounter financial difficulties. See *Supra*, note 200, at 15-23, Patton & Joyce, *supra* note 8.

⁷² 42 U.S.C.A. § 2210. Another model for addressing liability for catastrophic events is provided by the Oil Spill Liability Trust Fund (OSLTF) under the Oil Pollution Act (OPA), 33 U.S.C.A. § 2701.