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Submission to the

U.S House of Representatives Select Committee on Energy Independence and Global Warming

'The Future of Coal under a Carbon Cap and Trade Regime'

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Introduction

Global climate change is the greatest environmental challenge we face. We have at most a few decades to make the necessary investments to prevent the most serious impacts of climate change. Future generations will judge us based on the investments we are considering now.

In its February 2007 report, the Intergovernmental Panel on Climate Change (IPCC) warns that global emissions must peak no later than 2015 if we are to hold average global temperature increases to 2.4°C (4.3°F) or less. Moving to an emissions pathway that will hold temperature increases and other impacts to a minimum will require a colossal effort. There is no time to lose given the long lag in research and development cycles, and energy-intensive infrastructure and product turnover.

Fundamentally altering the world's energy system is unlikely to occur within this timeframe. It is thus imperative to find means to reduce the footprint of the existing system – most particularly, of coal, which is the most greenhouse gas intensive of the fossil fuels driving climate change. It is in this context that carbon dioxide capture and sequestration (CCS) becomes one of the most critical technologies in the menu of choices we have to cut greenhouse gas emissions. It is the only option that provides a potentially near-term solution to rapidly expanding coal use here, in China and around the world. CCS must play the critical role of curbing growth in emissions from coal until other alternatives are ready.

Energy efficiency and renewable energy have enormously important roles to play in helping countries meet their development goals more cleanly, but together are unlikely to be able deliver the quantity of energy needed to offset sufficient coal use in the near future. Some predict nuclear power could enter a renaissance, but it seems likely its contribution will be limited due to high costs and public concern. We have been reminded quite painfully over the past few years that oil and natural gas supplies are increasingly concentrated in a few, often unstable countries and are unlikely to substitute for coal on sufficient scale. Other low-carbon energy options are still more speculative. Given that coal fuels over half of this country's electricity production and almost 80 percent in China, while all low-carbon options need to be deployed to prevent the more serious impacts of climate change, a solution must be developed for the coal that will undoubtedly be consumed over the next few decades.

Unfortunately, we are not yet in a position to widely install CCS technology. It is currently expensive in all but relatively niche applications. The question of how the public will react to CCS is largely untested. And the issue of whether we can successfully scale up its use beyond the relatively small applications we have today is still hard to assess. But while CCS is not a panacea to the climate challenges we face, it is currently the only tool that allows us to deal with emissions from coal. Several steps will be critical, and we believe should be adopted to promote the rapid penetration of this technology:

Public funding to support energy research, development and demonstration (RD&D) has declined notably in most industrialized countries over the past few decades. WRI believes that greater spending on climate RD&D is called for in general, and more on CCS specifically. The knowledge gleaned from this RD&D will help us understand more quickly what role CCS will play in the climate solution.

A carbon cap and trade regime will be a critical first step in driving development and deployment of CCS technologies at the scale necessary to avoid catastrophic climate change. By creating a price for carbon, a cap and trade regime will provide incentives for industry to invest in low carbon technologies. It will also help the Department of Energy, Environmental Protection Agency, and other key institutions prioritize their work plans more effectively. However, even the most robust legislative proposals for cap and trade offered today will not be sufficient to drive large-scale investment in CCS over the first decade or so. Estimated carbon prices under such proposals are too low to offset the high capture costs that exist today.

Other policy tools are available and should be adopted to speed CCS deployment. These include special incentives for rapid technology development and deployment, and establishing clear siting regulations Barriers to widespread deployment of CCS, including lack of public understanding and acceptance, the need for accelerated RD&D, and resolution of legal and regulatory issues, must also be addressed.

In addition to the points raised below, the US Climate Action Partnership, to which WRI belongs, in June of 2007, announced a set of principles we believe could facilitate the development of legislation related to CCS.[1] We continue to believe that these USCAP principles provide a strong framework for progress.

1. What are the principle barriers- technical, economic, legal or regulatory to widespread commercial adoption of CCS technologies?

Lack of a policy driver. The largest barrier to commercial adoption of CCS technology is the lack of a federal carbon policy. Without price signals to place a value on carbon mitigation, companies have little incentive to invest and cannot do so with certainty given the enormous capital costs involved. CCS costs as estimated by Battelle Memorial Institute are \$40-60/ton-CO_2 for a pulverized coal facility. As noted in testimony to this committee on 6 September 2007 by David Hawkins (Natural Resources Defense Council) and Robert Sussman (Latham and Watkins, LLP), current legislative proposals to cap greenhouse gas emissions are unlikely to send the price signals necessary to promote widespread commercial adoption of CCS. Other policy measures are available, however, to specifically promote CCS deployment.

[1] See http://www.us-cap.org/policystatements/USCAPGeologic%20CarbonStorageRecommendations070608.pdf

Need for large-scale demonstration projects. The components of carbon capture, transport and sequestration largely exist now, but we need more experience integrating these pieces together to fully understand where opportunities and challenges remain. The only way to gain this experience and knowledge is through a diversity of large-scale demonstration projects. Integrating the lessons learned from such projects will be vital to establishing the necessary regulatory and legal frameworks to ensure safe and efficient deployment of CCS. DOE is leading important work through FutureGen and the Regional Carbon Sequestration Partnerships. Demonstration projects in the latter, however, are not large enough to establish the necessary experience and confidence in CCS technologies on the time scale needed.

Need for increased RD&D to improve capture technology. On the technical front, the capture component is by far the most expensive part of the entire CCS process. (See Figure 1). Greater urgency (and hence financing) is needed to discover ways to separate and pressurize carbon dioxide at lower cost. Both public and private stakeholders are conducting research on advanced technologies that could result in cost breakthroughs, even if these developments are generally incremental rather than overnight. Unfortunately, both public and private spending on energy research and development has declined substantially around the globe over the past few decades[2] despite our knowledge that these investments can return enormous commercial, social and strategic benefits as illustrated by the enormous benefits that resulted from public spending for space exploration. Success will require reversing this trend.

Legal and regulatory barriers. There is currently no comprehensive regulatory framework in the U.S. designed to deal specifically with CCS. CO_2 sequestration will require new standards and increased cooperation between federal and state agencies. Regulatory and legal analogs exist that can inform the development of a framework for CCS. Important lessons can and should be taken from analogous programs such as underground natural gas storage, enhanced oil recovery, landfill emissions mitigation and radioactive waste disposal. But CCS is fundamentally different from these other activities. In small quantities, it is not toxic. To protect the environment, we must limit leakage of CO_2 over periods of hundreds of years. And the volumes of material to be sequestered are staggeringly larger than those of all other disposal quantities combined. Thus, the lessons from other models are limited. An urgent need on the road to a successful CCS program will require a resolution to the debate over jurisdictional authority and institutions involved in regulation setting. Lack of cooperation among federal agencies, and between federal, state and local jurisdictions must be resolved in order to provide the certainty necessary to drive private investment and public confidence.

Lack of public understanding and acceptance. Public perceptions of technology are increasingly important to its long-term viability. The state of public understanding of CCS technology, its risks, costs and relation to alternatives is extremely low. In order

[2] See for example, Dooley, et al, "Energy R&D in the Industrialized World: Retrenchment and Refocusing", PNNL, Washington, DC, 1998.

for CCS to be deployed at the scale necessary to significantly reduce emissions, the public will need to understand more about the technology and have confidence in its safety and effectiveness. WRI's work on CCS has focused on ensuring that CCS projects, if they are to be done, use the highest environmental and safety standards practical. An early mistake could result in public opposition to the technology, forever removing it from our list of options to deal with emissions from coal.

2. What specific steps should this congress and the federal government more generally take to overcome these barriers and to ensure that CCS technologies are commercially available at the earliest possible date?

Addressing the barriers for large-scale CCS deployment will take a concerted effort to develop effective policy incentives, gain a better understanding of the challenges in technology integration and scale, reduce costs of implementation, develop a regulatory framework to ensure safe and effective projects, and to engage with the public to ensure acceptability of these practices. It should be noted that these cannot be done serially; that approach would take too long if we are to have any hope of reducing near-term GHG reductions goals from coal-based electric power. Instead, we must run these policies in parallel, and at significant levels. We discuss ways to address each of these challenges below.

a) Develop effective policy drivers. We believe it is important for both energy security and climate protection to give industry greater certainty as soon as possible to guide investments in the power sector. Without greater insights into the nature and magnitude of future domestic carbon constraints, we will not be able to prioritize where key investments are needed in new generation capacity and transmission.

WRI agrees with the thrust of the testimonies delivered to this Committee by Mr. David Hawkins and Mr. Robert Sussman on 6 September 2007. The prices expected under the proposed cap and trade programs are unlikely to incentivize the deployment of CCS, at least in the next decade or two. This delay in deployment would be costly in many ways. New coal plants built without CCS would result in substantial lock-in of CO_2 emissions for the long lifetime of these plants, and increase economy-wide costs of reducing emissions and meeting future national emission targets. Delays in deployment would also hinder much needed advancements in technology integration and cost reduction.

Therefore, additional policy drivers are needed to spur innovation and deployment of CCS technologies. Emission performance standards, requiring that all new power plants do not exceed a specific CO_2/MWh threshold, would ensure that no new coal plants would be built without CCS. A portfolio standard for CCS is another option, which would require that some portion of electric utility sales meet CO_2 standards achievable with CCS. Standards such as these should be considered to provide industry the incentives to invest in CCS, enabling important learning-by-doing benefits. In developing policy incentives, it will be critical to a) encourage early

adoption of these technologies b) reward, and not penalize early movers, and c) allow for flexibility in how targets can be met.

b) Support *larger*-scale CCS projects

DOE's Regional Carbon Sequestration Partnership program is conducting about 25 small scale (Phase II) and 7 medium scale (Phase III) demonstration projects. These projects will test a range of capture technologies and geological formations across North America. While much can be learned from these efforts, there is an urgent need for demonstration projects at the scale expected from capturing and sequestering CO_2 emissions from a coal-fired power plant. Integrating CCS technologies into a typical 800MW coal plant will require capturing and sequestering 4 to 5 million tons of CO_2 *every year*, an order of magnitude higher than planned demonstration projects, even those in Phase III. These larger demonstration projects are necessary to reach the higher injection rates, underground pressures, and overall CO_2 volumes expected as coal-fired power plants employ CCS. They would also aid in the development of an effective regulatory framework. The cost of buying CO_2 for the demonstration projects is the barrier preventing larger demonstrations from occurring.

c) Increase RD&D. Public funding for research, development and demonstration (RD&D) of clean energy technologies has declined considerably over the past decades and we believe much greater funding is justified given the economic, social and environmental benefits of reducing greenhouse gas emissions.

The most significant barrier to wide-scale commercial deployment of CCS is the high costs associated with capture. While DOE is leading important work on RD&D for CCS through their research programs, FutureGen and the Regional Carbon Sequestration Partnership program, much more can and should be done. Federal investment in RD&D focused specifically on reducing capture costs will be a critical addition to existing, though insufficient private funding. Increased RD&D funding is a compelling step that Congress could take to catalyze private sector investment, greater interest in innovative public-private partnerships, and ultimately reduce the cost barriers to commercial deployment of CCS.

In the longer term, an adequate response to the climate challenge will mean capturing emissions not only from new plants specifically designed for that purpose, but also retrofitting CCS capability onto existing conventional coal plants. This is a highly inefficient option, but needs to be compared to the high costs of prematurely retiring existing power plants. Further RD&D effort is needed to bring down the cost and energy penalty of retrofitting coal plants with CCS.

Increasing current funding of RD&D for CCS technologies, specifically, could also pay dividends in trade and competitiveness of U.S. technologies vis-à-vis other coal-consuming nations. There could be enormous markets for these technologies in the future, so we need to invest now to build capacity.

d) Develop a regulatory framework and address long-term liability. EPA's Underground Injection Control program, which oversees, in part, the injection of CO_2 underground for enhanced oil recovery, offers important lessons and experience to build from, but is incomplete. The UIC regulations do not address CCS-specific issues related to larger CO_2 volumes and higher pressures, measuring and monitoring needs, and long-term stewardship concerns.

It seems likely that EPA will move from its draft guidance for existing CCS projects to a new category of wells under the UIC regulatory structure. However, the development of this framework will be both resource-intensive and time-consuming. To accelerate adoption of these technologies and practices, more funding and higher prioritization of this effort at EPA is urgently needed. EPA should not be forced to "rob Peter to pay Paul" in order to fund development of CCS regulations.

WRI believes that an early regulatory framework for CCS should be environmentally robust, focused on protecting human health and safety, ecosystems, and underground sources of drinking water. In addition to the inherent importance of these protections, public perception of CCS is in a crucial formation stage. We cannot afford any mistakes that could turn public opposition against these practices. If this occurs, it could result in having CCS being prematurely removed from our list of options to address climate change.

Flexibility of this framework will be a key component; it will need to adapt to lessons learned in the field as we gain more experience with these practices. In addition, these regulatory requirements cannot be gold-plated, discouraging investment and innovation. We believe there is a way to promote good management of CCS projects by ensuring financial responsibility mechanisms that put carrot and stick incentives in the right places.

Long-term liability is an important issue from many perspectives. The public needs assurance that adequate care and funding will be in place to manage storage facilities long into the future, potentially long after the companies that operated storage facilities go out of business. Project developers, financiers, and insurers need to know the operational and regulatory requirements up front in order to manage costs and risks. There is a need for much greater clarity in this regard.

Developing a system to address these long-term liability issues can provide a more certain approach to mitigate CCS risks, foster incentives for private investment, and enhance public confidence in CCS technology. A framework crafted through federal legislation, rather than a patchwork of state regulations, may be better able to integrate lessons from past regulatory frameworks and to accommodate the views of different stakeholders. Some negotiation at the state level will still be required for hydrocarbon, water, and property issues, but such concerns can be mitigated through a common federal framework that clearly delineates performance standards, financial responsibility, and project liability.

WRI has held several stakeholder workshops on CCS liability and will have another in late October. We plan to deliver recommendations on policy options to deal with questions of long-term liability, potential indemnification and financial responsibility of CCS projects this winter.

e) Engage the public. Most people are not aware of carbon capture and sequestration as a carbon mitigation option, and even fewer understand the relative risks and benefits. There is good reason to be concerned over public perception of CCS; lack of information will prevent a balanced evaluation of the technology and create exaggerated perceptions of risk which can delay or stop implementation. As an example, earlier this year a number of environmental justice groups successfully opposed legislation to accelerate CCS regulations in California, comparing the risks of CCS to those of volcanic areas that have resulted in thousands of deaths from large, sudden leaks of CO_2.

Because most people know little about CCS, providing clear, timely, and unbiased information is a crucial aspect of developing public confidence. However, a one-way communication strategy, such as simply informing the public about CCS, is insufficient.

Greater public outreach and participatory dialogue on CCS projects will have important benefits. Information gained through stakeholder dialogues can improve the siting and monitoring practices by allowing industry to modify them in response to stakeholder needs and concerns. Public participation can also speed deployment by informing project developers of a project's viability early on, and avoid wasting resources in development of ill-fated projects. Finally, a healthy interactive dialogue with the public will help ensure long-term, sustainable public support by engendering confidence in the process as well as the technology.

The DOE's Regional Carbon Sequestration Partnerships have begun the enormous task of engaging local, state, and federal stakeholders on CCS demonstration projects. While experience from the DOE pilot projects will inform development of CCS regulations and future outreach efforts, the impact on the larger policy debate is likely to be minimal. Success at the project-level must be incorporated into a larger regulatory effort to manage the risks of CCS based on input from public participation.

Familiarity with CCS technologies, vital to creating wider public acceptance, can only be established through development of more large-scale demonstration projects. Another integral component of public acceptability is confidence in a regulatory structure that manages the risks of CCS and establishes channels for the public to participate and develop confidence in the technology. Any federal legislation that advances CCS deployment must include public outreach as a core element.

A larger national community will be observing carefully, especially in the early days of CCS. An expanded and carefully coordinated public outreach effort, in addition to a strong regulatory framework and successful early demonstration projects, will be critical to command and maintain public confidence in CCS.

3. What is the projected timeframe for commercial availability of CCS technologies and to what degree can the timeframe be accelerated through the measures identified in response to question 2, above?

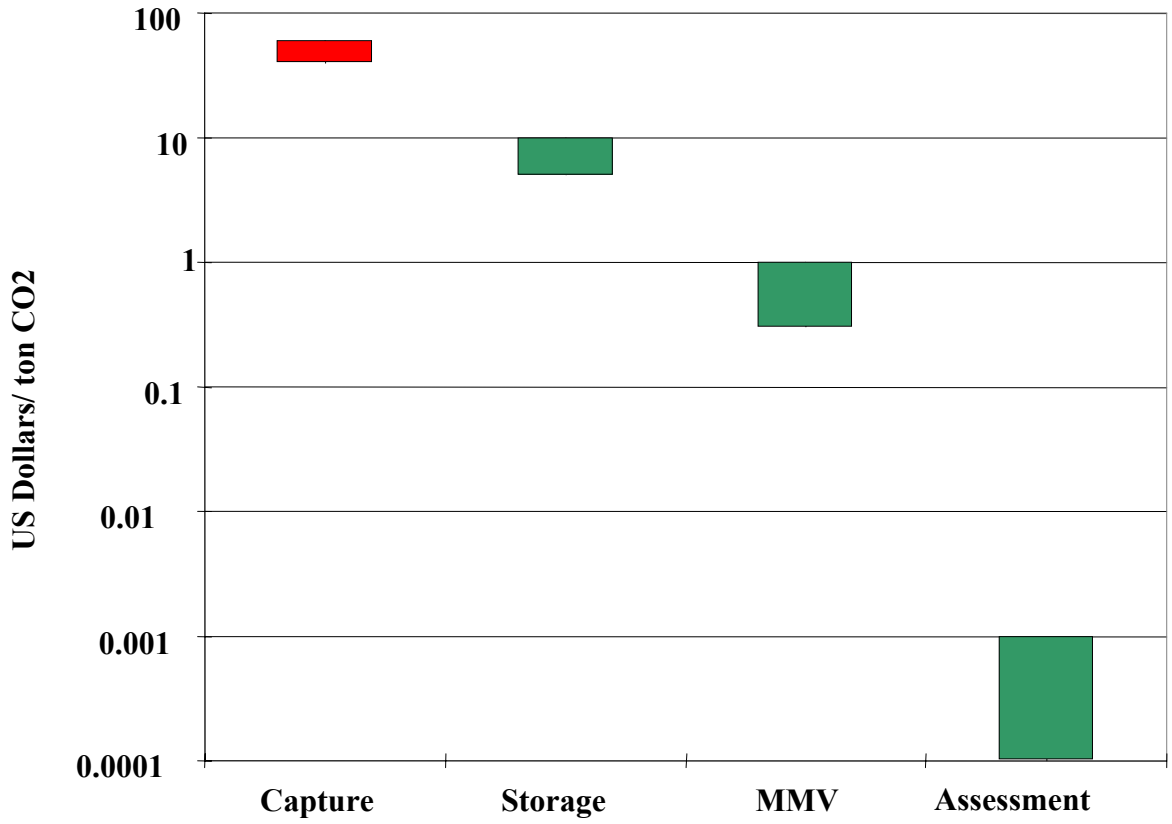
We are currently on a path of sequential research, demonstration and deployment that would make CCS commercially viable and widely deployed around 2025 or 2030. This schedule is not compatible with holding global concentrations of greenhouse gases at a safe level. Countries like China and India would almost certainly lag the U.S. in terms of deployment by 10 years or more. Given the coal-intensive infrastructure construction underway now and through the coming decades, we have no time to spare to demonstrate that CCS is safe and can operate under a viable economic framework. An aggressive (although still plausible) horizon would be a program that leads to large scale penetration of CCS technology by 2020. This will require urgent, high level efforts on each of the barriers outlined above.

This path is not without tradeoffs. The efforts towards accelerating the deployment of CCS need to be balanced so that CCS policy does not divert investments and attention away from other key components of the larger climate change strategy – in particular renewables and energy efficiency. Public acceptability will be a key concern, both at the local and the national levels. The CCS community needs to demonstrate to the public in a compelling way that the technology is a safe, necessary and affordable option to avoid the worst impacts of climate change. But the consequences of failure on this front should not be underestimated; unless we can reduce the GHG footprint from coal, we are certain to face a reality of significant global warming and its attendant very costly impacts.

Conclusion

Carbon capture and sequestration can only assume a role in curbing the growth of greenhouse gas emissions from coal combustion through a concerted government effort to create the right policy drivers to spur accelerated deployment. We face the monumental challenge of balancing the urgency for action within the next decade or two with the responsibility to ensure its safety and effectiveness. Congress must push forward on all fronts: creating a price through a cap and trade program to provide incentives for investment, funding full-scale demonstration projects and advanced RD&D with a focus on reducing capture costs, creating a sensible regulatory framework that creates certainty, and working to build public acceptance. Congress now has the opportunity to make these critical investments in a low-carbon future, and there is no time to lose.

Figure 1. Projected Costs of CCS Technology Elements



Source: Adapted from Julio Friedmann, Lawrence Livermore National Laboratory.