Testimony of Frances Beinecke
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Before The Subcommittee on Public and Consumer Solutions to Global Warming and Wildlife Protection
Committee on Environment and Public Works
United States Senate
Hearing On
America's Climate Security Act

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Thank you for the opportunity to testify today regarding America's Climate Security Act. My name is Frances Beinecke. I am the President of the Natural Resources Defense Council (NRDC). NRDC is a national, nonprofit organization of scientists, lawyers and environmental specialists dedicated to protecting public health and the environment. Founded in 1970, NRDC has more than 1.2 million members and online activists nationwide, served from offices in New York, Washington, Los Angeles and San Francisco, Chicago and Beijing.

Chairman Lieberman, and Ranking Member Warner, let me congratulate you both on the introduction of your global warming bill, America's Climate Security Act. NRDC views your legislation as an important, initial step toward enactment of comprehensive global warming legislation and we look forward to working closely with you, and the other members of the Subcommittee and the Committee, to report legislation to the full United States Senate.

The time for action on global warming has already been delayed too long. Every day we learn more about the ways in which global warming is already affecting our planet. As described in a full page story in Monday's Washington Post, dramatic new satellite pictures show that summertime arctic ice has declined by 40 percent since 1979 (Figure 1). The UN Intergovernmental Panel on Climate Change (IPCC) found that 11 of the past 12 years are among the 12 hottest years on record. The Greenland and West Antarctic ice sheets are losing mass at accelerating rates. Rising sea surface temperatures correlate strongly with increases in the number of Category 4 and 5 hurricanes. Increases in wildfires, floods and droughts are predicted to occur as global warming continues unabated. Our oceans are warming and becoming more acidic. Everywhere one looks, the impacts of a disrupted climate are confronting us.

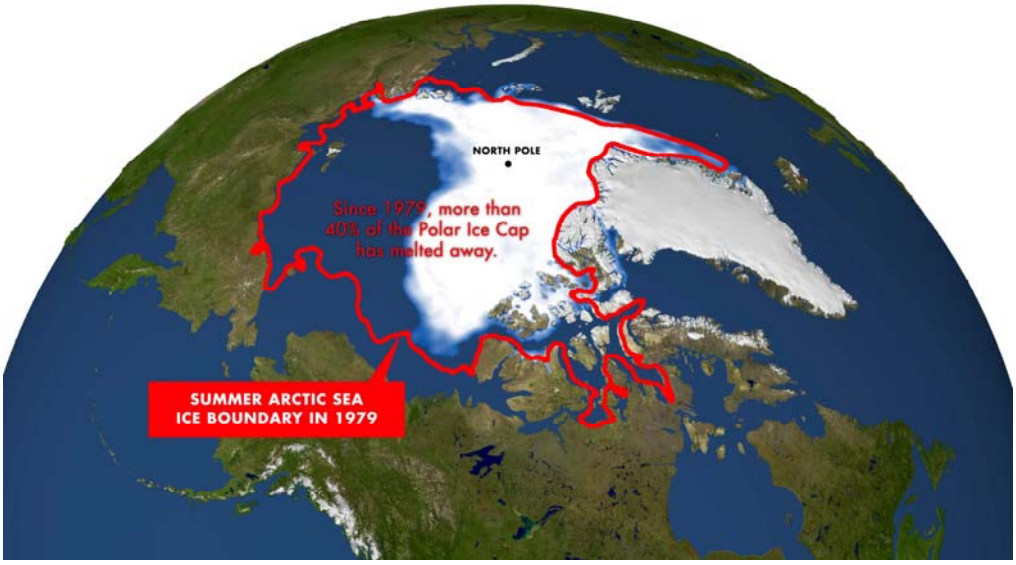

Figure 1: ARCTIC MELTDOWN - Arctic summer sea ice extent in 1979 and 2007. Source: NASA.

The reality of global warming is now a recognized fact throughout the world. Earlier this year, the United Nations Intergovernmental Panel on Climate Change concluded that

warming of the earth is “unequivocal” and that with 90 percent certainty, humans are causing most of the observed warming. At about the same time, major businesses, including many of the world’s largest companies in diverse industry sectors, banded together with environmental organizations, including NRDC, under the umbrella of the U.S. Climate Action Partnership (USCAP), to call for mandatory legislation that would reduce emissions by 60-80 percent by 2050. In April, the United States Supreme Court ruled that greenhouse gases are air pollutants subject to control under the Clean Air Act.

In the past year, stories about global warming have appeared on the covers of Time, Newsweek and Sports Illustrated. And recent polls show very high levels of concern about global warming. For instance, a recent opinion poll conducted by the Yale University Climate Center indicates that 62 percent of Americans believe that life on earth will continue without major disruptions, only if society takes immediate and drastic action to reduce global warming Finally, just this month, the Nobel Peace Prize was awarded jointly to Al Gore and to the IPCC for their work on global warming. Global warming has come of age as an issue of supreme importance.

Climate scientists warn us that we must act now to begin making serious emission reductions if we are to avoid truly dangerous global warming pollution concentrations. Because carbon dioxide and some other global warming pollutants can remain in the atmosphere for many decades, centuries, or even longer, the climate change impacts from pollution released today will continue throughout the 21st century and beyond. Failure to pursue significant reductions in global warming pollution now will make the job much

harder in the future—both the job of stabilizing atmospheric pollution concentrations and the job of avoiding the worst impacts of a climate gone haywire.

Since the start of the industrial revolution, carbon dioxide concentrations have risen from about 280 parts per million (ppm) to more than 380 ppm today, and global average temperatures have risen by more than one degree Fahrenheit over the last century. A growing body of scientific opinion has formed that we face extreme dangers if global average temperatures are allowed to increase by more than 2 degrees Fahrenheit from today's levels. We may be able to stay within this envelope if atmospheric concentrations of CO_2 and other global warming gases are kept from exceeding 450 ppm CO_2- equivalent and then rapidly reduced. However, this will require us to halt U.S. emissions growth within the next few years and then cut emissions by approximately 80% over the next 50 years.

This goal is ambitious, but achievable. It can be done through an annual rate of emissions reductions that ramps up to about a 4% reduction per year. (See Figure 2.) But if we delay and emissions continue to grow at or near the business-as-usual trajectory for another 10 years, the job will become much harder. In such a case, the annual emission reduction rate needed to stay on the 450 ppm path would double to 8% per year. In short, a slow start means a crash finish, with steeper and more disruptive cuts in emissions required for each year of delay.

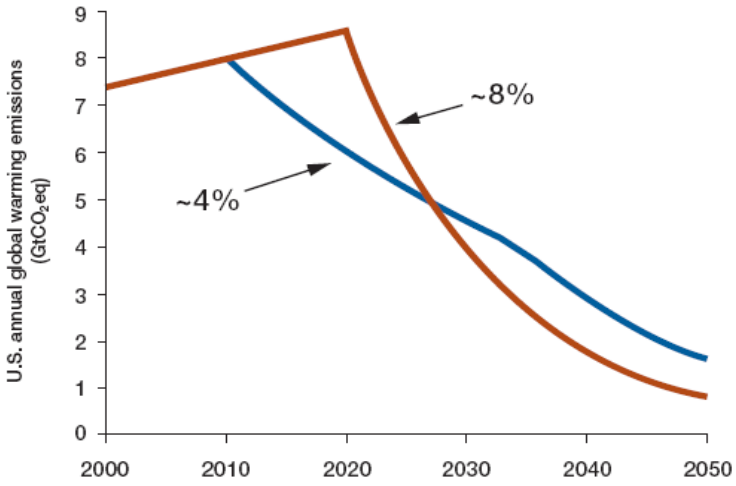

Figure 2: SLOW START… CRASH (OR BURN) FINISH
Source: Union of Concerned Scientists.

It is critical to recognize that continued investments in old technology will "lock in" high carbon emissions for many decades to come. This is particularly so for the next generation of coal-fired power plants. Power plant investments are large and long-lasting. A single plant costs around $2 billion and will operate for 60 years or more. If we decide to do it, the United States and other nations could build and operate new coal plants that return their CO_2 to the ground instead of polluting the atmosphere. With every month of delay we lose a piece of that opportunity and commit ourselves to 60 years of emissions. The International Energy Agency (IEA) forecasts that more than 20 trillion dollars will be spent globally on new energy technologies between now and 2030. How this money is invested over the next decade, and whether we will have the proper policies in place to drive investment into cleaner technologies, which can produce energy from

zero and low carbon sources, or that can capture and dispose of carbon emissions, will determine whether we can realistically avoid the worst effects of global warming.

In short, we have the solutions – cleaner energy sources, new vehicle technologies and industrial processes and enhanced energy efficiency. We just lack the policy framework to push business investments in the right direction and to get these solutions in the hands of consumers.

The Lieberman-Warner bill, America's Climate Security Act (S. 2191), is a major step towards putting our country on an emissions pathway consistent with avoiding extremely dangerous global warming. The bill caps and cuts emissions of three sectors – electricity, transportation, and industry – that together account for about 75 percent of U.S. greenhouse gas emissions. It calls for a 15 percent reduction in covered emissions by 2020 and for a 70 percent reduction in covered emissions by 2050. The bill also includes features to reduce emissions from the uncovered sectors, principally a set of energy efficiency measures for buildings and key energy-using activities, and a "set-aside" of allowances from within the cap to encourage emission reductions and sequestration in the agriculture and forestry sectors. Our calculations indicate that this combination will result in reducing *total* U.S.emissions by approximately 13-19 percent by 2020 and approximately 51-63 percent by 2050. In order to assure that we get on, and stay on, the necessary emission reduction pathway, NRDC believes the coverage of the bill and the total amount of emissions reductions should be increased.

S.2191 would implement its cap and reductions through an allowance trading system. NRDC agrees that – combined with complementary policies, some of which are contained in this bill and in other legislation, such as the pending energy bill – this is the most effective and efficient approach to curbing global warming pollution. As the sponsors are aware, a cap and trade system requires attention to how the emissions allowances are allocated, and for what purposes. It is important to distinguish between the abatement cost of a cap and trade system and its distributional implications. The abatement cost will be significant, but far less than the cost of inaction. At the same time, the value of the pollution allowances created by the law will be much higher: some estimates place their value between $30 and $100 billion per year.

NRDC believes these pollution allowances are a public trust. They represent permission to use the atmosphere, which belongs to all of us, to dispose of global warming pollution. As such, they are not a private resource owned by historical emitters and such emitters do not have a permanent right to free allowances. The value of the allowances should be used for public purposes including promoting clean energy solutions, protecting the poor and other consumers, ensuring a just transition for workers in affected industries, and preventing human and ecosystem impacts both here and abroad, especially where they can lead to conflicts and threats to security.

S. 2191 embraces the principle that these pollution allowances should be used for public purposes but it implements the principle too slowly. NRDC believes that over the first 25 years of the program the bill gives away more allowances to the biggest emitting firms than is needed to fully compensate such firms for the effects of their compliance obligations on the

firms' economic values. The result is that there are not enough available to fully meet public needs. As discussed more fully below, the allowance allocations in the bill can be substantially improved.

S. 2191 also allows the owner or operator of a covered facility to satisfy up to 15 percent of a given year's compliance obligation using "offsets" generated within the United States. These offsets would come from activities that are not covered by the emissions cap. The 15 percent limitation is essential to ensure the integrity of the emissions cap in the bill and to spur technology innovation. The total amount of offsets allowed should not be increased. In addition, further changes to the bill should be made regarding the types of offsets that should be allowed and the conditions for such offsets.

We are pleased to note that the Lieberman/Warner legislation includes "cost containment" provisions that protect the integrity of the emissions cap and preserve incentives for technology innovation. In particular, we commend your rejection of the misnamed "safety valve" concept that would allow the government to print unlimited pollution allowances at a set price.

The fundamental problem with the safety valve is that it breaks the cap without ever making up for the excess emissions. Simply put, the cap doesn't decline as needed or, worse, keeps growing. "Safety valve" is actually a misleading name. In boiler design, the role of a safety valve is to allow pressures to build within the vessel to working levels, well above atmospheric pressure. A safety valve's function is to open on the rare

occasion when the boiler is pressured beyond its safe operating range, to keep it from exploding. In the life of a well-run boiler, the safety valve may never open. Imagine, however, a boiler designed with a valve set to open just slightly above normal atmospheric pressure. The valve would always be open, and the boiler would never accomplish any useful work. That is the problem with the safety valve design in other legislative proposals. The valve is set at such a low level that it is likely to be open virtually all the time.

In addition to breaking the U.S. cap, a safety valve also would prevent U.S. participation in international trading systems. If trading were allowed between the U.S. and other capped nations, a major distortion would occur. Firms in other countries (acting directly or through brokers) would seek to purchase U.S. lower-priced allowances. Their demand would almost immediately drive the U.S. allowance price to the safety valve level, triggering the "printing" of more American allowances. Foreign demand for newly-minted U.S. safety valve allowances would continue until the world price dropped to the same level. The net result would be to flood the world market with far more allowances – and far less emission reduction – than anticipated.

Although NRDC believes that the primary and most effective cost containment device in any mandatory legislation will be the cap and trade system itself, NRDC also supports other means of providing flexibility. Banking has long been a feature of cap and trade systems. We also support the bill's provisions allowing firms to borrow allowances with appropriate interest and payback guarantees. The bill includes a further provision,

nicknamed the Carbon Fed, based upon a proposal developed by Senators Warner, Graham, Lincoln and Landrieu. The board created under this provision is charged with monitoring the carbon market and is authorized to change the terms of allowance borrowing, including the interest rate and the time period for repayment. Crucially, however, the Carbon Fed does not have the authority to change the cumulative emissions cap. Under such a proposal, the environment is protected and cost volatility is minimized.

While S. 2191 provides a solid framework for sound global warming legislation, there are some significant areas in which it can and should be substantially improved. A more detailed discussion of these areas follows:

Coverage of Emissions

As I mentioned, scientists are telling us that we will need reductions in total U.S emissions on the order of 80% by 2050 in order to do our proportional part in a global program of preventing catastrophic impacts. Our calculations indicate that the bill will result in reducing total U.S. emissions by approximately 51-63 percent by 2050. In order to ensure that overall reductions keep pace with the science, NRDC believes that the bill's coverage should be increased. The most important source of emissions that is not covered is the commercial and residential use of natural gas.

Scientific Review of Targets

The bill as introduced includes a provision under which the National Academy of Sciences would assess the extent to which emissions reductions required under the Act

are being achieved, and would determine whether such reductions are sufficient to avoid dangerous global warming. However, unlike the similar provisions of the Sanders/Boxer legislation, S. 2191 does not authorize the Environmental Protection Agency to respond to the NAS assessments and reports by adjusting the applicable targets. The bill should be revised to allow EPA to take all necessary actions to avoid dangerous global warming by requiring additional reductions, including by changing applicable targets or through increasing the coverage of the bill.

Complementary Performance Standards

Performance standards for key sectors are an important complement to the overarching cap on emissions. The bill recognizes the importance of performance standards for building codes and appliance efficiency and contains standards for these energy consuming activities. But energy producers also need performance standards to avoid counterproductive investments in the early years of the program.

Perhaps the most important performance standard for the production sector is for coal-fired electric generation. As I described above, new coal plants cost billions of dollars and will operate for 60 years or more. It is critical that we stop building new coal plants that release all of their carbon dioxide to the air. The bill contains several incentive provisions to reward developers who incorporate carbon capture and geologic disposal systems for new coal plants. NRDC supports such incentives but believes they should be coupled with performance standards to assure we do not build more coal plants that are uncontrolled for carbon dioxide.

The Sanders-Boxer bill contains two complementary performance standards for coal plants and we recommend the Subcommittee and Committee incorporate these concepts into S. 2191. The first standard is a CO_2 emissions standard that applies to new power investments. California enacted such a measure in SB1368 last year. It requires new investments for sale of power in California to meet a performance standard that is achievable by coal plants using CO_2 capture.

The second standard is a low-carbon generation obligation for coal-based power. Similar in concept to a renewable performance standard, the low-carbon generation obligation requires an initially small fraction of sales from coal-based power to meet a CO_2 performance standard that is achievable with carbon capture. The required fraction of sales would increase gradually over time and the obligation would be tradable. Thus, a coal-based generating firm could meet the requirement by building a plant with carbon capture, by purchasing power generated by another source that meets the standard, or by purchasing credits from those who build such plants. This approach, when combined with the allowance incentives in S. 2191, has the advantage of speeding the deployment of carbon capture systems while avoiding the "first mover penalty." Instead of causing the first builder of a commercial coal plant with carbon capture to bear all of the incremental costs, allowance incentives and the tradable low-carbon generation obligation would spread those costs over the entire coal-based generation system. With such performance standards included, the bill could--at no added cost--prevent construction of new uncontrolled coal power plants and free up some of the incentive allowances for other purposes.

Some have argued that key technologies, such as carbon capture and storage (CCS) are not yet available or are only available now at exorbitant cost. Such arguments are incorrect. All the elements of CCS systems are actually in use today. But arguments about what is available today, under today's market conditions, fundamentally miss the point, because global warming legislation is about setting the market conditions for technological progress going forward from today. Taking a frozen snapshot of the cost of carbon control technologies today is also misleading. Think how wrong such an assessment would have been if applied to computer technology at any point in the last thirty years. Speed and capacity have increased by orders of magnitude as costs plummeted. We now carry more computing power in our cell phones than the Apollo astronauts carried to the moon. Once market signals are in place, it will be the same for technologies such as carbon capture and storage. I attach an Appendix to my testimony prepared by David Hawkins, Director of NRDC's Climate Center, which discusses the current availability of carbon capture and disposal in detail.

Other complementary policies should also be considered for sectors such as the transportation area. NRDC supports a Low Carbon Fuel Standard, which would cut greenhouse gas emissions from fuels by 10% from today's levels by 2020 and spur development and use of cellulosic ethanol and other low carbon fuels. Senator Boxer's bill, the Advanced Clean Fuels Act of 2007, includes a Low Carbon Fuel Standard and we would support inclusion of such a performance standard in S. 2191. It is also important to note that other ongoing efforts in the Senate, such as the Corporate Average Fuel Economy measures included in the Senate Energy bill, could lead to substantial

reductions in greenhouse gas emissions and if enacted, will provide another important complement to the provisions in S. 2191.

Offsets

America's Climate Security Act allows the owner or operator of a covered facility to satisfy up to 15 percent of a given year's compliance obligation using "offsets" generated within the United States. These offsets would come from activities that are not covered by the emissions cap.

While there are many emission reduction activities outside the cap that are worth encouraging, many experts have worked for more than 30 years in an attempt to produce reliable, workable offset programs in both the clean air and global warming contexts but there is little reason for satisfaction with the results. Even if criteria for measurability and enforceability are met, offsets still have the potential to break the cap because of difficulties in assuring that actions being credited are actually "additional" – i.e., that they are not simply actions that would have taken place anyway in the absence of credit.

The additionality problem is not readily soluble, because it is extraordinarily difficult to devise workable rules for determining business-as-usual baselines at the project level. In some areas, credits may leverage new actions that would not have occurred, with a minimum of credit bestowed on "anyway" actions. But far more often, "anyway" actions make up a large – even dominant – fraction of the reductions credited. If offsets represent even a small percentage of "anyway" tons, climate protection actually moves backwards. A full ton is

added to the cap in exchange for an action that may represent only 0.9 ton of reduction – or worse, 0.1 ton of reduction. With each offset, net emissions increase.

Offsets also can delay key industries' investments in transformative technologies that are necessary to meet the declining cap. For instance, unlimited availability of offsets could lead utilities to build high-emitting coal plants instead of investing in efficiency, renewables, or plants equipped with carbon capture and storage.

For these reasons, NRDC has proposed setting aside a portion of the allowances from *within* the cap to incentivize mitigation actions from sources, like agriculture, that are outside the cap. Since the allowances would come from within the cap, they do not run the risk of expanding actual emissions as a result of rewarding this activity. Another acceptable approach would be to allow only a limited quantity of offsets in the cap-and-trade design.

The Lieberman/Warner bill takes both approaches. The bill includes a "set aside" for agricultural reductions which would provide allowances from within the cap, and the bill also limits domestic offsets from outside the cap to 15 percent of a facility's annual compliance obligation.

NRDC believes that there are some additional changes needed in the offset provisions to remove certain types of offsets where additionality fundamentally cannot be guaranteed. A number of other safeguards need to be strengthened. We will be glad to continue working with your staff regarding these provisions.

Allocation of Allowances

The Lieberman/Warner bill recognizes that allowances can and should be used to achieve important public purposes, but the bill provides too many allowances for free to emitters in the early years of the program.

The bill provides allowances for public purposes in two ways:

1) auctioned allowances, with the proceeds of the auction going for such purposes as climate-friendly technologies, low income energy consumers, wildlife adapatation, national security/global warming measures and worker training.

2) free allowances to electricity consumers, state and tribal governments, and U.S. farmers and foresters, for a range of designated public purposes.

But the bill also initially gives 40 percent of the allowances for free to emitters in the electric and industrial sectors. These free allowances to emitters continue at gradually reduced rates until 2036 when they are terminated. The amount of allowances that are auctioned for public purposes grows from 24 percent in 2012 to 73 percent in 2036.

NRDC appreciates the substantial changes that have been made to the bill since the bill outline was released in August. These changes include eliminating the perpetual free allocation to industrial emitters and removing free allowances to oil and coal companies.

The current bill's allocation to electric power and industrial emitters, however, is still much higher than justified under "hold-harmless" principles and will result in windfall profits to the shareholders of emitters. For example, an economic analysis by Larry Goulder of Stanford University suggests that in an economy-wide upstream cap and trade program, only 13% of the allowances will be needed to cover the costs that fossil-fuel providers would not be able to pass on to their customers. Similar analyses, with similar results, have been conducted by Resources for The Future and the Congressional Budget Office.

As a result, NRDC believes that the bill should be improved substantially by reducing the starting percentage of free allowances to emitters and phasing them out faster --within 10- 15 years of enactment. This would allow a greater percentage of the allowances to be devoted to public purposes from the start and over time. In particular, reducing the free allocations to emitters would allow for more resources to be directed to states, to low-income consumers in the United States, and to the most vulnerable among us, both here and abroad.

International Cooperation

The bill includes a provision to encourage other nations to join in action to reduce greenhouse gas emissions, and to protect American businesses and workers from unfair competition if specific nations decline to cooperate. Under this provision, the United States would seek to negotiate for "comparable emissions reductions" from other emitting countries within 8 years of enactment. Countries failing to make such commitments would be required to submit greenhouse gas allowances for certain carbon intensive products. NRDC supports this provision, while bearing in mind that the U.S., as the world's greatest contributor to the burden of global warming pollution already in the atmosphere, needs to show leadership in meeting the global warming challenge,.

Adaptation Issues

The sad truth is that if we do our utmost to cut global warming pollution starting tomorrow, people, and the sensitive ecosystems we depend on, will still suffer serious impacts due to the emissions that are already in the air and those "in the pipeline." We must do what we can now to ensure that communities and natural ecosystems are best prepared to withstand and adapt to ongoing and expected change. To that end, NRDC would like to thank Senators Warner and Lieberman for inclusion of language establishing an adaptation fund to assist Federal, State, and tribal entities to develop and adopt adaptation strategies.

I would also like to mention a bill introduced last week by Senator Whitehouse, with Senator Boxer. This bill, the Global Warming Wildlife Survival Act, addresses ongoing and expected impacts to our oceans, wildlife, and endangered species associated with global warming and ocean acidification. We are particularly excited to see that Senators Whitehouse and Boxer have elevated the issue of the threats facing our ocean ecosystems and resources, calling for the development and implementation of a National Ocean, Coastal, and Great Lakes Resiliency Strategy and for development of climate change resiliency plans under the Coastal Zone Management Act. These are the types of approaches we need to ensure that our oceans are as healthy as possible, so that they are better able to withstand the adverse effects of warming and acidification. We look forward to working with the Committee to incorporate these approaches into the final bill.

* * *

Chairman Lieberman and Ranking Member Warner, you have stepped forward at a key moment in history and you are to be commended for your vision, leadership and courage on this profoundly important issue. Together with Chairman Boxer, and the other members of the Committee, the work that you and your staff have done on this bill marks an important milestone in the movement toward enactment of strong, bipartisan global warming legislation. We look forward to further progress as your legislation moves through the Subcommittee and the full Environment and Public Works Committee, and we at NRDC stand ready to assist in anyway possible.

Thank you for the opportunity to testify and I would be pleased to answer any questions that you may have.

APPENDIX

Is CCD Ready for Broad Deployment?

David Hawkins

Director, Climate Center

Natural Resources Defense Council

Key Questions about CCD

I started studying CCD in detail ten years ago and the questions I had then are those asked today by people new to the subject. Do reliable systems exist to capture CO_2 from power plants and other industrial sources? Where can we put CO_2 after we have captured it? Will the CO_2 stay where we put it or will it leak? How much disposal capacity is there? Are CCD systems "affordable"? To answer these questions, the Intergovernmental Panel on Climate Change (IPCC) decided four years ago to prepare a special report on the subject. That report was issued in September, 2005 as the IPCC Special Report on Carbon Dioxide Capture and Storage. I was privileged to serve as a review editor for the report's chapter on geologic storage of CO_2.

CO_2 Capture

The IPCC special report groups capture or separation of CO_2 from industrial gases into four categories: post-combustion; pre-combustion; oxyfuel combustion; and industrial separation. I will say a few words about the basics and status of each of these approaches. In a conventional pulverized coal power plant, the coal is combusted using normal air at atmospheric pressures. This combustion process produces a large volume

of exhaust gas that contains CO_2 in large amounts but in low concentrations and low pressures. Commercial post-combustion systems exist to capture CO_2 from such exhaust gases using chemical "stripping" compounds and they have been applied to very small portions of flue gases (tens of thousands of tons from plants that emit several million tons of CO_2 annually) from a few coal-fired power plants in the U.S. that sell the captured CO_2 to the food and beverage industry. However, industry analysts state that today's systems, based on publicly available information, involve much higher costs and energy penalties than the principal demonstrated alternative, pre-combustion capture.

New and potentially less expensive post-combustion concepts have been evaluated in laboratory tests and some, like ammonia-based capture systems, are scheduled for small pilot-scale tests in the next few years. Under normal industrial development scenarios, if successful such pilot tests would be followed by larger demonstration tests and then by commercial-scale tests. These and other approaches should continue to be explored. However, unless accelerated by a combination of policies, subsidies, and willingness to take increased technical risks, such a development program could take one or two decades before post-combustion systems would be accepted for broad commercial application.

Pre-combustion capture is applied to coal conversion processes that gasify coal rather than combust it in air. In the oxygen-blown gasification process coal is heated under pressure with a mixture of pure oxygen, producing an energy-rich gas stream consisting mostly of hydrogen and carbon monoxide. Coal gasification is widely used in industrial processes, such as ammonia and fertilizer production around the world. Hundreds of

such industrial gasifiers are in operation today. In power generation applications as practiced today this "syngas" stream is cleaned of impurities and then burned in a combustion turbine to make electricity in a process known as Integrated Gasification Combined Cycle or IGCC. In the power generation business, IGCC is a relatively recent development—about two decades old and is still not widely deployed. There are two IGCC power-only plants operating in the U.S. today and about 14 commercial IGCC plants are operating globally, with most of the capacity in Europe. In early years of operation for power applications a number of IGCC projects encountered availability problems but those issues appear to be resolved today, with Tampa Electric Company reporting that its IGCC plant in Florida is the most dispatched and most economic unit in its generating system.

Commercially demonstrated systems for pre-combustion capture from the coal gasification process involve treating the syngas to form a mixture of hydrogen and CO_2 and then separating the CO_2, primarily through the use of solvents. These same techniques are used in industrial plants to separate CO_2 from natural gas and to make chemicals such as ammonia out of gasified coal. However, because CO_2 can be released to the air in unlimited amounts under today's laws, except in niche applications, even plants that separate CO_2 do not capture it; rather they release it to the atmosphere. Notable exceptions include the Dakota Gasification Company plant in Beulah, North Dakota, which captures and pipelines more than one million tons of CO_2 per year from its lignite gasification plant to an oil field in Saskatchewan, and ExxonMobil's Shute Creek

natural gas processing plant in Wyoming, which strips CO_2 from sour gas and pipelines several million tons per year to oil fields in Colorado and Wyoming.

Today's pre-combustion capture approach is not applicable to the installed base of conventional pulverized coal in the U.S. and elsewhere. However, it is ready today for use with IGCC power plants. The oil giant BP has announced an IGCC project with pre-combustion CO_2 capture at its refinery in Carson, California. When operational the project will gasify petroleum coke, a solid fuel that resembles coal more than petroleum to make electricity for sale to the grid. The captured CO_2 will be sold to an oil field operator in California to enhance oil recovery. The principal obstacle for broad application of pre-combustion capture to new power plants is not technical, it is economic: under today's laws it is cheaper to release CO_2 to the air rather than capturing it. Enacting laws to limit CO_2 can change this situation, as discussed in my testimony.

While pre-combustion capture from IGCC plants is the approach that is ready today for commercial application, it is not the only method for CO_2 capture that may emerge if laws creating a market for CO_2 capture are adopted. I have previously mentioned post-combustion techniques now being explored. Another approach, known as oxyfuel combustion, is also in the early stages of research and development. In the oxyfuel process, coal is burned in oxygen rather than air and the exhaust gases are recycled to build up CO_2 concentrations to a point where separation at reasonable cost and energy penalties may be feasible. Small scale pilot studies for oxyfuel processes have been announced. As with post-combustion processes, absent an accelerated effort to leapfrog

the normal commercialization process, it could be one or two decades before such systems might begin to be deployed broadly in commercial application.

Given, the massive amount of new coal capacity scheduled for construction in the next two decades, we cannot afford to wait and see whether these alternative capture systems prove out, nor do we need to. Coal plants in the design process today can employ proven IGCC and pre-combustion capture systems to reduce their CO_2 emissions by about 90 percent. Adoption of policies that set a CO_2 performance standard now for such new plants will not anoint IGCC as the technological winner since alternative approaches can be employed when they are ready. If the alternatives prove superior to IGCC and pre-combustion capture, the market will reward them accordingly. As discussed in my testimony, adoption of CO_2 performance standards is a critical step to improve today's capture methods and to stimulate development of competing systems.

I would like to say a few words about so-called "capture-ready" or "capture-capable" coal plants. Some years ago I was under the impression that some technologies like IGCC, initially built without capture equipment could be properly called "capture-ready." However, the implications of the rapid build-out of new coal plants for global warming and many conversations with engineers since then have educated me to a different view. An IGCC unit built without capture equipment can be equipped later with such equipment and at much lower cost than attempting to retrofit a conventional pulverized coal plant with today's demonstrated post-combustion systems. However, the costs and engineering reconfigurations of such an approach are substantial. More importantly, we

need to begin capturing CO_2 from new coal plants without delay in order to keep global warming from becoming a potentially runaway problem. Given the pace of new coal investments in the U.S. and globally, we simply do not have the time to build a coal plant today and think about capturing its CO_2 down the road.

Implementation of the Energy Policy Act of 2005 approach to this topic needs a review in my opinion. The Act provides significant subsidies for coal plants that do not actually capture their CO_2 but rather merely have carbon "capture capability." While the Act limits this term to plants using gasification processes, it is not being implemented in a manner that provides a meaningful substantive difference between an ordinary IGCC unit and one that genuinely has been designed with early integration of CO_2 capture in mind. Further, in its FY2008 budget request, the administration seeks appropriations allowing it to provide $9 billion in loan guarantees under Title XVII of the Act, including as much as $4 billion in loans for "carbon sequestration optimized coal power plants." The administration request does not define a "carbon sequestration optimized" coal power plant and it could mean almost anything, including, according to some industry representatives, a plant that simply leaves physical space for an unidentified black box. If that makes a power plant "capture-ready" Mr. Chairman, then my driveway is "Ferrari-ready." We should not be investing today in coal plants at more than a billion dollars apiece with nothing more than a hope that some kind of capture system will turn up. We would not get on a plane to a destination if the pilot told us there was no landing site but options were being researched.

Geologic Disposal

We have a significant experience base for injecting large amounts of CO_2 into geologic formations. For several decades oil field operators have received high pressure CO_2 for injection into fields to enhance oil recovery, delivered by pipelines spanning as much as several hundred miles. Today in the U.S. a total of more than 35 million tons of CO_2 are injected annually in more than 70 projects. (Unfortunately, due to the lack of any controls on CO_2 emissions, about 80 per cent of that CO_2 is sources from natural CO_2 formations rather than captured from industrial sources. Historians will marvel that we persisted so long in pulling CO_2 out of holes in the ground in order to move it hundreds of miles and stick in back in holes at the same time we were recognizing the harm being caused by emissions of the same molecule from nearby large industrial sources.) In addition to this enhanced oil recovery experience, there are several other large injection projects in operation or announced. The longest running of these, the Sleipner project, began in 1996.

But the largest of these projects injects on the order of one million tons per year of CO_2, while a single large coal power plant can produce about five million tons per year. And of course, our experience with man-made injection projects does not extend for the thousand year or more period that we would need to keep CO_2 in place underground for it to be effective in helping to avoid dangerous global warming. Accordingly, the public and interested members of the environmental, industry and policy communities rightly ask whether we can carry out a large scale injection program safely and assure that the injected CO_2 will stay where we put it.

Let me summarize the findings of the IPCC on the safety and efficacy of geologic disposal. In its 2005 report the IPCC concluded the following with respect to the question of whether we can safely carry out carbon injection operations on the required scale:

"With appropriate site selection based on available subsurface information, a monitoring programme to detect problems, a regulatory system and the appropriate use of remediation methods to stop or control CO2 releases if they arise, the local health, safety and environment risks of geological storage would be comparable to the risks of current activities such as natural gas storage, EOR and deep underground disposal of acid gas."

The knowledge exists to fulfill all of the conditions the IPCC identifies as needed to assure safety. While EPA has authority regulate large scale CO_2 injection projects its current underground injection control regulations are not designed to require the appropriate showings for permitting a facility intended for long-term retention of large amounts of CO_2. With adequate resources applied, EPA should be able to make the necessary revisions to its rules in two to three years. We urge the members of this Committee to support legislation to require EPA to undertake this effort this year.

Do we have a basis today for concluding that injected CO_2 will stay in place for the long periods required to prevent its contributing to global warming? The IPCC report concluded that we do, stating:

"Observations from engineered and natural analogues as well as models suggest that the fraction retained in appropriately selected and managed geological reservoirs is very likely to exceed 99% over 100 years and is likely to exceed 99% over 1,000 years."

Despite this conclusion by recognized experts there is still reason to ask about the implications of imperfect execution of large scale injection projects, especially in the early years before we have amassed more experience. Is the possibility of imperfect

execution reason enough to delay application of CO_2 capture systems to new power plants until we gain such experience from an initial round of multi-million ton "demonstration" projects? To sketch an answer to this question, my colleague Stefan Bachu, a geologist with the Alberta Energy and Utilities Board, and I wrote a paper for the Eighth International Conference on Greenhouse Gas Control Technologies in June 2006. The obvious and fundamental point we made is that without CO_2 capture, new coal plants built during any "delay and research" period will put 100 per cent of their CO_2 into the air and may do so for their operating life if they were "grandfathered" from retrofit requirements. Those releases need to be compared to hypothetical leaks from early injection sites.

Our conclusions were that even with extreme, unrealistically high hypothetical leakage rates from early injection sites (10% per year), a long period to leak detection (5 years) and a prolonged period to correct the leak (1 year), a policy that delayed installation of CO_2 capture at new coal plants to await further research would result in cumulative CO_2 releases twenty times greater than from the hypothetical faulty injection sites, if power plants built during the research period were "grandfathered" from retrofit requirements. If this wave of new coal plants were all required to retrofit CO_2 capture by no later than 2030, the cumulative emissions would still be four times greater than under the no delay scenario. I believe that any objective assessment will conclude that allowing new coal plants to be built without CO_2 capture equipment on the ground that we need more large scale injection experience will always result in significantly greater CO_2 releases than starting CO_2 capture without delay for new coal plants now being designed.

The IPCC also made estimates about global storage capacity for CO_2 in geologic formations. It concluded as follows:

"Available evidence suggests that, worldwide, it is likely that there is a technical potential of at least about 2,000 GtCO2 (545 GtC) of storage capacity in geological formations. There could be a much larger potential for geological storage in saline formations, but the upper limit estimates are uncertain due to lack of information and an agreed methodology."

Current CO_2 emissions from the world's power plants are about 10 Gt (billion metric tons) per year, so the IPCC estimate indicates 200 years of capacity if power plant emissions did not increase and 100 years capacity if annual emissions doubled.