Testimony of David Hawkins
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Before The Committee on Environment and Public Works
United States Senate
Hearing On
America's Climate Security Act of 2007, S. 2191.

November 13, 2007

Thank you for the opportunity to testify today regarding America's Climate Security Act. My name is David Hawkins. I am the Director of the Climate Center 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.

Chairwoman Boxer, I would like to thank you for the opportunity to testify and share NRDC's views on the America's Climate Security Act (S. 2191) and for your leadership in addressing the critical challenge posed by global warming. I also want to thank Senator Lieberman and Senator Warner for all of your work to develop this legislation and improve it in Subcommittee. We view favorable Committee action on this measure 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 Committee, as you act to report legislation to the full United States Senate.

On October 24th NRDC President Frances Beinecke testified before the Subcommittee on Public and Consumer Solutions to Global Warming and Wildlife Protection on America's Climate Security Act (ACSA).[1] In her testimony she stated that the time for action on global warming is now. 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. Failure to pursue significant reductions in global warming pollution very soon 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 climate chaos.

A growing body of scientific research indicates that we face extreme dangers to human health, economic well-being, and the ecosystems on which we depend if global average temperatures are allowed to increase by more than 2 degrees Fahrenheit from today's

[1] Frances Beinecke, Testimony before the Subcommittee on Public and Consumer Solutions to Global Warming and Wildlife Protection Committee on Environment and Public Works, "America's Climate Security Act", October 24, 2007. http://docs.nrdc.org/globalwarming/glo_07102401A.pdf.

levels. We have good prospects of staying below this temperature increase if atmospheric concentrations of CO2 and other global warming gases are kept from exceeding 450 ppm CO2- equivalent and then rapidly reduced. To make this possible requires immediate steps to reduce global emissions over the next several decades, including action to halt U.S. emissions growth within the next few years and then cut emissions by approximately 80% by mid-Century.

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. 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, or if insufficient action is taken a seriously disrupted climate.

Costs of Inaction

The claim that climate protection is "too expensive" treats it like a discretionary expense – perhaps like a luxury car or exotic vacation that is beyond this year's budget. No harm is done by walking away from a high-end purchase that you can't quite afford.
But if we walk away from climate protection, we will be walking into danger. Unless we act now, the climate disruption will continue to worsen, with health, economic, and environmental costs far greater than the price of protection.

Scholars and economists have only begun a serious assessment of the costs of inaction but it is clear from their work that it is climate disruption, *not* climate protection programs, which will wreck the economy.

- The Stern Review, sponsored by the British government and directed by Sir Nicholas Stern, formerly the chief economist at the World Bank, estimated that 5% of world economic output would be lost, given a narrowly defined estimate of economic damages. Add in an estimate for environmental damage and for the increased chance of an abrupt climate change catastrophe, and Stern's estimates of losses from climate disruption climb to 11% or more of world economic output.[2]

- A recent study from the University of Maryland reviews the extensive research literature on the costs due to plausible climate change in the U.S., including coastal property losses from sea level rise, increased damages from intensified hurricanes, drought and wildfire risks in the west, disruption of water supplies,

[2] Sir Nicholas Stern, "Stern Review: Economics of Climate Change", January, 2007. http://www.hm-treasury.gov.uk/independent_reviews/stern_review_economics_climate_change/stern_review_report.cfm.

decreased agricultural yields in most of the country, and many more harmful impacts.[3]

This extended excerpt from the report provides a sobering summary of how high the economic stakes are:

"The effects of climate change will be felt by the entire nation:
"• all sectors of the economy—most notably agriculture, energy, and transportation—will be affected;
• essential infrastructures that afford us reliable services and high standards of living (such as water supply and water treatment) will be impacted; and
• ecosystems, on which quality of life relies (such as forests, rivers, and lakes), will suffer.

"**In the West and Northwest**, climate change is expected to alter precipitation patterns and snow pack, thereby increasing dry fuel loads and the risk of forest fires. Forest fires cost billions of dollars to suppress, and can result in significant loss of property. The Oakland, California fire of 1991 and the fires in San Diego and San Bernardino Counties in 2003 each cost over $2 billion. Every year for the past four years, over 7 million acres of forests in the National Forest System have burned with annual suppression costs of $1.3 billion or more.

"**The Great Plains and the Midwest** will suffer particularly from increased frequency and severity of flooding and drought events, causing billions of dollars in damages to crops and property. For example, the North Dakota Red River floods in 1997 caused $1 billion in agricultural production losses, and the Midwest floods of 1993 inflicted $6-8 billion in damages to farmers alone.

"**The Northeast and Mid-Atlantic** regions will see increased vulnerability to sea level rise and storms. Depending on the category of the event, evacuation costs for the Northeast region may range, for a single event, between $2 and $6.5 billion. Since 1980, there have been 70 natural weather-caused disasters, with damages to coastal infrastructure exceeding $1 billion per event. Taken together, their combined impact surpassed $560 billion in damages.

"Decreased precipitation levels in **the South and Southwest** will strain water resources for agriculture, industry and households. For the agriculturally productive Central Valley in California alone, the estimated economy-wide loss during the driest years is predicted to be around $6 billion per year. Net agricultural income for the San Antonio Texas Edwards Aquifer region is predicted to decline by 16-29% by 2030 and by 30-45% by 2090 because of competing uses for an increasingly scarce resource—water.

[3] M. Ruth, D. Coehlo, D. Karetnikov, "The US Economic Impacts of Climate Change and the Costs of Inaction," A Review and Assessment by the Center for Integrative Environmental Research (CIER) at the University of Maryland, October 2007. http://www.cier.umd.edu/climateadaptation/index.html.

"The true economic impact of climate change is fraught with "hidden" costs. Besides the replacement value of infrastructure, for example, there are real costs of re-routing traffic, workdays and productivity lost, provision of temporary shelter and supplies, potential relocation and re-training costs, and others. Likewise, the increased levels of uncertainty and risk brought about by climate change impose new costs on the insurance, banking, and investment industries, as well as complicate the planning processes for the agricultural and manufacturing sectors and public works projects. Since the early 1990s, and especially during the 21st century, significant progress has been made in understanding the impacts of climate change at national, regional, and local scales."[4]

- States particularly vulnerable to climate change are likely to suffer considerable negative economic impacts. Florida, a prime example, can expect large revenue losses due to decreases in tourism as the climate worsens, losses to coastal residential property from sea level rise, intensified hurricane damages, and increased electricity costs for air conditioning. Those categories of damages will significantly affect the gross state product. In addition, Florida, like many other states, will face a water crisis, as hotter temperatures increase the demand for water but decrease the usable supply.

Inaction on climate change also increases the chance of an abrupt, irreversible catastrophe, which would be much worse than the predictable costs of inaction discussed above. This point is emphasized in the Stern Review, and the economic analysis behind it is supported by recent research by Harvard University economist Martin Weitzman.[5] The collapse and complete melting of either the Greenland or West Antarctic ice sheets would cause sea levels to rise by 20 feet or more, causing devastation of coastal cities and regions where a large fraction of the American population lives. No one can say for certain at what temperature this will occur, but it becomes more likely as the world warms. We are taking a gamble, where the stakes are unbelievably high and the odds get worse the longer we stay on our current course.

No sensible person bets his or her home on a spin of the roulette wheel. But inaction on climate change is betting the only home humanity has. Who knows, we might get lucky and win the bet; a few scientists still doubt that hurricanes are getting worse. But the consequences of a bad bet are enormous. Without arguing that Katrina was "caused" by global warming, the misery it caused the people of Louisiana and Mississippi and the

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[4] *Ibid.*

[5] *See, e.g.,* "On Modeling and Interpreting the Economics of Catastrophic Climate Change," (November 2007), where Weitzman argues that conventional cost-benefit analyses of climate change are misleading because they ignore nontrivial risks of genuine disaster. "Standard conventional cost-benefit analysis (CBA) of climate change does not even come remotely close to grappling seriously with this kind of potential for disasters. When CBA is done correctly, by including reasonable probabilities of (and reasonable damages from) catastrophic climate change, the policy implications can be radically different from the conventional advice coming out of a standard economic analysis that (essentially) ignores this kind of potential for disasters." http://www.economics.harvard.edu/faculty/Weitzman/papers/Modeling.pdf

continuing economic turmoil it produced are wake-up calls that show how much harm a disrupted climate can produce.

A catastrophe, such as 20 feet or more of sea level rise, is not certain to occur; we don't know enough today to say how quickly we may lock in these catastrophic events with current emission paths. But homeowners buy fire insurance although they are not likely to have a fire next year; healthy young parents buy life insurance to protect their children, although they are not likely to die next year. The most catastrophic dangers from climate change are so immense that even if we believe the chance of catastrophe is small, it is irresponsible to ignore them. Taking action against climate change is life insurance for our home planet, needed to protect everyone's children.

Costs and Benefits of Action

The debate on global warming in Washington has turned decisively from "Is it a problem?" to "What are we going to do about it and how much is it going to cost?" In fact, we can't afford not to solve global warming. Economic analyses of the cost of reducing global warming pollution do not attempt to tally the benefits of preventing global warming. As the studies just discussed make clear, the costs of inaction are far higher than the costs of reducing emissions.

Even considering only the direct economic implications, it is clear that action to reduce global warming pollution presents opportunities as well as costs, as recognized by the leading business and environmental leaders that have formed the US Climate Action Partnership. We need only look to California as a prime example of how aggressive implementation of climate friendly energy efficiency measures has been accompanied by strong economic growth. Due to these measures, California's per capita electricity consumption has been level over the last 30 years while that of the US as a whole has steadily increased. Per capita electricity consumption in California is now more than 40 percent lower than in the rest of the country. Meanwhile, from 1990 to 2005 the California economy grew by more than 50 percent in real terms, an average annual growth rate of 2.9 percent.[6] And from 2003-2006 California has had an average annual real growth rate of 4 percent, while nationally the growth rate was 3.1 percent per year.[7]

The results of recent economic studies analyzing the costs of global warming cap and trade bills have shown that we can cut our global warming pollution substantially in a manner that is affordable for consumers and the US economy as a whole.

A useful starting point is EPA's analysis of the "Climate Stewardship and Innovation Act of 2007" (S.280), introduced by Senators Joe Lieberman (I-CT) and John McCain (R-

[6]California Department of Finance, http://www.dof.ca.gov/html/FS_DATA/STAT-ABS/TABLES/d1.xls.

[7]Bureau of Economic Analysis, U.S Department of Commerce, http://www.bea.gov/national/xls/gdplev.xls.

AZ) in January of this year.[8] This bill is similar to ACSA in its cap levels and overall structure. The bottom line from this EPA analysis is that solving global warming is affordable.

EPA finds that reducing global warming pollution will have an imperceptible effect on economic output overall. If we take no action to cut emissions, GDP is projected to grow at 2.61-2.72 percent per year from 2010 to 2050, which of course ignores the prospect that climate disruption in this period would harm the economy. With S. 280, GDP grows between 2.54-2.69 percent per year. EPA's analysis, which we consider to be conservative, finds that the reduction in GDP growth from enacting the Climate Stewardship Act is a mere 0.03-0.07 percent per year. If S. 280 were enacted, consumption of goods and services by U.S. households would increase 103% between 2005 and 2030, according to the *Applied Dynamic Analysis of the Global Economy* (ADAGE) model used by EPA, which is virtually indistinguishable from the 105% increase projected without the legislation. Of course, household consumption is not the same as welfare. It does not include the value we place on reducing the risk of catastrophic storms, preserving our favorite beaches and alpine meadows, and preventing polar bears and countless other species from being driven to extinction.

What about energy prices? Changes would be far smaller and less disruptive than those consumers have experienced in recent years. According to EPA's analysis, S. 280 would have modest impacts on electricity and gasoline prices, and natural gas prices would not be significantly affected. The ADAGE model projects that the price of CO2 allowances will be $27/ton in 2030, which would add 23 cents per gallon to the price of gasoline. But unlike recent, much larger, price increases, the money won't go to OPEC or national oil-producing economies under laws like ACSA. The money we spend on global warming solutions will be spent in the U.S., creating new jobs and economic opportunities. ACSA helps ensure this result by directing over time the entire economic resource created by the emission allowance program to public benefits, such as helping finance more fuel-efficient vehicles, homes, and appliances for American consumers and promoting the deployment of climate-friendly technologies here at home.

EPA projects that S. 280 would increase electricity prices somewhat (less than 1 cent per kilowatt-hour), but we don't write checks for *prices,* we write them for *energy bills* EPA concludes that under S. 280 the total cost of generating electricity would decrease 7 percent in 2025 because energy efficiency measures will reduce total electricity consumption. Along with lower power production come significant health benefits from lower particulate and mercury emissions from power plants.

Using a version of the ADAGE model employed by EPA, the Nicholas Institute at Duke University just completed an analysis of the August 2nd version of ACSA.[9] Their results

[8] United States Environmental Protection Agency's Analysis of Senate Bill S.280 in the 110th Congress, The Climate Stewardship and Innovation Act of 2007, July 2007.
http://www.epa.gov/climatechange/economicanalyses.html#s280

were very similar to EPA's results for the Climate Stewardship Act. In particular, the Duke study found that compliance with the targets has a small effect on rising GDP. By 2030 GDP is projected to increase 112% from 2005 levels in the Reference Case, and by 2050 the projected increase in GDP from 2005 levels is 238%. Under ACSA, GDP is projected to increase 111% by 2030 and 236% by 2050.

In reality, the opportunities to cost-effectively reduce total energy demand are greater than considered in EPA's or Duke's analysis. Stronger building and appliance efficiency standards, a national Renewable Electricity Standard, and higher vehicle fuel economy standards are all part of a sound energy policy designed to increase energy security and lower consumer costs by overcoming market barriers that are slowing the adoption of these technologies. These policies would also help achieve the global warming pollution reductions required by ACSA, reducing compliance costs. EPA's analysis of S.280 does not consider these complementary energy policies. As a result it understates the role that renewable energy and vehicle efficiency improvements can play in achieving the emission reductions required by the bill, and overstates the role of other low-emission electricity generating technologies, offsets, and international credits. Several such complementary energy policies are included in ACSA and Congress can act even more quickly to adopt these policies by enacting this year a strong energy bill incorporating the best elements of the House- and Senate-passed bills.

It bears highlighting that no economic model can fully anticipate the advances in technology likely to be spurred by a policy package that caps and reduces emissions and uses allowances and performance standards to promote innovation. For example, prior to enactment of the cap on SO2 emissions in the 1990 Clean Air Act amendments, EPA projected that the price of SO2 allowances would be $500-$1000 per ton.[10] In fact, prices have been far lower, generally in the range of $100 to $200 per ton until it became clear that emission limits would be tightened further than originally enacted by Congress.

To ensure the affordability of a global warming cap and trade bill the legislation must be designed smartly. That means establishing a firm pollution cap that will spur innovation, allowing trading such that emission reductions can be made at least-cost, and using the value of emission allowances in the public interest making it possible to offset any increases in energy costs for low and middle-income consumers. A recent MIT analysis of the Lieberman-McCain Climate Stewardship Act found that a family of four could receive in 2015 more than $3500 in revenue from the auction of allowances under this legislation, increasing over the years of the program.[11]

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[9]B.C. Murray and M.T. Ross, "The Lieberman-Warner America's Climate Security Act: A Preliminary Assessment of Potential Economic Impacts", October 2007.
http://www.nicholas.duke.edu/institute/econsummary.pdf.

[10] Acid Rain Program: 2005 Progress Report, http://epa.gov/airmarkets/progress/docs/2005report.pdf

[11] S. Paltsev, J.M. Reilly, H.D. Jacoby, A.C. Gurgel, G. E. Metcalf, A.P. Sokolov, and J.F. Holak, "Assessment of U.S. Cap-and-Trade Proposals", MIT Joint Program on the Science and Policy of Global Change, Report No. 146, p. 25, April 2007.
http://web.mit.edu/globalchange/www/MITJPSPGC_Rpt146.pdf

Some economic analyses estimate much higher costs. In particular, during the hearing last Thursday (November 8, 2007) you heard testimony from Dr. Anne Smith of CRA International and Dr. Margo Thorning of American Council for Capital Formation. We believe their analyses are seriously flawed. The attached memorandum from several well respected economists who have worked and published in the field of climate economics and energy economics for over three decades identifies some of the most serious defects, including the failure to examine the economic benefits of protecting the climate and the unjustified assumption that the business as usual economy operates in a perfect welfare-maximizing fashion. The memo's purpose is to promote understanding of the issue of abatement cost studies by pointing out the economic logic, assumptions, and deficiencies of the CRA and ACCF analyses in relation to best-practice in this field. This is especially important because these analyses have been privately produced and have not appeared in the peer-reviewed literature.

Focusing briefly on Dr. Smith's testimony, her analysis suggests that most of the emission reductions will occur in the electricity sector, neglecting opportunities to reduce emissions in industry and the transportation sector. Further, the CRA model limits the amount of advanced technology that can come into the electricity sector in the future—for example, constraining deployment rates for carbon capture and disposal systems and assuming less penetration of renewable energy than Energy Information Administration's Annual Energy Outlook.

Other issues with CRA modeling include an artificially high emissions "baseline" (what would happen without a cap), which results in much higher costs for complying with emission caps. For example, the Energy Information Administration estimates additional lower carbon energy capacity will come on board even without a climate policy. EIA assumes that in coming decades if new coal plants are built they will probably be IGCC plants. However, CRA assumes business as usual coal technology and therefore factors in the full cost of new advanced technologies like IGCC with CCS when only the incremental costs of CCS should be included, thereby significantly increasing the overall cost estimates.

As a result of these and other assumptions, the cost impacts predicted by CRA are much higher than EPA's or Duke University's Nicholas School's recent modeling, which find that compliance with the emissions targets has only a small effect on GDP.

Finally, CRA's suggestion that delaying emission reductions would reduce costs ignores the primary driver of innovation. Entrepreneurs will only invest in developing and deploying the low-emission technologies we need if a market for these innovations is established by capping global warming pollution now. Delaying action will only delay progress in further reducing the costs of the many technology options available today.

When all is said and done, solving global warming is not only affordable, it is likely to be beneficial to the economy as well as our environment and public health. But even if it costs several times as much as EPA's or Duke's estimates, it is still a much better choice

than gambling our future through inaction. (See attached "Economists' Statement on Climate Change")

We have the solutions – cleaner energy sources, new vehicle technologies and industrial processes and enhanced energy efficiency. What we lack is the policy framework to push business investments in the right direction and to get these solutions in the hands of consumers. America's Climate Security Act is a solid start on a policy framework that will trigger the necessary technological innovation in a manner that will strengthen our economy and lower the risk of catastrophic climate disruption.

Global Warming Pollution Reductions under ACSA (as amended in Subcommittee)

NRDC appreciates that ACSA was amended in the Subcommittee last week to expand its coverage of natural gas emissions. The bill covers all sources of global warming pollution that emit more than 10,000 tons of carbon dioxide equivalent per year in the electric power and industrial sectors as well as all transportation fuel providers whose products will produce more than 10,000 tons per year when consumed, and as amended in the Subcommittee, all emissions from natural gas consumption in the United States.

The expanded coverage adopted in Subcommittee significantly increases the emission reductions that ACSA would achieve. A recent analysis by the World Resources Institute (WRI) estimates that the bill, as amended, covers 84% of U.S. emissions, up from 75% as originally introduced.

The impact of the bill on total greenhouse gas emissions depends on assumptions made about state action, emissions from non-covered sources, and changes in biological carbon sequestration. The bill includes incentives for states to adopt climate policies that are more stringent than the federal program, to adopt and enforce model building codes, decouple electric and gas utility revenue from sales, and make energy efficiency investments as profitable as increasing energy supplies. The bill also includes energy efficiency standards for residential boilers and provisions requiring regular updates to residential and commercial building codes. Finally, the bill sets aside 5% of the total allowance pool to promote increased biological sequestration in domestic farms and forests and an additional 2.5% for similar international efforts.

These provisions will reduce emissions from non-covered sources below business as usual levels but the magnitude of these benefits is difficult to quantify. NRDC has constructed an Optimistic and Pessimistic case to bound the likely range of total greenhouse gas emission reductions under the bill.

- State Programs:
    - The Optimistic case assumes that any states that enact climate programs more stringent than the federal program retire the bonus allowances allocated to

them (2% of the total allowance pool). While the bill makes clear that states have the authority to enforce global warming pollution standards more stringent than federal requirements currently there is no clear mechanism by which these state programs would result in reductions in national emissions other than by retiring their bonus allowances. Further elaboration of the state authority provisions could allow for greater national benefits from state programs.

  - The Pessimistic case assumes that these states programs help achieve the emission caps specified in the bill but do not achieve additional environmental benefits.

- Emissions from non-covered sources:
  - In the Optimistic case non-covered emissions from the residential and commercial sectors and non-covered methane emissions are assumed to decline at the same annual rate as they did from 2000 to 2005 (0.7% and 1.2%, respectively). Emissions of nitrous oxide and other non-covered greenhouse gases are assumed to remain constant at 2005 levels. In addition, the 7.5% allowance set aside for biological sequestration is assumed to generate one ton of benefits for each ton of allowances devoted to this purpose.[12]
  - In the Pessimistic case emissions from all non-covered sources are assumed to increase at the rate projected by EPA in its analysis of S.280 using the ADAGE model (0.3% per year) and the 7.5% allowance set aside for biological sequestration is assumed to generate 0.5 tons of benefits for each ton of allowances devoted to this purpose.

Based on these assumptions, we estimate that ACSA, as reported by the Subcommittee, would reduce total U.S. greenhouse gas emissions by 18 to 24 percent in 2020 compared to 2005 levels. By 2050 the bill would reduce total emissions by 59 to 66 percent. More detailed results are provided in the table below.

Year	Emissions of Covered Sources	Estimated Total Emissions Optimistic Case (MMTCO2e)	Estimated Total Emissions Pessimistic Case (MMTCO2e)	Reductions in Emissions from Covered Sources (2005 Baseline)	Estimated Range of Reductions in Total Greenhouse Gas Emissions (2005 Baseline)
2012	5,773	6,359	6,715	6%	8-12%
2020	4,920	5,538	5,923	20%	18-24%
2030	3,854	4,517	4,933	37%	32-38%
2040	2,789	3,501	3,945	54%	46-52%
2050	1,732	2,499	2,966	72%	59-66%

[12] While some "anyway" tons are likely to be promoted through these programs the cost per ton to reduce emissions through biological sequestration is expected to be less than the market price for allowances within the cap. The assumption here is that price differential between the incentives for biological sequestration and the price of allowances sold compensates for the anyway tons.

Coverage of Emissions

The cap and trade program should cover as much of the economy's GHG emissions as is possible. We commend the Subcommittee for expanding the bill's coverage to include all emissions from the use of natural gas. Similar to the transportation sector, it is not feasible to cover emissions from natural gas use in homes and offices at the point of emission due to the very large number of small sources. It is, however, feasible to include these emissions within the cap by moving the point of regulation upstream. We believe the most straightforward way to implement full coverage of natural gas is to keep coverage in the electric power and industrial sector at the point of emission as in ACSA as introduced, and to make all natural gas distributors above a given size threshold responsible for managing allowances for emissions by their residential and commercial customers (e.g. all distributors that sell natural gas to residential and commercial customers, the combustion of which generates more than 10,000 tons of carbon dioxide equivalents).[13]

Alternatively, allowances could be managed by interstate and intrastate pipelines or by a combination of natural gas processors, importers, and pipelines for gas that is not processed. Downstream sources would not be required to submit allowances for emissions associated with their use of natural gas. This option is only acceptable if it is implemented in a way that prevents bypass of the point of regulation. Furthermore, this option moves the point of regulation further away from the actors who have direct control or influence over emissions. This could reduce the responsiveness of emitters to the cap, increasing compliance costs.

Allowance Allocations and other Policies under ACSA

ACSA 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 higher than the abatement costs: 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

[13] 10,000 tons of CO2 corresponds to 183 million cubic feet of natural gas. There are about 500 entities that distribute this volume of natural gas or more to residential and commercial customers.

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.

ACSA 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 allocations available to fully meet public needs. As discussed more fully below, the allowance allocations in the bill can be substantially improved.

ACSA 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, as discussed below, 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 ACSA 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.

Areas for Additional Improvement

While ACSA 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:

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, ACSA 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 comprehensive 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.

Carbon Capture and Disposal:

Perhaps the most important performance standard for the energy production sector is for coal-fired electric generation. It is critical to recognize that continued investments in old technology will "lock in" high carbon emissions for many decades to come and create a tremendous economic burden. 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.

It is critical that we stop building new coal plants that release all of their carbon dioxide to the air. The Sanders-Boxer bill contains two complementary performance standards for coal plants and we recommend the Committee incorporate these concepts into ACSA. 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. 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 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.

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 though we believe that the bill currently over allocates to carbon capture and disposal (CCD) projects. In particular, the program for advanced coal under the auction is limited to 20 GW, but is allocated more revenue than it would need to deploy this capacity. As a result this amount could be reduced significantly without reducing the number of projects that are supported. In addition, the bonus allowance program for CCD provides more of an incentive than is needed given the caps in the bill. These revenues and

allowances could be put toward other public benefits such as the adaptation needs of disadvantaged peoples and communities in the U.S and internationally who will be adversely affected by global warming impacts.

Some have argued that key technologies, such as carbon capture and disposal (CCD) are not yet available or are only available now at exorbitant cost. Such arguments are incorrect. All the elements of CCD systems are actually in use today but not are used in an integrated fashion. Arguments that claim full CCD systems are not ready because they are not in use today, under today's market conditions, fundamentally miss the point that sound global warming legislation will create the market conditions for deployment of such systems going forward from today.

Expert studies have concluded that we have the knowledge base now to proceed safely with geologic disposal of carbon dioxide in the amounts produced by the typical coal fueled power plant.[14]

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 disposal.[15]

Low-Carbon Fuels Standard:

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. We support inclusion of such a performance standard in ACSA. It is also important to note that other

[14] *See, e.g.,* the "Special Report on Carbon Dioxide Capture and Storage" of the Intergovernmental Panel on Climate Change discussed in Appendix C. *See also,* MIT's report on "The Future of Coal" (2007). The MIT report's lead authors, Professors John Deutch and Ernest Moniz, had this to say about the safety of multi-million ton injection projects to the Senate Energy and Natural Resources Committee in March 2007: "Each plant will need to capture millions of metric tonnes of CO2 each year. Over a fifty-year lifetime, one such plant would inject about a billion barrels of compressed CO2 for sequestration. *We have confidence that megatonne scale injection at multiple well-characterized sites can start safely now*, but an extensive program is needed to establish public confidence in the practical operation of large scale sequestration facilities over extended periods and to demonstrate the technical and economic characteristics of the sequestration activity." (Deutch, emphasis supplied); "I think the important thing to emphasize, so there's no confusion, is that we feel very, very confident about the wisdom of going ahead now with those mega-ton per-year projects." (Moniz). U.S. Senate, Energy and Natural Resources Committee, "Future of Coal," March 22, 2007, S. Hrg. 110-69 at 9, 11.

[15] Appendix C contains a more thorough discussion of the readiness of carbon capture and disposal systems.

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 ACSA.

Offsets:

ACSA 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 offsets for forest management activities, where additionality fundamentally cannot be guaranteed. Moreover forest management activities focused on maximizing carbon storage could result in ecological damage to forests, which have many functions in addition to carbon

storage. The authority of the Carbon Market Efficiency Board to expand the use of offsets should also be constrained. 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 adaptation, 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 with no requirement that these allowances be used for public purposes. 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 ACSA 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 initially and in later years. 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 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.

The impacts of global warming will be felt to a much greater extent by vulnerable communities abroad, particularly those in the least developed countries that bear the smallest share of responsibility for increases in greenhouse gas concentrations.

The average American is responsible for many times more emissions than an average citizen of most African countries. Providing assistance for international adaptation is not only the right thing to do, it is also in our national interest. Global warming is a destabilizing force that will act against our hopes for the advancement of human rights and democracy. It will elevate the risk of displacement, famine, and poverty–the kind of conditions in which violence, oppression, and radical ideologies can flourish. Providing support for adaptation will also help advance international negotiations toward an effective global agreement for the period beyond 2012.

But our motive for providing help should not rest solely on whether these countries are a "security" threat, but also because this is the right thing to do, and because we have a crucial opportunity to ameliorate worldwide suffering by assisting these nations in adopting more sustainable energy and development paths.

* * *

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 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 A
Economists' Statement on Climate Change
Statement Signed November 7, 2007

As economists, we believe that the overwhelming scientific evidence of climate change warrants significant reductions in greenhouse gas emissions to insure against potentially catastrophic social, environmental, and economic risks.

The Bush Administration and Congress have repeatedly heard that policies requiring domestic emission reductions will prove too costly to the economy and result in significant job loss. As economists, we disagree with this assessment. Economic theory does not require us to ignore the threat of climate change. Climate policy should reflect our responsibility to future generations, the long-term benefits of a growing and innovative economy, and equity in sharing the burdens associated with the necessary reductions in emissions of greenhouse gases. We need to invest in an "insurance policy" that reduces the risks of catastrophic climate change. Well-designed policies that encourage switching to energy-efficient technologies and renewable energy resources will enable these emissions reductions to be made cost-effectively, and will encourage additional technological progress as well. The economy cannot be stable and dynamic in the long run if the Earth is threatened by disastrous climate change.

Smart climate policy will involve: (i) large-scale public investment to support the rapid transition to new technologies, (ii) a cap-and-trade system that *sells* polluters the rights to generate a limited and steadily declining amount of emissions and recycles the revenues equitably, and (iii) a cooperative international approach to climate change that situates domestic emissions reduction as part of a global response to climate change. As the largest and most powerful nation in the world economy, it is our responsibility to lead the search for global warming solutions.

Sincerely,

Frank Ackerman, Tufts University
Paul Baer, EcoEquity
James Barrett, Redefining Progress
James Boyce, University of Massachusetts, Amherst
Nathan Sivers Boyce, Willamette University
Gardner Brown, University of Washington
Graciela Chichilnisky, Columbia University
Herman Daly, University of Maryland
Stephen DeCanio, University of California, Santa Barbara
Thomas Drennen, Hobart and William Smith College
Jon Erickson, University of Vermont
James K. Galbraith, University of Texas
Gloria Helfand, University of Michigan
Eban Goodstein, Lewis and Clark College
Robin Hahnel, American University
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Farzin Hossein, University of California, Davis
Richard Howarth, Dartmouth College
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Neha Khanna, State University of NY, Binghampton
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David Levy, University of Maryland, Baltimore
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Kristen A. Sheeran, St. Mary's College of Maryland
Tom Tietenberg, Colby College
David J Vail, Bowdoin College

All signatories endorse this statement as individuals and not on behalf of their institutions.

APPENDIX B

Memorandum to: Senator Boxer
Chair of the Senate Environment and Public Works Committee

From: Kristen A. Sheeran Ph.D.
Executive Director
Economics for Equity and the Environment: E3 Network

Having examined the statements of Anne E. Smith of Charles River Associates (CRA), and Margo Thorning of the American Council for Capital Formation (ACCF) regarding the impacts of America's Climate Security Act (S.2191), I have drafted the following response on behalf of E3 Network's climate economists. We bring to this analysis our combined experience and expertise as professional and academic economists who have worked and published in the field of climate economics and energy economics for over three decades.

The purpose of this memorandum is not to review all of the studies that have been conducted on S. 2191, nor to provide a comprehensive review of the literature. Our purpose is to illuminate the debate over S.2191 by pointing out the economic logic, assumptions, and deficiencies of the CRA and ACCF analyses in relation to best-practice in this field. This is especially important because these analyses have been privately produced and have not appeared in the peer-reviewed literature. Without a careful discussion of their methodology, it is difficult, if not impossible, for lawmakers to assess its value as policy guidance.

The Broader Context:

It goes without saying that legislation such as S. 2191 has both moral and economic dimensions. Climate legislation will impact the quality of life for future generations here and abroad. We understand the science of climate change to be unequivocal: climate change is a real phenomenon with the potential for serious, and potentially catastrophic, disruptions to natural, social, economic, and political systems. The question for economists is not whether to take action now to reduce emissions, for the science tells us we must, but how to achieve those reductions in a cost-efficient manner that distributes the burdens equitably.

Sound climate policy will involve: (i) large-scale public investment to support the rapid transition to new and more energy efficient technologies, (ii) a cap-and-trade system that *sells* polluters the rights to generate a limited and steadily declining amount of emissions and recycles the revenues equitably, and (iii) a cooperative international approach to climate change that situates domestic emissions reduction as part of a global response to climate change. The economic costs will be lower, and the economic benefits of avoided

climate change damages will be higher, if we act sooner, rather than, later to enact meaningful climate legislation.

CRA bases their analysis on the results of their MRN-NEEM model. This model is a type of Integrated Assessment Model (IAM) that economists often use to estimate the economic impacts of climate policy options. There is a lengthy scholarly literature that compares model results for policies such as S.2191. As a privately produced model, MRN-NEEM has not appeared in the scholarly literature. Our purpose is not to engage in a "dueling models" comparison. Rather, we will point out several deficiencies in the CRA model that contradict emerging best practice in the field.

Exclusion of Benefits:

In her testimony, Anne E. Smith states that "net societal costs are an inescapable aspect of an emissions limit via a cap-and-trade program that cannot be eliminated through any allocation formula that may be devised" (Anne E. Smith, prepared testimony dated 8 November 2007). It is impossible for her to arrive at any other conclusion, since CRA's model includes only costs and virtually no benefits. Excluding the benefits of emissions reduction from the analysis is equivalent to assuming that the science predicting potential damages from climate change is flawed and that environmental improvements have no impact on human well-being and happiness. Neither point is substantiated in the literature.

In contrast, the benefits of avoided damages from climate change are well-supported by the literature. The recent Stern Report commissioned by the British government by Sir Nicholas Stern, former chief economist of the World Bank, estimated conservatively that the equivalent of 5% of world output would be lost from economic damages from climate change. A Tufts University forthcoming study estimates damages to the state of Florida from climate change equivalent to 5% of Gross State Product by the close of the century. A recent University of Maryland study reviews the literature on the costs of inaction on climate change in the US. Damages include coastal property loss from flooding and sea level rise, loss of life and property from more frequent and severe hurricanes and tropical storms, increased drought and wildfire risks, and disruption of water supplies. Until recently, it was believed that warming might increase agricultural yields in the colder northern states. However, a recent MIT study finds that the increase in ground level ozone from the increased use of fossil fuels will offset any possible benefits from warming and concludes that agricultural yields will decline throughout the US as the climate warms. While difficult to aggregate all of these costs into one single dollar value for the nation as a whole, these studies reveal the hidden real costs of inaction in every region of the country. The costs of inaction - the benefits of avoided damages - should be included in any sensible debate over climate policy.

Failure to act on climate change also increases the likelihood of abrupt, irreversible climate catastrophe, the costs of which would be far worse than the predictable costs of inaction highlighted above. The Stern Review emphasized this point, and estimated that world output could decline by as much as 11% in the event of abrupt catastrophic change.

Stern's emphasis on risk and uncertainty is supported by Harvard economist Martin Weitzman. Best practice in economics with regards to uncertainty and risk is rapidly evolving, partly in response to the challenges posed by climate change. The CRA model does not incorporate these new approaches.

It is also possible to make the benefits of avoided climate damages "disappear" through the use of the mathematically convenient, but ethically questionable, practice of discounting future benefits. The CRA analysis uses a 5% annual discount rate. At this rate, a dollar of income fifty years from now is worth only $.08 today. First, we challenge whether real people are actually this myopic in their consideration of the environment. Discounting the importance of future generations seems to contradict the concerns of most Americans for the well-being of their children and their grandchildren. On a more technical level, we challenge the use of a high discount rate as applied to highly uncertain future outcomes. Economists such as Sir Partha Dasgupta of Cambridge have noted that if environmental damage is sufficiently great as to reduce consumption in the future, the discount rate would be much smaller than society's pure rate of time preference, and potentially even negative. A negative discount rate would mean that any sum of money spent today to avoid climate change would be worth less than the equivalent sum of money in the future. Other economists, like Harvard's Weitzman, have noted that the existence of uncertainty creates a precautionary motive for increased savings, which lowers the discount rate.

Inadequate Treatment of Costs:

The CRA analysis essentially eliminates the possibility for "no-regrets" options. A no-regret strategy is one that could reduce greenhouse gas emissions without curtailing economic productivity or economic performance. It does this by assuming, as most IAMs do, that business organizations and consumers behave rationally to achieve their objectives and are successful in optimizing their behaviors. However, it is well-known in the economics literature that businesses do not exploit every opportunity for profit. There are many opportunities to increase efficiency, reduce costs, and improve productivity that are routinely "left on the table" due to organizational and institutional constraints. Recent studies by the American Council for an Energy Efficient Economy (ACEEE) have estimated that cost-effective reductions of 25-30% of current emissions are now possible. The role of climate legislation is to provide clear and persistent policy signals to the market to seize upon these existing opportunities and rapidly develop others.

There are more satisfying ways of mapping cost-effective technologies into IAMs than CRA has done. Studies by DeCanio et. al and Laitner et. al, which embed technology in a more meaningful way in their analyses, reach different conclusions about the economic costs of emissions limits. The CRA model documentation (see footnote 1 in Smith's testimony) admits, in effect, that no engineering assessment was done on the demand side, to determine the potential savings from reduced energy consumption. On the supply side, their model includes no combined heat and power, no recycled energy or other conversions of waste to useful energy. These technologies could provide upwards of 20% of today's existing electricity generation at a substantial reduction in emissions. There are

additional technologies that could be developed and could become cost-effective if there were clear and persistent policy signals to guide the market.

Without even considering productivity improvements for the economy in the long term, it is clear that technological change in response to climate legislation will improve economic performance in the near-term. Cost-effective technologies can stimulate new investment, save consumers money, stimulate productive research and development with spill-over benefits for other sectors and positive multiplier effects, and help to reduce energy imports and increase technology exports. As the rest of the world moves ahead with policies to curb emissions, the U.S. risks losing its technological advantage globally. In the early 1980s, US companies led the world in wind energy technologies. Today, we import those technologies from Europe.

Misrepresenting policy outcomes:

S. 2191 would reduce carbon pollution by instituting a cap-and-trade system. Economists widely agree that well-designed cap-and-trade systems can achieve any level of emissions reduction at the lowest total cost of compliance. But a critical question surrounding cap-and-trade still remains: how should we get the permits into the hands of polluters? The question sounds trivial, but it may be the single most important issue at stake with regards to climate policy. How government distributes and invests the revenues from that auction will have a significant impact on the economy. Economists used to consider the issue of how permits are distributed as largely one of fairness. Economists now understand that how permits are distributed affects economic outcomes. The mechanism for distributing permits must be included in any sensible debate over climate policy. Here is what we know:

The effect on energy prices will be the same whether the legislation requires that permits are auctioned or given away for free (grandfathered). No matter how permits are distributed, polluters will not receive enough permits to cover their current pollution levels, and at least some polluters will need to cut their pollution. Polluters who can do it cheaply will cut their emissions and sell their unused permits to polluters with relatively high abatement costs. In either case, someone somewhere will now have to either pay for a permit or pay to cut emissions. They will pass at least some of those production cost increases onto consumers. And once one producer increases prices, the rest will follow suit.

In case you're not convinced, try the following analogy. Imagine buying World Series tickets from a scalper. Would he charge you any less if he found the tickets on the ground or got them free from a friend inside the ticket office? Of course he wouldn't. In fact, scalpers typically buy their tickets for far less than they sell them. But don't ask for a discount based on that. Like energy, the street price of World Series tickets is based on supply and demand. The supply and demand for tickets is the same no matter how much the scalper paid for them, and so the price he charges you will also be the same no matter how he got them. Of course, the scalper would *much rather* get his tickets for free. And that's precisely the point. Polluters are financially much better off if permits are given

away instead of auctioned, but the cost of cutting emissions and the resulting effect on energy prices will be the same no matter how the permits are delivered.

Giving permits away for free allows polluters to raise their prices without raising their costs. It would result in the transfer of hundreds of billions of dollars every year from consumers and businesses to the polluters themselves: energy companies and their stockholders. It's no surprise that energy companies have lobbied for grandfathered permits.

But fairness and the distribution of wealth from energy policy is not all that is stake. If the government auctions permits, the revenues from the permit auction could be used to "make whole" low-income consumers who might otherwise be hurt by the regressive increase in carbon prices. This could be done either by distributing some or all of the income from permit sales on a per capita basis, or by targeting low-income families with a subsidy. Recent work by DeCanio and, Boyce and Riddle show that per capita distribution of the revenues would benefit of majority of Americans. Furthermore, government can use the revenues from permit auctions to invest in new and more energy efficient technologies. By auctioning permits, government could potentially accelerate economic growth and job creation faster than would have happened without climate policy in the first place. For these reasons, we strongly recommend that 100% of the permits in any cap-and-trade scheme should be auctioned. Since S.2191 auctions only a portion of the permits, it falls short in this regard. This is the most salient criticism of S2191.

Sincerely,

Kristen A. Sheeran, on behalf of:

Frank Ackerman
Paul Baer
James Barrett
Stephen DeCanio
Eban Goodstein
John "Skip" Laitner
Astrid Scholz

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Economics for Equity and the Environment: E3 Network
Climate Economics Taskforce Biographies

Frank Ackerman, Ph.D.
Research Director
Global Development and Environment Institute, Tufts University

Frank Ackerman is the director of the Research and Policy Program at the Global Development and Environment Institute at Tufts University. He has written widely on the limitations of cost-benefit analysis of health and environmental protection, and has worked closely with environmental groups including NRDC, Riverkeeper, Greenpeace, the Alliance for a Healthy Tomorrow (Massachusetts), and the Farmworker Justice Fund. His recent books include Priceless: On Knowing the Price of Everything and the Value of Nothing (The New Press, 2004, jointly with Lisa Heinzerling), and The Flawed Foundations of General Equilibrium: Critical Essays on Economic Theory (Routledge, 2004, jointly with Alejandro Nadal). Some of his recent work on precautionary approaches to toxic chemicals has been supported by European governments and NGO's. Ackerman is a Member Scholar at the Center for Progressive Reform. He received a B.A. in mathematics and economics from Swarthmore College and a Ph.D. in economics from Harvard University.

Paul Baer, Ph.D.
Research Director
EcoEquity

Paul Baer is an interdisciplinary scholar-activist with expertise in ecological economics, ethics, philosophy of science, risk analysis, and simulation modeling, specializing in climate science and policy. He completed his PhD in 2005 at UC Berkeley's Energy and Resources Group; his dissertation examined the interconnection between equity, risk and scientific uncertainty, three topics at the heart of the climate problem. He also has a BA in Economics from Stanford University and a Masters in Environmental Planning and Management from Louisiana State University. He recently completed a post-doctoral research fellowship at Stanford University's Center for Environmental Science and Policy, addressing the interaction of climate change and forest fire in Alaska. He is currently the Research Director for EcoEquity, a climate-advocacy organization he co-founded in 2000 with Tom Athanasiou, with whom he also co-authored the 2002 book "Dead Heat: Global Justice and Global Warming (Seven Stories Press).

Jim Barrett, Ph.D.
Executive Director
Redefining Progress

Dr. Barrett has worked on a variety of issues concerning energy and environmental economics, including the impacts of carbon reduction programs on the U.S. economy, the economic implications of opening the Arctic National Wildlife Refuge to oil exploration, and the technical and economic feasibility of hydrogen production. Prior to joining Redefining progress, Dr. Barrett was an economist at the Economic Policy Institute, senior economist on the Democratic staff of the Joint Economic Committee of the U.S. Congress, and staff economist at the Center for the Advancement of Genomics and the Institute for Biological Energy Alternatives. Dr. Barrett earned his B.A. in economics from Bucknell University and his M.A. and Ph.D. in economics from the University of Connecticut.

Stephen DeCanio Ph.D.
Professor of Economics
University of California, Santa Barbara.

Dr. DeCanio served as Senior Staff Economist at the President's Council of Economic Advisers. He has been a member of the Economic Options Panel convened by the United Nations Environment Programme to review economic aspects of the Montreal Protocol on Substances that Deplete the Ozone Layer, and is currently Co-Chair of the Montreal Protocol's Agricultural Economics Task Force of the Technical and Economics Assessment Panel. His research focuses on the economics of climate change, protection of the stratospheric ozone layer, factors affecting the diffusion of energy-efficient technologies, and the impacts of greenhouse gas reduction policies. He is one of the founders of UCSB's Computational Laboratories Group. His most recent book, *Economic Models of Climate Change: A Critique*, is available from Palgrave-Macmillan. His resume gives a complete list of publications, and a selection of them is shown below

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His research has been featured in The New York Times, Scientific American, Time, Chemical and Engineering News, The Economist, and The Chronicle of Higher Education. He received his B.A. from Williams College and his Ph.D. from the University of Michigan. He serves on the editorial board of Environment, Workplace and Employment, and is a Member Scholar at the Center for Progressive Reform. From 2006 to 2008 Goodstein is directing a national educational imitative on global warming solutions for America, Focus the Nation.

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Skip Laitner is a resource economist with more than 35 years experience in energy and economic impact studies, public policy analysis, and economic development planning. He most recently served 10 years as the Senior Economist for Technology Policy within EPA's Office of Atmospheric Programs. In that capacity, Skip was awarded EPA's 1998 Gold Medal for his work with a team of EPA economists that helped set the foundation for the Kyoto Protocol on Greenhouse Gas Emissions. In 2003 he was acknowledged as a technology leader when given the "CHP Champion" award by the U.S. Combined Heat and Power Association.

In May 2006 Skip resigned his position with EPA to join the American Council for an Energy-Efficient Economy (ACEEE), an established and respected think tank based in Washington, DC. In his current capacity Skip will focus on characterizing the scale and scope of energy efficiency technologies as that larger resource might promote a significant but cost-effective reduction in greenhouse gas emissions. He will also explore more dynamic economic modeling techniques to better reflect and evaluate the macroeconomic impacts of productive energy efficiency investments. Skip has written more than 160 papers and reports in the fields of community and economic development, decision sciences, energy and utility costs, and natural resource issues. He is a widely recognized speaker and has given both technical and public policy presentations in the United States and abroad. Skip has a master's degree in resource economics.

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Astrid Scholz is Vice President for Knowledge Systems at Ecotrust, a Portland, Oregon, based conservation organization committed to building a future that strengthens communities and the environment from Alaska to California. An ecological economist by training, she conceptualizes and analyzes the linkages between ecological, economic and social systems in the West Coast's emerging conservation economy. In her capacity as a member of Ecotrust's executive team, she is responsible for managing a staff of 12, overseeing several projects and contracts, and fundraising. She is an affiliate faculty

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APPENDIX C

Is Carbon Capture and Disposal (CCD) Ready for Broad Deployment?

David Hawkins

Director, Climate Center

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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.