

S. HRG. 110-1233

**AMERICA'S CLIMATE SECURITY ACT OF 2007,
S. 2191**

HEARINGS

BEFORE THE

**COMMITTEE ON
ENVIRONMENT AND PUBLIC WORKS
UNITED STATES SENATE**

ONE HUNDRED TENTH CONGRESS

FIRST SESSION

NOVEMBER 8, 13, AND 15, 2007

Printed for the use of the Committee on Environment and Public Works



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U.S. GOVERNMENT PRINTING OFFICE

73-583PDF

WASHINGTON : 2013

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COMMITTEE ON ENVIRONMENT AND PUBLIC WORKS

ONE HUNDRED TENTH CONGRESS
FIRST SESSION

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ANDREW WHEELER, *Minority Staff Director*

¹Note: During the 110th Congress, Senator Craig Thomas, of Wyoming, passed away on June 4, 2007. Senator John Barrasso, of Wyoming, joined the committee on July 10, 2007.

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**AMERICA'S CLIMATE SECURITY ACT OF 2007,
S. 2191**

THURSDAY, NOVEMBER 8, 2007

U.S. SENATE,
COMMITTEE ON ENVIRONMENT AND PUBLIC WORKS,
Washington, DC.

The full committee met, pursuant to notice, at 9:30 a.m. in room 406, Dirksen Senate Office Building, Hon. Barbara Boxer (chairman of the full committee) presiding.

Present: Senators Boxer, Inhofe, Lieberman, Carper, Lautenberg, Cardin, Sanders, Klobuchar, Whitehouse, Warner, Voinovich, Isakson, Vitter, Alexander, Bond, Barrasso, and Craig.

Senator BOXER. Good morning, everybody. The hearing will come to order.

We are here today to consider a landmark global warming bill, thanks to the bipartisan leadership of Senators Lieberman and Warner. For me as Chair, I couldn't be more proud of the work that they have done. I want to thank all members of the Committee for really helping us get to this point.

Senator Warner has a need to go back to his office, because he is nursing a serious wound that he encountered. As a result of that, I have decided, and Senator Inhofe agrees, that we will ask Senator Warner if he will make his statement first.

Senator, welcome.

**STATEMENT OF HON. JOHN W. WARNER, U.S. SENATOR FROM
THE COMMONWEALTH OF VIRGINIA**

Senator WARNER. Thank you, Madam Chairman. I thank my old friend and the distinguished Ranking Member.

I hit a small pothole, but I am on the mend, but under doctor's orders I can't sit. That is a unique experience, after 80 years of healthy life, nor bend. But that soon will pass. In the meantime, I just wanted to come up and say two words to everybody present: thank you. First and foremost to the leadership of this Committee and to my good colleague, Senator Lieberman, for enabling this Committee to fulfill what I believe is his responsibility to the U.S. Senate. I believe the Executive Branch has its position and I think it is important that the Legislative Branch fulfill its constitutional responsibilities. This Committee, under the Senate rules, is the one entrusted to do just that.

I became interested in this issue, because I do believe there are ramifications that relate to national security, although they are potential. I have, together with other Senators, participated in efforts, which I think are going to be successful, to produce a national in-

telligence assessment. I carefully use the word assessment rather than estimate. But I believe the document will have a standing equivalent to an estimate. That is forthcoming.

I am also working on the National Security Annual Authorization bill. As a matter of fact, we hope to meet again today to conclude that. Hopefully there will be a reference in there to the need for the various military departments to make their own assessments, as well as the Department as a whole.

So with those things in mind, I just urge the Committee to continue its work on this. I readily acknowledge that there are many members of this Committee and indeed, members of the Senate, that have done a great deal of work on this, and that I joined the effort somewhat later in time, but with no less energy and commitment to do what I can to see that the Senate performs its duties.

I do believe that in the coming year, the American public will look to both the Democratic Party and the Republican Party as to their stance on these various issues. I think the forthcoming issues will have it as an active issue of debate. All the more reason for this Committee to assemble as best we can a record, so that people can draw from that record.

With that, I will wind up and go back down where I occupy my prone position and watch this on television. With the concurrence of the Chair and Ranking Member, I have questions. When my time comes, I believe Senator Lieberman will ask those questions on my behalf.

I thank my colleague from Wyoming from sitting in to the subcommittee staff to enable the subcommittee to fulfill its work and to go to the full Committee. So I wish you luck. A lot is known; a lot is unknown. We have a heavy obligation to the extent we can achieve the highest degree of bipartisanship, to make those assessments, to prepare this record and to fulfill what I believe is the duty of this Committee to report to the Senate Floor a bill.

I thank the Chair, the Ranking Member.

[Applause.]

**STATEMENT OF HON. BARBARA BOXER, U.S. SENATOR FROM
THE STATE OF CALIFORNIA**

Senator BOXER. Senator Warner, go in better health. We know you are going to be just fine. We miss you and we feel that the work you have done has really been extraordinary for this Committee. This is a special day for the Committee as we look at this landmark legislation, a very good bill indeed.

We also, Senator Inhofe and I, on another matter where we fully agree, are going to have a great day for our Committee, and I just wanted to take a moment out to say thank you for everyone's work on WRDA. This was one where we really worked together so hard. Senator Inhofe and I, joined by Senators Baucus and Isakson, and each and every one of you, all of your contributions to the WRDA bill were just really strong. I wanted to say to Senator Vitter, I know how much this means to you and to Senator Landrieu. I think that the members of this Committee, across party lines, showed its desire to help with Louisiana. We went down to see with our own eyes and you and Senator Landrieu were most helpful to this Committee.

So it is a good day, from my perspective, on all fronts.

I am going to put my full statement in the record on this matter, but I will quote from it. Senator Warner and Senator Lieberman, by coming together to write a bill on global warming, I think is leading this Committee in the right direction and leading the Senate in the right direction.

The way I look at it, each of us has several choices here in what we decide to do on global warming. One is to do nothing. I believe that is very, very dangerous. Two is to embrace a dangerously weak bill. I think that is dangerous. Because if we pass a weak bill, if we pass a bill that doesn't have the proper framework, we could get caught into the aspects of the bill that we could never change later, or it would be very difficult. So I think doing nothing and passing a dangerously weak bill would be something I would oppose.

Now, that leaves two other options. One is to pass the perfect bill. I would say that every member on this Committee could write a perfect bill from his or her perspective. I would suggest that 100 Senators each could write a perfect bill, 100 perfect bills. That is not going to get us anywhere. We are in the Legislative Branch. We are not executives. We have to work together.

That leaves the final choice, which is a very good bill. I believe the bill before us is a very good bill. Can we make it better? Absolutely. Can we make it better in Committee? Absolutely. Can we make it even better on the Floor? Yes. I think the most important thing we can do for the American people is to move this process forward. I would say not to do that, in my view, is completely irresponsible, given the status of what we already know from the scientists on global warming.

So Senators Lieberman and Warner have given us a pathway. Now, I sat through the entire Subcommittee markup, and I want to praise certain Senators. Senator Lautenberg, you are one of them, but you have to listen.

[Laughter.]

Senator BOXER. Because in the Subcommittee, we moved this bill forward. We adopted amendments of Senator Lautenberg, Senator Sanders, and Senator Barrasso. We did it in, I think, a very strong way. Everybody's voice was heard. Some amendments were rejected. The reason I believe they were rejected is they would have upset the balance so we could move this bill forward. Right now, what I hope we can do as we listen to our panel and we go through the briefings that we will have is to be able to keep that delicate balance that we have across party lines to get this bill out.

This bill will create a great climate for strong economic growth, new green jobs, vigorous environmental protection. If it is passed as it is, and we look at the modeling, it is changing, but it is moving in the right direction. It will be the strongest global warming bill, the most far-reaching ever passed in the world. The fact that this Committee could do it is very exciting. It sets the Nation on a clear path to reducing greenhouse gas emissions. The goals are strong and we hope to make them stronger.

We set up a cap and trade program, by the way, cap and trade was invented in America, as we looked at the issue of acid rain. So we know that it works. It preserves the rights of States to go

and do even more. It includes provisions to help consumers, especially low and middle income consumers. It includes measures that will make the substantial auction revenues available to help ease the cost of transition, pay for weatherization, mitigate potential impacts of energy price increases.

We look at the international scene. I think that Senator Warner's interest was indeed sparked by national security. All we have to do, folks, is listen to our Pentagon and our intelligence people who are there telling us unequivocally that unfettered global warming will in fact be the cause of wars. We already see some evidence of that occurring.

So I approach this issue with hope, not fear. I think the bipartisan breakthrough on this Committee gives me even stronger hope. I don't think we can turn our back on the scientists. There is a consensus out there. I don't think we can turn our back on the economic analysis or Nicholas Stern telling us that every dollar now saves \$5 later. So this is in many ways a great day for this Committee. I know there will be some negative voices, and that is fine. That is part of what we do here.

But I still believe we have the momentum, we have the wind at our back, and I want to thank everyone on the Committee for their help. I just want to say one word about Senators Inhofe and Barrasso for a moment. They have not to this point been for the Lieberman-Warner bill. I understand that. They could have thrown a monkey wrench into the process and all the rest of it. They didn't do that.

When Senator Inhofe could not be here because he had obligations on the Defense Committee, there came Senator Barrasso as a, I think, just taking the high road and helping Senator Warner. I want to tell you, Senator, publicly, because I have told you privately, how much it really meant to me as the Chairman of this Committee, and I want to thank you so much.

So to all members, thank you. It is now time to yield to Senator Inhofe.

[The prepared statement of Senator Boxer follows:]

STATEMENT OF HON. BARBARA BOXER, U.S. SENATOR FROM THE
STATE OF CALIFORNIA

We are here today to consider a landmark global warming bill, thanks to the bipartisan leadership of Senators Lieberman and Warner.

They have worked so hard to come together and craft this thoughtful, comprehensive piece of legislation, and we could not have done it without their tireless dedication to this issue.

This legislation brings to us a strong framework and solid foundation to build upon, and I am so happy that they were able to successfully pass the bill out of their subcommittee.

Today we will hear that the cap and trade approach is not new, and has been applied in the United States for many years. This market-based system has been proven to successfully reduce air pollution.

This bill's approach provides an effective system for emissions reduction, and opportunities for businesses to thrive.

This bill will create a great climate for strong economic growth, new green jobs, and vigorous environmental protection.

There are several important provisions of the bill that make it such a breakthrough proposal:

- It sets the nation on a clear path to reducing greenhouse gas emissions to avoid the worst effects of global warming.

- The goals in the bill are strong and will continue to be reviewed by scientists to ensure we are on the right path.
- It sets up a cap-and-trade program that will establish a price signal to drive the development of technologies and encourage energy efficiency while keeping costs low.
- It preserves the right of states, including my home state of California, to implement their own solutions to global warming, building on the significant progress they have already made.
- It includes provisions to help ensure that consumers—especially low and middle income consumers—will be protected.
- This includes measures that will make substantial auction revenues available to help ease the cost of transition, pay for weatherization of homes, and mitigate any potential impacts of energy price increases on low and middle-income consumers.
- It includes important steps to ensure that action is taken internationally to address this problem, and that our national security is protected.
- It creates American jobs, supports American workers in the transition to a green economy, and it provides support for wildlife and natural resources.

I will continue to work to strengthen this bill at each step of the process.

I believe that it is a moral imperative to do what we can to ease the impacts of global warming—not only on the American consumer, but on world populations suffering from droughts, floods and famine. I look forward to working with communities of faith and others as we work to address these issues.

It is our obligation to act now. The Intergovernmental Panel on Climate Change, or IPCC, has warned of the dangers that global warming poses for us all, such as droughts, extreme weather events, threats to water resources, more frequent and intense wildfires, threats to public health, and the extinction of up to 40% of the species on the planet.

Sir Nicholas Stern, former chief economist of the World Bank, has told us that a dollar invested in combating global warming can save \$5 later.

We cannot afford to do nothing. We cannot afford to pass a weak bill. We must pass the strongest bill we can, but we must remember that the perfect cannot be the enemy of the very good.

STATEMENT OF HON. JAMES M. INHOFE, U.S. SENATOR FROM THE STATE OF OKLAHOMA

Senator INHOFE. Thank you, Madam Chairman. I want to make sure everyone is aware that you and I will be working together at 10:45 this morning, and I am a little concerned now as I look around and see the participation that we have. Because I definitely want to hear from our witnesses, and I have some questions to ask. But also, we need to be down there in an hour or two, so we will try to make that happen.

Let me just say that I appreciate the fact that you have commented on my feeling about the process. If anything, I want the process to be more than it is right now. I think we need to have the administrative analysis of the costs and the benefits of this bill. While we don't have a lot of the things I think we should have at this point, I think we have some excellent witnesses today that will allow us to start talking about what we are really addressing here.

First of all, the Kyoto process, the cap and trade concept, is something that has been a total failure. I don't think there is anyone in this room, in this Committee, or even in Europe, who believes that it has worked. Even the European environmentalists say it has not been a success, it has been a failure. Only two countries out of 15 western European countries have been able to meet their targets.

So I think if we want to address this thing, there are other ways of doing it. I know that several members of this Committee are looking to other options. While the supporters of putting the brakes

on our economy say that our leadership will encourage these other countries to follow us down this path of self-destruction, I don't hear that. I certainly don't hear that from the developing nations. I don't hear it from China. China right now has become the number one emitter. It used to be just a few months ago the United States. I understand right now that India will be passing us up as the greatest emitter of greenhouse gases.

Now, as far as I know, what we always say is, the science is settled, the science is settled, the science is settled. I want to extend my thanks to my colleague, Senator Craig, who yesterday confessed to me that he actually read my whole 2½-hour statement on the Floor of the Senate that was a week ago Friday. I wish everyone would do that, because what I did was, just to show what the science has said, just since 2007, this year. So that is something we are not going to discuss today, we are not going to debate it. But certainly if you look at it, it is not settled.

But one thing that is for sure is that we are embarking on something here that if it became a reality would be a huge economic disaster for our country. We have some excellent witnesses here today to talk about this. The impacts would be terrible, climbing steadily until the costs reach up to about a trillion dollars a year. We used to look at the Kyoto, and that was going to be \$300 billion and this is probably three times that.

So we need to study these things and look and see what the cost is going to be, what the benefits are going to be. I look forward to this hearing and look forward to joining with you on something with which we agree on the Floor at 10:45.

[The prepared statement of Senator Inhofe follows:]

STATEMENT OF HON. JAMES M. INHOFE, U.S. SENATOR FROM THE
STATE OF OKLAHOMA

Madame Chairman,

Thank you for agreeing to hold this and next Tuesday's legislative hearings on S. 2191 after we sent you a letter complaining about the lack of process in the rush to pass this bill out of Committee. But it is not enough. We have yet to see any analysis from the Administration on the costs or benefits of this bill. We have yet to have your staff and those of the sponsors sit down with the staff of all the other offices on the Committee to walk through our concerns. The ability of stakeholders to comment has been limited. But it does allow us to engage in the beginnings of what I hope will be a deliberative process going forward.

On the substance of this bill, I am very concerned. As this chart shows and we will hear today, the Kyoto Protocol cap and trade scheme has been a complete failure, with only two countries expected to meet their targets. Of course, some people try to defend the accord, but nobody believes them anymore—not even European environmentalists. Why would we want to adopt what is one of the biggest economic and policy failures of modern times? Is it credible for supporters to say "Sure, it's failed to reduce emissions or protect Europe's economy, but we think we can tweak it to work?" Is it really wise to bet our children's future on a policy we know will achieve nothing?

EPA's October 1st analysis shows that emissions reductions in the range contemplated in this bill will only reduce global greenhouse gas concentrations by about four percent—that's right, four percent! In the meantime, the world's leading producer of coal—China—has turned from a net exporter to net importer of coal and is building three new coal plants a week. India's economy is also exploding. Officials in both countries have been extremely clear they have no intention of slowing their growth out of concern over global warming.

Yet supporters of putting the brakes on our own economy say that our leadership will encourage these other countries to follow us down this self-destructive path.

I am gratified that, even though we have yet to receive an Administration analysis of this bill, we do have some credible analysts with us here today to discuss

the impacts of this bill. And the impacts will be terrible—climbing steadily until costs reach up to \$1 trillion per year and 2 million jobs lost within the 8 years.

The fact is that this bill ignores we are a growing economy with a growing population. It would be extremely costly to the economy to flatten emission growth, let alone cut emissions 70 percent.

This bill does nothing to protect Americans from spiking natural gas prices and lost jobs that will go to the emerging nations which will emit more greenhouse gases.

Madame Chairman, it is unfortunate that for a bill this important, this costly, and I would add, this disastrous to our way of life would be pushed through the Committee process without any real examination simply to score political points at a UN conference. I think the American deserves more from Congress.

**STATEMENT OF HON. JOSEPH I. LIEBERMAN, U.S. SENATOR
FROM THE STATE OF CONNECTICUT**

Senator LIEBERMAN. Thanks very much, Chairwoman Boxer, for your leadership on this very important subject. I appreciate all the support that you have given us as we brought this both into fruition and then through the Senate, through the Subcommittee on Climate Change with a bipartisan vote.

We have a problem. Yes, I believe very strongly that the scientists are right. It is a broad, international consensus. In fact, I think most members of this committee and most members of the Congress agree that there is a problem. The President of the United States agrees that there is a problem of global warming.

The disagreement now, and this is different than it used to be, the disagreement now is what to do about the problem. I think that the bill we brought forward, America's Climate Security Act, gets the job done and does it in a way that will not hurt our economy, in fact, I think will ultimately help our economy. Are there costs? There are costs. But forgive the homely analogy, but if there was a fire in the kitchen of your house, would you pay the cost of the fire department to have them come to put out the fire before your whole house burned down? I think the answer is yes. That is where we are with global warming now.

I want to take the time that I have to focus in on the cost question. In July of this year, the Environmental Protection Agency, this is not some environmental group, this is the Environmental Protection Agency of the Bush Administration, completed an analysis of the climate change bill that Senator McCain and I previously put in. The emission reductions required in that bill were actually somewhat less than this bill that is before us now. So they were comparable.

EPA's analysis found that the reductions in U.S. greenhouse gas emissions mandated by the McCain-Lieberman bill would, making conservative assumptions about the pace of emissions reductions in the rest of the world, keep the concentrations of greenhouse gases in the atmosphere below 500 parts per million at the end of this century. When I say conservative assumptions about what the rest of the world does, interestingly, that means that there is an assumption that the rest of the world will do nothing for 5 years, and that China and India, for instance, will get on board 5 years after we do, but not really do as much as we are doing until 2025 or 2030.

But still, we are such a critical factor that if we adopt the McCain-Lieberman bill or this bill that Senator Warner and I have

put together now, this bipartisan bill, we would keep greenhouse gases below 500 parts per million at the end of this century. Why is that important? Because according to the consensus of more than 2,000 scientists from around the world, the IPCC, keeping the atmospheric concentration of greenhouse gases below 500 parts per million will avoid a high risk of global warming that will cause severe impacts. So this reaches the goal.

Now, what about the cost? The Clean Air Task Force has now completed an economic analysis of the America's Climate Security Act, as reported out last Thursday. This analysis uses the Energy Information Administration's economic model for climate change as applied to earlier legislation. Again, the EIA is part of the Administration. Incidentally, EIA reaffirmed its confidence in that model in a report that it submitted to Senators Inhofe, Voinovich and Barrasso on October 29.

So the analysis of the Subcommittee-reported bill projects that the price of an emission allowance would not exceed \$50 until after 2030. According to EIA's report to the three Senators I have mentioned, fuel switching from coal to natural gas would not make any economic sense until the price of an allowance exceeded \$50. So one should not expect fuel switching to occur under the America's Climate Security Act before 2030. By 2030, even the pessimists say that we will have commercial deployment of carbon capture and sequestration technology for coal.

The analysis goes on to project that U.S. gross domestic product would more than double by 2030. The projected increase is only 1 percentage point lower than the increase projected by the absence of America's Climate Security Act and I don't believe accounts for the costs of not doing something about global warming. Electricity prices, and I want to be really specific about this, because there are costs. But as I said at the beginning, they are worth it. Electricity rates would over 25 years rise from 8.1 cents per kilowatt hour to about 9.8 cents per kilowatt hour.

Now, are the American people willing to pay that extra penny per kilowatt hour over 25 years to do something to stop the warming of the planet? I am sure they are. Thus, this most recent modeling report on the Subcommittee-reported bill confirms the modeling results that I entered into the record of the October 24th Subcommittee hearing. In short, the costs are manageable. Of course, none of these analyses take into account the staggering economic costs that we will face in this country, not to mention the impact on our way of life and our economy if we fail to curb global warming.

Thank you, Chairman Boxer.

[The prepared statement of Senator Lieberman follows:]

STATEMENT OF SENATOR JOSEPH LIEBERMAN, U.S. SENATOR FROM THE
STATE OF CONNECTICUT

Thank you, Chairman Boxer. I thought I would describe the core of America's Climate Security Act and summarize some of the projections of the bill's environmental and economic impacts.

The bill identifies the large greenhouse gas emitting sources that will be covered by the bill's emissions cap. Those sources include power plants and large manufacturing facilities that burn coal, importers and refiners of gasoline and other fossil fuel-based liquid fuels, and importers and processors of natural gas. The sources

covered by the bill's cap are responsible for over 80 percent of U.S. greenhouse gas emissions.

The bill requires each covered source, at the end of each year beginning in 2012, to hand over to EPA one emission allowance for every carbon dioxide equivalent that the source has emitted in that year. A carbon dioxide equivalent is, for each greenhouse gas—and there are six of them covered by the bill—the amount of the greenhouse gas that makes the same contribution to global warming as 1 metric ton of carbon dioxide.

For each year from 2012 through 2050, the bill identifies the specific number of emission allowances that will be made available to the entire pool of covered sources for that year. The way the bill reduces greenhouse gas emissions is by decreasing, from year to year, the number of emission allowances available to the entire pool of covered sources.

The number of emission allowances goes down each year by 1.8 percent of the 2012 cap level. By 2020, the cap is down to 15 percent below the number of carbon dioxide equivalents that the covered sources emitted in 1990. By 2050, it is down to 70 percent below the amount that the covered sources emitted in 2005.

The bill directs EPA, at the beginning of each year, to allocate all of that year's emission allowances to various government entities, public-private partnerships, and covered sources. The largest share always goes to the Climate Change Credit Corporation, which is directed to auction off all of the allowances it receives.

Once the initial allocating and auctioning has happened at the start of a year, the bill allows for unlimited trading of emission allowances. Because the allowances can be bought and sold freely, a market develops, and the price of an emission allowance becomes uniform across the market.

A covered source that can reduce its own emissions at a cost lower than the market price will do so. If those reductions leave the source with more allowances than it needs to cover its own emissions at the end of the year, the source will sell the surplus on the market. A covered source that cannot reduce its own emissions without incurring a cost that exceeds the market price will purchase credits on the market in lieu of reducing its emissions. The market thus enables facilities to comply with the law at a cost lower than the one they would bear in the absence of trading.

There is a lot more to the bill, particularly when it comes to controlling compliance costs for covered sources and using allowance allocations and auction proceeds to commercialize advanced technologies and protect low-income Americans from economic harm. But what I have described represents the core.

I would like to conclude by mentioning some of the environmental and economic impacts that the EPA and Energy Information Administration computer models project for the bill.

In July, EPA completed an analysis of the McCain-Lieberman climate bill, whose emissions reductions were somewhat less than what this new bill is projected to achieve. EPA's analysis found that the reductions in U.S. greenhouse gas emissions mandated by the McCain-Lieberman bill would—making conservative assumptions about the pace of emissions reductions in the rest of the world—keep the concentration of greenhouse gases in the atmosphere below 500 parts per million at the end of this century. According to the IPCC, keeping the atmospheric concentration of greenhouse gases below 500 ppm will avoid a high-risk of global warming that would cause severe impacts.

Now the Clean Air Task Force has completed an economic analysis of the introduced version of America's Climate Security Act. The Clean Air Task Force uses a modeling firm called OnLocation, which in turn uses the Energy Information Administration's economic model. Incidentally, EIA reaffirmed its confidence in that model in a letter that it sent to Senators Inhofe, Voinovich, and Barrasso on October 29.

The analysis of the introduced Climate Security Act using the EIA model finds the following:

First, the price of an emission allowance would not exceed \$50 until after 2030. According to EIA's October 29 report to Senators Inhofe, Voinovich, and Barrasso, fuel switching from coal to natural gas would not make any economic sense until the price of an allowance exceeds \$50. So one should not expect fuel switching to occur under America's Climate Security Act before 2030. By 2030, even the pessimists say we will have commercial deployment of carbon capture and sequestration technology for coal.

The analysis goes on to project that U.S. gross domestic product would more than double by 2030. The projected increase is only 1 percentage point lower than the increase projected in the absence of America's Climate Security Act.

Electricity rates would, over 25 years, rise from about 8.1 cents per kilowatt-hour to about 9.8 cents per kilowatt-hour.

Thus, this most recent modeling report on the subcommittee-reported bill confirms the modeling results that I entered into the record of the October 24 subcommittee hearing. In short, the costs are manageable. And, of course, none of these analyses take into account the staggering economic costs that we will face in this country if we fail to curb global warming.

Thank you, Chairman Boxer.

Senator BOXER. Thank you. You just note that instead of doing the usual first come, I went to Senator Lieberman first. If there is no objection, I will go down the seniority list, but in the case of Senator Klobuchar, who was here first, she has to leave at 10:00. So after the next speaker on the Republican side, if there is no objection, may I call on her next? OK.

Then we will go to Senator Voinovich. Welcome, Senator.

**STATEMENT OF HON. GEORGE V. VOINOVICH, U.S. SENATOR
FROM THE STATE OF OHIO**

Senator VOINOVICH. Thank you very much, Madam Chairman.

Climate change is a serious and complex issue that deserves our full attention. Madam Chairman, I acknowledge your commitment to timely legislation. But the abbreviated process by which this legislation is moving I don't believe is conducive to good public policy.

Moreover, it is not in keeping with Senate precedent for acting on complex legislation or with the standards of courtesy by which this body traditionally operates. Consideration of legislation of this magnitude, which will touch on every aspect of our lives, requires a thorough vetting by the Committee of jurisdiction before moving forward. Senate 2199 was introduced only a few days ago on October 18, 2007. It is a lengthy, complex bill that has major implications for our economy, our energy security, our environment and our citizens.

Senator Lieberman's subcommittee held a single hearing less than a week after introduction with only one minority opposing witness. Then on October 31, the subcommittee was presented with substantive revisions to the bill, prior to a hurried-up markup. Now, just 7 days later, I am told that we will just have one more hearing next Tuesday before proceeding to a markup and a final vote on or before December 5. The pace of Committee action is unprecedented, and belies the significant impact the bill will have on the United States and international economies, the environment and our quality of life. Climate policy development necessitates more than political will. Members must be accorded the time to ensure the policy response is appropriately calibrated.

At this point, it is not possible to assess the costs and benefits of this bill. We do not understand how this legislation impact on our GDP or the price, supply or reliability of electricity, gasoline and other commodities that millions of Americans depend upon every day. I am talking bottom line jobs. I am not aware of a credible analysis regarding the regressive impacts the legislation may have on the elderly, those on fixed incomes and those living in poverty, the most vulnerable in our society.

We have no assurance that the bill's international provisions are adequate to ensure the effective participation of China, India and other developing nations. The very mechanism the bill advances to contain costs seems to be more the stuff of academic theorizing than scientific analysis. We have heard from no witnesses on the

efficacy of the Carbon Board and its ability to protect the economy. Veiled allusions to the Federal Reserve Board only remind us of the decades of trial and error endured before that institution regularized its procedures.

In fact, until being provided with today's testimony, we have been presented with no analysis of how these very important issues will be affected by the bill. While these analyses are helpful, as one might expect, the assumptions built into the analysis and their predict impacts are colored by their source. So the differences of opinion underscore my point: sufficient time has not been provided for members to thoroughly analyze the bill.

At the very least, members should be provided with an economic analysis undertaken by an independent agency like the Energy Information Administration or the Environmental Protection Agency before moving forward. In the past, this was considered routine. Indeed, multiple analyses were run at the request of Senators Baucus, Carper, Chafee and Obama during the 2003 to 2005 period when I chaired the Committee and we dealt with Clear Skies.

I am asking that a letter that was sent to Senator Inhofe by those Senators be inserted into the record, because they said, we want analysis of all the bills before we do Clear Skies. We took the time. We had boxes of information, and that piece of legislation was like a pimple on the back-end of an elephant compared to this legislation that we are talking about, which is going to be the biggest elephant in terms of our economy, our future and dealing with the environment.

So Madam Chairman, I think it is important that we understand the implications of the votes we take on our economy and environment and our respective States and Nation. This is serious business. Major organizations have major problems with this legislation. The American public deserves to know what implication it has for jobs on the vulnerable people that live in our society, on our ability to deal constructively with the issue of climate change and the speed with which we can move to get the technology to capture carbon and to sequester carbon, to make a difference.

So I am asking that you slow it down. I know that Bali is coming up in December, and I know that some people would like to go with maybe a scalp in their hand for doing something. But Madam Chairman, this is too important. This is too important to rush it down the road. Thank you.

Senator INHOFE. Madam Chairman, I would ask for a unanimous consent request to have four letters entered into the record expressing major concerns.

Senator BOXER. Certainly.

[The referenced material follow on pages 148–164.]

Senator BOXER. Also, I understand that your side would like to have Senator Bond be the next Republican after Senator Klobuchar.

Senator Voinovich, I don't think Clear Skies ever became law. I think some people come here and they want to get things done. For the record, I will say that you don't have to tell me that this is important and that voices have to be heard, because I agree with you. That is why we have held 20 hearings on global warming. As a matter of fact—

Senator VOINOVICH. But not on this legislation.

Senator BOXER. If I might continue. We have held 20 hearings on the various aspects of global warming and the various ways to move to address it. The fact of the matter is, we had leaders from State, local government, county government, mayors, who are already acting and we heard them. We heard from the biggest industries who put forward the very concepts that are embedded in this bill.

So I would take issue to the fact that this is being rushed. We may never go to Bali because we may have it scheduled here in the Senate, that has nothing to do with it. The fact of the matter is, we already have a subcommittee bill to go with to Bali and show how we are moving in a bipartisan way. That has nothing to do with it. The fact is, this is an urgent problem.

Now, not only have we had 20 hearings on global warming, but we have had, as you pointed out, a subcommittee hearing on the legislation, a markup on the legislation where over 20 amendments were filed, and many of them discussed and voted on. We have planned two legislative hearings in the full Committee on this legislation; two members briefings, one of them I hope you will be at this afternoon on this legislation—good. In addition, we have daily briefings for individual staff members of our colleagues, where my staff is available. I personally am meeting with every single U.S. Senator on this Committee who wants to meet with me, so we can discuss the matter as deep as you want to go. If you are interested in amendments, we welcome that. We want this to be a very transparent process.

So I would only say to you that I disagree with what you are saying. We are not rushing this through. We are doing this in the right way. I think if you disagree with the bill and you don't want to have a bill, I respect that. But I don't think that you should criticize the fact of the way we are getting this done. Because I think we are listening to members. We received a letter from you and other Senators demanding more hearings. We put those hearings on as a show of respect. If you want to have more briefings, we will have more briefings. We will brief every single day.

I know Senators Lieberman and Warner's staff are ready to discuss this. We have invited—so many of your staffs have been doing such a great job on that.

Senator INHOFE. I have to correct you on one thing, Madam Chair.

Senator BOXER. I will yield to you when I complete.

Senator INHOFE. All right, that is good.

Senator BOXER. So my point is, you want to debate whether or not we should have legislation, but don't bring up Clear Skies. That is a failure. That never got done. I am a Committee chairman that wants to work with each and every one of you to get something done. The American people are tired of the partisan bickering. They are tired of us not getting anything done. They see this issue coming at them. They are very concerned about it. I think the fact that Senators Warner and Lieberman reached out across the aisle to bring us a bill that is very carefully thought out and didn't just come out of the blue, I mean, these provisions in here have been

discussed for years. Cap and trade system is already in progress in America on acid rain.

So I just wanted to take the strongest objection to your points of view. I respect you, I really do. But I don't agree with what you are saying.

Senator Inhofe, I will be happy to give you equal time.

Senator INHOFE. No, I don't want equal time, because I want to get down to the Floor and get this thing done. But it has to get in the record that our staff has been requesting meetings with your staff for as long as this bill has been discussed, and that has been denied. So hopefully today will change that.

Senator BOXER. OK, I sure would like to see evidence of that, but that is—but we are ready to go.

Senator Klobuchar.

**STATEMENT OF HON. AMY KLOBUCHAR, U.S. SENATOR FROM
THE STATE OF MINNESOTA**

Senator KLOBUCHAR. Thank you, Madam Chair, and thank you for holding this historic hearing and for the work you have done.

I also wanted to thank Senator Lieberman and Senator Warner for the difficult work they have done.

What brings me to this issue is just what I have seen in our State, where we have hunters in Hibbing, Minnesota, who have seen the changes to the wetlands. We have seen ski resort owners who have seen a 30 percent reduction in profits because there is not enough snow. I went to Greenland and saw first-hand the melting of these humongous icebergs where the water is coming off like spigots and we have lost the size of Texas and Arizona combined in ice into the sea.

With all due respect to my friend, Senator Voinovich and my fellow Slovenian, from my perspective of being someone new here, we have waited too long. We have waited while States have moved ahead and ahead and ahead and developed their own standards, where 31 States have had to develop their own climate registry because we haven't done it on the Federal level. We have waited while wildfires are raging in California, and we have seen bills that are similar to this that Senator Lieberman and Senator McCain put out there.

So I think we have studied this enough to know that there is a problem. You know, when Justice Brandeis used to talk about how States could be courageous and be the laboratories of democracy, we have let them do that. Now it is our time. We stood in that chamber yesterday while the French President stood up and talked about the history of this country and how we have been on the front line, taking up bold challenges. When he brought up climate change, I would say the vast majority of the Senators and the Congressmen stood up and cheered and yelled that we were going to do something.

Well, the rhetoric is over and it is time for action. I know that this bill isn't perfect. I am sure there are things—I would love it to be exactly like our State's law and I would love it to have all kinds of things that would promote more cellulosic ethanol and wind and specifically mention them. But it is not going to be perfect for every State.

What this bill is is a strong, steady bill that brings in this idea of cap and trade that worked so well with reducing acid rain. It is going to at least give some direction to business to invest with certainty to make the investments that we need to get us to where we are so we can lead the world instead of just following the rest of the world with investment in alternative technology and to be a leader in this new green revolution and energy independence. I know there are issues we should address, to look at how the climate change evolves and if there are going to be some changes in the future and we should look back at it to have the proper incentives for clean energy.

But basically, we need to start somewhere, and we need to get a bill going. I am not one that believes that we should wait until after the Presidential election to act on this. I have seen that water coming off those icebergs. I have seen what the people in my State see. I have seen the courageous acts of leaders across this country, governors, Republicans and Democrats, who have been willing to take on this issue. So I just don't believe we can wait any longer, and we need to move now and I thank Senator Lieberman and Senator Warner for taking the lead on this.

Senator BOXER. Thank you, Senator.

Senator BOND.

**STATEMENT OF HON. CHRISTOPHER S. BOND, U.S. SENATOR
FROM THE STATE OF MISSOURI**

Senator BOND. Madam Chair, my sincere thanks to you, the Ranking Member and my colleagues for allowing me to go forward. It is strange being this far down on the table, but I came early and appreciate the chance to comment.

Make no mistake, I support cutting carbon emissions. But there are many ways we can cut carbon emissions without cutting family budgets, and devastating sectors of America. We have the solutions available now, aggressive but achievable CAFE standards, a clean portfolio standard, wind, solar, hydro, tidal and zero carbon nuclear power, low-carbon biofuels and zero carbon nuclear plus capturing carbon emissions, cleaning up coal and getting sequestration of that carbon.

But when I look at the bill proposed by my very good friends for whom I have high respect, the Senator from Connecticut, the Senator from Virginia, I say this is a very problematic bill, among others, for farmers. It is a long and complicated bill with many detailed provisions. Staff is still struggling to understand it. Every time we peel back the onion, we find another layer. Whether the consequences of the provisions are intentional or not, vulnerable families, workers and farmers caught in its cross-hairs will feel very real pain.

We are talking about a farm bill on the Floor today. I hope nobody makes the mistake of thinking that this cap and trade carbon emissions limitation bill won't have a heavy impact on farmers. Now, the bill has tried to provide some relief to the stakeholders, as we often do around here, in this case with free carbon allowances. But no farmer should fail to understand that the farm costs of Lieberman-Warner far outweigh the benefits. They will suffer record high fertilizer prices. I have already pointed out they will go

even higher under this bill. For years, ammonia fertilizer that puts the nitrogen, the N factor, it used to cost farmers \$250 a ton. No one thought it would break \$400. Now it is seeing \$500.

I buy a little bit of fertilizer for my operations. I have seen the Triple 13 price go way up because of the cost of the nitrogen fertilizer. Not even corn at \$6 a bushel can support where fertilizer prices are heading. The bill before us will make more expensive fertilizer's main ingredient, natural gas. But electric utilities competing for natural gas can pay higher natural gas prices, passing that along to their consumers. I am one of the elderly Midwesterners who has to pay those bills. But there are a lot of people who have a lot of problems meeting those costs.

But they buy up natural gas, we drive natural gas-using industries offshore and the jobs they create. Foreign fertilizer imports are coming in from cheap natural gas countries like China, Russia and the Persian Gulf. But they have already risen to more than half our supplies.

Now our farmers are being dependent on Persian Gulf imports. Farmers will face much higher fuel costs to run their trucks, higher drying costs and higher transportation costs to get to the market. The bill attempts to buy off family farmers by allocating them Ag and forestry sequestration allowances, but the effort falls far short. The total number allocated will fall 70 percent by 2050. The amount actually reaching farmers is unknown since they must share with forestry. Also it is unknown whether active farmers can even continue qualifying projects that have to show long-term mitigation benefits.

How are we going to get our food supplies? Farmers receiving allowances will still be deluged with higher fertilizer costs, transportation costs and higher heating. The Warner-Lieberman Ag Offset program could decimate small communities. Desperate electric utilities, lacking technologies to cut emissions, would take full advantage of the bill's offset. They have billions of dollars to spend retiring crop land. Hey, we need that crop land for food.

But the existing Conservation Reserve Program authorized by the Farm Bill took more than 30 million acres out of production. I support it, but that program has limits to prevent harm to the area because we have already seen harm. Because in the West and some parts of the Midwest, communities suffered when the economic viability of those serving the farm community were destroyed because of excessive CRP enrollments.

This Committee has not considered these. I think that this is just one of the many problems that this bill causes. I appreciate the chance to share my concerns and we will be hearing more about them.

I thank you, Madam Chair.

Senator BOXER. Thank you so much, Senator.

Senator Carper.

**STATEMENT OF HON. THOMAS R. CARPER, U.S. SENATOR
FROM THE STATE OF DELAWARE**

Senator CARPER. Thank you, Madam Chairman.

Anyone in this country or the world who might be wondering why we haven't made more progress on addressing issues like cli-

mate change need only listen to the first 30 minutes of discussion in this hearing. We are divided on these issues. These are difficult issues, there is a lot of disagreement. It is not entirely partisan, but it certainly is strong and it is just difficult to overcome.

I just want to start my comments by thanking my friends, Joe Lieberman and John Warner and our Chair for having the courage, temerity and the will to try to forge a compromise in the face of all these different opinions, conflicting opinions. It is not an easy thing to do, and I say this as one who sought to address this issue, at least with one sector, and that is the power plant sector in our country.

Having said that, I want to be able to support this legislation. In order for me to be able to support this legislation, I need assurances that the concerns that many of you heard me state for years, that we also use this as an opportunity to address the emissions of sulfur dioxide, nitrogen oxide and mercury, we don't let this opportunity pass us by. I am also concerned, deeply concerned, with the way that we allocate credits under this proposal, because I believe we should allocate credits to those who produce clean energy. We ought to incentivize those who are producing the most electricity with the least amount of pollution. I have said to many of you, I just don't believe we are true to that principle here. If we, in my view, for me to be able to support this legislation, I need assurances that that will be addressed, too.

I come from a little State on the East Coast, about 100 miles long and about 50 miles wide at our widest point. Delaware and other States along the mid-Atlantic, along the East Coast, we find ourselves at the end of the tailpipe, if you will, of emissions that are put up in other parts of our country. As Governor of Delaware, when we were fighting and trying to come into compliance with nitrogen oxide emissions and so forth, we literally, we are not in attainment in any of our three counties. We could almost close down our State, close down our industries in our State, not drive at all, and we would still have parts of my State that would not be in attainment for ozone.

It is not our fault. The fault is the people who live in West Virginia, where I was born, the people who live in Virginia, where I grew up, the people who live in Ohio where I went to Ohio State, along with my colleague, George Voinovich, the people who live in Kentucky where my sister and her family live. They and other States are putting all kinds of stuff up into the air, nitrogen oxide, sulfur dioxide and mercury, that harms my State, not just my State, the health of people in my State, but other States along the East Coast, north and south.

Delaware has the highest rate of asthma among children of any State. One out of every eight kids in my State suffers from asthma. I was principal for a day in a school in our State a couple of weeks ago, it is a wonderful program that we have. I stopped by a lot of classes. I also stopped off to visit the school nurse. I said, what kinds of problems are you hearing from kids, these are sixth, seventh, eighth grade kids. I thought it might be attention deficit disorder, I thought it might be flu, I thought it might be this or that. She said, it is asthma. We have so many kids here who have asthmatic attacks, who have to take medicine every day, who go to the

hospital. In my State, it is not just by dozens or scores or hundreds, it is thousands of kids who are going to be hospitalized some time during the course of this year.

With respect to sulfur dioxide emissions in this country, 24,000 Americans will die, 24,000 Americans in this country will die from sulfur dioxide emissions this year just because of those emissions from power plants. Not the other sources. Two-thirds of the sulfur dioxide emissions come from power plants. Twenty-four thousand, 24,000 this year, over 400 this week, today before we go to bed tonight, some 60 more will die because of sulfur dioxide emissions.

We have another chart that shows mercury. I eat a lot of fish, maybe you do, too. We encourage people to eat fish because it is good for their health. But if you happen to be a woman who is going to become pregnant, that child that you are going to give birth to may not be so fortunate. Because we know in this country there are going to be 600,000 plus kids that are going to be born this year to moms who have very high levels, carry high levels of mercury, in many cases because of the fish that they ingest.

A large part of that mercury, about 40 percent, I think the largest source of mercury pollution in our country comes from power plants. For us to ignore the threat to our health caused by sulfur dioxide emissions, nitrogen oxide emissions and mercury emissions, for us to fail to take this opportunity to address them I think we would make a big, big mistake.

Again, I want to support this legislation. I hope to be able to support this legislation. Madam Chair, I have indicated, and I appreciate your willingness to meet with all of us.

I will close with this. I appreciate the fact that we have tried to address the transportation sector here, and its contributions to our problem and to our solution. I would hope, and as I said to Chairman Boxer yesterday, I would have us focus on three things with respect to transportation. One, clean fuels. Two, clean cars. Three, other options to travel around our communities, around our States, around our country, other than our cars, trucks and vans.

The last thing I would say, there is going to be an amendment on nuclear. I am an advocate of nuclear power. I think nuclear energy is part of the solution. We can have a nuclear amendment that is offered in Committee or on the Floor that actually addresses clean energy and moves us closer to clean energy in reducing these emissions, or we can just have a nuclear amendment that frankly doesn't move us in the direction that we need to go. I think it is important that those of us who think that nuclear is part of the solution that we come up with a compromise that actually makes sense and gets the job done.

Thank you, Madam Chair.

Senator BOXER. Senator Carper, thank you for your thoughtful presentation today.

Senator Vitter.

STATEMENT OF HON. DAVID VITTER, U.S. SENATOR FROM THE STATE OF LOUISIANA

Senator VITTER. Thank you very much, Madam Chair. I will be brief and submit the rest of my statement for the record.

I certainly agree with you and others that this is an extremely important issue. I also agree with you and others that the stakes are very, very high. That is exactly why we need to make sure we get this right. I also agree with Senator Voinovich and others on this side of the Committee who have expressed grave concern about this accelerated process with regard to this particular bill. Because I don't think it allows us the opportunity to get it right.

Yes, there has been discussion of global warming for years in Committee hearings. That is not the same at all as hearings specifically on the provisions of this very voluminous and complex bill. So I would again urge the Committee to have more hearings specifically on this bill, so we can try to get it right.

I don't think there is any State represented here that has more at stake, quite frankly, than my State of Louisiana. Climate change, global warming, particularly to the extent it can affect sea levels, could have an enormous impact on coastal Louisiana, the most coastal State, in many ways, of any of our States. At the same time, if we act rashly or unwisely and do things with regard to our present fuels that aren't justified and that don't produce results, Louisiana will be among the first States to feel that hit to the economy.

So we do have to get it right. We do have to figure out what will have an impact, what the science supports, how we intelligently deal with this issue. I am just very, very concerned that we are taking as big and complex and important a bill as I have ever seen in the Senate and rushing through with regard to it, acting on sound bites, in my opinion, not science. Perhaps good politics, but not sound policy.

I am eager to hear from the witnesses. I am eager to hear from more witnesses, so that we can look carefully at a very long, complex bill and try to get it right. But I do again underscore that I believe we need more time and hearings specifically about this bill in order to do that.

Thank you.

Senator BOXER. Thank you, Senator.

Senator Lautenberg.

**STATEMENT OF HON. FRANK R. LAUTENBERG, U.S. SENATOR
FROM THE STATE OF NEW JERSEY**

Senator LAUTENBERG. Thank you, Madam Chairman. I begin by thanking you for holding this hearing. Your leadership has spurred action on so many issues of great concern, and we are grateful to you for your activity.

I also want to thank Senators Lieberman and Warner for their determination and diligence on this legislation and for making changes and improvements as the bill moved through our subcommittee. We have to face it: one can't find a more critical environmental issue facing this Committee or our country or our world than fighting global warming. We need legislation that faces this problem head-on.

Otherwise, I believe that our descendants, as nearby as our children and certainly our grandchildren will never understand our unwillingness to deal with this situation. We worked very hard in this Subcommittee to improve the good start that Senator Lieberman

and Senator Warner put forward. Together, we enlarged the reductions and emissions from 10 to 15 percent by 2020. By expanding the bill to include natural gas, it protected States' rights to go beyond Federal benchmarks and created a process for independent scientists to continually evaluate whether we need stronger laws to fight the effects of climate change over the long term.

But if we want our actions on global warming to match the goals of science, there is still more work that has to be done on this bill. The Union of Concerned Scientists has made it clear that true leadership against global warming means the United States should reduce emissions by at least 80 percent by 2050. I hear our friends who say they are concerned about jobs and the economy and so forth. But my friends, there is an endangered species out there. It is called human beings. Unless we get onto doing something about it, we will be looking back, yes, there will be plenty of jobs available, there just won't be enough people to do them.

Despite these ominous warnings, the bill before us would achieve only a 60 percent reduction by 2050, less than what is needed to fully protect the world we are accustomed to. We need to reach further to meet the long-term standard. The bill also gives away cost-free permits for industry to emit greenhouse gases until 2035, a full 28 years from now. We need to move to a polluter pay system much earlier, and our Committee should act aggressively to move this date forward. Moving to a polluter pay system will make it a smart business decision for companies to reduce their greenhouse gas emissions and develop new, cleaner technologies.

Finally, we should think twice before giving out the majority of free permits to companies with the highest level emissions, such as coal power plants, to encourage companies to go green. Some of these permits should be given to clean companies, such as those that promote solar power and other energy sources that have fewer or no emissions.

Again, I think we are off to a good start with this legislation. I am hopeful that this bill can be improved as the process moves forward. Before closing, Madam Chairman, I want to respond to our friend Senator Inhofe, who said cap and trade don't work. Well, I will tell you, it had a heck of a good effect, positive effect on acid rain. So the system works, and we have to be able to use it carefully, but not to ignore it. Thank you very much.

Senator INHOFE. Well, since he referenced me, let me just respond to that. Cap and trade in acid rain is not the same animal that we are talking about, the cap and trade today. The example that we have, the model that we have is in Western Europe, of 15 countries, only 2 are able to meet their expectations or their goals.

Senator LAUTENBERG. I said what I said, thank you.

Senator BOXER. Thank you, Senator.

Senator INHOFE. Yes, and I said what I said, thank you.

Senator BOXER. Yes, you did.

Senator LAUTENBERG. Are we going to have a tit for tat?

Senator CARPER. This reminds me of Popeye the Sailor Man. I am what I am.

[Laughter.]

Senator BOXER. Well, at the next briefing, I will hand out spinach to everyone.

Senator Barrasso.

**STATEMENT OF HON. JOHN BARRASSO, U.S. SENATOR FROM
THE STATE OF WYOMING**

Senator BARRASSO. Thank you very much, Madam Chairman, and thank you for your kind words at the beginning of this hearing. As I have stated before, the debate on global warming can't be ignored, can't be rejected. We must adapt, we must make changes, we must be ready and we must be ready to put our money where our best hopes are. A number of us had a chance to sit down this morning, Madam Chairman, with Thomas Friedman, the author of the book, *The World Is Flat*. He is working on his new book, and it is on energy and a greener planet.

I will tell you I believe we cannot simply though shut off our current traditional energy sources by setting unrealistic goals for the industry in my home State, which for the most part is carbon-based but also we are committed to renewables in our State of Wyoming, where we have been blessed with incredible resources and can do a lot to help our Nation become energy independent.

There is a story in today's *Wall Street Journal*, page A4, and it is called, *Why Coal Is To Get Additional Attention*. The International Energy Agency says that with tightening energy supplies and a surge in global warming emissions, as China and India burn more coal to power their booming economies, it talks about China and India, and I am going to go through this because of why I believe it is important that we in America today invest in the technology. Because no matter what we do in America, if we don't have the technology to apply worldwide, we are not really going to solve the problem that we are aiming at solving, which is a world that by the year 2030 will be consuming 55 percent more energy than it is now, with almost half of that growth because of soaring demand in China and India.

Coal share is expected to jump to 28 percent of global consumption from 25 percent in the next 25 years. There are tables that talk about as China's and India's demand for coal continues to increase, that will drive up global CO₂ emissions. There are some charts. China and India will account for 80 percent of the growth in coal consumption over the next two decades. Then it goes on to talk about renewable sources, and it says, they will grow, but all renewable energy sources will remain a fraction of total energy use globally in 2030 at about 10 percent, unchanged from the percentages of today.

So I look at the current language of the bill, I have concerns about the ability of coal-fired power plants to be able to capture 85 percent of the carbon emissions. That is not scientifically feasible today and I was pleased at the subcommittee to hear Senator Lieberman say that he is interested in working with me and stair-stepping to that point over a number of years going into the future. Because we need to innovate, we need to prepare for changes, but we need to retain our ability to use the power we need today, so that the companies have the resources that they need to develop the clean energy technologies that we will need for tomorrow. We need to continue to invest in improving existing energy industries

today, and that is going to create the new jobs and strengthen the economy.

I do worry about unintended consequences that they will have, that energy limitations will have on our economy. There was a Washington Post article yesterday that speaks to the high energy costs that the average taxpayer will have to pay under certain legislation. But I want to reiterate that I do want to address the problem of global warming. We can get there, but only if we show China and India that we can pass a bill that strengthens our economy, creates jobs, and develops the needed technology that can be used worldwide to continue in our fight for a cleaner environment.

So I would like to continue to work with the members of the Committee on achieving these objectives. Thank you, Madam Chairman.

Senator BOXER. Thank you, Senator, very much.
Senator Cardin.

**STATEMENT OF HON. BENJAMIN L. CARDIN, U.S. SENATOR
FROM THE STATE OF MARYLAND**

Senator CARDIN. Thank you, Madam Chair, and let me thank you for your leadership on this issue and getting us to where we are today. I want to thank Senator Lieberman and Senator Warner for their extraordinary leadership and patience as we try to put together a bill that will really speak to the priorities of our Nation and have an excellent chance of being passed. The American Climate Security Act gives us our best hope to pass meaningful climate legislation and once again put America back into the leadership role on the world stage.

I am proud to be an original co-sponsor of this legislation. The cap and trade program at the heart of the bill is an effective method to drive down emissions permanently and cost-effectively. By harnessing the power of the marketplace, the system puts America's greatest strength, our economy, to work on the Nation's most important long-term environmental issue.

I must tell you, Madam Chair, I think this issue represents more than just an issue of climate change. It is a matter of national security for us to use less fossil fuels, so that we can have control of our own destiny on energy, we don't have to finance countries that disagree with our way of life. I think it is in our economic interests to deal with this issue.

So I think it is a win-win-win situation, it allows us to pay proper attention to our environmental concerns as well as dealing with our energy independence and the security issues.

The American Climate Security Act is based on two important pillars. By setting a firm and declining cap on emissions, we begin to address the underlying problem of global warming and the emission of greenhouse gases into the atmosphere. The bill keeps getting better in this regard. It started with the announcement of an outline, we then saw the text of the bill, which I think was an improvement. We then had the Committee markup, which was an improvement. It keeps getting better, Senator Lieberman. I applaud you for these efforts.

We are not quite done yet. I think we can still improve this bill and I hope that we will improve this bill. I hope that in two re-

spects that we will be able to improve the bill. First, it is clear to me from the scientific information that is available that we should strive for an 80 percent reduction by the year 2050. I hope that will be our goal.

Second, it seems to me that from the inception of the caps, we would be better off auctioning the credits to the utilities and the companies, which would give us not only revenue coming in earlier, putting market forces to work earlier, but it would also give us the financial wherewithal to deal with the problems of low and moderate income consumers and the cost of energy, as well as developing the types of technologies and, I hope, good jobs that Senator Sanders talks about frequently, that will be available as a result of new technology.

So I think for all those reasons, I would hope that we would get to an earlier start, a more ambitious goal, and to be able to really put our market forces together earlier. I think this bill is a great bill, a great start. It restores America's international leadership on this issue and I am proud of the work of our Committee.

Thank you, Madam Chair.

[The prepared statement of Senator Cardin follows:]

STATEMENT OF HON. BENJAMIN L. CARDIN, U.S. SENATOR FROM THE
STATE OF MARYLAND

Madame Chairman, thank you.

First of all, let me reiterate my congratulations to Senator Lieberman and Senator Warner for the great work they have done in crafting the bill we have before us today.

America's Climate Security Act of 2007 gives us our best hope to pass meaningful climate change legislation and once again put America back into a leadership role on the world stage. I am proud to serve as an original cosponsor of the bill.

The cap and trade program at the heart of the bill is an effective method to drive down emissions permanently and cost-effectively. By harnessing the power of the market place, this system puts America's greatest strength—our economy—to work on the nation's most important long-term environmental issue.

And climate change represents more than just an environmental issue. Our energy independence and our national security are at stake as well.

We need to rid ourselves of a dangerous reliance on imported oil. Oil prices now hover around \$100 a barrel.

The amount of our national fortune that is going to regimes that stand in opposition to American values is vast and continues to grow. This bill can help us break that dependence.

Reducing our dependence on foreign oil will strengthen American security. Reducing the threats posed by climate change will also improve American security.

As defense analysts have pointed out, social disruptions related to sea level rise, storm severity, and other climate changes increase the risk for instability across the globe. The world is already perilous enough.

This bill presents a way forward.

America's Climate Security Act is based on two important pillars. By setting a firm and declining cap on emissions, we begin to address the underlying problem with global warming: the emissions of greenhouse gases into the atmosphere.

The bill keeps getting better in this regard. The outline announced in August pointed us in the right direction. The text of the bill when it was introduced was further strengthened in this regard, with somewhat tighter caps. The bill reported out of the subcommittee moves us even further in the right direction.

We aren't there yet. The best scientific minds in the world tell us that we need to reduce emissions by 80 percent by 2050. We should not shy away from that benchmark. In fact, we should embrace it. The stakes are simply too high for us to come so far, but still fall short of what science demands.

Similarly, the cap-and-trade program in the bill also keeps getting better. But I am a firm believer in the power of the American economy and in American ingenuity. Rather than giving away allowances to certain sectors of the economy for dec-

ades, we should adopt a full auction of all pollution credits beginning immediately, and put those proceeds to the public uses outlined in the bill:

- to cushion cost increases to low- and moderate-income consumers;
- to invest in the new 'green' jobs that will transform our workforce; and
- to manage our adaptation to changes in the natural and world landscapes.

The legislation also provides some key incentives for energy efficiency. Today's witnesses will describe energy efficiency as the low-hanging fruit' that can help us get off to a fast start in reaching the objectives of this legislation. I want to focus on a specific energy efficiency technology that is available today and already reaping the kinds of rewards that the larger bill promises.

The CO₂-reducing potential of America's Climate Security Act will be enhanced by the deployment of a smart electric grid or "Smart Grid," which can lower electricity consumption by 10% and grid-related emissions by 25%. (DOE, EPRI Study).

Since grid-related emissions are 40% of total CO₂ emissions in the United States, the reductions that a Smart Grid will allow are significant.

Smart Grid is a 2-way, interactive, data-producing communications network that overlays the existing electric grid to transform every electrical outlet into a "smart socket." This allows utilities in real-time to turn down millions of air conditioners, pool pumps and other appliances during times of peak demand to make. This control allows Smart Grid to make additional megawatts equivalent to those produced by new power plants, but at less cost to consumers and the environment.

Smart Grid is being deployed today by a Maryland company to two million homes and businesses in Dallas, Texas.

As we look ahead to a markup session, I hope that we will take a closer look at this successful example and focus on how we can provide the right economic signals to deploy these cutting-edge technologies sooner.

This legislation is a major step forward for all of us who want to act now to curb the explosive growth in greenhouse gas emissions. It is comprehensive and bi-partisan and everyone agrees that this bill represents our best hope of enacting meaningful global warming legislation during this Congress.

I will work to further strengthen this strong bill as it moves through this Committee and the Senate floor.

I look forward to hearing from today's witnesses, and moving this landmark legislation quickly through the full Committee and on to the floor of the Senate.

Congress and America need to once again establish our rightful place as world leaders. Thanks to Chairman Boxer, Senators Lieberman and Warner and their America's Climate Security Act, that time is now.

Senator BOXER. Thank you, Senator Cardin.
Senator Craig.

STATEMENT OF HON. LARRY E. CRAIG, U.S. SENATOR FROM THE STATE OF IDAHO

Senator CRAIG. Madam Chairman, thank you very much.

I don't fear at all the process you have set forward, as long as it is open, clearly transparent and allows a fair and responsible vetting of alternatives. My position has been consistent over the years, Madam Chairman, cap and trade is obsolete in its approach toward greenhouse gas reduction. It hasn't worked. I don't think it will work. This bill clearly distorts. If you are a coal State, you have the allocation. If you are not a coal State, you don't.

My State of Idaho is the cleanest State in the Nation today, and we are proud of that. We get nothing but higher energy prices. There is no benefit for Idaho unless you design a system that is output-based. Therefore, entering this concept, the concept is flawed.

What we are doing in an economy-wide way is simply transferring wealth. That does not stimulate the kinds of things that we need. When we were crafting EPAC05, I jokingly said, Madam Chairman, we ought to call that the Clean Energy Act of 2005. Why? Because what it did is now showing up in the marketplace. It stimulated nuclear, it stimulated cellulosic in the area of

biofuels, and it has stimulated greatly efficiencies. That is where we ought to be headed, because in every one of EPAC05's issues and results, we are producing clean energy. We haven't penalized the consumer. We are not distorting the marketplace. We are driving ourselves, as we should, by allowing our Government to incentivize the marketplace toward cleaner energy.

Now, I am sorry Senator Clinton isn't here today, because last week out in Iowa she did something that somewhat surprised me, and I was frankly—let me put it this way, Madam Chair, and I would wish your attention, Senator Clinton did something that surprised me and deserves to be complimented by it. I am going to hand around a chart that shows what Senator Clinton has proposed as it relates to climate change legislation from CAFE to portfolio standards to RFS, incentives, much paralleling what the current Administration is doing in some respects, and much paralleling what many of us on this side are doing in relation to driving the marketplace toward efficiencies and new and clean energy.

So I applaud the Senator, I wish she were here today. I don't often compliment her. But she deserves to be complimented when she gets it right. I find that it is most interesting that it is in many ways in conflict with the great piece of legislation that some are bestowing compliments on today that are driving us in the direction that this Committee thinks it is being driven.

I would request of you, Madam Chair, a thorough analysis, a thorough analysis by EIA and by EPA of this legislation. We are going to request that. There should be a time of adequacy, so that we can thoroughly understand. None of us dispute the magnitude of the effort. None of us therefore dispute the magnitude of the impact of the effort if we get it wrong. The rest of the world is frustrated. They have tried and they are failing. It is only through new technologies and efficiencies, and incentivizing the marketplace to drive us in that direction, that we get there.

This is not a time to rush to get it wrong. This is a time to think about and work at getting it right. Therefore, Madam Chair, I would respectfully request that the markup of Lieberman-Warner be postponed until we have the effective and responsible analyses by those, shall we say, impartial groups and impartial observers, so that we can look at this through the eyes of somebody other than those of us who by our character tend to be a little bit more political than we tend to be policy. In this instance, I would hope that we could back off, take a deep breath and allow ourselves to analyze what we are doing as we do it.

Thank you, Madam Chair.

Senator BOXER. Thanks, Senator.

Since you asked something of me, I will respond to you. We haven't even announced when the markup is. So postponing a markup that hasn't even been announced doesn't even really make much sense.

The other thing is, we are going to have so many briefings here, we are going to make it so easy for members and staff that I hope you will feel very comfortable with that. I also—

Senator CRAIG. Well, Madam Chair, let me say this—

Senator BOXER. Let me finish first, and then I'm happy to—

Senator CRAIG [continuing].—asking you to postpone a briefing for me does make sense. I am sorry you misinterpreted me.

Senator BOXER. Sir, sir, I didn't interrupt you and I am going to finish my comments—

Senator CRAIG. Of course you will.

Senator BOXER [continuing].—and then I will be glad to call on you. Thank you very much.

Senator Clinton is also on Sanders-Boxer. So let's not distort Senator Clinton's strong views that we need global warming legislation. Yes, she is for all the other things we are all for. But she is also for global warming legislation. I just wanted to set the record straight on that.

In any case, Senator, I went back and looked at the record, the time before long ago when we passed the great landmark environmental legislation. We heard the same thing then: don't do it, it is not time, we need more information. We all know what a slow dance is around here. We weren't born yesterday.

So there seems to be a very interesting chorus over there, let's slow it down, let's slow walk it. On this side of the aisle, and I think Senator Warner believes this, and I am going to have a statement e-mailed up and the staff is putting it into writing. We think the time is now to act. But we certainly will give your side of the aisle on this particular request more consideration. We have added hearings, briefings, we are happy to do that.

We think this legislation, this Lieberman-Warner bill, as it is being improved, really as it goes through, deserves to be examined and looked at. We are very proud of it. So we will be happy to do that.

Senator Craig, did you want to respond to my comment?

Senator CRAIG. Thank you, Madam Chair. Your courtesies are always appreciated.

Senator BOXER. Senator Sanders.

**STATEMENT OF HON. BERNARD SANDERS, U.S. SENATOR
FROM THE STATE OF VERMONT**

Senator SANDERS. Thank you very much, Senator Boxer, and thank you very much for your leadership.

We have come a long way in a year, and I think you, Senator Boxer, are one of the people responsible for turning this debate around. Because all over the world, as people grapple with the cross of global warming, they are wondering what is happening in the United States. Thankfully, we are beginning to at least in a serious way begin to address the problem. As I think most members of the Committee know, I have serious problems with this legislation, because I believe it does not go far enough.

I don't think it is asking too much from the American people to ask why it is that we are not listening to the scientific community and doing what they say needs to be done to avert the enormous tragedy that faces us if we do not get our act together. What the scientific community has said over and over again is, we made a mistake. We under-estimated the problem of global warming and the severity in which this problem is surfacing. Anyone who looks at the front pages of the paper any given day knows that they are

right. They are saying, we have to be more aggressive, not less aggressive.

Colleagues, what I beg of you, we cannot continue to do politics as usual. We need to work this issue without old-fashioned deal making. The time is too late, the planet depends upon bold action. When the scientists are telling us that at the least, if we are going to avert a tragedy, with a 50–50 chance, we need to reduce greenhouse gas emissions by 80 percent by the year 2050, to my mind, the 63 percent at most that Lieberman-Warner does just doesn't go far enough. We have to do better than that.

There are a number of other issues within this bill dealing with the auction that I think Senator Carper and Senator Lautenberg touched on. I would echo their concerns about the need to say to polluters, I am sorry, you can't have 20 or 25 years to continue to destroy the environment. You must start paying if you are going to pollute.

I also have concerns about the new entrants provisions, which gives support to existing fossil fuels, but do not encourage the new sustainable energies.

Mostly I want to spend these few minutes by saying that while there is a lot of bad news out there, there is some extraordinarily good news. My view, in fact, is we know how to reverse global warming. It is out there. Right now, in the southwestern part of this country, and I know Mr. Darbee, who is head of Pacific Gas and Electric, he will speak to this, we are making great strides in energy efficiency. The potential out there is enormous. Cities, my city of Burlington, VT, States like California, making great strides. One of the major concerns I have about this piece of legislation is that when you look at the auction beneficiaries, while there is a big pot of money for zero and low-carbon energy technology, there is not one nickel specific to energy efficiency, which everybody knows is the low-hanging fruit. We can make huge gains. Let's do that.

Second of all, in terms of solar energy, Pacific Gas and Electric has signed a contract with an Israeli solar plant company which will produce 535 megawatts of electricity. That is a small nuclear power plant, zero greenhouse gas emission. They are estimating that the cost of that will be 10 cents a kilowatt hour, competitive day. The cost is going to go up minimally over the next 25 years. Let me quote from the Federal Government's own National Renewable Energy Lab. They are saying "The cost for concentrated solar power technologies are declining from approximately 16 cents per kilowatt hour to approximately 8 cents in the year 2050," 8 cents per kilowatt hour for non-polluting solar energy. It is sitting there. These plants cost about \$2 billion apiece. If we put \$20 billion into it, we can produce gigawatts of electricity, huge amounts of electricity. Why aren't we doing that?

Wind is sitting out there. We have recently learned that there is a small wind turbine manufacturer who for \$10,000 can produce a small wind turbine that can produce 40 percent of the electricity in a given home, \$10,000. You subsidize that, as California is already doing, by \$5,000, we could have millions of these turbines out there.

So my main concern about this piece of legislation is we are not taking advantage of the technologies that are existing now. I don't

know, Senator Barrasso, what the future of clean coal is. I don't know that. I am willing to explore it. But what I am telling you now is you don't have to spend hundreds of billions of dollars on wind and solar to determine whether it is going to work. It is working today. We make a grave mistake by not working with those utilities like Pacific Gas and Electric who are already doing the right thing.

So let me just conclude by saying, we know the answers. They are sitting out there, cities, towns, States are already doing it. Utilities are beginning to do it. Let us work with those, we can make giant steps forward in saving the planet. Thank you, Madam Chair.

Senator BOXER. Thank you, Senator.

Just a couple of items, I would ask unanimous consent to place Senator Isakson's full statement into the record.

[The prepared statement of Senator Isakson follows:]

STATEMENT OF JOHNNY ISAKSON, U.S. SENATOR FROM THE STATE OF GEORGIA

Thank you Madam Chairman.

In July 2007, I took a two-day trip to Greenland with members of the Senate Environment and Public Works Committee to view the effects of climate change and to learn more about its impacts on the ice and glaciers of the world's largest island. My visit to Greenland was informative to see firsthand what we all hear so much about. What is occurring in Greenland today began 14,700 years ago at the peak of the last ice age.

Two brilliant scientists who accompanied us, Dr. Richard Alley of Penn State and Dr. Minik Rosing of Denmark, both confirmed that the climate has changed naturally in the past, including warming about 14,700 years ago as the last ice age ended. They told me that most scientists believe that at least some of the recent warming has been accelerated by carbon. However, they could not say for sure by how much.

With those facts as a backdrop, and given the uncertainty in the science behind the causes of climate change, I believe that we should take proactive steps, both personally and as a nation, to reduce our emissions footprints. One of those steps is addressing the carbon issue in the context of promoting all sources of renewable energy. You cannot reduce carbon levels without reducing the burning of fossil fuels, and you cannot do that without building nuclear power plants and furthering the development of cellulose-based energy.

My state of Georgia already enjoys the benefits of nuclear power from Plant Vogtle, which is applying for one of the first Nuclear Regulatory Commission licenses for reactor expansion. Our state has the greatest supply of cellulose in our forest products industry.

Our country has responded in the past to challenges with innovation and incentives. The issue of carbon reduction in our nation should be approached in the same way and through the same processes. Reducing the burning of fossil fuels without developing all our renewable resources would be a mistake.

I commend Senators Warner and Lieberman and their staff for the bipartisan way in which they came together, and for the work they have done in attempting to tackle a tough issue. They are to be commended for their efforts. I do have concerns, however, that this legislation puts mandates on our economy without providing tools to meet those mandates.

For example I would have preferred to see a bill that is comprehensive in not only the requirements for reductions in carbon, but also in offering incentives and methods on how to get there. I see no specific mention of nuclear power in here. I see no specific incentives for retrofitting coal fired power plants so that power generators can keep existing baseline capacity. I see no mention of programs to help America's manufacturers retool their equipment and processes to meet these mandates. In fact, Senator Lieberman in the Subcommittee markup said: "It's hard to imagine that [Lieberman-Warner] will not cost-over time—these two sectors (electric power and industrial), hundreds of billions of dollars to comply with the demands of this bill."

To Senator Warner and Senator Lieberman's credit, they have pledged that they will work with me and others on the Committee who share these concerns. I appreciate their willingness to work with us, and look forward to doing so through this

process. However, I am extremely concerned that the additional energy costs in this bill will put a significant burden on Georgia's hard working families.

In closing, I am concerned that, in a rush to judgment, this Committee and the Senate will enact measures that will have dramatic negative effects on our manufacturing sector while also causing significant increases in the cost of power generation. As members of the Environment and Public Works Committee we have a very important responsibility. We should work to ensure that we enact common-sense measures designed to address climate change that have been thoroughly debated, while ensuring that the economic impact of these measures on our economy is not adverse.

I yield back.

We have a message from Senator Warner, he wanted to prove to us he has been watching this debate. Here is what he said: "This Committee had a chance to hold legislative hearings on the Climate Stewardship Act, that was the McCain-Lieberman bill, and did not. We are making up for lost time in this Congress. Senator Warner."

Senator Alexander, I understand you have laryngitis. Do you have enough left to say anything at all? No. Well, we will put your statement into the record. We need you back, so take care of your throat.

[The prepared statement of Senator Alexander follows:]

STATEMENT OF LAMAR ALEXANDER, U.S. SENATOR FROM THE STATE OF TENNESSEE

I believe that there is a scientific consensus that human activity is having a significant influence on global temperature increases. Most of the warming since 1965 is very likely to have been caused by human activity. In other words, global warming is real.

Since my first year in the Senate—2003—I have introduced legislation to put a cap on carbon emissions from the first of these large sectors, electricity power plants. These plants produce 40% of the carbon dioxide and 33% of the greenhouse gases in the United States.

I will now broaden my legislation to include two other major sectors of the economy:

1. A low carbon fuel standard for the fuels used in transportation. Transportation produces another one-third of America's greenhouse gases.

2. An aggressive approach to building energy efficiency. I am still working on these pieces.

Tailoring our approach to just these three sectors—power plants, transportation, and buildings—would cover about two-thirds of U.S. greenhouse gas emissions.

This compares very favorably with the Lieberman-Warner bill's coverage of the economy which at introduction was described as capping 75% of the economy (As reported by the subcommittee, the bill's coverage is broader because it now caps natural gas producers).

As we implement laws reducing emissions from these three sectors, we can learn more and move on to the other sectors in the future.

A sector-by-sector approach minimizes guesswork. For example, the United States has 16 years experience with a cap-and-trade program designed to reduce acid rain pollution from power plants. The program cost less than expected. Utilities have experience with how it works. And we have in place right now the mechanisms we need to measure and regulate carbon from utility smokestacks.

A sector-by-sector approach allows us to build on steps already taken. For example, in the transportation sector, Congress has already begun to mandate renewable fuels to reduce greenhouses gases. This year, the Senate enlarged that mandate and adopted fuel efficiency standards for cars and trucks.

I believe we should add to those steps a low carbon fuel standard—that is, requiring transportation fuels to decrease gradually the amount of carbon in the gasoline or diesel that they contain—which is a logical and manageable next step.

Finally, both in the energy bill of 2005 and the energy bill that the Senate passed earlier this year, Congress began to encourage more efficient buildings. Making those steps more aggressive holds the promise for enormous carbon savings at the least cost. Japan, for example, has found that its major obstacle to reducing carbon emissions has been the lack of building energy efficiency.

Finally, I believe a sector-by-sector approach will do the least harm. It avoids imposing new regulations directly on the manufacturing sector (who nevertheless may have higher costs for fuel and electricity) and therefore avoids adding to the pressures to ship those jobs overseas.

A sector-by-sector approach will allow us to leave manufacturing and small business alone for the moment.

I also believe that a sector-by-sector approach is the easiest approach for Members of Congress to understand and explain to our constituents. As the recent debate on comprehensive immigration should have taught us, this is not an insignificant concern.

The Lieberman-Warner economy-wide climate change legislation is an important contribution. It is a good faith beginning and a complex bill which raises lots of unanswered questions.

Some of the questions raised are:

1. Why cap and trade rather than a carbon tax?
2. Why is the cap in the transportation sector a so-called "upstream cap"—in other words, a cap on the importer, blender, and refiner of transportation fuels?
3. Does the allocation scheme selected in the Lieberman-Warner bill for utilities make sense? The Lieberman-Warner bill will award approximately one-third of the allowances to power plants pursuant to output allocation. Output allocation rewards fuel-switching to natural gas. Output allocation gives natural gas power plants two carbon allowances for every one carbon allowance received by coal plants.
4. Why does the bill employ such a large auction and why does it increase so quickly and steeply? Will an auction of this size unnecessarily drive up the price of complying with the bill?
5. This auction is expected to raise extremely large sums of money. Where should the money go? Into the Treasury? Should Congress be able to appropriate it?
6. What should the money be spent on?
7. What should be included in this legislation to keep natural gas prices from spiking upwards?

I know this Committee has had a lot of hearings. But this bill, S. 2191, was introduced in its current form on October 18, and I think members of the Committee should be given more time to review it.

I see no advantage to sending this bill rapidly to the Senate floor.

The Committee is the place to make any corrections to the bill that may be justified.

Senator BOXER. Senator Whitehouse, you will have the last word, I think, from Senators, and then we will finally get to our panel.

**STATEMENT OF HON. SHELDON WHITEHOUSE, U.S. SENATOR
FROM THE STATE OF RHODE ISLAND**

Senator WHITEHOUSE. Thank you, Madam Chair.

One of the things that is said fairly often around Government is that we are able to see farther because we stand on the shoulders of giants. As we go forward with this legislation, we will be focusing, of course, on the areas where we still disagree and where work still remains to be done and where issues are still not settled. But nothing in that focus going forward should take away from the remarkable achievement that you have made, Madam Chair, and that Senator Lieberman and Senator Warner have made in getting us to where we are today.

As we go forward, what we will do will indeed be standing on the shoulders of, I don't want to say giants, because that is not going to be a very good phrase—

Senator BOXER. Are you saying something about my physical—
[Laughter.]

Senator WHITEHOUSE [continuing].—but we will certainly stand on the shoulders of your giant work.

I do want to indicate some of the areas that I have concern and intend to work with the Chair and with the other members. The first is that our greenhouse gas targets need to be adequate and

they need to be enforceable. They need to have teeth behind them. I think those are important, basic points and that we need to make sure we are getting to where we need to be on that point.

The second is that the auction needs to be adequate, but it also needs to have integrity. This is going to be an important process, in which many billions of dollars are going to wash around in it. Right now, the entity isn't even subject to the Administrative Procedures Act, or even subject to the open meetings or open records laws. Only one of the members is subject even to advice and consent.

When you look at how long it took to develop the stock markets, the Federal Reserve, when you look at some of the market efforts that have been made with California energy pricing, I think there is reason to work to improve and help guarantee the integrity of this auction process.

Finally, when it comes to divvying up all the revenues that this will produce, I think it is vitally important that we focus on the low-income folks who will bear the costs as these signals flow through in varieties of products into their families' pocketbooks. I am not convinced that we are there yet.

So those are the key issues that I will be working on. I am very pleased that the wildlife and conservation issue that I have raised appears to be getting a very good response. I look forward to that being in the manager's package, if that can be arranged. I hope to work with Mr. Darbee and the others in the utility community, going back to my days many years ago as a utility litigator, to try to further define the role of our public utilities, particularly the distribution companies who are well regarded by their clients who have consumer relationship already and who are in a position to be extremely helpful as we implement the conservation piece.

So I will conclude by saying thank you for where we are so far. I look forward to working with this Committee in very good faith to get to where we need to be. I salute you for what has been accomplished. Thank you.

Senator BOXER. Senator, thank you so very much.

As I understand it, we are now ready to turn to our panel, which has been very patient. As you can see, this is not an easy issue for members on both sides. It is fraught with a lot of concern, emotion and we appreciate your patience.

When I have to leave with Senator Inhofe, it is to make the closing arguments on the override of the WRDA bill. At that time, I am going to hand the gavel over to Senator Lieberman.

Why don't we get started now. Mr. Darbee, we are very pleased to have you back here. The Committee has already heard more than 140 witnesses on global warming. This is your second time back, so we welcome you, sir. You are from Pacific Gas and Electric, you are the chief executive officer and president.

**STATEMENT OF PETER A. DARBEE, CHAIRMAN, CEO AND
PRESIDENT, PACIFIC GAS AND ELECTRIC CORPORATION**

Mr. DARBEE. Thank you, Chairman Boxer, Ranking Member Inhofe and members of the Committee. Thank you for inviting me to speak here today.

I am here because I am convinced with climate change we face an unprecedented challenge. A long-term crisis, but one that urgently needs near-term action. A global problem, but one that is unsolvable without this Nation's commitment. A threat with consequences that defy the imaginable, but one that is going to require incredible imagination and ingenuity to defuse.

This is truly going to be a thousand mile journey, and right now I believe the world is watching and waiting for us to take that proverbial first step. In our analysis, America's Climate Security Act provides an appropriate starting point for continued debate and progress toward a responsible national policy on and in response to climate change. It presents a real opportunity to advance the discussion at the Federal level where frankly, it must occur. It presents a real opportunity to signal that we are serious about coming to grips with our greenhouse gas emissions. While it would benefit from modifications in some key areas, it presents a real opportunity to roll up our sleeves and get to work on this issue.

We believe the bill's cap and trade approach, together with a package of complementary measures, provides an effective way to begin ratcheting down America's greenhouse gas emissions, while preserving the economy. We especially appreciate the focus on energy efficiency. Improving energy efficiency is one of the lowest cost options for managing growing energy demand while eliminating greenhouse gas emissions. In fact, the cost of energy efficiency is about half that for a new gas-fired power plant. Thus, energy efficiency helps make the U.S. economy more competitive in the worldwide marketplace.

Policies and incentives should encourage and maximize improvements in energy efficiency throughout our economy. This bill wisely gives priority to these strategies. One important example is its support for decoupling, breaking the link between electric sales volume and electric company earnings. This is a proven strategy. It effectively removes the financial incentives for utilities to simply sell more power. We believe it is absolutely fundamental as a country, we want to unleash the full potential of our utilities to help consumers use less energy and use it more efficiently.

The bill also deals wisely with the fact that costs for the Nation's electric customers will be significant and need to be mitigated. A study by the U.S. Energy Information Administration suggests that households and businesses at the end of the supply chain will bear 87 percent of the carbon dioxide compliance costs. Very importantly, this bill allocates emission allowances to electric distribution companies on behalf of their customers, based on the electric power load they serve. This is the right approach. It puts the value of the allowances in the hands of electricity customers who will ultimately bear the costs of shifting to new, cleaner technologies through their electric rates.

Speaking more broadly about costs, the bill takes positive steps toward recognizing that a national program must balance the many economic, technology, environmental and societal challenges. As I alluded to earlier, we also do see the need for modifications. For example, we recommend adding clarity and transparency around the workings of the Carbon Market Efficiency Board. Also similar to the provisions that are in Senator Carper's Clean Air Planning

Act, we see opportunities to expand the role of offsets to add measures that account for the link between power sector emissions and the natural variability in weather and precipitation, as well as strong incentives for clean generating technologies and recognition for early action.

For example, the bill could also be modified to give more credit for early actions to reduce emissions and to speed up advances in renewables and other low-carbon technologies by distributing allowances based on the generator's efficiency rather than on their historic emissions. We believe it is important for a share of allowances to be used to encourage investments in energy efficiency and new, clean generating technologies.

In closing, I want to underscore again how important it is for our Nation to act meaningfully on climate change. In fact, the sooner we take concrete action, the smaller will be the impact on our economy. The optimist in me is certain that we are going to meet this challenge. But the realist in me knows that we can't keep putting off our first step. This bill is a worthy point of departure for the long journey ahead, the result of which must be enactment of an environmentally effective and economically sustainable national policy.

On behalf of PG&E, thank you for the opportunity provided today. I appreciate your commitment and I pledge my cooperation as you move forward.

[The prepared statement of Mr. Darbee follows:]

STATEMENT OF PETER A. DARBEE, CHAIRMAN, CEO AND PRESIDENT,
PG&E CORPORATION

Chairman Boxer, Ranking Member Inhofe, and Members of the Committee, I am honored to appear before you this morning to offer my views on the America's Climate Security Act of 2007. I believe climate change is one of the most pressing issues of our time. It is clear that the link between greenhouse gas emissions and the Earth's warming climate is sufficient to warrant an aggressive response, the potential consequences serious and the need for action urgent. I am pleased that this Committee is showing leadership on this very important issue by having a hearing that will advance the legislative process.

PG&E Corporation is an energy holding company headquartered in San Francisco, California and the parent company of Pacific Gas and Electric Company. Pacific Gas and Electric Company is California's largest utility, providing electric and natural gas service to more than 15 million people throughout northern and central California. PG&E is a recognized leader in energy efficiency and has among the cleanest mix of electric power of any utility in the country.

Our work on energy efficiency and support of clean generating technologies are part of a broad portfolio designed to provide advanced energy solutions to our customers. Through technology and innovation we allow our customers to meet their energy needs, while providing unique opportunities for them to manage their energy use, reduce costs, promote new technologies and address climate change.

PG&E'S POSITION ON AMERICA'S CLIMATE SECURITY ACT

PG&E believes America's Climate Security Act provides a solid starting point for constructively advancing a comprehensive, national response to and policy on climate change. The framework established in the bill—a cap-and-trade system with key complementary policies and measures—provides the foundation for a program that will achieve significant and sustained emission reductions from all sectors of the economy. Specifically, the bill includes provisions that prioritize energy efficiency and technology development and deployment, as well as innovative ideas to protect electricity consumers, manage overall program costs, and provide states with the resources to help address the unique needs of their communities and citizens as we transition to a low-carbon economy and adapt to a changing environment. America's Climate Security Act takes positive steps toward recognizing that a na-

tional program must balance the economic, technology, environmental and societal challenges of combating climate change.

While we think that the bill provides a solid starting point, we recognize and anticipate that modifications will be made and issues debated as the legislative process continues, with a focus on winning passage this Congress. We plan to be a constructive voice throughout that process. For example, it is our recommendation that the cost containment measures in the bill become more robust by providing additional clarity and transparency regarding the role and workings of the Carbon Market Efficiency Board, and expanding the use and range of offsets available to meet compliance obligations. Additional measures should also be included that recognize and account for some unique characteristics of emissions from the electric power sector that are influenced by year-to-year variability in weather and precipitation. We also believe that aspects of the bill could be modified to more fully recognize early actions taken to reduce greenhouse gas emissions and to facilitate and encourage the rapid development and deployment of renewable generation and other low-emitting technologies.

PG&E bases its assessment of the bill and our recommendations on a set of principles which guide our thinking on climate policy. These include:

- *Mandatory greenhouse gas reductions are necessary.*—Voluntary programs alone are insufficient and will not send the appropriate price signal to U.S. industry to make a measurable impact on global climate change. Only a mandatory, national reduction program is capable of stimulating sustained action and investment on the scale required to meaningfully reduce emissions and establish the U.S. as a leader in the response to global climate change.

- *Market-based programs minimize costs and maximize innovation.*—Market-based strategies—such as cap-and-trade—provide the economic incentive and the flexibility to cut emissions in the most innovative, cost-effective ways. This approach is key to driving development of the next generation of clean, highly energy-efficient technologies and practices.

- *Long-term greenhouse gas targets provide a rational basis for action.*—Addressing climate change will ultimately require stabilizing greenhouse gas concentrations in the atmosphere at a level that will avoid dangerous climate change. Setting ambitious, but achievable, targets now is important because it establishes a clear objective and sends the appropriate price signals from which incremental objectives and action plans can be created, as technologies emerge and scientific understanding progresses.

- *Broad-based participation leads to better, more cost-effective results.*—Multi-sector participation creates efficiencies that will be essential to keeping costs low. A national program should eventually encompass all major sectors that emit greenhouse gases, with each sector responsible for its fair share of reductions. Sector-specific programs can, however, serve as a starting point for creating the infrastructure on which to base a broader economy-wide program and strategy.

- *Energy efficiency must be a top priority.*—Improving energy efficiency is one of the lowest cost options for managing growing energy demand, while eliminating greenhouse gas emissions. Policies and incentives should encourage and maximize improvements in energy efficiency throughout the economy. For example, utilities are empowered to aggressively pursue energy efficiency and demand response programs when regulators “decouple” the link between revenues from the sale of electric power and utility earnings by setting fixed revenue levels and thus eliminating the financial incentive to sell more energy.

- *Investment in low- and zero-emission electric generation and other technologies is critical.*—Policies should lower barriers and create incentives for investment in renewable power, nuclear power, advanced coal technologies with carbon capture and storage, distributed generation, advanced transportation options, such as plug-in electric hybrid vehicles, and other low- and non-emitting technologies. Driving investment in these technologies, along with aggressive support for energy efficiency and demand response, will reduce greenhouse gas emissions, enhance and improve the efficiency and reliability of the nations’ energy infrastructure, create economic opportunities for American business, reduce reliance on imported fossil fuels, and support overall U.S. energy independence and security.

- *Early action deserves to be rewarded—not penalized.*—Policies must recognize and provide credit to responsible parties that have proactively cut emissions before being required to do so. Ignoring prior efforts sends a signal that stepping up, taking risks, and taking responsibility is not something valued by policymakers. Importantly, failing to recognize early action puts these parties at a competitive disadvantage, forces them and their customers to “pay twice” for emissions reductions, and discourages similarly responsible initiatives in the future.

- *Any climate program must be economically sustainable, achieve the ultimate environmental objectives of the program, and begin to address physical impact and adaptation issues.*—Some economic sectors, geographic regions and income groups may be disproportionately impacted by both climate change impacts and mandatory greenhouse gas reductions. Any climate protection program needs to take account of these impacts and provide appropriate assistance to those impacted constituencies. At the same time, policies need to recognize that, ultimately, the majority of program costs will be born by energy consumers, and policies must therefore be structured to address this issue.

- *Near-term opportunities for cost-effective, verifiable greenhouse gas reductions should be pursued.*—Policies should encourage actual greenhouse gas reductions, regardless of their geographic location or sector of the economy from which the greenhouse gas reduction opportunities originate. At the same time, a rigorous system must be developed to ensure the environmental credibility and integrity of these reductions. Taking this approach can help to encourage actions by other countries, spur technological innovation, reduce overall compliance costs, and offer ancillary benefits.

- *Standardized emissions reporting is an essential first step and must form the basis of any mandatory program.*—Developing consistent and coordinated greenhouse gas emission inventories, protocols for standard reporting, and accounting methods for greenhouse gas emissions is fundamental to establishing a credible reduction program that is capable of tracking and verifying progress toward emissions goals and facilitating a tradable emissions credit system. PG&E was a Charter Member of the California Climate Action Registry, which is now working with 38 other states to develop a consistent set of reporting standards and protocols. We believe that this effort can serve as a model for a national registry system and that any national system should leverage the work that the states have already done.

These principles guided our analysis of the America's Climate Security Act and serve as the basis for some of the specific comments raised above. The remainder of my testimony will provide additional detail on these and some other aspects of the legislation. We provide them in the spirit of our pledge to work cooperatively and constructively as the issue moves through the legislative process.

Electric power consumers will bear the substantial share of the costs of a mandatory climate protection program, so including provisions to mitigate costs to electricity consumers is critical.

We support the approach taken in the America's Climate Security Act to mitigate costs to electricity consumers by allocating emissions allowances to load serving entities (e.g., regulated local electric distribution companies) on behalf of their electricity customers.

This approach is consistent with those outlined in separate reports from the National Commission on Energy Policy, the California Market Advisory Committee, and the Natural Resources Defense Council; each have outlined an approach that avoids the inequities and the inefficiencies that stem from solely employing an Acid Rain-style, or input based, allocation approach, while benefiting electricity consumers.

This allocation approach can help to mitigate some of the issues surrounding allowance allocation that arose during the first phase of the European cap-and-trade experience, and that we expect to manifest itself in electric markets throughout the U.S. For example, in Europe, power companies reflected the cost of allowances in their wholesale power prices regardless of whether they initially received the allowances for free. Electricity customers pay more for electricity and power companies receive a valuable asset in the form of allowances. We expect this phenomenon to occur in competitive wholesale and retail markets throughout the U.S.

In regulated power markets, a different set of issues emerges when a large share of the allowances are allocated at no cost to generating facilities and energy regulators claim the allowances for the benefit of the energy consumers within their jurisdiction. First, some states import a significant share of their power and would never see the benefit of the allowances allocated to power plants outside of their borders. California, for example, imports 22 to 32 percent of its electricity supply and most power distribution companies, whether they are investor-owned or municipally-owned utilities, purchase power from the wholesale markets on behalf of their customers. So while customers in states that import a large share of their power supplies will face higher wholesale power prices, they see no benefit from the free distribution of allowances to out-of-state power plants, whether they operate under cost-of-service regulation or are merchant facilities. Again, this raises important equity concerns that should be factored into the allocation methodology.

Therefore, we believe that the allocation to electricity consumers is an important provision that must be preserved in the legislation as the debate moves forward. Taking this approach will distribute the allowance value where it should go—in this case, the electricity customer—who will ultimately bear the costs associated with making the transition to lower-emitting power generation technologies through the electric rates they pay each month. A study by the U.S. Energy Information Administration suggests that households and businesses at the end of the supply chain will bear 87 percent of CO₂ compliance costs. In addition, according to the Congressional Budget Office, firms subject to a CO₂ cap would pass along most such costs to their customers in the form of higher prices, with regressive impacts on U.S. households. The distribution of allowances for consumer benefit can help offset the price increases experienced by consumers.

So, no matter if a consumer is from a competitive or regulated state, a coal-intensive or non-coal-intensive state, electricity consumers will experience higher costs; allocating allowances to local distribution companies will allow the revenues generated from the sale of allowances to be directed most effectively to end use consumers. We welcome the opportunity to offer further refinements to the language included in the America's Climate Security Act to ensure that it both achieves its intended purpose—mitigating costs to customers without impacting competitive markets or masking the price of carbon—and does so in a way that provides state regulatory bodies with the oversight they need to ensure that they have the ability to best direct the proceeds to serve the unique needs of the consumers and communities whose welfare they are charged with protecting.

Energy efficiency must be a frontline response.

We are very pleased that the bill recognizes the important role that energy efficiency will need to play in meeting our nation's climate change objectives. Existing energy efficiency technologies can help the U.S. to slow and stop current emissions trends and do so in a way that will increase the overall productivity and efficiency of the economy. The bill includes numerous provisions that provide significant incentives for states, utilities, manufacturers and consumers to aggressively pursue energy efficiency, such as: Providing incentives for States to pursue policies that “decouple” electric utility revenues from sales and implement aggressive building codes and standards; targeting of auction revenues to “buy-down” costs of new energy efficient end-use technologies; and providing allowances to load serving entities for the amount of electricity their customers save.

We believe that the energy efficiency provisions included in the bill have the potential to make significant contributions to achieving the emission reduction targets established. For example, the American Council for an Energy Efficient Economy estimated that the energy efficiency measures included in the House Energy Bill, many of which are incorporated in America's Climate Security Act, could result in emissions reductions on the order of 550 million metric tons per year by 2030, while Environmental Defense suggested in their analysis that the savings could be higher. A recent McKinsey study said that, through energy-efficiency, we could reduce the growth rate of worldwide energy consumption by more than 50 percent over the next 15 years. And McKinsey said we can do this using the technology we have available today. Finally, PG&E is an underwriter of a study on the potential for energy efficiency savings in the U.S. While the results are not final, indications are that the potential for savings in the U.S. are on par with or even exceed the potentials McKinsey found in the worldwide study. These savings would not only result in positive greenhouse gas benefits for the country, but would also help to reduce energy costs in the process. What is needed is a shift in current policy to overcome market barriers to realizing the significant potential of energy efficiency and to accelerate its deployment. We believe that this bill provides a significant step in the right direction.

Economic sustainability must be a key program objective.

We are encouraged that the legislation recognizes that a holistic approach to cost containment must be taken and that measures need to be put in place that are designed to protect the overall economy—we believe the provisions included in the bill are a step in the right direction that will not only protect our environment, but also our economy and energy consumers. These provisions include allocation of allowances to local electric distribution companies on behalf of their customers, unlimited trading, offsets, banking, borrowing, as well as the recognition that there will need to be some other mechanism to ensure that unsustainably high CO₂ prices do not jeopardize both the existence of the program and the expansion of our economy.

In this regard, and as the legislative process progresses, we suggest that additional provisions be included to provide added transparency and clarity on the Car-

bon Market Efficiency Board (CMEB) to ensure that the actions of the CMEB provide the necessary cost and environmental certainty for the program. For example, we think the 180-day period currently specified in the legislation—i.e., the period after the CMEB has carried out cost relief measures to expand borrowing, but before it may increase allowances for the applicable year—is too long to prevent potentially disastrous outcomes for companies and significant segments of the economy. During the California Energy Crisis, for example, the financial health of the state’s two biggest utilities was significantly impaired in less than 180 days, requiring the state to enter into high-price contracts and take on the electric purchasing obligation for electricity consumers. California’s electric consumers are still paying for these high price contracts today and the state was required to take on additional debt obligations. We suggest shortening the period to 30 days in order to avoid such outcomes; this will be particularly important in the first 10 to 15 years of the program.

In addition, we suggest that additional criteria be included in the legislation to better define what the “trigger prices” would be to activate the CMEB powers. Currently the bill is virtually silent on what criteria will be used to determine the price, making it impossible for business to predict the future costs of the program, even within a reasonable range. Providing this clarity and transparency will remove the subjectivity from the workings of the CMEB and provide the certainty needed for investment planning by business going forward.

We also think that it should be made explicit that the CMEB can purchase credits out of the market in order to maintain the lower limit of the price range established by the Congressional Budget Office. This type of “price collar” approach can help manage overall volatility and macro-economic costs, while at the same time provide a clear path for technology investors and ensure that there is a “price for carbon” that is recognized by the broader economy. We are continuing to think through these very complex and important issues surrounding the overall functioning and transparency of the CMEB and will share them with the Committee and publicly when we finalize our initial work.

We also recommend including an additional provision that will help entities, particularly in the power sector, manage overall program costs and mitigate price volatility. Cap-and-trade programs for conventional pollutants are typically based on annual compliance periods. At the end of each year, affected sources retire allowances for each ton of emissions they generated. However, because of the long-term nature of the climate change problem, multi-year compliance periods, like those proposed by Regional Greenhouse Gas Initiative and the Clean Air Planning Act, are perfectly appropriate. This flexibility is particularly important for the electric power sector because emissions within this sector can vary significantly depending on weather and precipitation. For example, a dry year reduces hydroelectric capacity in California and the Pacific Northwest and increases PG&E’s reliance on fossil-fired power plants, increasing carbon dioxide emissions in that year. Multi-year compliance periods, particularly in the early years of the program before companies have the opportunity to bank allowances, can allow them to manage variability such as this, while also containing costs and reducing price volatility within the sector.

Finally, with regard to offsets, we are pleased that offsets are considered as a part of the bill and believe that they are an important piece of creating an effective approach to managing the overall costs of the program. Offsets can both help provide cost-effective compliance options and do so in a way that both reduces the emissions of uncovered sectors and sources and that provides added environmental benefits, both in the U.S. and abroad. We are particularly pleased that the bill recognizes the need for independent, third-party verification of the offsets, as that is a key piece of ensuring their overall credibility.

We do have some suggestions for modifications to both the offset pool and the process. First, we suggest increasing the percentage of offsets allowed to be used as a compliance option. Again, we believe that offsets are an important cost control mechanism and one that can provide additional environmental and other ancillary benefits. Second, we suggest expanding the sources of offsets to include the preservation and restoration of wetlands and preservation of forests because research has shown that these activities represent one of the largest opportunities to sequester carbon dioxide and mitigate adverse consequences of climate change. Third, we recommend taking a performance-based approach to measuring the offsets consistent with the approach of the California Climate Action Registry. Fourth, all efforts should be made to ensure that the offsets are “real” (help reduce the overall emissions under the cap) and “permanent” (ensuring that the reductions are maintained over time). And, finally, while we appreciate that the Administrator is provided the authority to expand the offset pool beyond agriculture and forestry, we believe it is important to make explicit that these other actions are of equal weight and importance.

Encouraging the development and deployment of the most efficient, lowest-emitting power generation technologies is key.

We appreciate that the bill recognizes that new sources of power generation will also need access to emission allowances. We are encouraged that the approach taken with regard to allocating allowances to new power generating sources is based on the performance or efficiency of a facility as opposed to the amount of pollution it emits. Basing allowance allocations solely on historic emissions only serves to reward and encourage the highest emitting resources and discourages rapid development and deployment of cleaner, lower-emitting technologies.

We are actively pursuing renewable generation resources on behalf of our customers, and have made recent announcements on contracts we have signed with wind, geothermal, biogas and solar developers. Earlier this week we announced plans to contract for power from a solar facility being developed by Ausra Inc., in San Luis Obispo County, CA. Earlier this year, we announced a contract with Solel-MSP to purchase energy from the Mojave Solar Park. This project will deliver 553 megawatts of solar power, enough power to serve 400,000 homes. We believe the potential for solar thermal technology, as well as other concentrating solar power (CSP) technologies, is significant.

For example, a study by the National Renewable Energy Laboratory (NREL) on CSP potential in California and the rest of the Southwest indicated that CSP in California could produce upwards of 7 times the energy needed to serve the state. NREL also suggests that costs for CSP technologies are declining, from approximately 16 cents per kWh on average today, to approximately 8 cents per kWh in 2015, assuming at least 4,000 MW of CSP were built by then to achieve “learning curve” benefits. (This compares to estimates for advanced coal with carbon capture and storage on the order of 11 cents per kWh or a new supercritical pulverized coal plant on the order of 6 to 6.5 cents, plus the cost of carbon, which could add upwards of 1.5 cents per kWh depending on carbon prices).

This is just one example of the potential for renewable technologies. That is why we believe it is critical for a climate bill to not only support the transition to advanced coal technologies that release little or no greenhouse gases to the atmosphere, but to also provide significant support to accelerating the development and deployment of renewable technologies, as well.

While we recognize that the bill attempts to balance the interests of incumbent utilities with the need to encourage the deployment of low carbon technologies, we would encourage you to consider (1) making clear that the percent of allowances allocated to new entrants increases over time, (2) expanding the definition of new entrants to include all forms of renewable energy (the bill limits allocations to fossil fuel-fired facilities only), and (3) modifying the definition of new entrants to include facilities that commence operation in 2000 or later.

First, by gradually increasing the percent of allowances allocated to new entrants, investment in new, lower emitting generating technologies will be encouraged. The current bill directs EPA to establish a reserve of allowances for new entrants, leaving discretion for the Agency to establish a “fixed” reserve of allowances. We do not believe that this was the intent of the legislation. Rather, the size of the new source set aside should vary consistent with the methodology outlined in Sec. 3903(a)(2) of the bill (i.e., the average emission rate multiplied by the output of the facility).

Second, by including all forms of renewable generation in the new entrant reserve, investment in low carbon technologies and more rapid development and deployment of these technologies will be encouraged (helping to achieve the price points projected by NREL for CSP technologies, for example). As currently drafted, the bill may have the unintended effect of encouraging investment in fossil fuel-fired generating technologies only. Finally, by defining new entrants to include facilities that commence operation in 2000 or later, the legislation will recognize the early investments that companies have made in modern, high efficiency power plants, potentially helping to alleviate some of the claims that will be made under the early action provisions and helping to free up more allowances for other early actions.

Another alternative to adjusting the generator allocation to accommodate renewable generation would be to establish a set aside, similar to the bonus allowances established for carbon capture and storage. It is our understanding that this bonus allowance system is intended to accelerate the development and deployment of advanced coal technologies with carbon capture and storage; we suggest a parallel system be established for renewable technologies. Accelerating the deployment of all of these technologies will help to smooth the transition to a low carbon economy and provide additional economic opportunities.

Encouraging and recognizing early action is important to successfully achieving climate goals.

Overall, we are pleased to see that the legislation includes provisions to recognize actions taken by companies, consumers and states, both as a result of voluntary actions and state greenhouse gas reduction programs. We think it is important for U.S. policy to send the signal that taking risks and taking early action will be recognized under this program. To that point, in Section 3302(b), we suggest changing the timeframe for receiving credit for early action from “date of enactment of this Act” to “the first allocation period.” There will clearly be a lag between the date of enactment and the first allocation period, and in those intervening years, this program should encourage companies to continue to take action. In the alternative, companies may refrain from continuing to take actions prior to this date. At the same time, since this section is giving credit to companies that need to comply with existing state-only or regional programs, many of these programs will come into force in the 2010 to 2012 time period. Therefore, reductions made in these years should be credited as well. We also believe it is appropriate to raise the overall limit in terms of allowances available to credit early actions. The 5 percent set-aside would equate to approximately 260 million metric tons of CO₂-e in 2012. Given the spate of activity that has occurred in the economy and the plethora of state programs slated to come on line in the 2010 timeframe, this number of allowances may be inadequate to reward credible early action.

THE TIME IS NOW

Our country has an historic opportunity to change the way we produce and use energy in ways that will lower the threat of climate change and improve our environment. The optimist in me is certain that we’re going to achieve this goal over the course of the next generation. But the realist in me knows that we can’t take this outcome for granted. Achieving it will be a very substantial challenge. And that is why we are committed to being a pragmatic, responsible participant in this effort.

On behalf of PG&E, I want to thank you for the opportunity provided today. I appreciate the commitment of this Committee to addressing climate change and hope that as deliberations move forward, the focus remains on establishing a pathway to pass an environmentally effective and economically sustainable bill this Congress. I pledge my cooperation and support as the process moves forward on debating the America’s Climate Security Act of 2007 both in Committee and the full Senate.

Thank you.

Senator BOXER. Thank you so much for that encouraging testimony.

Jonathan Pershing, Director, Climate, Energy and Pollution Program, Climate and Energy, World Resources Institute.

STATEMENT OF JONATHAN PERSHING, DIRECTOR, CLIMATE, ENERGY AND POLLUTION PROGRAM, WORLD RESOURCES INSTITUTE

Mr. PERSHING. Thank you very much, Madam Chair.

My name is Jonathan Pershing. I am the Director of the Climate, Energy and Pollution Program at the World Resources Institute, which is a non-profit environmental think tank based here in Washington. I am very pleased to be here to speak to what I consider the most pressing environmental problem that faces the world, and to what I consider a very strong legislative proposal that places the United States firmly on the path to addressing that problem.

My written testimony goes through a number of critical points, but I will emphasize only four here. First, the problem is one of enormous urgency. It requires very aggressive action if we are to hope to limit damages. The science is clear. The IPCC says that it is unequivocal that the earth’s climate is warming, and there is greater than a 90 percent probability that it is human activities that have caused it. It suggests we have to reduce emissions glob-

ally 50 to 85 percent below 2000 levels by 2050 if we would like to see temperatures remain below 2 °F. If the United States doesn't act quickly and aggressively, the rest of the world will lag, and we can't afford to wait.

My second point, the damages from climate will be enormously costly. A report authored last year by Sir Nicholas Stern, former lead economist at the World Bank, found that the costs of climate change could range from 5 to 20 percent of global GDP, a staggering \$7 trillion. A few recent examples demonstrate the cost. California wildfires, which will increase, already estimated to run between \$900 million and \$1.6 billion for this series of events alone. The drought in the Southeast, the Atlanta Journal Constitution says it has already cost the Georgia landscape industry \$1.2 billion and the Ag industry \$782 million, just this one event. Hurricanes, projected to increase, well, look at Katrina alone, the damages \$70 billion to up to \$130 billion.

My third point, the cap and trade system and the complementary policies in this act provide strong environmental benefits and send a price signal to invest in new technology. A price signal is required in order to ensure that polluters recognizes their impact, begin to control what has been unfettered access to our atmosphere and pay for their pollution. The approach has two main attractions: One, cap and trade, which is clear and specific limit on emissions, creating a price that achieves a target lower than what would otherwise be possible. WRI has conducted a preliminary analysis to quantify the reductions that might be expected. The Act would subject 82 percent of all U.S. emissions to mandatory reduction obligations, nearly full economy-wide.

The bill also includes complementary measures designed to achieve reductions in emissions from sectors outside the cap. Our estimate is that the bill would reduce covered emissions from 2005 levels by 17 percent in 2020 and by 71 percent in 2050. Total U.S. emissions are estimated to be 16 percent below 2005 levels by 2020 and 27 percent below 2005 by 2030, if we assume, based on EIA numbers, a growth of 0.8 percent in the uncovered sectors. Complementary policies in the current bill do partly offset some of this growth.

The cap and trade regime sends a price signal to the market and pushes investments to reduce emissions. There is a huge range of technology options at low to modest cost. McKinsey, the consulting company, suggests that more than 4 billion tons of abatement could be provided with current technology at prices below \$50 a ton. Other estimates support the low price. Duke University's Nicholas Institute suggests that GDP would increase with no policy about 112 percent between 2005 and 2030—112 percent with no policies. With the policies, 111 percent, less than 1 percent difference in the total inclusion of all the policies here.

The bill also provides a number of mechanisms to help control compliance costs: Rewards for early action, capture and storage; a free and very substantial allocation of 40 percent of the total allowance pool; allocation borrowing and banking; offset provisions; the Carbon Marketing Efficiency Board. These are likely to succeed in smoothing the price, although they are somewhat controversial.

Finally, my last point. The bill sends a strong international signal. The global community is assembling in one month in Indonesia to continue discussions about global action. There will be three issues on the table: Mitigation efforts by major emitters, forestry, and approaches to help countries adapt to climate change. This bill signals to the United States that the United States is acting and will be taking steps. It also acknowledges the problem of forestry and seeks to move forward on that front. However, the bill does not address the issue of adaptation, and this could well be an area where you, Madam Chair, and the Committee, may choose to focus further.

Thank you very much for providing me the opportunity to speak. I appreciate the opportunity and the importance of this session.

[The prepared statement of Mr. Pershing follows:]

STATEMENT OF JONATHAN PERSHING, WORLD RESOURCES INSTITUTE

My name is Jonathan Pershing, and I am the Director of the Climate, Energy and Pollution Program at the World Resources Institute. The World Resources Institute is a non-profit, non-partisan environmental think tank that goes beyond research to provide practical solutions to the world's most urgent environment and development challenges. We work in partnership with scientists, businesses, governments, and non-governmental organizations in more than seventy countries to provide information, tools and analysis to address problems like climate change, the degradation of ecosystems and their capacity to provide for human well-being.

I am very pleased to be here to speak to what I consider the most pressing environmental issues faced by the world—and to what I consider a very strong legislative proposal to place the United States firmly on the path to addressing the problem.

URGENCY AND SCALE

The Earth is warming, primarily due to human activities. The fossil fuels that have led to huge increases in human productivity and great improvements in human well-being, together with significant deforestation, have been the most important causes of global warming. The buildup of carbon dioxide and other greenhouse gases (GHGs) is accelerating, and unless we act very soon to control emissions warming, will rise to very dangerous levels during our children's lifetimes.

In February 2007, the Intergovernmental Panel on Climate Change (IPCC)—the official science process endorsed and supported by the world's governments and in which the United States was an active participant) released its most recent report. The report states that it is "unequivocal" that Earth's climate is warming, and confirms that the current atmospheric concentration of carbon dioxide and methane, two important GHGs, "exceeds by far the natural range over the last 650,000 years." Further, the IPCC concludes that it is now "very likely" (greater than 90% probability) that GHG emissions from human activities have caused "most of the observed increase in globally averaged temperatures since the mid-20th century."

Indeed, the impacts of warming have become increasingly evident. Sea ice in the Arctic is shrinking, and Greenland's massive ice sheet is receding—far faster even than predicted in the IPCC report released prior to this summer's unprecedented melting. Glaciers are rapidly shrinking from the Rockies to the Alps. There have been fatal heat waves in Northern Europe and a three year drought in the Amazon. Farmers and hunters across the United States report changing growing seasons and changing bird migration. If we already see these kinds of damages with only about 0.6 °C (1 °F) of warming, the nature of future damages, with temperatures ranging to 2°C and higher, are likely to be catastrophic.

The IPCC also gave us a clear sense of the emissions reductions required to limit the damages—and a timeframe in which to achieve them. The IPCC suggests that we must reduce emissions globally by as much as 50–85% below 2000 levels by 2050 if we wish to see global average temperatures remain below 2 °C of warming. We must stabilize global emissions by 2035.

The warming occurring today is the result of greenhouse gases emitted over the past half century. The United States, with 4.6 percent of the world's population, has contributed 28 percent of the emissions currently in the atmosphere.¹ Our strong economic growth in the 20th century was fueled by fossil fuel technologies we in-

vented. And it is clear that today the U.S., with the most advanced economic and technological resources and capacity, must take the lead in transforming the global economy to a low-carbon future. We cannot expect the rest of the world to act if we do not—or expect that countries with per capita incomes $\frac{1}{10}$ of our own to act until we do.

The emissions limits we set for the U.S. matter. Action by the U.S. will be seen as the benchmark against which other countries will measure their commitments. The U.S., with its historical responsibility for the current build up of greenhouse gases in the atmosphere, will continue to be a key contributor to temperature rise—even as other countries may pass us in annual emissions levels. With our European allies committing to a 20–30 percent reduction in greenhouse gas emissions by 2020 to align with the science, U.S. and European action and leadership could help advance the efforts of other countries to take action.

U.S. action alone will not be enough to reduce global emissions to the extent required. It is widely understood that without timely and aggressive U.S. action, a successful international agreement on climate change will be impossible to achieve. The policies you are developing here will have the potential to demonstrate the American commitment to global action on climate change, and consequently, to move the world.

THE COST OF CLIMATE DAMAGES

The U.S. emitted 7,260 billion tons in 2006,ⁱⁱ and because greenhouse gas pollution is not regulated, these harmful emissions had no financial consequence to those who produced them—but significant consequences to future generations. A price signal is required in order to ensure that polluters recognize their impact, begin to control what has been unfettered access to our atmosphere, and pay for their pollution. Economists consistently point out that there is no free lunch; climate change is no exception. A report authored last year by Sir Nicolas Stern, former lead economist at the World Bank and advisor to then UK Chancellor of the Exchequer (and now Prime Minister, Gordon Brown), found that the costs of climate change could range from 5 to 20 percent of global GDP.ⁱⁱⁱ In dollar terms, this is equal to about \$6.98 trillion—a staggering cost against which our current mitigation price expectations pale.^{iv}

A few recent examples demonstrate the point: The California wildfires (a phenomenon expected to increase considerably in a warmer world), are estimated by Risk Management Solutions, a leading provider of products and services for catastrophe risk management, to already run between \$900 million and \$1.6 billion.^v The drought in the Southeast, a potential harbinger of future events, has led the governors of Florida, Georgia and Alabama to request aid from the President, and has been reported by the *Atlanta Journal-Constitution* to have already cost the Georgia landscape industry \$1.2 billion in losses and the agricultural industry \$782 million in losses.^{vi} Among the most devastating impacts likely to arise from climate change is increased frequency of high intensity storms and hurricanes. According to the Congressional Budget Office, damages estimated from Hurricane Katrina alone are expected to run between \$70 and \$130 billion.

CAP AND TRADE: A SIGNAL FOR INNOVATION

It is in the context of the clear understanding of the science and impacts of climate change that strong and prompt action is required. The Climate Security Act provides this. As with all cap-and-trade regulatory systems, the approach in S. 2191 has two main attractions: it puts a clear and specific limit on aggregate emissions and it achieves the emissions-reduction target at lower cost than would otherwise be possible. The cap establishes certainty as to the total amount of emissions that will occur under the program. Meanwhile, the ability to trade emissions allowances yields cost-savings by promoting emissions reductions at those sources that are able to achieve the reductions most cheaply. Trading emissions allowances lowers costs to the facilities covered under the program. In doing so it reduces economic impacts on workers, consumers, and taxpayers.

THE ENVIRONMENTAL BENEFITS

While several organizations are preparing full economic models of S. 2191, WRI has conducted a preliminary analysis to quantify the emission reductions that might be expected under this bill. Our analysis has included three elements of the legislation:

1. Coverage of the cap
2. Emission targets
3. Complementary policies

COVERAGE

It is highly unlikely that all U.S. emissions would ever be directly covered in any cap and trade regime. The coverage of the EU-ETS during phase one was approximately 46 percent of total EU emissions. The Northeast states' Regional Greenhouse Gas Initiative applied its initial caps to the power sector alone, accounting for approximately 22 percent of total regional emissions. The limited coverage of these programs reflects the fact that some sources of emissions are easier to monitor and track, while others are more onerous to regulate. Nevertheless, maximizing the ability of a carbon market to find low-cost abatement options generally depends upon the inclusion of diverse sources of emissions. More comprehensive coverage will be necessary to achieve economy-wide targets while keeping compliance costs to a minimum.

S. 2191 (as amended in subcommittee to include emissions from the use of natural gas in the residential and commercial sectors) subjects 82 percent of all U.S. emissions to mandatory reduction obligations. The bill covers emissions from significant facilities in the power, industrial and transportation sectors as well as a majority of emissions in the residential and commercial sectors. The bill includes both reduction obligations, and complementary measures designed to achieve reductions in emissions from sectors outside the cap, from sectors where a price signal alone is unlikely to spur a technological transformation, and includes recognition of state circumstances and cost mitigation requirements.

EMISSION TARGETS

S. 2191 sets straightforward annual budgets for covered facilities, and does so with absolute rather than relative numbers. WRI estimates that the bill would reduce covered emissions from 2005 levels by 17 percent in 2020 and by 71 percent in 2050. Over the life of the program covered emissions are reduced at an average annual rate of just over 3 percent. However, as noted above, nearly 20 percent of U.S. emissions are not covered by mandatory reduction targets under the cap. If we assume a rate of growth of emissions of approximately 0.8 percent for these uncovered sectors, total U.S. emissions are estimated to be 16 percent below 2005 levels by 2020 and 27 percent below 2005 levels by 2030. Interactions between covered and uncovered sectors of the economy, particularly in the out years of 2030 to 2050, are difficult to assess.¹ Complementary policies in the current bill will only partly offset the growth in the uncovered sectors, and Congress will need to further review and adopt additional policies (see chart 1).

COMPLEMENTARY POLICIES

Although specific mandates are not set for all sectors, S. 2191 does establish a wide variety of complementary policies to address emissions in these uncovered sectors. While many of the policies act also as cost-containment mechanisms (reducing overall compliance costs from "covered sectors"), there are several that explicitly reduce emissions outside the cap. In particular, S. 2191 incentivizes reductions through allowance allocations. The most significant of these allocates allowances to the USDA to promote biological sequestration through domestic agriculture and forestry programs. While estimating these additional emissions reductions is subject to considerable uncertainty, figure 2 below shows a potential range that may result from the combined policies.

While the intent of the bill is excellent, there may still need to be some strengthening of the rules for biological sequestration, in particular to ensure that reductions incentivized through this program would be additional and permanent, and that appropriate rules be developed to guarantee environmental benefits from this aspect of the program.

UNDERSTANDING COSTS

S. 2191 sends a price signal to the market. By capping GHG emissions, it implicitly establishes a value on such emissions, and pushes investors to design and implement policies to reduce them. Economic and technology analysis suggests that the range of options to reduce emissions at modest costs is large.

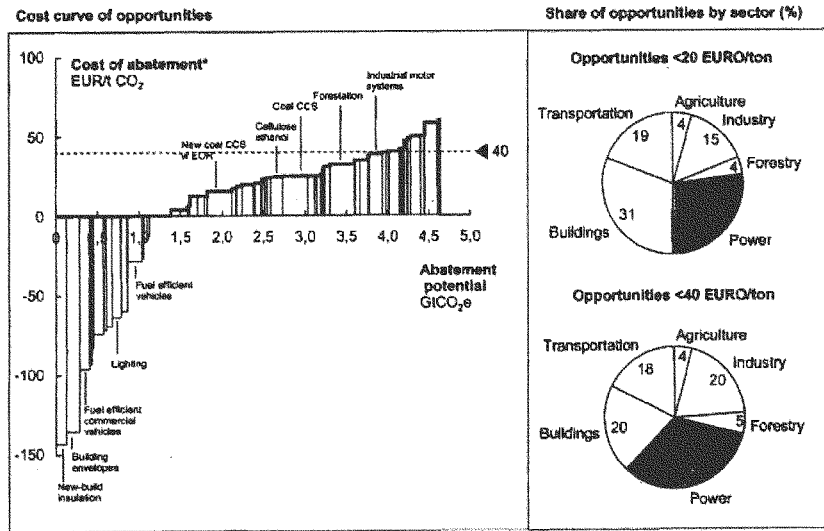
A study being undertaken by McKinsey^{vii} suggests that a wide variety of technologies, with more than 4 billion tons of abatement potential, would penetrate the market at costs below \$50/ton of carbon (see figure 1 below). However, even such

¹Uncovered emissions growth in WRI's analysis is based on EIA projections of these sectors under business as usual reference case, and does not capture the potential interactions across sectors. Our assessment of emissions trends uncovered sectors may thus be conservative.

a figure is misleading: a carbon price of \$50/ton does not imply a loss to the economy of this amount. Rather, it implies a shift—from systems and operations that are GHG intensive to those that are not. In turn, this suggests we are likely to see major investment in new energy and transport technologies that could continue to power the U.S. economy.

Figure 1

Abatement opportunities in North America in a 2030 perspective



Source: McKinsey, 2007

The subject of overall economic cost of emissions limits has been much studied. Modeling of S. 2191 as introduced into subcommittee (with only modest differences to the current draft proposal) and other similar scenarios have estimated that the cost of allowances would rise to \$26.27 (2005 dollars) by 2020 (see table 1) and to \$56.71 by 2030.^{viii} Since the economy must now internalize the cost of carbon where it was otherwise free, there is the potential for these costs to influence economic growth.

However, the economic impact of those prices is extremely small. Duke University's Nicholas Institute conducted an analysis of the earlier bill draft submitted by Senators Lieberman and Warner to the subcommittee. This analysis showed that in a business as usual scenario, GDP would increase 112% from 2005 levels by 2030. Under S. 2191 GDP is projected to rise by about 111% from 2005 levels by 2030. The decline in economic activity is less than 1% of GDP over the course of the next two decades.

In the Nicholas Institute analysis, by 2050, the projected increase in GDP from 2005 levels is 238%—and under the bill, this would still increase by 236.4%. This means that in 2050, the same overall economic growth would be observed in the economy, but it would occur about 8 months later in the calendar year. The scale of the U.S. economy is huge, and even small percentages in growth are thus large absolute numbers. The context must be taken into account, however, and here it is clear: action on climate can be achieved at quite modest costs.

Table 1 provides the results of several economic modeling studies that reviewed cap and trade programs similar to S. 2191. The comparison looks both at the price per ton of carbon, and the impact of that price level on GDP.

Table 1. Results from modeling exercises of cap and trade scenarios similar to S. 2191 ^x						
	Allowance price, \$ 2005/metric Ton			Impact on GDP percentage growth relative to 2005, (change from reference case)		
	2020	2030	2050	2020	2030	2050
Nicholas Institute	25.50	41.80	111.10	58% (-0.82%)	110% (-0.98%)	237% (-1.64%)
Massachusetts Institute of Technology	37.25	55.13	120.80	64% (-0.56%)	119% (-0.70%)	268% (-0.28)
Clean Air Task Force	26.27	56.71	NA	NA	NA	NA

None of the economic analysis developed to date has included a complete accounting of the complementary policies or the explicit uses of the emissions trading revenues accruing to the government from an auction of allowances in minimizing economic impacts. These can be substantial. For example, WRI recently facilitated a multi-stakeholder process in Illinois to develop recommendations for a state climate mitigation program. The diverse stakeholder group was charged with submitting policy recommendations to reduce total state-wide emissions to 1990 levels by 2020—comparable to near term targets under consideration in S. 2191. Illinois is representative of many U.S. states as it relies on coal for about half of its electricity generation, is home to both large metropolitan areas and rural agriculture, and is currently witnessing significant growth in its GHG emissions. The policies under consideration included a cap and trade program for large emitters in the industrial and electric generation sectors as well as several complementary policies addressing energy efficiency, renewable energy, CCS equipped coal generation and reducing GHG emissions from passenger vehicles. In short, the process reviewed many of the approaches proposed in America's Climate Security Act.

ICF Consulting was contracted by the Illinois to analyze the economic costs of the policy package. Economic modeling of the entire package of recommendations found that the price of allowances in the cap and trade program rose to over \$18/tonne in 2020, but that even at this price, state GDP increased by nearly 1 percent as compared to business as usual. Personal disposable income and net employment saw similar gains.^x These results are in line with those of a similar study led by David Roland-Holst at the University of California—Berkley which looked at the economic effects of California's GHG reduction policies.^{xi} The policy package in that study, which also sought to reduce GHG emissions to 1990 levels by 2020, found that a cap on emissions in combination with complementary policies achieved up to a 3.4 percent increase in state GDP as well as an increase in net employment. These state examples show that robust and comprehensive climate policy can meet environmental goals while enhancing the nation's economy.

The positive economic impacts of the implementation of a climate change regime are obvious. The U.S. economy has grown while becoming more efficient and reducing pollution for decades. A price on carbon in conjunction with appropriate complementary energy policies can accelerate this positive trend. Indeed, as existing and new American technologies are likely to thrive in a carbon constrained world, new business opportunities will plausibly lead to a more robust economy that can generate new jobs while increasing national energy security.

EASING THE TRANSITION: STRATEGIES TO CONTAIN COSTS

Although new opportunities will be significant, the cap-and-trade program will create uneven costs across the economy. In designing an effective cost containment strategy, five economic burdens must be balanced:

- cost to any particular company
- cost to an industry
- cost to a region
- cost to a class of consumers
- cost to the economy

Designing cost mitigation programs will therefore require different approaches depending on whose costs one mitigates. There are four ways in which the bill seeks to provide economic mitigation assistance: (i) free allocation of pollution allowances

to regulated entities, (ii) a public auction to generate revenue for investment in new technologies and provide low income assistance, (iii) inclusion of energy efficiency and consumer and state programs as recipients of free allowances for public purposes, and (iv) specific cost mitigation programs such as offsets and borrowing.

In addition to rewards for early action and carbon capture and sequestration, the bill provides regulated entities a free allocation of 40 percent of the total allowance pool, phased out over time, disappearing entirely after 24 years. If we assume a price of \$20/ton of CO₂ equivalent, this implies a value of \$45 billion in transition assistance to regulated entities in the first year of the program. For comparison, a recent Congressional Budget Office report estimated that as few as 15 percent of freely allocated allowances could allow for regulated entities to remain “whole” as they transition into the new low-carbon economy.^{xii}

Auctioning allowances and using the revenues to cut distortionary taxes may be the most efficient and least expensive approach to implementing a market-based system according to economic models.^{xiii} Auctions may also allow the government to raise revenue for any number of other purposes, including technology investments or deficit reduction. Furthermore, evidence exists that auctions tend to stimulate greater innovation than free allocations and may lead to more efficient investments in technology.^{xiv} Real-world complexities, however, such as multiple distortionary policies, monopoly power, and differences among regulated firms, complicate the issue, making the optimal choice between full auctioning and full free allocations of allowances less clear.^{xv} However, S. 2191 makes a clear statement regarding the importance of auctioning, starting at a level that is far higher than proposed in other legislation, and currently surpassed only by individual state proposals in the Regional Greenhouse Gas Initiative program in Northeast (where most states plan to auction 100 percent of their allowances).

While an auction tempers the politics of allowance distribution, there are still important political decisions that must be made regarding the distribution of auction revenues. Such revenue will be key to mitigating the costs of the program on low-income households, for worker transition programs, as well as for funding new low carbon technology programs that will ultimately lower overall compliance costs. By making specific provisions for such allocations, S. 2191 seeks to address the potential regressivity of the policy while providing dedicated funding to develop the technologies required to reduce emissions and ensure the U.S. remains economically competitive.

Since markets do the best job of controlling costs over time, the most effective cost mitigation policy will be based upon the robustness of the cap and trade program. There have been concerns raised that large price fluctuations may arise in a new GHG market. Such large price changes create risks both to firms in terms of technology investment, and potential cost to consumers. S. 2191 attempts to limit price distortions and fluctuations through two mechanisms: (1) allowance borrowing and banking and (2) the establishment of a Carbon Market Efficiency Board which can adjust the amount and terms of borrowing to limit negative economic impacts. Additional consideration will be needed to assure that the Board has a clear, transparent and effective governance structure.

Offsets are another design element that can contain costs. Offsets provide regulated entities with additional options to reduce GHG emissions that occur outside of the cap. This is desirable as many offset opportunities are estimated to be of lower cost than abatement options at regulated facilities. A well designed offset program that contains a framework to insure that reductions are real, additional, permanent and verifiable can lower overall compliance costs while maintaining the environmental integrity of the program. S. 2191, contains a design framework that should achieve these dual outcomes, including offsets from both within the U.S. and internationally.

INTERACTION WITH STATES

To date, states have been leading the policy response to climate change; California's AB32 and the Regional Greenhouse Gas Initiative serve as two notable examples. Recent WRI work on the influence of states in federal policy finds that a common development is for the federal government to (at least partially) preempt state authority, and set a regulatory floor to which all states must adhere (but which states may choose to exceed).^{xvi}

S. 2191 follows this tradition by applying a uniform national policy floor, but by allowing states to exceed this floor based on their particular circumstances. This approach achieves a more robust environmental outcome than one that stifles the innovation that will almost certainly emerge from continued state experimentation.

However, it also serves to set a national standard that will reduce compliance costs for industry, which legitimately fears a patchwork of state regulation.

S. 2191 follows state precedent in another, equally important fashion: it explicitly instructs the EPA to cooperate and harmonize federal emissions reporting and tracking requirements with the Climate Registry, a common emissions reporting and tracking platform in which 40 states currently take part. The Climate Registry uses generally accepted accounting protocols that are common in the private sector and in other GHG programs around the world. By adopting this standard, the bill provides for a common infrastructure for both state and federal programs, and one that already has national buy-in.

INTERNATIONAL INTERACTIONS

The global community is assembling in a month in Indonesia to continue discussions about the global action required to protect the climate. There are three major issues on the table: mitigation efforts by major industrial emissions sources and emitting countries, reducing emissions from deforestation and encouraging sustainable forest carbon management, and programs and approaches to help countries, ecosystems and vulnerable populations adapt to climate impacts.

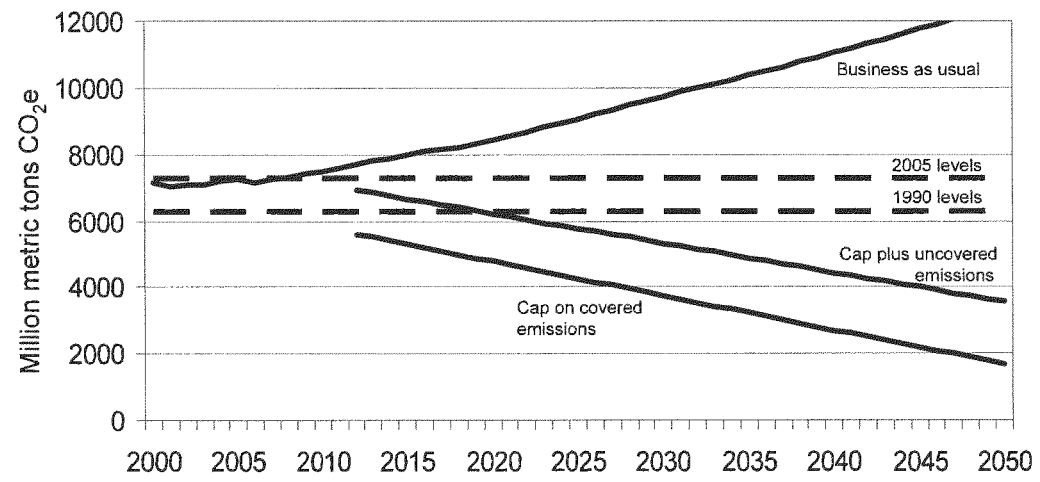
America's Climate Security Act focuses on U.S. mitigation efforts, but also clearly acknowledges forestry through both the inclusion of an offsets program, and through an innovative set aside for forestry both in the U.S. and globally. In the U.S. and around the world, impacts and costs of climate change are already mounting and hurting the world's poor populations and harming fragile ecosystems and water resources. S. 2191 provides only one lens for this issue—the national security implications for the United States of a fragile natural resource base and vulnerable populations. The broader adaptation agenda is both a responsibility and an opportunity for the U.S. to rebuild its international leadership in the climate arena and support robust private and public engagement to help protect people and the planet.

Just as S. 2191 provides a clear roadmap for industry in the U.S. on the emissions reductions required through its targets and timetables, the bill also signals to the international community that the U.S. will take the steps required to reign in its emissions and its impact on people and ecosystems around the world. With the U.S. and Australia currently reviewing climate policies, and Europe's cap and trade program underway, China releasing its National Climate Change Plan, and the Meeting of the Parties next month, we can chart a course for a new international agreement by 2012.

Thank you Madame Chair. I appreciate the opportunity to present this testimony. I welcome any questions you or the committee might have.

Chart 1

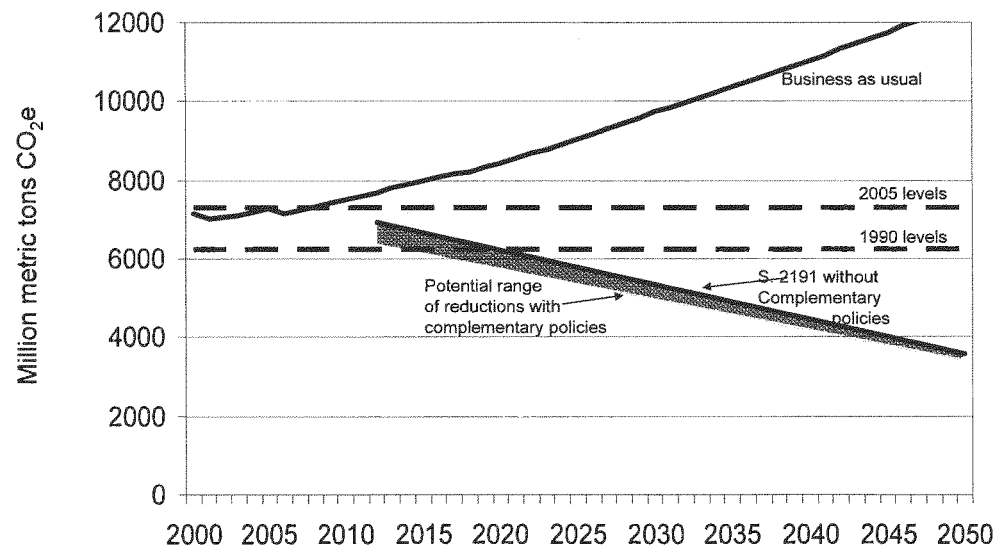
Emissions cap and total economy-wide emissions under S. 2191



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Chart 2

Potential emission reductions under S. 2191



NOTES

ⁱ Environmental Protection Agency, October 1, 2007. “EPA Analysis of Bingaman-Specter Request on Global COP₂ Concentrations”.

ⁱⁱ See EPA GHG Inventory; <http://www.epa.gov/climatechange/emissions/downloads06/07ES.pdf>

ⁱⁱⁱ Stern, Nicholas. 2006. *Stern Review on the Economics of Climate Change*. (Cambridge University Press: Cambridge, United Kingdom).

^{iv} In the Stern report, the upper bound of projected costs of climate change were estimated at \$3.68 trillion. At the time of the report’s release, this was equal to \$6.98 trillion.

^v See <http://www.rms.com/>

^{vi} See <http://www.ajc.com/news/content/news/stories/2007/10/20/waterecon1020.html?cxntlid=inform>

^{vii} This figure, from new analysis underway by McKinsey, is posted by the Wisconsin DNR as part of their work to design a state climate change program: <http://dnr.wi.gov/environmentprotect/gtfgw/documents/Ma3TF20071019.pdf>

^{viii} Showalter, Sharon. October 23, 2007 memo to Joe Chaisson, Clean Air Task Force. Re: Warner-Lieberman Bill NEMS Modeling Analysis.

^{ix} Nicholas: Murray, Brian; Ross, Martin. 2007. “The Lieberman-Warner America’s Climate Security Act: A Preliminary Assessment of Potential Economic Impacts.” (Duke University: Durham, North Carolina). Data from “Warner-Lieberman Tighter Cap Scenario” is used to represent the tighter cap of S. 2191 in comparison to the caps of the annotated table of contents modeled in the core scenario.

MIT—Paltsev, et al. 2007. Assessment of U.S. Cap-and-trade Proposals. MIT Joint Program on the Science and Policy of Global Change Report 146. Data from “203 bmt limited sectoral coverage” scenario is used to represent less than full-economy coverage of S. 2191.

CATF: Showalter, Sharon. October 23, 2007 memo to Joe Chaisson, Clean Air Task Force. Re: Warner-Lieberman Bill NEMS Modeling Analysis.

^x Illinois Climate Change Advisory Group, forthcoming. Report of the Illinois Climate Change Advisory Group to Governor Rod R. Blagojevich. For an overview presentation of modeling results please see <http://www.epa.state.il.us/air/climatechange/documents/07-09-06/modeling-of-policy-proposals.ppt>

^{xi} Roland-Holst, Robert, 2006. Economic Growth and Greenhouse Gas Mitigation in California. University of California—Berkeley.

^{xii} Congressional Budget Office, 2007. Trade-offs in Allocating Allowances for COP₂ Emissions. Economic and Budget Issue Brief.

^{xiii} Fullerton, D., and G. E. Metcalf. 2001. Environmental Controls, Scarcity Rents, and Pre-existing Distortions. *Journal of Public Economics* 80(2): 249–67. Goulder, L. H., et al. 1999. The Cost-Effectiveness of Alternative Instruments for Environmental Protection in a Second-Best Setting. *Journal of Public Economics* 72(3): 329–60.

^{xiv} Adoption: Evidence from the U.S. Lead Phasedown. *Journal of Industrial Economics* 51(3): 317–43. Milliman, S. R., and R. Prince. 1989. Firm Incentives to Promote Technological-Change in Pollution-Control. *Journal of Environmental Economics and Management* 17(3): 247–65. Popp, D. 2003. Pollution Control Innovations and the Clean Air Act of 1990. *Journal of Policy Analysis and Management* 22(4): 641–60.

^{xv} Babiker, M. H., et al. 2003. Tax Distortions and Global Climate Policy. *Journal of Environmental Economics and Management* 46(2): 269–87. Fischer, C., I. W. H. Parry, and W. Pizer. 2003. Instrument Choice for Environmental Protection When Technological Innovation Is Endogenous. *Journal of Environmental Economics and Management* 45(3): 523–45.

^{xvi} Aulisi, et al. 2007. Climate Policy in the State Laboratory: How States Influence Federal Regulation and the Implications for Climate Change Policy in the United States. World Resources Institute.

Senator BOXER. Thank you, sir.
Anne Smith, vice president, CRA International.

STATEMENT OF ANNE E. SMITH, Ph.D., VICE PRESIDENT, CRA INTERNATIONAL

Ms. SMITH. Madam Chairman, members of the Committee, thank you for inviting me. I am Anne Smith, a vice president of CRA

International, an economics consulting firm. My testimony is my own and does not represent CRA or any of its clients.

The economic impacts of any new policy should be carefully examined when that policy will be expected to dramatically alter patterns in consumer behavior and in markets. This is certainly the case for S. 2191. Using CRA's MRN-NEEM model for assessing climate policy costs and considering many different sets of assumptions, I estimate that the present value of S. 2191's net costs to U.S. consumers will be between \$4 trillion and \$6 trillion through 2050.

In terms of GDP, in 2015 alone, GDP would be lower by about \$160 billion to \$250 billion. Eventually, the annual loss in U.S. GDP would increase to the range of \$800 billion to \$1 trillion, stated in today's dollars. For context, these losses exceed our current annual outlays for Social Security.

In terms of jobs, by 2015 alone, S. 2191 would result in net job losses of 1.2 million to 2.3 million jobs. These are net losses, despite a substantial increase in so-called green jobs. But the most troubling aspect to me of the impact estimates is their speed of change. Just to meet the 2015 cap, U.S. electricity generators could have to cut their use of coal by as much as half, and increase their use of natural gas by as much as 70 percent. These shifts are found to be necessary, despite large reductions in electricity use and very large increases in renewables.

To deliver that much more gas in a space of just a few years would likely cause gas prices to spike far higher than the 15 to 20 percent price increases that our and other equilibrium models indicate. The problem is that the caps in S. 2191 are far ahead of the technologies needed to produce deep emissions cuts. Everyone likes to say technology is the solution, and it will be. But the technologies they are talking about will take a lot more time than S. 2191 is allowing. Meeting the S. 2191 caps would require large additions of coal-based generation that captures and stores carbon emissions underground.

My estimates including building as many new power plants with this technology as the entire current U.S. fleet of coal-fired power plants by 2050. My estimates also project enough vehicles using enough new zero emitting fuels to displace all of the vehicle emissions from the current U.S. vehicle fleet, but by 2050. These changes plus much more nuclear power at the key technological solutions that are on the horizon. They can contribute to very large reductions by 2050.

However, even by 2025, only about one-tenth of this technological potential can be in place, and effectively none of it can help meet the caps before 2015. Renewables and energy efficiency can start earlier, and they do in my analyses. But their potential is just not sufficient to meet the stringent, near-term targets of S. 2191 cost effectively. Consequently, initial compliance involves a disruptive large switch toward natural gas, a fossil fuel that emits a lot of CO₂ in its own right. This is a switch that hardly moves us toward greater energy security during that time period prior to about 2025.

But then by about 2025, all of that new natural gas infrastructure and generation will lose market share to the new low-carbon

technologies as they start to come online, the ones that were needed all along. The rapidly built-up infrastructure supply chains for natural gas will become under-utilized within about 15 years of being created. We will need to restart the coal mines and the transportation network that were shuttered so rapidly only 15 years before.

S. 2191 sets ambitious caps, but its near-term ambitions are far ahead of the necessary technologies. Despite the economic risks that this poses in the near-term, the bill does not provide any protection from leakage when manufactured goods from unregulated countries out-compete our own.

[The prepared statement of Ms. Smith follows:]

STATEMENT OF ANNE E. SMITH, PH.D., VICE PRESIDENT, CRA INTERNATIONAL

Madame Chairman and Members of the Committee:

Thank you for your invitation to participate in today's hearing. I am Anne Smith, and I am a Vice President of CRA International. Starting with my Ph.D. thesis in economics at Stanford University, I have spent the past twenty-five years assessing the most cost-effective ways to design policies for managing environmental risks, including cap-and-trade systems. For the past fifteen years I have focused my attention on the design of policies to address climate change risks, and have prepared many analyses of the economic impact of climate policies. I thank you for the opportunity to share my estimates of the impacts of America's Climate Security Act of 2007 (S. 2191) with you. My written and oral testimonies reflect my own research and opinions, and do not represent any positions of my company, CRA International, or its clients.

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. The potential economic impacts of any new policy should be carefully explored, but particularly so when one expects that the new policy would cause dramatically altered patterns of economic activities and consumer behavior. This is certainly the case for a greenhouse gas policy such as S. 2191.

I have estimated the costs and economic impacts of S. 2191 using a model called MRN-NEEM that I and my colleagues at CRA International have developed over the past two decades specifically to provide a credible and state-of-the-art ability to assess greenhouse gas emissions control policies. I will summarize the results of these analyses in my testimony, and also discuss some other issues with how S. 2191 would affect the economy that are not directly addressed in the model analyses.

OVERVIEW OF ECONOMIC IMPACT MODEL

Detailed documentation of the MRN-NEEM model is available on CRA's website.¹ In brief, this model is a "general equilibrium" model of the U.S. economy. This means that it tracks every dollar that is spent in order to reduce emissions through the economy, accounting for economic gains in those sectors that provide the goods and services that result in emissions reductions, as well as economic costs to those who must incur these added expenditures, and to those sectors that lose demand as a result of the policy. The model also accounts for any changes in the distribution of wealth that result from the combined impact of emissions control spending and the disposition of the wealth associated with newly created allowances. The results of a model run thus reflect the *net* impact to the U.S. economy after all of the winners and losers under a proposed policy have been accounted for. It is these net costs that should be compared to the changes in climate-related risks expected of the policy.

The model assumes that implementation of an emissions cap will occur in a least-cost fashion with fully-functional, competitive product and allowance markets. The only limits imposed on the efficiency of a cap-and-trade market are those that are directly specified in a Bill, such as when some sectors are not covered by the proposed cap scheme.² Leakage of some economic activities outside of the U.S. is also

¹ http://www.crai.com/pubs/pub_7748.pdf

² Placing sectors that are not covered by the proposed cap into the offsets category still limits the program's efficiency.

estimated for sectors that face competitors in other countries that do not have their own emissions caps.

Additionally, MRN–NEEM assumes all businesses and consumers have “perfect foresight” of future allowance prices and policy requirements. This means that the model does not include any costs due to uncertainty and “surprises” that will probably also be associated with compliance with a new policy. It captures only a long-run equilibrium in all of the markets, and thus does not include any of the costs of an overly rapid shift in markets due to imposition of a new policy. The potential disruptiveness of the transition to the new equilibrium, however, can be assessed by considering the rate of change in key markets observable in the model results.

MRN–NEEM represents the U.S. economy in 9 geographic regions and 10 business sectors from 2010 through 2050. Table 1 lists the 10 sectors. The model also includes household emissions (including from personal automobile use) and government spending. The electric sector—a very central playing in the emissions control effort—is represented in exceptional detail. Electricity markets are divided into 29 regions interconnected by limited transmission capabilities. Every generating unit in the U.S. is represented in the model, with its current emissions control equipment, and retrofit opportunities. Generating emissions of SO₂, NO_x and Hg (and their associated caps) are also included. Use of existing power plants is determined by their ability to serve electricity load cost-effectively, and the model retires plants that can no longer do this as emissions caps come into effect. The model contains substantial detail on new generating technologies that can be built, including all of the major forms of renewables generation, new nuclear power, and an ability in the future to add (or retrofit) carbon capture and storage onto advanced coal-based generating units.

TABLE 1.—Business Sector Disaggregation Used in MRN–NEEM Model for Analysis S. 2191

Energy Sectors	Non-Energy Sectors
Coal extraction	Agriculture
Oil and gas extraction	Energy-intensive sectors
Oil refining/distribution	Manufacturing
Gas distribution	Transportation services
Electricity generation	Services

SUMMARY OF ESTIMATES OF THE ECONOMIC IMPACTS OF S. 2191

Key Assumptions

Using the MRN–NEEM model, I and my colleagues have prepared a number of different simulations of the economic impact of the emissions cap-and-trade program of S. 2191. These simulations (or “scenarios”) differ in their input assumptions, thus providing a *range* of estimates of the impact of the Bill that I summarize in my testimony below. The range reflects a variety of assumptions about the following key inputs:

- *The precise numerical level of the cap.*—This is the most important cause of the ranges that I will report. Characterizations of S. 2191 imply that the cap in 2012 would be set at 2005 emissions levels. However, the Bill itself states a numerical cap of million metric tons of CO₂ in 2012 that is about 10% lower than the official U.S. Greenhouse Gas Inventory’s 2005 emissions reported for the sources that S. 2191’s cap would cover. Lacking any information to resolve this discrepancy, I present results that have applied a cap at the numerical limits stated in Section 1201(D) of S. 2191, and also at the higher level that we find reported in the U.S. Inventory. As in any cap-and-trade program, the stringency of the cap determines the cost of the policy. The scenarios that were run using the more stringent caps stated in S. 2191 are generally those that define the more severe economic impacts shown in the ranges that I report below. Similarly, the scenarios that were run using the less stringent cap levels (based on the data published in the inventory for the covered sectors) generally define the less severe economic impacts in the ranges that I report below.

- *Timing for availability of advanced, low-carbon technologies.*—All scenarios showed exceptional reliance on advanced, low-carbon technologies that are not presently commercially available, particularly coal-based generation that uses carbon capture and sequestration (CCS) and zero-carbon liquid fuels, such as could be provided by commercialization of cellulosic ethanol. Scenarios reported here reflect a wide range of different assumptions about the date of availability and rate of potential construction of CCS technology, although even the most “pessimistic” of the as-

sumptions used did allow a very large amount of the technology to be introduced, as I will explain below.

- *Cost and effectiveness of advanced, low-carbon technologies, and rate of cost improvement.*—Although cost estimates are available for technologies that will one day come into the market place, these estimates are viewed as quite uncertain. They will also change over time, even if a current estimate is a sound one for a given point in time. Our scenarios reflect a variety of the current estimates of technology costs and different rates of improvement over time in those costs.

- *Rate of growth in electricity demand.*—The rate of increase in energy demand as the economy grows (i.e., the energy-intensity of the economy) also contributes to the degree of effort that it will take to meet a future cap of any particular level. Our scenarios contain a range of base case electricity load growth assumptions, generally defined by projections of the National Electricity Reliability Council (NERC) which monitors the sufficiency of U.S. electricity supplies and by the projections of the Energy Information Administration (EIA) in its *Annual Energy Outlook 2007*.

- *Natural gas prices.*—Long-term natural gas prices forecasts are very uncertain, but can have a significant effect on the cost of achieving different CO₂ levels. Our scenarios rely on the reference cases of the EIA's Annual Energy Outlooks (both 2006 and 2007) through 2030, where that forecast ends. After that, our scenarios vary in whether they assume gas prices would continue to increase over time, or would remain flat (in real dollars) after 2030.

- *Quantity of offsets allowed.*—S. 2191 would allow a limited number of offsets to be used in meeting its caps. There is some uncertainty in interpreting its provisions regarding how much flexibility these provisions would provide to use a variety of sources and types of offsets. Our scenarios use offsets limits that range from 15% to 30%, reflecting different views on how much could be obtained through international channels under Title II.E.

- *Quantity of new nuclear capacity that may be built.*—All of our scenarios allow new nuclear generation to be built after 2015, and allow the existing fleet of capacity to remain through 2050. The scenarios allow a maximum of 85 to 130 GW of new nuclear capacity to be added by 2050 (depending on the scenario), and they all impose limits on how fast these can be built. These quantities are approximately equal to the amount of nuclear capacity already in place in the U.S., and so our analyses essentially double U.S. nuclear capacity between now and 2050.

- *Degree of emissions banking that will be adopted.*—S. 2191 allows unlimited banking. However, our analyses reveal that the incentives to bank in the period 2012–2020 are driven by expectations of very rapid allowance price escalation in much later years (e.g., in 2035–2050). It is debatable whether companies will engage in large amounts of banking to optimize costs over such a long period when they imply such substantial added near-term cost. Allowing the model to simulate such banking reduces total present value of costs, but it increases the impacts in the first years of the policy while it reduces the later year impacts by even more. Our scenarios include cases with and without banking behavior.

All of our scenarios have substantial quantities of new renewables, available immediately. The maximal quantity of different types of renewables varies by region, based on publicly available information on these resources. Our scenarios do not vary the assumptions about these technologies.

S. 2191 allows some constrained amounts of borrowing. We reviewed our scenario results for whether borrowing would occur. We find that if long-term incentives are fully considered, there is actually an incentive even in the first years of the policy to bank rather than borrow. If a more myopic view is assumed, there would be a very slight incentive to borrow in the first few years of the period, if there were no penalty for doing so.³ Given the financial penalties that S. 2191 would impose, and the limits to borrowing, we do not believe borrowing behavior would affect our cost estimates, and we did not make an effort to model it directly. We also find it difficult to see how borrowing could proceed, given that S. 2191 intend to place allowances into accounts only on a year to year basis. Without having possession of one's future allocations of allowances, borrowing would be a complex process, if possible at all.

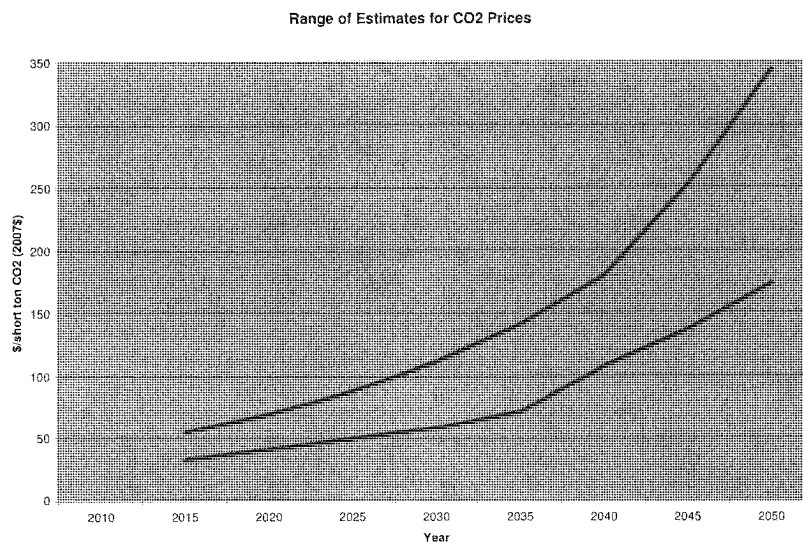
³That is, allowance prices in the initial periods when we turn off banking rise at about 1% to 4% in real terms into the next 5 years. (In later years prices escalate by over 10% per year, implying a great desire to have built up a bank before that time period arises.) With a real discount rate of 5%, one might wish to borrow slightly from the next time period. However, a strong incentive to borrow would only occur if we were to see allowance prices falling in real terms, and we have not observed that outcome. The decision to tighten the cap in 2020 between the draft and final version of S. 2191 weakened the potential incentives to borrow at the outset.

RANGES OF ESTIMATED MACROECONOMIC IMPACTS

Figure 1 presents the range of estimates of the marginal costs of meeting the S. 2191 caps observed in the scenarios we have simulated. In this figure (and all that follow in my testimony), the two lines presented reflect the upper and lower bounds of our results.⁴ Individual scenarios' results fall inside the ranges presented, with the exception of the single highest and lowest estimate for each year.

The estimates shown in Figure 1 are the marginal costs of control, stated as dollars per short ton of CO_{2-e}. This model output is commonly described as the allowance "price." However, it is important to note (as will be discussed in a later part of this testimony) that actual market prices of allowances are highly volatile, and rarely reflect their long-run equilibrium level. The results presented here indicate the long-run equilibrium prices levels that may be expected under various different assumptions. The stringency of the cap itself is the greatest driver of these results, with higher prices associated with tighter caps. As noted above, just the uncertainty in what the actual numerical level of the cap may be under S. 2191 determines where in the range shown in Figure 1 one might expect to be.

Figure 1. Range of Estimates of Marginal Costs of Meeting S.2191 Caps (Allowance "Prices")



As Figure 1 reveals, marginal costs of controls are projected to be in the range of \$32 to \$55 per short ton of CO₂ by 2015. Although our projections show prices rising to levels that are much higher after 2015, even the 2015 prices are "high" in an absolute sense. The 2015 projected price levels, if injected into the economy in a period of only a few years, would be disruptive to the economy, and cause a painful transition. Our modeling effort considers only long-run equilibrium outcomes, and does not in any way capture short-term transitional costs, that can be much larger. It is my assessment, looking at these initial prices levels, that the first few years of a cap such as prescribed in S. 2191 would be a time of substantial market turmoil that is not reflected in any of the impact estimates that I report next.

MRN-NEEM is a model that optimizes economic welfare. Thus, the change in economic welfare that will result from a policy is its key output, and it is stated as a present value over the full time period analyzed, which is 2010–2050 in the current case. Our scenarios imply that S. 2191 would decrease U.S. average economic welfare by 1.1% to 1.7%. This impact varies by region, and the degree of regional impact can be varied by the formulas for allocating the allowances. Our analyses

⁴These are not "confidence intervals" but true minimum and maximum values over the set of scenarios we have run. We also note that there was nothing in the construction of our scenarios intended to capture a probability distribution of any sort. That would require much more work than has been accomplished.

included a representation of the allocation formulas in the draft version of S. 2191 (i.e., the August “Annotated Table of Contents”). Using that set of allocations and formulas for recycling of auction revenues, we find that New York, New England states, and California would experience welfare impacts substantially less than the U.S. average, while regions heavily reliant on fossil fuel energy sources would face impacts somewhat greater than the U.S. average.

Figure 2 presents these economic welfare impacts restated in terms of changes in the annual value of all goods and services consumed by the average U.S. household. This measure is very similar to an estimate of the change in real disposable income. Our scenarios imply that real annual spending per household would be reduced by an average of \$800 to \$1300 in 2015. If the percentage consumption impacts projected for each future year were to be stated in terms of current real spending power (we use 2010 spending as the proxy for “current” here), these spending impacts would increase to levels of \$1500 to over \$2500 by the end of our modeled time period, 2050. The costs shown in Figure 2 reflect the net impact on consumption due to more than just higher household energy bills. These costs also capture the net effect of increased costs of all goods and services, which require energy to produce.

Another commonly used metric of economic impact is gross domestic product (GDP). This declines as consumers demand fewer goods and services, and it also declines if U.S. businesses close down due to competition from international suppliers. Offsetting these declines are increases as new investments are made in advanced energy technologies. Our scenarios find a net reduction in 2015 GDP of 1.0% to 1.6% relative to the GDP that would occur but for S. 2191. The impact rises to the range of 2% to 2.5% thereafter. Figure 3 shows the associated dollar amount by which GDP would be reduced in each year, stated in real 2007 dollars. (Inflation will make the dollar amounts larger over time.) GDP would be lower in 2015 by about \$160 billion to \$250 billion. Eventually, the annual loss in GDP would increase to the range of \$800 billion to \$1 trillion (stated in real, 2007 dollars). (To provide some context, current annual outlays for Social Security are about \$600 billion.)

Naturally, with reductions in GDP come reductions in real wages and job losses. We have estimated 1.2 million to 2.3 million *net* job losses by 2015 over our set of scenarios. By 2020, our scenarios project between 1.5 million and 3.4 million net job losses. There is a substantial implied increase in jobs associated with “green” businesses (e.g., to produce renewable generation technologies), but even accounting for these there is a projected net loss in jobs due to the generalized macroeconomic impacts of the Bill.

Figure 2. Impacts to Average US Household's Annual Consumption (in terms of current spending)

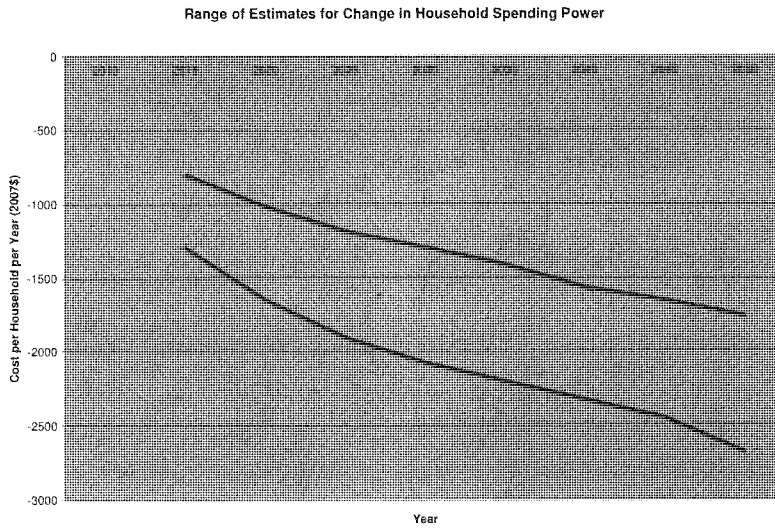
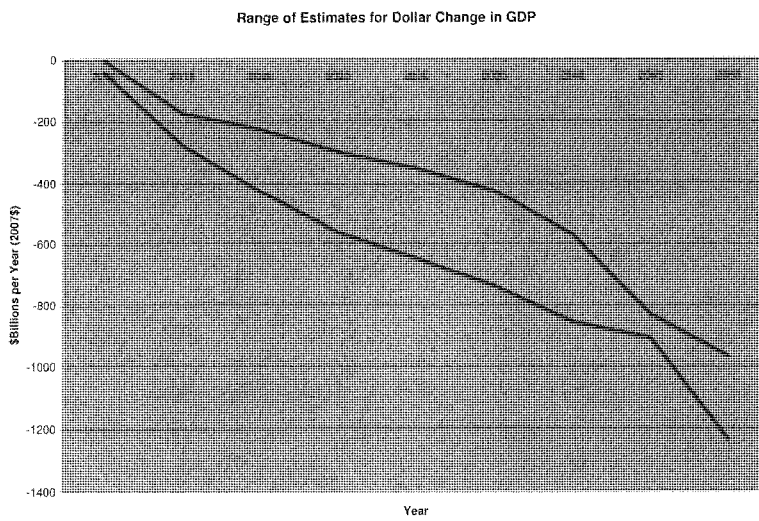


Figure 3. Change in GDP by Year Compared to No Carbon Cap ("BAU")



RANGES OF ESTIMATED ENERGY MARKET IMPACTS

Impacts I have presented thus far reflect the economy-wide, or “macroeconomic” impacts that are projected to occur when a cap such as that of S. 2191 is imposed. Underlying those impacts are significant alterations to the way that energy needs are met. I will now turn to some of the changes in fuels and electricity markets that drive the macroeconomic impacts described above.

In the near term, the only way to make large reductions in emissions without reducing energy use is to shift from coal-fired generation to natural-gas fired generation of electricity. As I will show later, the electricity sector is projected to make a very large increase in natural gas demand (i.e., up to 4 quadrillion Btus by 2015–2020). Somewhat offsetting this very large increase, our scenarios also project a decrease in natural gas demand from other productive sectors covered by the S. 2191 cap.⁵ We project a net change in U.S. natural gas demand of up to 3 quadrillion Btus. (For context, current gas consumption in the U.S. is about 20 to 21 quadrillion Btus, of which 5 to 6 quadrillion Btus are consumed by electricity generators.)

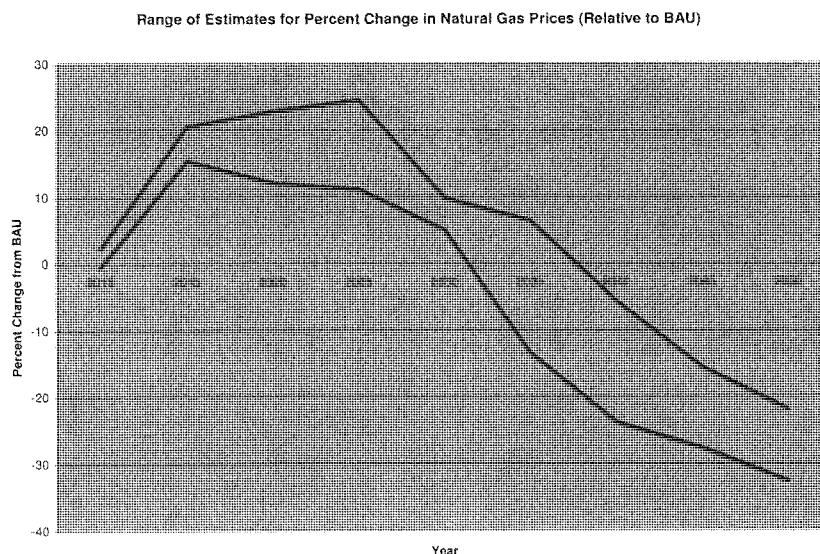
Naturally, increases in gas demand will translate into higher natural gas prices. Figure 4 presents the percentage changes in projected natural gas prices that our analysis estimates would occur *under long-run equilibrium conditions*. Even with a long-run equilibrium view, we project gas price increases of 15% to 20% by 2015, and staying high through 2030. As I mentioned earlier, however, sudden shifts in demand such as those projected by 2015 would cause significant market turmoil and much higher price spikes until a new long-run equilibrium of gas supply can be established.

Figure 4 also shows that in later years (i.e., after 2030), natural gas demand actually starts to fall relative to currently projected future levels. This occurs as more advanced technologies are projected to become more widely available. Natural gas may emit less CO₂ than current coal-fired generation, but it does still emit substantial amounts of CO₂. In the longer run, as the cap tightens further, natural gas becomes the highest-emitting source of energy and also starts to face declines in demand. This suggests that near-term caps that can only be met through a disruptive shift to greater use of natural gas may be a more costly policy than necessary to achieve large cumulative, long-run reductions in greenhouse gas emissions.

Our analyses of S. 2191 account for all sources of greenhouse gas emissions (including the non-CO₂ greenhouse gases) on a nearly economy-wide basis. A substantial share of the long-run reduction is due to major shifts in all parts of the economy, including a transformation of the way that vehicles are fueled. However, the majority of the emissions reductions in the near-term come from changes in electricity generation emissions. These emissions account for about 34% of total greenhouse gas emissions today, but they are projected to contribute well over 50% of the emissions reductions under S. 2191 prior to 2030. I will therefore describe now the types of electricity sector changes that our analyses are projecting will occur in order to achieve the reductions under S. 2191.

⁵All of the scenarios summarized in my testimony exempted household and commercial uses of natural gas, as they were prepared before the mark up of S. 2191 in which these sources became covered by the cap as well.

Figure 4. Changes in Projected Long-Run Equilibrium Prices of Natural Gas



Electricity-related emissions changes are projected to come from a mixture of use of different fuels, use of different technologies, and reduction in electricity demand. These are interrelated phenomena. For example, changes in emissions from generation will not be cheap, and they will drive up the wholesale price of electricity. That price increase, in turn, will incentivize efficiency improvements and behavioral changes to consume less electricity.

Figure 5 presents the range of projected wholesale electricity price increases on a U.S. annual average basis after accounting for all of the combined effects in their most cost-effective combination. The increases are substantial, including a 36% to 65% increase in those prices by 2015 alone. They continue to rise thereafter, reaching the range of an 80% to 125% increase by 2050. This occurs despite extensive technological advancements and efficiency enhancements. These estimates do not reflect any of the volatility in allowance or natural gas prices that can be expected, particularly in the initial years of the policy.

Figure 6 portrays the extent to which our analyses project electricity growth to moderate. The projected “business as usual” (BAU) growth in U.S. electricity demand is shown as a range by the pink (i.e., upper two) lines (there is a range because our scenarios used different BAU growth paths). The range between the blue (i.e., lower two) lines shows demand after consideration of price-induced (and policy-induced) demand changes. These demand changes are on the order of 30% from BAU, and nearly levelize electricity demand growth. They do not occur costlessly. This degree of demand reduction can only occur *because* of the electricity price increases shown in Figure 5. These declines are, in part, induced by the higher cost of electricity, which makes technological and behavioral changes in consumption a cost-effective choice. However, to some degree, these declines also reflect reductions in the productive output of the U.S. economy, which is what I meant by the term “policy-induced” demand reduction. To some extent the latter declines may reflect mere leakage, which I discuss in the next section of my testimony.

Figure 5. Projected Percentage Change in Wholesale Electricity Prices (Relative to "BAU")

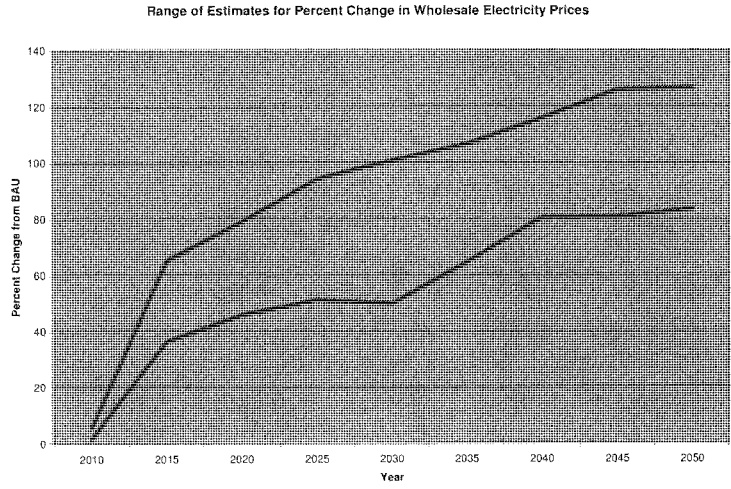
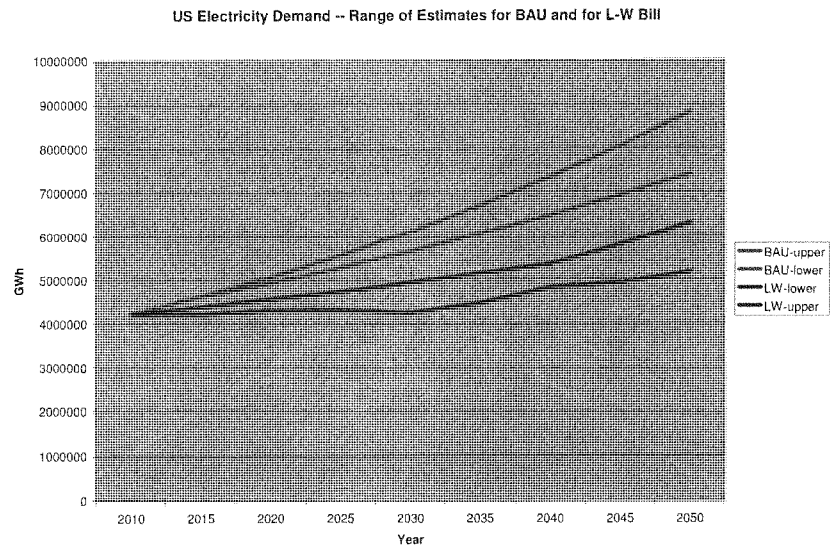
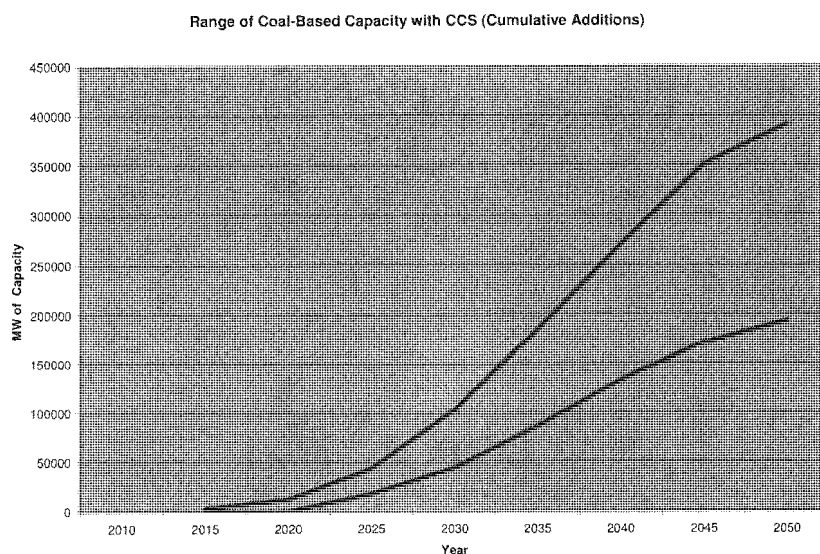


Figure 6. Electricity Demand with S.2191 and without a CO2 Limit



Demand reduction, although large, contributes a relatively small share of the electric sector's emissions reductions. In the short-run, the major response is a rapid and large increase in the use of natural gas. In the longer-run, new technology plays the major role. Figure 7 shows the amount of CCS capacity that is assumed to be possible to install over time in our set of scenarios. Although not yet commercially available, our scenarios allow between 200 GW and over 400 GW of this technology to be installed by 2030. These are highly uncertain assumptions because there has been very little done yet in terms of technical feasibility studies to suggest realistic expectations for constructing new and replacement generation on the rapid timescales implied by this type of policy. The projected uptake of this allowed amount is usually at its maximal allowed levels.⁶ To put these quantities into context, the current installed capacity of coal-fired generation in the U.S. is about 300 GW. Thus, these scenarios allow the entire existing coal-fired asset base to be effectively replaced with CCS. (There are also very large amounts of zero-emitting renewables and nuclear generation that are available—and adopted—in these scenarios.)

Figure 7. Rates of Uptake of Advanced Coal-Based Generation with CCS



A notable element of Figure 7 relates to the *timing* of this large potential for future CCS installations. Although the scenarios assume that we can effectively replace our existing fossil fueled fleet with an equivalent capacity that has very low emissions (due to the CCS), this cannot be done in the near-term. Almost no CCS capacity can be realistically expected to help meet S. 2191 targets in 2012–2015. Even by 2025, the quantity that can realistically be brought into the generating system is very small compared to the ultimate potential. In brief, the emissions targets of S. 2191 are far ahead of the time curve of availability of the most critical technologies for achieving large emissions reductions. (We see similar temporal constraints on the low-carbon vehicle fueling options.)

With the timing of the target stringencies so far ahead of the ability of advanced technologies to respond, the only option of the electricity sector to meet the limits of S. 2191 is a large shift from coal to natural gas generation during 2012 through 2030, and then an equally large shift back in the years from 2030 through 2050. The magnitude of these cycles is visible in Figures 8 and 9.

The projected cycle in coal and gas demands by the electricity sector will imply many types of costs and transitional issues not apparent in the model results. Huge

⁶Exceptions have occurred in the later years for scenarios with the largest allowed amounts of CCS combined with the lowest BAU demand forecast. Even in those cases, the projected use is at the maximum assumed to be possible in the mid-years, and very near the maximum even in the later years.

changes in energy supply infrastructure will have to occur to enable both the first phase of the cycle (through 2030) and then again for the later phase of the cycle (after 2030). This cycle can be avoided altogether by better aligning the timing of the emissions targets with the availability of the advanced technologies that are expected to represent the long-run solution to greenhouse gas emissions. Doing so would also eliminate the near-term shocks to energy and electricity prices (such as evident in Figures 4 and 5), and allow a more gradual increase to the ultimately high prices that are necessary to reduce emissions to levels far below current emissions. Given that climate change risks are a long-term, cumulative phenomenon and not a near-term acute concern, true policy cost-effectiveness will come from a policy that allows a more gradual and steady transition to a low-carbon economy.

LEAKAGE: A CONCERN NOT FULLY ADDRESSED IN THE MODEL ANALYSIS

Some domestic companies whose products compete in international markets are likely to be driven out of business no matter what allocation they receive.

A generous allocation could increase the shareholder value of a company that is unable to increase its prices due to competition in international markets (i.e., a “trade exposed” industry). However, it will do this in a perverse way that policy-makers need to be aware of. As the price of allowances rises, a company that cannot raise its product prices will experience falling margins. If that company is also granted free allocations, it can use them to offset some of the costs, and thus maintain profitability. However, this will only be true for a range of lower allowance prices. At some allowance price point, however, the profit margins will be negative and the company will cease production. There will be premature retirement of the existing productive assets in our trade-exposed sector, and reductions in the economic activities associated with those sectors. Given that the cause of the closures is international competition, these lost U.S. manufacturing activities would be replaced by foreign manufacturing: global emissions will not fall but the U.S. economy will still pay the price.

Figure 8. Cycle of Coal Demand by Electricity Sector due to S.2191 Targets

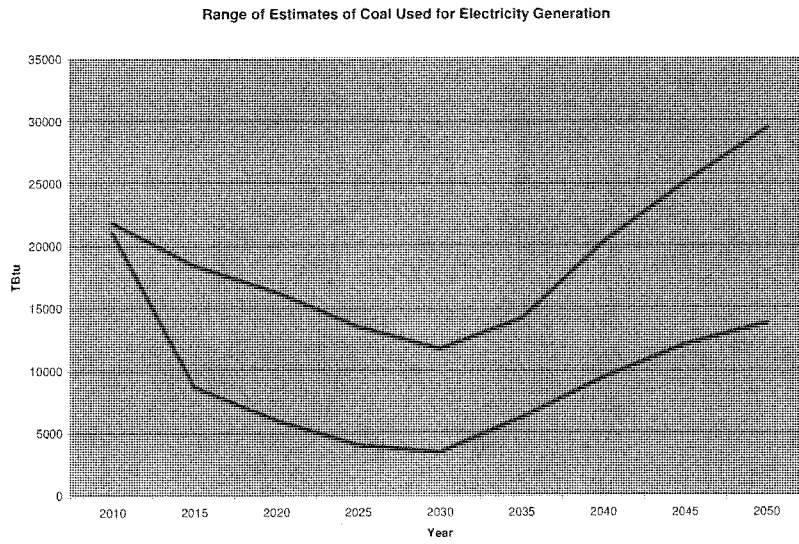
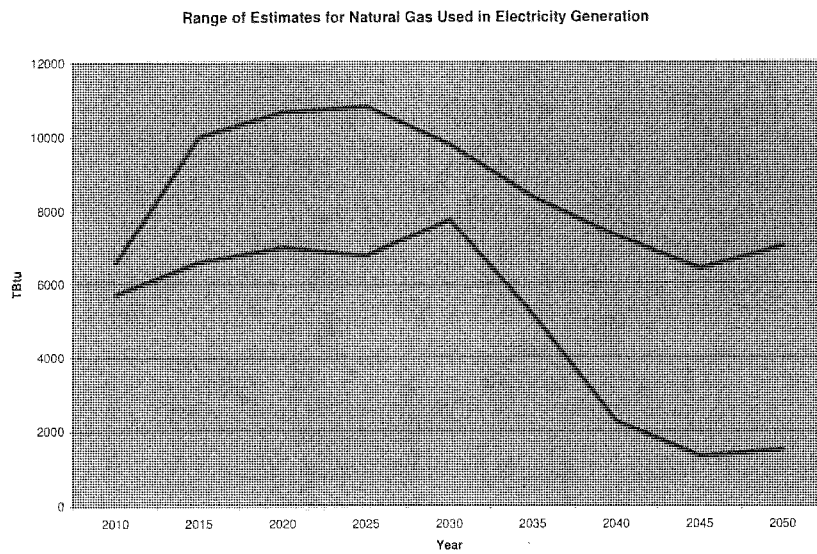


Figure 9. Cycle of Natural Gas Demand by Electricity Sector due to S.2191 Targets



This perverse outcome of climate policy is called “leakage” because the policy is rendered ineffective environmentally when it causes emissions to “leak” across national borders. Emissions from any part of the globe have comparable impacts on climate risks, as they all first accumulate together in the global atmosphere to have their combined and joint effect on the global greenhouse effect. On the one hand, this fact offers important flexibility to reduce emissions anywhere in the globe that has cost-effective opportunities to do so, and not to confine domestic efforts to actions within U.S. borders. On the other hand, it also means that any GHG cap we impose domestically, and its attending domestic reductions, may be undermined by offsetting emissions increases in nations that do not have comparable caps on their own economies. Large sums of money could be spent with no actual global environmental benefit. U.S. economic output and jobs leak to other countries as well.

Leakage has often been talked about in very general terms. Estimates of leakage due to a U.S. domestic policy are suggested in the range of about 10–15%, meaning that for every 10 tons that is reduced in the U.S., 1 ton is just emitted elsewhere in the world. This may sound like a relatively small price to pay in order to get a net 9 tons of reduction from U.S. action. The difficulty with this view, however, is that leakage is not a phenomenon that applies to every ton of emissions reduction. Instead, there may be almost no leakage associated with controls on emissions that are not trade-exposed (e.g., personal and commercial transportation, electricity generation, and services), but nearly 100% leakage associated with controls on emissions in sectors that are trade-exposed (e.g., many of the energy-intensive manufacturing processes such as cement, iron and steel, chemicals, transportation equipment manufacturing, textiles, etc.). Concentrated economic impacts on specific sectors that offer no benefit in terms of global emissions reduction make no sense as a matter of policy design.

The potential severity of the impacts to trade-exposed industries appears not yet fully appreciated by policy analysts or policymakers. Most of the attention on estimating climate policy impacts has been focused on transportation and electricity generation, which are among the least concerned with potential leakage. The potential plight of the trade-exposed industries has been mostly thought to be something that could be dealt with through compensating allocations. While that might solve the concerns of some of the shareholders of those businesses, policymakers should closely examine whether they are prepared to face the economic impacts of reduced exports, increased imports, and losses of domestic output of many important elements of the U.S. manufacturing base.

POLICYMAKERS SHOULD FOCUS ON HOW TO LIMIT U.S. EMISSIONS WITHOUT CREATING LEAKAGE

There are two ways to mitigate leakage without exempting trade-exposed sectors from an emissions cap:

1. The first is to impose domestic emissions limits only as part of a global agreement among all nations that compete with our products, or which might start to compete once a policy offers them a greater cost advantage than they have now. Clearly, the present policy proposals in the Congress would not accomplish this.

2. The second is to find ways to remove the competitive advantages of competitors at our borders, through “border tax adjustments.” Border tax adjustments are allowed only under very special circumstances under the rules of the World Trade Organization (WTO).

The legality of obtaining effective border tax adjustments in the case of a cap-and-trade system is quite questionable at present.⁷ Title VI of S. 2191 represents an attempt to construct a system of border tax adjustments in a way that would be WTO-compliant, but it appears to have dubious chances of success in limiting leakage due to a cap-and-trade proposal. Title VI contains a complex set of provisions, each aimed at addressing one of several hurdles that would be faced in order to achieve the ultimate goal of equalizing costs of imports at the U.S. border in a WTO-compliant manner. Each of these steps—believed to be required to satisfy international law—would be open to legal challenge, leaving multiple potential ways that the approach in Title VI could fail to provide the intended protection from leakage. Most critical in my mind, however, is that these many steps require time to accomplish. As embodied in S. 2191, the imposition of leakage protection might not be possible until 2019. Given that the cap in this Bill would start in 2012, this would imply up to seven years during which U.S. trade-exposed manufacturers would be facing

⁷J. Pauwelyn, *U.S. Federal Climate Policy and Competitiveness Concerns: The Limits and Options of International Trade Law*, Nicholas Institute for Environmental Policy Solutions Working Paper NI WP 07–02, April 2007.

competitive pressures, eroded ability to profitably continue in business, and experiencing leakage. Delays of this sort in obtaining that coverage are not acceptable for the businesses that face rapidly responding markets.

The method of S. 2191 in Title VI for obtaining WTO-compliant leakage protection was crafted to work with a cap-and-trade form of proposal. Interestingly, the prospects of successfully and immediately implementing border tax adjustments are considered to be much greater in the case of a greenhouse gas tax than in the case of cap-and-trade.⁸ If a carbon tax would provide better prospects for an immediate and WTO-compliant border tax adjustment, perhaps we should consider applying this type of approach for industries exposed to leakage through international competition, so that they at least can have the protection from leakage, even while other less vulnerable sectors could be in a cap-and-trade scheme if they choose. This might be especially useful to consider for certain commodities for which a heavy reliance on imported supply might be a strategic concern for the U.S. Those having a hand in creating a climate policy for the U.S. should become much more familiar with the intricacies of WTO rules, and the likelihood of successfully creating immediate and durable protection from leakage under different types of greenhouse gas policy designs. This needs to be sorted out *before* and not after a greenhouse gas policy is enacted.

In the absence of a clear mechanism for preventing leakage with a cap-and-trade system, the only alternative for keeping economic impacts within acceptable bounds is to place a ceiling on the cost of allowances.

The higher the price of permits under the domestic cap, the more serious “leakage” is likely to be if there are no border tax adjustments in place. Thus, potential for leakage provides an important reason for directly ensuring that the price of permits that may occur under a domestic GHG cap-and-trade program will remain relatively low. The only way to design a domestic cap-and-trade program to address this international competitiveness risk is simply to keep the carbon price low enough that such losses remain within acceptable bounds. This, naturally, limits the amount of domestic emissions reductions that will be achieved as well. Until international competitiveness issues are resolved (either through coordinated action or a system of border tax adjustments) ambitions to make significant reductions through any domestic cap-and-trade program will be thwarted, or else highly disruptive to key parts of our economy. This also implies that any domestic cap-and-trade program that is implemented in advance of internationally coordinated efforts should be designed with clearly defined permit price caps.

PRICE UNCERTAINTY AND VOLATILITY: ANOTHER CONCERN NOT ADDRESSED IN THE MODEL ANALYSIS

An allowance price ceiling has important additional merits for businesses and government.

Prices in all previous and existing cap-and-trade programs have exhibited substantial volatility, and this can be expected of GHGs as well.⁹ Price volatility, however, is likely to have much greater generalized economic impacts with a CO₂ cap than for caps on SO₂ and NO_x. CO₂ is a chemical that is an essential product during the extraction of energy from any fossil fuel. As long as fossil fuels are a key element of our energy system (which they are now, and will remain for many years even under very stringent caps), any change in the price placed on GHG emissions will alter the cost of doing business throughout the economy. This is because all parts of the economy require use of energy to one degree or another.

In contrast, under the Title IV SO₂ cap, a fluctuating SO₂ permit price would only affect emissions from coal-fired electricity generation. In deregulated electricity markets, coal-fired electricity does not always affect the wholesale price of electricity, and even significant fluctuations in SO₂ permit prices might have almost no effect on electricity prices. Even in regulated electricity markets, the impact of the SO₂ price on the cost of all electricity generation would be diluted by the unaffected costs

⁸*Ibid.*

⁹Some have argued that banking reduces price volatility. While it may reduce it, it certainly does not eliminate it. For example, the Title IV SO₂ market has experienced high volatility over the past two years, even though it has a large bank already in place. During 2005, SO₂ permit prices rose from about \$600/ton to above \$1600/ton, then plummeted to below \$400/ton by the beginning of 2007. Additionally, banking offers little price stability at all during the start up of a new cap, simply because no bank yet exists, and this initial-period volatility can be very large if the first-period cap requires a substantial amount of reduction and/or has a relatively brief regulatory lead time. The experience of the first year in the NO_x cap of the Ozone Transport Region of the northeastern U.S. is a classic example.

of all other sources of generation before it reached customers. Also in contrast to an economy-wide GHG cap, no other sources of energy in the economy are affected at all by SO₂ price changes. Finally, under the Title IV SO₂ cap, price variations during the past year that range from \$400/ton to \$1500/ton (the range observed in the past year under Title IV) have a modest effect on the majority of coal-fired units that are already either scrubbed or burning low-sulfur coal. Such units might see the cost added due to its SO₂ emissions vary between 7% and 26% of its base operating cost,¹⁰ and (as noted) the impact on consumer's cost of electricity would be much smaller, if anything.

Variation of CO₂ prices such as that observed in the EU ETS market over the past two years (approximately \$0/ton to \$35/ton) would cause all coal-fired units to see additional costs varying between about 10% and 175% of their base operating costs. Further, even gas-fired units would experience absolute cost increases equal to about half those of the coal-fired units.¹¹ Since gas-fired units do frequently set the wholesale market price of electricity, consumer electricity prices would also vary markedly with the price of GHG permits. Retrofits would not be available to attenuate these costs (at least, not until even higher permit price levels would be achieved and sustained at those levels.) At the same time, all other key energy demands in the economy (e.g., for transportation, industrial process heat, building heating and air conditioning, etc.) would also experience similar fluctuations with varying GHG permit prices. Clearly, the effect on the economy could be disruptive.

These are not just theoretical calculations. The EU's statistics bureau, Eurostat, reports that electricity prices rose significantly throughout the EU in 2005. Household rates rose by 5% on average over all 25 EU countries, and industrial rates rose by 16% on average.¹² The high prices of GHG permits under the EU ETS during that period is widely viewed as having contributed to this price increase, and indeed, wholesale electricity prices have fluctuated in step with the wide swings in ETS permit prices. It is not clear yet how or whether the wide variations in permit prices may begin to contribute to the variation in economic activity. However, it should also be noted that the EU ETS does not cover all sources of GHGs, or even a majority of sources of CO₂ emissions in the EU. (This may dampen the impacts of CO₂ permit price volatility on the EU economy, but is also a widely observed flaw in that cap-and-trade system's potential to produce sufficient cuts in GHG emissions necessary for the EU to meet its GHG targets.)

To sum up, price uncertainty and price volatility will impose impacts in the case of GHG emissions limits that are completely different in scale and scope from those under previous emissions trading programs. Their potential to increase variability in overall economic activity thus should be viewed as a core concern in designing a GHG cap-and-trade program. At the same time, the nature of climate change risks associated with GHG emissions is such that it is possible to design price-stability into a GHG cap-and-trade program without undermining its environmental effectiveness. In the case of a stock pollutant such as greenhouse gases, there is no need to absorb high costs in return for great specificity in achieving each year's emissions cap.¹³ Economists widely agree that the cost to businesses of managing the price uncertainty of a hard cap is not worth the greater certainty on what greenhouse gas emissions will be from year to year.

Businesses clearly prefer having reliable allowance price expectations, but even governments would probably prefer some stability in the year to year revenue streams from an auction. For example, would large variability and uncertainty in allowance auction revenues be of any use if those revenues are intended to fund important technology-related projects that have long-term funding needs? Even if the revenues would simply be rebated to citizens, would either the government or the citizens find any value in such uncertainty in the size of the rebate checks?

A PRICE CEILING IS THE ONLY APPROACH THAT WILL OFFER THE REQUISITE DEGREE OF PRICE CERTAINTY AND STABILITY

There are various ways to provide much greater price certainty under a cap-and-trade program, although none have been used in any trading programs to date. One of the simplest concepts that has gained substantial attention for GHGs has been

¹⁰By "base" operating cost, I mean the cost of generating a unit of electricity before accounting for the emissions price. The majority of this cost is the cost of the fuel.

¹¹However, the percentage increase in the base operating cost would be much smaller (i.e., about 30% compared to 175%) because natural gas is so much more expensive than coal.

¹²Eurostat, "News Release—July 14, 2006" (Revised version 93/2006), available at <http://ec.europa.eu/eurostat>

¹³Richard G. Newell and William A. Pizer 2003, "Regulating Stock Externalities Under Uncertainty," *Journal of Environmental Economics and Management*, Vol. 45, pp. 416–432.

called a “safety valve.” Unfortunately, this term has begun to be used loosely (e.g., under the rules of the Regional Greenhouse Gas Initiative, and in California’s AB32 program) for a variety of mechanisms that do not actually provide the price certainty originally intended. To be quite specific, the cap-and-trade program mechanism that provides the requisite price cap is one where the government offers to issue any number of additional permits to regulated companies at a pre-specified and fixed price per permit. This price is set low enough that it is not considered punitive, but rather as an assurance by the government that it would not consider control costs above that level to be desirable as a normal course of events.¹⁴ This is the mechanism that has been incorporated into the bill of Senators Bingaman and Specter.

Because regulated entities know that they need not ever pay more for a permit than the established safety valve price, it functions as a price ceiling. No company would ever pay more to purchase a regular permit in the emissions market if it knows that it can always obtain sufficient permits at that price from the government, if necessary. Permit prices may fluctuate at levels below the safety valve price, but by judicious selection of an appropriate safety valve price, policy makers can ensure that these variations would not rise to a level that might be viewed as potentially harmful to the economy at large. If the safety valve price is hit on an occasional basis under a cap, then the goal of achieving long-term reductions in emissions is not harmed, given that the primary environmental risk of GHG emissions is a long-term, cumulative one. If the safety valve price is hit on a perpetual basis, this suggests an important need for policy makers to consider how we should address the evidence that meeting targets that are more difficult than hoped; however, this policy deliberation will be possible without the urgent need to throw “band-aid” solutions onto the cap-and-trade program, and with concrete evidence of the degree of economic pain that is associated with the initially-established maximum permit price. A higher price might then be deemed acceptable, but if not, the safety valve will have helped us avoid the greater pain of learning that fact through a hard cap approach.

A final advantage of a price ceiling provision is that it will limit the potential for gaming and other concerns with market manipulation that are often expressed for cap-and-trade schemes. The possibility of limiting risks of unacceptably high policy costs, providing planning certainty, eliminating wasteful price volatility, and mitigating concerns with allowance market manipulations ought to seem like a powerful argument in favor of a price ceiling provision.

THE CARBON MARKET EFFICIENCY BOARD OF S. 2191 WILL NOT PROVIDE PRICE
CERTAINTY OR STABILITY

Aversion to the idea of a price ceiling has been widespread among parties that prefer hard caps at any cost over a long-run policy that offers price certainty in exchange for some flexibility in year to year emissions outcomes. Recently, a proposal for a “Carbon Market Efficiency Board” (CMEB) was released that was supposed to offer an alternative to the price ceiling approach.¹⁵ This concept has been incorporated into S. 2191 as Title II.F. Title II.F would provide no cost certainty at all. In fact, the white paper for the CMEB proposal that Title II.F follows explicitly states that it does not wish to diminish allowance price volatility: “The cost relieve measures are not intended to relieve brief price spikes that are part of normal, healthy market volatility.”¹⁶ The proposal goes on to assert that “‘volatility’ in price is expected and even desirable.”¹⁷ As I have noted above, volatility creates unneces-

¹⁴ Outside of the U.S., further confusion about the notion of a “safety valve” has been created by application of this term to the traditional notion of a penalty for noncompliance. The EU ETS has a penalty for noncompliance that is €40/ton CO₂ in Phase I and will be €100/ton in Phase II, starting in 2008. This is often described as a price cap, but its very high level relative to the price at which the cap is expected to be met makes it extremely ineffective. Further, its role as a penalty rather than as an additional compliance mechanism clearly would undermine the willingness of companies to resort to its use for planning purposes. The same confusion of penalty and safety valve appeared in the proposal for an Australian emissions trading scheme released in 2007 by Australia’s National Emissions Trading Taskforce. The notion of a “safety valve” should be clearly separated from the role of a noncompliance penalty, with the former being set at a price that is considered an acceptable level of policy implementation cost, and the latter being set at a much higher level that is considered “punitive” and not acceptable as an indicator of the cost of meeting the policy goals.

¹⁵ “Cost Containment for the Carbon Market: A Proposal,” developed in consultation with the Nicholas Institute of Environmental Policy Solutions, Duke University, July 24, 2007. Available: <http://www.nicholas.duke.edu/institute/carboncosts/carboncosts.pdf>.

¹⁶ *Ibid.*, p. 3.

¹⁷ *Ibid.*, p. 7.

sary planning and management costs to businesses, and should be eliminated if possible without harming one's objectives for reducing emissions within acceptable cost bounds. This is entirely possible in the case of a market that is entirely the result of regulation, such as an allowance market. The CMEB proposal does not meet the objectives of providing price certainty or policy cost containment.

CONCLUSION

There is no question that achieving significant reductions in greenhouse gas emissions will be very costly, and it is therefore important to strive to minimize those costs. The design of the program matters, and mitigating the ranges of costs I have estimated for S. 2191 will require taking care to incorporate several modifications to the present Bill. The most important attributes missing in S. 2191 are:

- An approach that ensures policy costs will be held to a level considered acceptable to U.S. citizens.
- A cap stringency that is timed to match the availability of new, low-carbon technologies.
- A policy that offers businesses price certainty for planning major new investments in new technologies (e.g., in the form of a price ceiling).
- A policy that protects against leakage of emissions to economically competing nations.
- A supportive set of policies that provide effective incentives for research and development on breakthroughs in technologies that produce low-carbon energy.
- Provisions in the policy to limit the costs that it will impose on the economy overall if emissions reductions turn out to be more expensive than considered acceptable.
- A policy that will deliver even larger emissions reductions if the targets turn out to be less expensive to achieve than is considered acceptable.

It may be wise for policymakers to take time to consider more closely alternatives to the cap-and-trade approach for greenhouse gases. Cap-and-trade is not the only form of market-based policy option, and others may be more able to offer the above list of attributes, and thus be better suited for meeting the challenge of reducing greenhouse gases to levels that are being proposed without excessive damages to our economy.

RESPONSE BY ANNE E. SMITH, PH.D., TO AN ADDITIONAL QUESTION FROM SENATOR INHOFE

Question. Based on your testimony and the testimony of the other witnesses, is there anything else you would like to add?

Response. The figures cited are provided at the end of this document.

Comparisons to the Nicholas Institute Analysis of the Lieberman-Warner Bill.—I would like to provide some insight about the reasons why the Nicholas Institute analysis reputed to be a simulation of the costs of S. 2191 are lower than those of CRA International that I summarized in my testimony of November 8, 2007. In doing so, I address some unfounded criticisms in the testimonies on S. 2191 of others (who are unfamiliar with CRA's analysis).

David Hawkins stated in his written testimony before the EPW committee (November 13, 2007, at p. 8) that CRA's analyses are unreasonably constraining the use of carbon capture and sequestration (CCS) technology, the use of renewables, and emissions reductions in the transportation and industrial sector. Mr. Hawkins's statements on this matter are unfounded in the facts. Jonathan Pershing made a similar statement during the hearing of November 8, in which he said he expected that CRA's technology introduction constraints were a reason for a difference between CRA's and the Nicholas Institute's different cost estimates. Dr. Pershing's guess was not correct.

- First, it should be noted that CRA's MRN-NEEM model and the ADAGE model used by Nicholas Institute are both the same generic type of model: a computable general equilibrium model. The CRA model appears to have a much more detailed representation of the U.S. electricity generating sector, with every unit in the country individually represented and dispatched economically within 28 electricity dispatch regions. The main differences in model results should therefore be tied to either input assumptions, or modeling detail.

- Figure 1 below shows the electricity generation mix in CRA's high and low end cases (defined as the runs with the high and low CCS uptake assumptions in Figure 7 of my written testimony). I developed Figure 1 specifically to compare to Figure A-13 in the Nicholas Institute paper on the LW Bill, which I have copied here as Figure 2.

- In Figure 1, notice that renewables generation (which includes existing hydro) in CRA's analysis more than doubles by 2015. In fact, when existing hydro generation is removed, the remaining non-hydro renewables rise by a factor of 3 to 5 between 2010 and 2015. A comparison of Figures 1 and 2 show that CRA's analysis has about three times more renewables generation than the Nicholas Institute's analysis. Note that CRA's analysis allows a very rapid expansion of new renewables during the period 2010–2020.

- Nicholas Institute assumes about 28% more nuclear than CRA, which implies that whereas CRA's analysis allows up to 110 GW of new nuclear capacity by 2050, the Nicholas Institute is probably assuming up to 140 GW. This is not a large difference, but the Nicholas Institute is more optimistic about the potential rate of builds of new nuclear generation.

- Comparison of Figures 1 and 2 also shows that CRA's high-CCS case has approximately the same amount of CCS generation by 2050 as Nicholas Institute's, and the market penetration of CCS technology (the one true "advanced" generation technology in either analysis) is actually faster in CRA's analysis during the period prior to 2030. In CRA's low-CCS case, the reduced access to CCS is compensated by a combination of even more renewables, less remaining gas-generation (fossil), and greater energy efficiency by the industrial as well as commercial and residential consumers.

- CO₂ emissions in the non-electric sectors drop off substantially in the CRA analysis. For the industrial sector, the MRN–NEEM model captures the following inputs to production: materials, labor, capital, and energy. These inputs are traded off against each other in response to carbon prices meaning that other inputs can be substituted for energy. The CRA model does not neglect opportunities to reduce emissions in industry as page 8 of Hawkins's testimony suggests.

- Page 8 of Hawkins's testimony says that "CRA assumes business-as-usual coal technology" (in the baseline). CRA does not assume which coal technologies are chosen in the baseline—the technologies are chosen by economics. Indeed, IGCC technology (without CCS) is chosen by CRA's model in the later years in the baseline. There is no IGCC with CCS chosen in the baseline—this is realistic (without a price signal to carbon, utilities will not install IGCC with CCS).

CRA has not been able to determine through the available documentation how much energy efficiency is assumed in the Nicholas Institute analysis, but it plays a major role in CRA's analysis. There is effectively a 0.6 price-elasticity of demand for all forms of energy in CRA's MRN–NEEM analysis, meaning that a 100% increase in energy prices results in a 60% improvement in energy efficiency. This occurs as energy efficiency and conservation—businesses do not have to close in order for this amount of demand response to occur in CRA's analysis, and it accounts for the large majority of the estimated reduction in energy demand that occurs in the MRN–NEEM analysis. This amount of energy efficiency response occurs within about 5 years of an energy price increase. Most energy analysts would agree that CRA energy efficiency assumptions are on the optimistic end of standard practice. They are far higher than that found in the EIA NEMS model.

It is also not possible to compare CRA's input assumptions about the transportation sector with those of the Nicholas Institute analysis given the information provided in the Nicholas Institute paper. However, there is a remarkable degree of improvement in transportation-related emissions rates over time in the CRA model. This appears in the form of a zero-carbon fuel alternative that is a perfect substitute for gasoline. (It can be thought of as cellulosic ethanol, but could be any new fueling alternative to petroleum products.) In our analyses, the alternative fuel starts to be used by 2015, and—as I stated in my testimony—by 2050 there is so much used that it is like a 100% conversion of all cars on the road today to be zero-emitting. On the other hand the Nicholas analysis shows increasing petroleum consumption in all years of their analysis (see p. 10).

The costs of the technologies discussed above are consistent with publicly available data. Importantly, we allow learning curves for both the zero-emitting fuel, and also for CCS in one case, thus reducing technology costs over time. For example, at the outset, the alternative transportation fuel with zero-emissions costs 3 times the price of petroleum products now in use. By 2050 it costs only 50% more. Similarly, in one case, the cost of CCS is 75% lower by 2050 than its initial cost at the outset. We assume the current engineering estimates for this technology are consistent with costs in 2030, when it ought to be a mature technology, but costs continue to be cut in half again by 2050.

Clearly technology limits and insufficient representation of the industrial and transportation sectors are not the reasons for the differences between CRA's and Nicholas Institute's results.—We at CRA have concluded that the key reasons for the different costs estimated by Nicholas Institute result from a combination of:

(a) Nicholas Institute assumes a looser cap than CRA does—and one that is looser than the 5200 mmt CO₂ cap in 2012 that is written into the Bill. They say it is 5450 million tons on p.2 of their write up. (We used 5200 million tons as dictated by the Bill)

(b) Inspection of Nicholas Institute paper's figures indicates that that analysis appears to assume 30% of the S. 2191 cap may be met using offsets, but the Bill only allows 15% through domestic offsets. (Regarding the 15% for use of "international allowances," the word "offsets" was actually removed in the markup; we interpret that provision to allow U.S. emitters to use actual allowances issued under programs like the EU-ETS—if they can be had at a lower cost than the going price in the U.S. market, which we assume will not be the case anymore in the future than it is right now. Therefore, we do not expect significant international allowance purchases.)

(c) Nicholas Institute apparently assumes offsets (even the 15% from domestic sources that we do agree the Bill provides for) are much cheaper than we do, by assuming away things like project transactions costs and timing constraints in getting forestry sequestration offsets to their maximal growth rates. (We have to base this statement on their EPA report of Lieberman-McCain analysis assumptions, as the Lieberman-Warner paper does not explain their offsets cost assumptions at all.) CRA has taken a more conservative—and we feel more realistic—approach.

As a result, the actual US GHG emissions reductions achieved in the Nicholas Institute analysis are far less than those in CRA's analysis. Figure 3 shows these emissions for both analyses. As is always the case, the larger the emissions reductions, the higher the cost. Therefore, the key question in assessing the relative merits of the two analyses, is whether CRA or Nicholas Institute have more correctly interpreted the wording of the LW Bill regarding the actual level of the cap that would be imposed, and the provisions of the Bill regarding use of offsets. Assumptions about the quantity of domestic offsets that would be available at various prices and in the initial years may also be important.

Analyses of the Lieberman-McCain Bill Does Not Provide a Valid Estimate of the Impacts of S. 2191

In his testimony, Mr. Hawkins repeatedly cited the costs from analyses of the Lieberman-McCain Bill as if they are also consistent with S. 2191. This is simply not the case. The Lieberman-McCain Bill has a much less stringent cap overall, and more lenient limits on offsets. Thus, it is not valid to suggest that any estimates made of that Bill are representative of cost estimates for S. 2191. CRA has also prepared scenarios of the Lieberman-McCain Bill using the same sets of input assumptions as we used for some of our scenarios representing S. 2191. Uniformly, the impacts for the Lieberman-McCain Bill are substantially lower than those we obtain for S. 2191. This fact is also reported and discussed at length in the Nicholas Institute report on the Lieberman-Warner analysis. As always, the stringency of the cap determines the cost and impact of the policy.

Analyses of Carbon Limits by MIT Do Not Provide a Valid Estimate of the Impacts of S. 2191

Dr. Pershing also cites cost estimates from MIT as if they were simulations of S. 2191, which is not correct either. MIT's report did not simulate scenarios of any specific bills at all, but only generic time paths of emissions reductions. None of those time paths are consistent with the caps specified in S. 2191. Additionally, the MIT analyses did not address any of the Bill's specific provisions such as the limits on the quantities of offsets that may be used for compliance. These features change the costs of a policy.

Lack of Clarity about the S. 2191 Cap Level

A significant issue with respect to the Lieberman-Warner Bill is the level of the cap. As noted in my testimony repeatedly, the stringency of the cap is a very significant determinant of its costs.

The cap covers CO₂ and other greenhouse gas emissions from the Electric Power, Transportation and Industrial Sectors, as defined in "Inventory of U.S. Greenhouse Gas Emissions and Sinks: 1990–2005."¹ In addition, the Manager's Mark-up also added emissions from natural gas combustion. Senators Lieberman and Warner have stated, "The cap over those sources starts at the 2005 emission level in 2012 and then lowers year-by-year at a constant, gradual rate, such that it reaches the 1990 emissions level in 2020. . ."² However, the 2005 emissions level for Electric Power, Transportation and Industrial Sectors in 2005 does not equal the 5,200 million metric ton cap specified in S. 2191, nor does the 1990 emissions level equal the

¹ Available at <http://www.epa.gov/climatechange/emissions/downloads06/07CR.pdf>.

² See <http://warner.senate.gov/public/index.cfm?FuseAction=Files.View&FileStore—id=42576573-e4cf-480d-b6fd-c5964f4f62dd>.

2020 cap.³ These cap levels differ by almost 10%, which is particularly significant in early years.

³S. 2191, Sec. 1201(d) of Manager's Markup and Table ES-7 of "Inventory of U.S. Greenhouse Gas Emissions and Sinks: 1990-2005."

	1990 Emissions	2005 Emissions
Electric Power	1,859.7	2,429.8
Transportation	1,523.0	2,008.9
Industrial	<u>1,470.9</u>	<u>1,352.8</u>
Total	4,853.6	5,791.5
S.2191 Cap	2020: 4,432	2012: 5,200
Difference	421.6	591.5

These numbers also do not reflect the 2005 emissions level of natural gas, which was added to the coverage of the bill in the Manager's Mark-up. Including the 2005 emissions associated with natural gas combustion from the Commercial and Residential sectors (and other sectors) would only widen the gap between the cap specified in S.2191 and the 2005 and 1990 emissions level that the cap is supposedly using.

Figure 1. Generation Mix for CRA High and Low CCS Uptake Cases

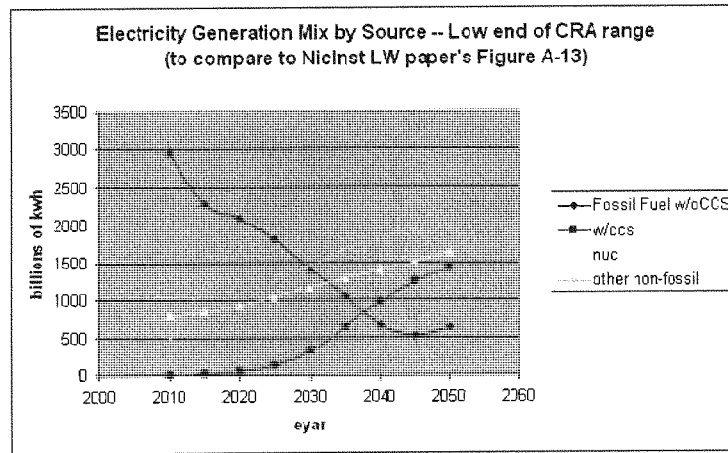
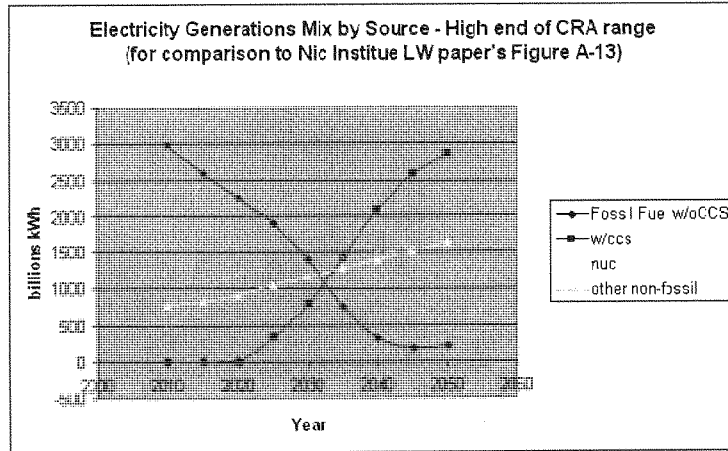


Figure 2. Copy of Figure A-13 in Nicholas Institute paper with Same Information as in Figure 1 above.

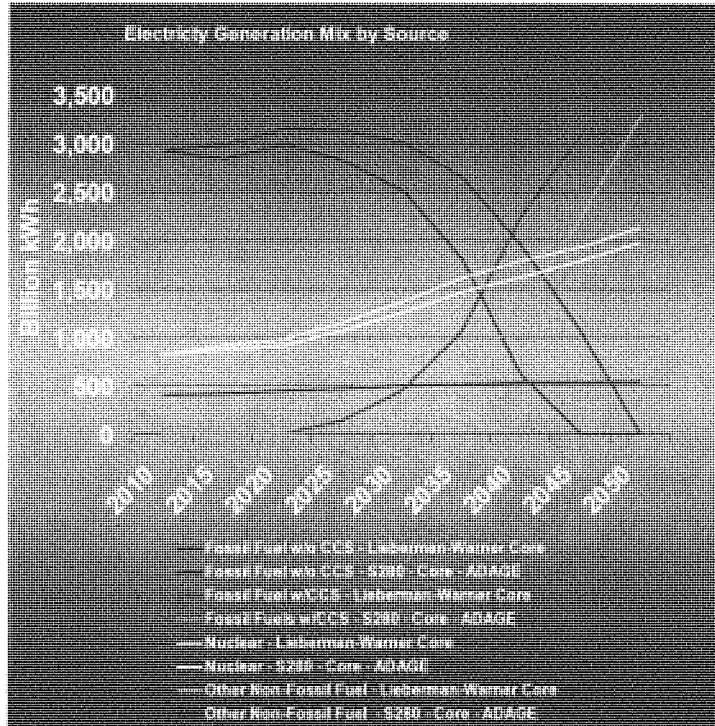
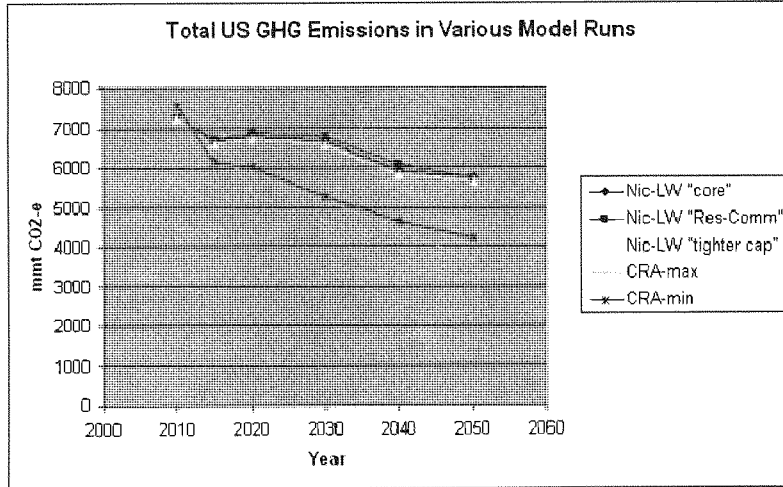


Figure A-13. Electricity Generation Mix over Time: Lieberman-Warner vs S.280

Figure 3. Emissions Reductions in CRA's Analysis Are Greater than those in the Nicholas Institute's Analysis



Senator BOXER. Ms. Smith, I am sorry, we have to cut you off there, because Senator Inhofe and I have to run down to the Floor. We want to get a chance at some questions.

Ms. Thorning, you are a Ph.D., you are a senior vice president and chief economist at the American Counsel for Capital Formation. Welcome.

STATEMENT OF MARGO THORNING, PH.D., SENIOR VICE PRESIDENT AND CHIEF ECONOMIST, AMERICAN COUNSEL FOR CAPITAL FORMATION

Ms. THORNING. Thank you, Madam Chairman. Thank you for inviting me to appear before this Committee.

I will ask that my testimony be submitted for the record, and I will just briefly summarize. I have two or three charts I would like to draw your attention to.

My analysis is not based on simulations, as was the previous witness, but merely looking at historical data. I would like to draw your attention first to the fact that the EIA forecast predicts that U.S. emissions will grow by approximately 30 percent between now and 2030. As you can see, the green line on my first chart shows that. The targets under S. 2191 would require a cut by 2030 of over 4 billion metric tons. This presents sort of a visual of how stiff the challenge is.

Given U.S. population growth, and projected growth and emissions, another way to look at this is with respect to the required reductions in per capita emissions. If I could have the second chart. Regarding, per capita emissions, the best we have ever done to reduce emissions was from 1990 to 2000, where we reduced over that whole decade per capital emissions by .8 percent. The targets in S. 2191 would require a reduction of approximately 50 percent by 2030. On that chart, the arrow should be out over the 2030. It is also table 1 in my testimony. So it would require an effort of 25 to 35 times greater than we have ever done before to get per capita emissions down to the levels that would be required by S. 2191.

Another point I would like to make is that the cap and trade system may not be the most appropriate way to go. If we are going to have a mandatory system of carbon reductions we might want to consider that most economists think that a carbon tax is a much more straightforward way. It allows for flexibility, it allows for economic growth. It prevents gaming of the system, as we have seen widespread instances of in Europe, and windfall profits being accrued by companies that were allocated the credits.

A third point I would like to make is that the European Union is not on track to meet its emission reduction targets. In fact, the latest Fourth Assessment Report published in October suggests that European emissions will be 7 percent above, not 8 percent below, by 2010, without strong new measures, including extensive use of JI and CDM. Of course, those are subject to verification and may not be able to be achieved, given the difficulty of approving those types of projects.

The final point I would like to make is that solutions to this important problem, and I think we all agree this is an important problem and that we do need to reduce greenhouse gas emissions, are going to be based on developing the technologies which do not

yet exist, as the previous witness made the case, to bring down emissions very rapidly.

But if we take a look at where the emission growth is coming from, which as we know is from the developing countries, China and India, as my last chart makes the case, right now Chinese installed plant and equipment and Indian installed plant and equipment is far less energy-efficient than is that of the United States and Japan. Each billion dollars of GDP in China is associated with about .7 million metric tons of carbon. Their new investment, which I believe is the green bar, is much more energy-efficient as previous, but not nearly so efficient as the United States or Japanese investment. Studies by CRA International show that if we could get the latest technology into the developing country hands, we could reduce emissions by as much as would have been achieved under the Kyoto Protocol if all 39 signatories were to meet their target.

Another point I would like to make is that the U.S. tax code, if we could consider improving depreciation, speeding up capital cost recovery. Our tax code provides the slowest capital cost recovery for energy-efficient investments in the industrial world. Smart meters, for example, an investor gets only 29 cents back on the dollar after 5 years, whereas in China and India you get a dollar back after 5 years. I would like to submit a full table for the record documenting that.

Senator BOXER. Without objection, we will.

[The referenced information follows on page 87.]

Ms. THORNING. So finally, if we could consider the fact that economic growth itself can be a driver, the United States has reduced its emissions faster over the last couple of years.

Senator BOXER. Sorry to interrupt you. We are going to move on now.

[The prepared statement of Ms. Thorning follows:]

STATEMENT OF MARGO THORNING, PH.D., SENIOR VICE PRESIDENT AND CHIEF
ECONOMIST, AMERICAN COUNCIL FOR CAPITAL FORMATION

INTRODUCTION

Madam Chairman and members of the Senate Committee on Environment and Public Works, my name is Margo Thorning, senior vice president and chief economist, American Council for Capital Formation (ACCF),¹ Washington, D.C. I am pleased to present this testimony to the Committee.

The American Council for Capital Formation represents a broad cross-section of the American business community, including the manufacturing and financial sectors, Fortune 500 companies and smaller firms, investors, and associations from all sectors of the economy. Our distinguished board of directors includes cabinet members of prior Republican and Democratic administrations, former members of Congress, prominent business leaders, and public finance and environmental policy experts. The ACCF is celebrating over 30 years of leadership in advocating tax, regulatory, environmental, and trade policies to increase U.S. economic growth and environmental quality.

Senators Lieberman and Warner and the members of the Senate Environment and Public Works Committee are to be commended for their efforts to reduce greenhouse gas emissions so as to mitigate the threat of human-induced climate change. The questions we need to ask are first, what challenges will The America's Climate

¹ The mission of the American Council for Capital Formation is to promote economic growth through sound tax, environmental, and trade policies. For more information about the Council or for copies of this testimony, please contact the ACCF, 1750 K Street, N.W., Suite 400, Washington, D.C. 20006-2302; telephone: 202.293.5811; fax: 202.785.8165; e-mail: info@accf.org; website: www.accf.org

Security Act of 2007 (S. 2191) pose for the U.S. economy and second, what type of GHG reduction policies should the U.S. and other countries adopt to minimize the impacts on economic growth and maximize the benefits to the environment? Greenhouse gas reduction policies should not be undertaken without considering their impacts on energy security, economic growth, and U.S. competitiveness. My testimony will address these key issues.

THE AMERICA'S CLIMATE SECURITY ACT OF 2007 (S. 2191)

The goal of The America's Climate Security Act of 2007 (S. 2191) is to substantially reduce U.S. greenhouse gas emissions (GHGs) over the 2012-2050 period. The Act covers electric power, transportation, and manufacturing sources, which account for 75 percent of U.S. emissions. The cap requires reducing emissions to 2005 levels by 2012 and then lowers emissions at a constant rate, reaching 1990 levels by 2020 and then a target of 65 percent below 1990 levels by 2050. The Act also strengthens energy efficiency standards for appliances and buildings in order to address commercial and residential sector emissions not covered by the emission reduction targets.

- U.S. Projected Growth in Emissions and Population: Effect on Achievement of S. 2191 Targets

Emissions Growth

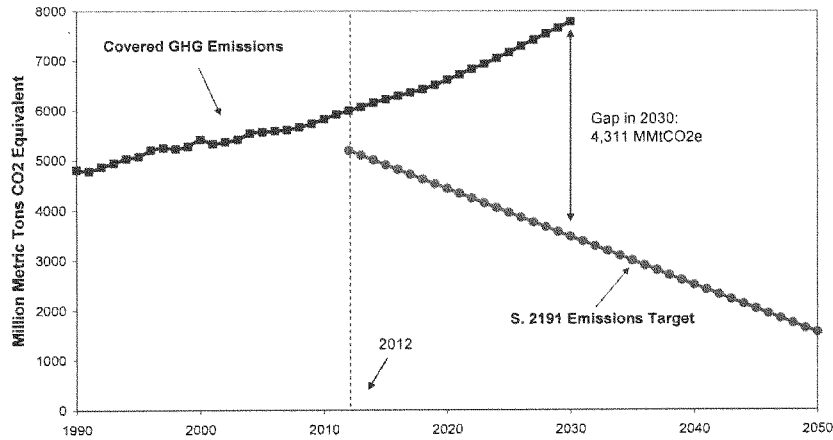
A major stumbling block to the U.S.'s meeting the S. 2191 targets is projected increases in covered emissions (emissions included in the bill) and population over the next several decades. According to estimates by the U.S. Department of Energy's Energy Information Administration, covered emissions under the baseline forecast ("baseline" means no new mandatory carbon emission reduction programs) grow by 30 percent from 2012 to 2030.¹ The baseline forecast already includes assumptions about increased energy efficiency but, even so, covered GHG emissions are projected to rise to 6,613 million metric tons of carbon dioxide equivalent (MMTCO₂e) by 2020, compared to the S. 2191's required reduction to 4,432 MMTCO₂e. Sharp cutbacks in U.S. energy use would be necessary to close the 33 percent gap (2,181/ MMTCO₂e) in 2020 between projected emissions and the S. 2191 target. By 2030, the gap between the baseline forecast and the S. 2191 target rises to 55 percent or 4,311 MMTCO₂e (see Figure 1).

Per Capita Emissions

The projected increase in U.S. population, from 308 million residents in 2010 to 335 million residents in 2020 and 363 million in 2030, will make GHG emission reductions very challenging, since more people means more energy is needed for home heating and cooling, job growth and transportation (see Figure 2). To illustrate the difficulty of reducing U.S. emissions to S. 2191 levels, consider that over the decade between 1990–2000 period, per capita emissions in the U.S. fell by only 0.8 percent and they are projected to decline by a total of only 0.6 percent from 2000 to 2012 (see Table 1). EIA's forecast projects increases in per capita covered emissions between 2012 and 2030 (see Table 1).

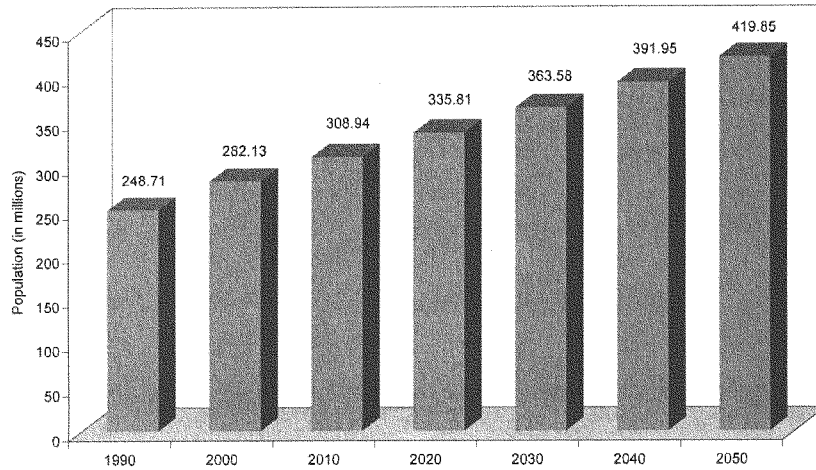
¹"Energy Market and Economic Impacts of S. 280, the Climate Stewardship and Innovation Act of 2007". U.S. Department of Energy, Energy Information Administration, August 2007 and ACCF calculations using S. 2191 targets.

Figure 1. Greenhouse Gas Emissions: Under EIA Baseline Forecast and S. 2191 Targets (Million Metric Tons CO₂ Equivalent)



Source: "Energy Market and Economic Impacts of S.260, the Climate Stewardship and Innovation Act of 2007". U.S. Department of Energy, Energy Information Administration, August 2007 and ACCF calculations.

Figure 2. U.S. Population Projected to Increase



Source: U.S. Census Bureau, 2004, "U.S. Interim Projections by Age, Sex, Race, and Hispanic Origin," <http://www.census.gov/ipc/www/usinterimproj/>

Table 1. U.S. Per Capita Covered GHG Emissions under Baseline Forecast and Decrease Required for S. 2191 Targets							
Year	Historical and Baseline Emission				S. 2191 Targets		
	Emissions (MMTCO ₂ E)	Population (Millions)	Per Capita GHG Emissions	Percent Change	S. 2191 Targets	Required Per Capita GHG Emissions	Per Capita Percent Change in Emissions
1990	4,810.15	248.71	19.34				
2000	5,413.78	282.13	19.19	-0.8%	5414	19.19	
2012	5,995.47	314.28	19.08	-0.6%	5,200	16.55	-13.8%
2020	6,613.74	335.81	19.70	3.2%	4,432	13.20	-20.2%
2030	7,783.32	363.58	21.41	8.7%	3,472	9.55	-27.6%
			2000-2030	11.6%			-50.2%
			2012-2030	12.2%			-42.3%

Note: Baseline is for covered emissions.
Source: Source for historical and baseline Emission forecast is "Energy Market and Economic Impacts of S.280, the Climate Stewardship and Innovation Act of 2007". U.S. Department of Energy, Energy Information Administration, August 2007 and ACCF calculations using S.2191 targets.

In order to meet the emission reduction targets in S. 2191, U.S. per capita emissions would have to fall by a total of 13.8 percent over the 2000–2012 period, an additional 20.2 percent from 2012 to 2020 and a further 27.6 from 2020 to 2030 (see Table 1). In other words, the required reductions in per capita emissions are about 25 to 35 times greater than what occurred from 1990 to 2000. The technologies simply do not exist to reduce total (and per capita emissions) over the next 17 years by the amounts mandated in S. 2191—to say nothing of the time and expense required to replace existing energy-using equipment—without severely reducing the growth in the U.S. economy and in employment. The analysis above tends to corroborate Senator Lieberman’s recent statement that S. 2191 would cost “hundreds of billions” of dollars over the next few decades. Previous macroeconomic analyses of emission reduction targets similar to those of S. 2191 have concluded that the required cuts in U.S. energy use would reduce GDP levels by 1.5 to 2.5 percent annually and result in significant net job loss.

PROS AND CONS OF MANDATORY GREENHOUSE GAS EMISSION REDUCTION PROGRAMS:
CAP AND TRADE VERSUS A CARBON TAX

As policymakers deliberate the imposition of mandatory approaches to reducing U.S. GHG emissions, it is helpful to evaluate the strengths and weaknesses of the two prominent strategies: a cap and trade system and a carbon tax. A cap and trade system puts an absolute restriction on the quantity of emissions allowed (i.e., the cap) and allows the price of emissions to adjust to the marginal abatement cost (i.e., the cost of controlling a unit of emissions). A carbon tax, in contrast, sets a price for a ton of emissions and allows the quantity of emissions to adjust to the level at which marginal abatement cost is equal to the level of the tax.

In a recent paper, Ian Perry of Resources for the Future notes that as a result of the success of the U.S. sulfur dioxide trading program and the start up of the European Union’s Emission Trading System, many in Congress have expressed support for a cap and trade system in the U.S. Perry cautions, however, that other options, such as tax on carbon emissions, may be a superior instrument if a mandatory federal carbon emission program were to be established (Weathervane, March 23, 2007).

- *Cap and trade system and carbon price volatility*

Price volatility for a permit to emit CO₂ can arise under a cap and trade program because the supply of permits is fixed by the government, but the demand for permits may vary considerably year to year with changes in fuel prices and the demand for energy. As mentioned above, price volatility for energy has negative impacts on economic growth. In contrast, a CO₂ tax fixes the price of CO₂, allowing the amount of emissions to vary with prevailing economic conditions.

For example, in the EU the price of a permit to emit a ton of carbon has varied by 17.5 percent per month over the first 22 months’ operation of the ETS. As a new study by Dr. Michael Canes, senior research fellow at LMI, points out, volatility in fossil energy prices have strong adverse impacts on U.S. economic growth. Even a reduction in the rate of growth from such a shock of as little as 0.1 percent per year implies costs of over \$13 billion per year. (*Why a Cap & Trade is the Wrong Policy to Curb Greenhouse Gases for the United States*, The Marshall Institute, July, 2007).

In addition, studies have shown that a cap and trade program that gives away (rather than auctioning the permits) can be highly inequitable; the reason is that firms receiving allowances reap windfall profits, which ultimately accrue to individual stockholders, who are concentrated in relatively high-income group.

- *Cap and trade system and flexibility in timing of reductions*

Many experts conclude that it makes economic sense to allow nationwide emissions to vary on a year-to-year basis because prevailing economic conditions affect the costs of emissions abatement. This flexibility occurs under a CO₂ tax because firms can choose to abate less and pay more tax in periods when abatement costs are unusually high, and vice versa in periods when abatement costs are low. Traditional permit systems do not provide similar flexibility because the cap on economy wide emissions has to be met, whatever the prevailing abatement cost.

- *Cap and trade system: impact on consumers and workers*

Regardless of how the allowances were distributed (unless they were all auctioned and the proceeds rebated to low income households), most of the cost of meeting a cap on CO₂ emissions would be borne by consumers, who would face persistently higher prices for products such as electricity and gasoline. Those price increases would be regressive in that poorer households would bear a larger burden relative to their income than wealthier households would. In addition, workers and investors

in parts of the energy sector—such as the coal industry—and in various energy-intensive industries would be likely to experience losses as the economy adjusted to the emission cap and production of those industries' goods declined. (Congressional Budget Office, Economic and Budget Issue Brief, April 25, 2007.) In contrast, carbon tax revenues could be rebated to low income individuals to offset the impact of higher energy prices caused by the tax on fossil fuels.

- *Impact of a cap and trade system on innovation*

Caps on emissions are not likely to promote new technology development because caps will force industry to divert resources to near-term, "end of pipe" solutions rather than promote spending for long-term technology innovations that will enable us to reduce GHGs and increase energy efficiency. An emission trading system will send exactly the wrong signals to investors because it will create uncertainty about the return on new investment. A "safety-valve" price of carbon (designed to create a sense of confidence about future energy costs) can easily be changed. Such uncertainty means that the hurdle rate, which new investments must meet, will be higher (thus less investment will occur) and they will be less willing to invest in the U.S. A tax on carbon would provide more certainty for investors and allow them to replace old capital equipment with less carbon intensive equipment during the replacement cycle.

- *Impact of a U.S. cap and trade system on global GHG emission growth*

Finally, caps on U.S. emission growth are unlikely to succeed unless all the relevant markets exist (in both developed and developing countries) and operate effectively. All the important actions by the private sector have to be motivated by price expectations far in the future. Creating that motivation requires that emission trading establish not only current but future prices, and create a confident expectation that those prices will be high enough to justify the current R&D and investment expenditures required to make a difference. Motivating new investment requires that clear, enforceable property rights in emissions be defined far into the future so that emission rates for 2030, for example, can be traded today in confidence that they will be valid and enforceable on that future date. The EU's experience over the last two years, with the price of CO₂ emission credits fluctuating between 1 and 30 euros per ton of CO₂, does not inspire confidence in companies having to make investment decisions. The international framework for climate policy that has been created under the UNFCCC and the Kyoto Protocol cannot create that confidence for investors because sovereign nations have different needs and values.

- *Carbon taxes: potential drawbacks*

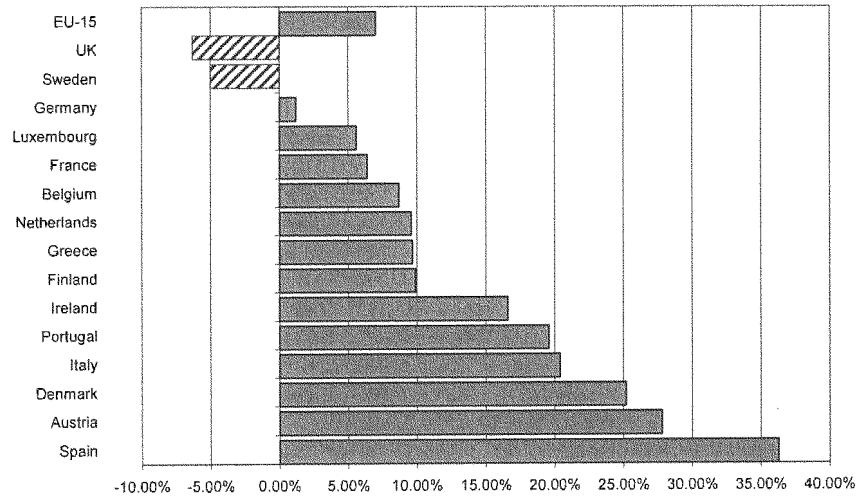
A carbon tax, as a system of inducing emissions reductions, is not without drawbacks. First, revenues from a CO₂ tax (or auctioned permits) might end up being wasted; for example, if the revenue went toward special interests, rather than substituting for other taxes. Second, progress on emissions reductions is uncertain under a CO₂ tax because emissions vary from year to year with economic conditions.

WHAT CAN WE LEARN FROM THE EUROPEAN UNION'S EMISSION TRADING SYSTEM?

As we attempt to choose the right path for a U.S. GHG emission reduction strategy, it is useful to examine the cost-effectiveness of current policies to reduce GHG emissions in developed countries. In the European Union, reduction of GHGs has become a major policy goal and billions of euros, from both the private and the public sector, have been spent on this policy objective. Many policymakers, the media and the public believe that the European Union's Emission Trading System (ETS) has produced reductions in GHG emissions and that their system could serve as a model for the U.S. The ETS, created in 2005, is a market-based, EU-wide system that allows countries to "trade" (i.e., buy and sell) permits to emit CO₂. The ETS covers about 11,500 installations and almost half of the EU's GHG emissions.

The EU 15 (the major industrial countries) have a Kyoto Protocol target of an 8 percent reduction below 1990 levels in GHGs by 2010–2012. The European Environmental Agency's latest projections (October 2006) show that without strong new measures, EU 15 emissions will be 7.4 percent above 1990 levels in 2010, rather than 8 percent below as required by the Kyoto Protocol (see Figure 3). Further evidence of the challenge the EU faces in meeting its Kyoto Targets is found in a recent report by the European Commission showing that electricity consumption continues to rise. Over the 1999–2004 period, residential and commercial electricity consumption increased by 10.8 percent and industrial electricity use rose by 6.6 percent in spite of numerous incentives to increase EU energy efficiency (*Electricity Consumption and Efficiency Trends in the Enlarged European Union*, Joint Research Centre, European Commission, July, 2007).

Figure 3: Greenhouse Gas Emissions in the European Union Projected to Exceed Kyoto Targets in 2010



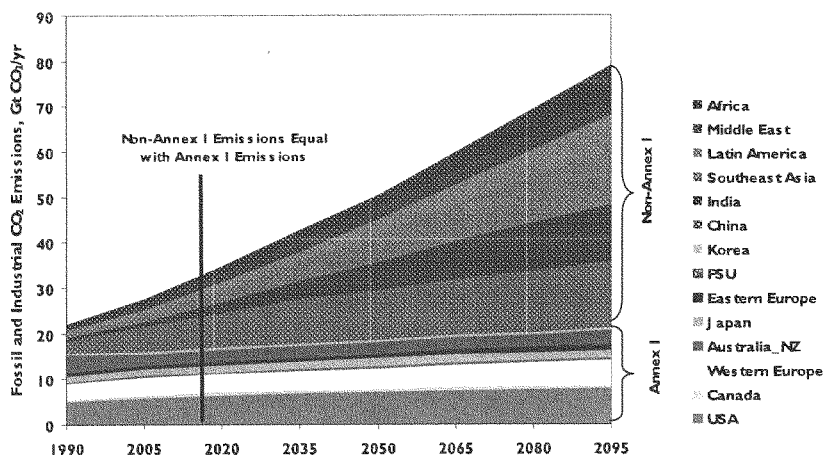
Source: European Environmental Agency, October 2006

The fact that the European Environmental Agency projects that the EU 15 will be 7 percent above 1990 levels of emissions in 2010 (instead of 8 percent below) demonstrates that the mandatory ETS system as currently structured is not providing the desired results and that much stronger measures will be required to meet the Kyoto Protocol target as well as the new post-2012 target. In addition, the EU's new report "The Fourth Assessment" (October 10, 2007) observes that "a further reduction of 7.1 percent or 303 million tonnes of CO₂ equivalent is needed to meet the Kyoto target" and that further domestic policies and measures will have to be implemented. Implementing even tighter emission targets or higher energy taxes in the EU is likely to be politically difficult.

STRATEGIES TO REDUCE GLOBAL AND U.S. GHG EMISSION GROWTH

Slowing the growth of global GHG emissions will depend on factors such as increased energy efficiency, technology developments in both fossil fuels (carbon capture and storage, for example) and renewable fuels (wind and solar, in particular) and, most likely, on increased reliance on nuclear power for electricity generation. In addition to reducing GHG growth in the developed countries, it will be necessary to increase energy efficiency and reduce the growth of greenhouse gas emissions in the developing world since that is where the strong growth in emissions is coming from (see Figure 4). Making progress on these objectives will require a significant commitment of resources, much of which will need to come from the private sector.

Figure 4. World Carbon Dioxide Emissions



Source: Data derived from *Global Energy Technology Strategy, Addressing Climate Change: Phase 2 Findings from an International Public-Private Sponsored Research Program*, Battelle Memorial Institute, 2007.

Technology development and deployment offers the most efficient and effective way to reduce GHG emissions and a strong economy tends to pull through capital investment faster. There are only two ways to reduce CO₂ emissions from fossil fuel use—use less fossil fuel or develop technologies to use energy more efficiently to capture emissions or to substitute for fossil energy. There is an abundance of economic literature demonstrating the relationship between energy use and economic growth, as well as the negative impacts of curtailing energy use. Over the long-term, new technologies offer the most promise for affecting GHG emission rates and atmospheric concentration levels.

The role of international partnerships in promoting institutional change and favorable investment climate in developing countries

Research by Drs. David Montgomery and Sugandha Tuladhar of CRA International makes the case that agreements such as the Asia-Pacific Partnership on Clean Development and Climate (AP6), an agreement signed in 2005 by India, China, South Korea, Japan, Australia and the United States, offers an approach to climate change policy that can reconcile the objectives of economic growth and environmental improvement for developing countries. (See www.icfglobal.org for the full paper.) Together, the AP6 partners have 45 percent of the world's population and emit 50 percent of man-made CO₂ emissions. The projections of very strong growth in greenhouse gases in developing countries over the next 20 years mean that there is enormous potential for reducing emissions through market-based mechanisms for technology transfer.

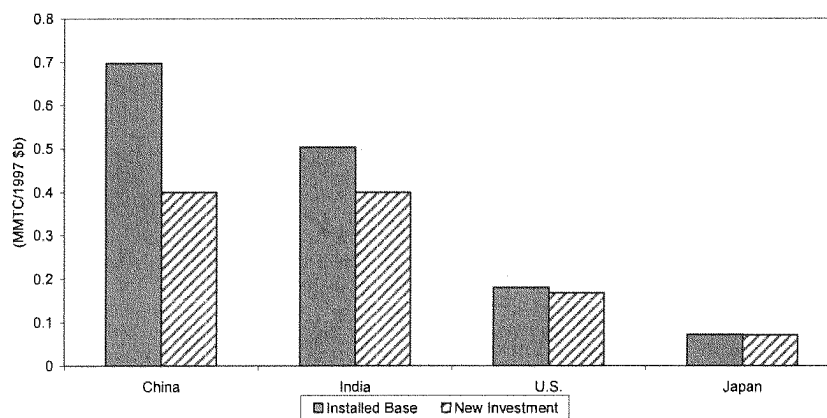
Drs. Montgomery and Tuladhar note that there are several critical factors for ensuring the success of an international agreement which relies strongly on private sector investment for success. Their research shows that institutional reform is a critical issue for the AP6 because the lack of a market-oriented investment climate is a principal obstacle to reducing greenhouse gas emissions in China, India and other Asian economies. China and India have both started the process of creating market-based economic systems, with clear benefits in the form of increased rates of economic growth. But the reform process has been slow and halting, leaving in place substantial institutional barriers to technological change, productivity growth, and improvements in emissions. The World Bank and other institutions have carried out extensive investigations about the role of specific institutions in creating a positive investment climate. These include minimizing corruption and regulatory burdens, establishing an effective rule of law, recognition of intellectual property rights, reducing the role of government in the economy, removing energy price distortions, providing an adequate infrastructure and an educated and motivated labor force.

- *Importance of technology transfer for emission reductions*

As described above, technology is critically important because emissions per dollar of income are far larger in developing countries than in the United States or other industrial countries. This is both a challenge and an opportunity. It is a challenge because it is the high emissions intensity—and relatively slow or non-existent improvement in emissions intensity—that is behind the high rate of growth in developing country emissions.

Opportunities exist because the technology of energy use in developing countries embodies far higher emissions per dollar of output than does technology used in the United States; this is true of new investment in countries like China and India as well as their installed base (see Figure 5.) The technology embodied in the installed base of capital equipment in China produces emissions at about four times the rate of technology in use in the United States. China's emissions intensity is improving rapidly, but even so its new investment embodies technology with twice the emissions intensity of new investment in the United States. India is making almost no improvement in its emissions intensity, with the installed base and new investment having very similar emissions intensity. India's new investment also embodies technology with twice the emissions intensity of new investment in the United States.

Figure 5. Greenhouse Gas Emissions Associated with Existing and New Investment in 2001
(Million tons of Carbon per \$ Billion of Gross Domestic Product)*



* Calculated using Market Exchange Rates

Source: "Promoting a Positive Climate for Investment, Economic Growth and Greenhouse Gas Reductions," W. David Montgomery and Sugandha Tuladhar (see www.iccfglobal.org)

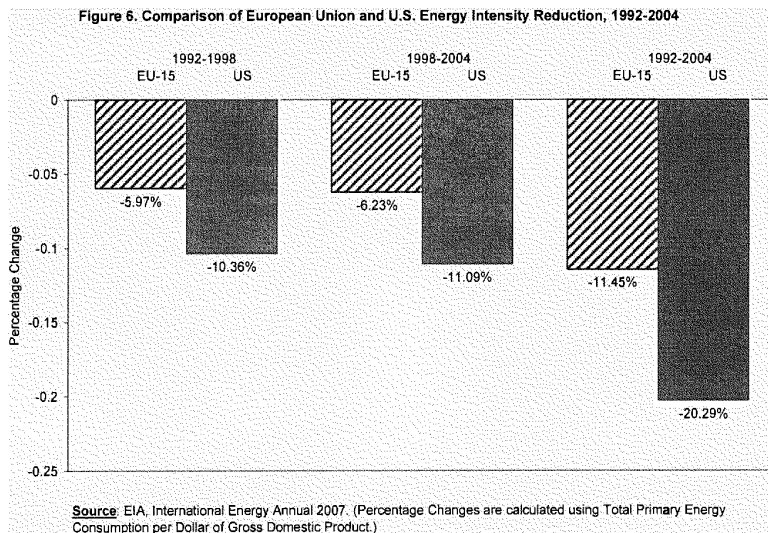
- *The role of economic growth and technology in GHG reduction*

Many policymakers overlook the positive impact that economic growth can have on GHG emission reductions. For example, in 2006, while the U.S. economy grew at 3.3 percent, CO₂ emissions fell to 5,877 MMTCO₂, down from 5,955 MMTCO₂ in 2005, a 1.3 percent decrease. Overall energy use only declined by 0.9 percent, indicating the U.S. economy is becoming less carbon intensive even without mandatory emission caps or carbon taxes.

Internationally, the U.S. compares well in terms of reducing its energy intensity (the amount of energy used to produce a dollar of output). The U.S., with its voluntary approach to emission reductions, has cut its energy intensity by 20 percent over the 1992-2004 period compared to only 11.5 percent in the EU with its mandatory approach (see Figure 6). Strong U.S. economic growth, which averaged over 3 percent per year from 1992 to 2005 compared to about 1 percent in the EU, is responsible for the U.S.'s more rapid reduction in energy intensity in recent years.

- *Accelerating U.S. energy efficiency and GHG reductions*

The development of various high technology programs and new energy efficient investments can be accelerated through government programs as well as by reforms to the federal tax. For example, some policies may be of particular help to taxable entities while others would be of more benefit to cooperatives (which pay little or no federal income tax).

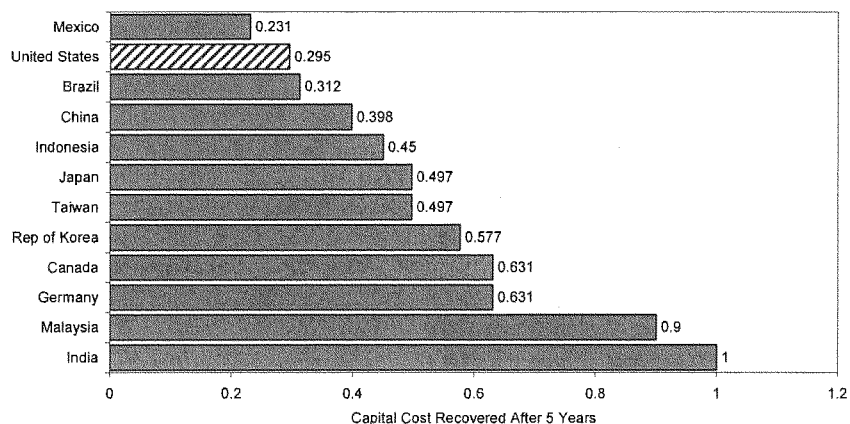


Companies subject to the federal income tax

The efforts of U.S. industries to increase energy security and efficiency and to reduce growth in GHG emissions are hindered by the slow rate of capital cost recovery allowed under the U.S. federal tax code and by the high U.S. corporate tax rate. As a new Ernst & Young international comparison shows, the U.S. ranks last or nearly last among our trading partners in terms of how quickly a dollar of investment is recovered for many key energy investments. For example, a U.S. company gets only 29.5 cents back after 5 years through depreciation allowances for each dollar invested for a combined heat and power project. In contrast, in China the investor gets 39.8 cents back, in Japan, 49.7 cents, in India, 55.6 cents and in Canada the investor gets 79.6 cents back after 5 years for every dollar invested. Another example is U.S. investment in “smart meters”, which can substantially reduce electricity use. U.S. investors only get 29.5 cents back after 5 years, compared to \$1.00 in India and 63.1 cents in Germany (see Figure 7). (See full report at: <http://www.accf.org/pdf/Energy-Depreciation-Comparison.pdf>.)

In addition to slow capital cost recovery allowances, U.S. industry faces the highest corporate income tax rates among our primary trading partners. Of the 12 countries in the E&Y survey, only Japan had a higher corporate tax rate than the U.S. Reforms to the U.S. tax code to speed up capital cost recovery allowances and reduce the corporate tax rate would reduce the cost of capital and could have a positive impact on energy sector investment, and help “pull through” cleaner, less-emitting technologies.

**Figure 7. U.S. Capital Cost Recovery for Smart Meters
Compares Poorly with Our Trading Partners**
(Percent of Nominal Capital Cost Recovered After 5 Years)



Source: "International Comparison of Depreciation Rules and Tax Rates for Selected Energy Investments," prepared for the American Council for Capital Formation by Ernst & Young LLP, May 2007. For full report, please see www.accf.org.

Non-taxable entities

For non-taxable entities such as electric utility cooperatives, other incentives could be provided to encourage the more rapid adoption of new technologies to reduce GHG emissions. For example, electric cooperatives and their consumers cannot apply or benefit from traditional tax incentives because as not-for-profit utilities, they do not have significant federal income tax liability to offset. However, to ensure that the not-for-profit electric utility sector is able to participate in incentives for advanced low carbon technologies, incentives comparable to those offered to for-profit entities can be created. One example is the successful Clean Renewable Energy Bond program that permits electric cooperatives and others to issue bonds that act as interest-free loans for the purpose of building qualified renewable generation. The CREB program can be adapted for other technologies that achieve carbon reduction goals. Grants are another avenue to assist not-for-profits in adopting new technology.

CONCLUSIONS

To be effective, policies to reduce global GHG emission growth must include both developed and developing countries. Policies which enhance technology development and transfer are likely to be more widely accepted than those that require sharp, near term reductions in per capita energy use. Extending the framework of the Asia-Pacific Partnership on Clean Development and Climate to other major emitters will allow developed countries to focus their efforts where they will get the largest return, in terms of emission reductions for the least cost.

Finally, if the United States does adopt a mandatory greenhouse gas emissions reduction program, serious consideration should be given to implementing a carbon tax rather than an EU-style cap and trade system. A key component of any mandatory U.S. program should be allowing emissions to increase as both economic growth and U.S. population increase.

International Comparison of Nominal Capital Costs Recovered After Five Years for Selected Energy Investments, 2006

	Electric Generation					Electric Transmission & Distribution Lines			Pollution Control Equipment	Petroleum Refining	
	Gas	Coal	Nuclear	Combined Heat & Power Generation	Self-Generated Electricity	Transmission Lines	Distribution Lines	Smart Meters	Discharge Modification	Crude Unit (Distillation Unit)	Fluid Catalytic Cracking Unit
United States	37.7%	29.5%	37.7%	29.5%	37.7%	37.7%	29.5%	29.5%	84.3%	63.1%	63.1%
Brazil	37.7%	47.5%	N/A	37.7%	63.1%	20.6%	20.6%	31.2%	89.6%	63.1%	63.1%
Canada	79.6%	79.6%	79.6%	79.6%	79.6%	31.2%	31.2%	63.1%	79.6%	79.6%	79.6%
China	39.8%	39.8%	39.8%	39.8%	39.8%	39.8%	39.8%	39.8%	41.3%	39.8%	39.8%
Germany	30.0%	30.0%	37.5%	30.0%	30.0%	33.1%	33.1%	63.1%	79.6%	72.3%	79.6%
India	55.6%	55.6%	55.6%	55.6%	55.6%	55.6%	55.6%	100.0%	100.0%	66.1%	66.1%
Indonesia	45.0%	45.0%	45.0%	45.0%	45.0%	45.0%	45.0%	45.0%	45.0%	45.0%	45.0%
Japan	49.7%	49.7%	49.7%	49.7%	45.6%	37.4%	37.4%	49.7%	76.9%	72.3%	72.3%
Rep of Korea	57.7%	57.7%	57.7%	57.7%	57.7%	57.7%	57.7%	57.7%	89.0%	89.0%	89.0%
Malaysia	100.0%	100.0%	100.0%	100.0%	100.0%	90.0%	90.0%	90.0%	100.0%	90.0%	90.0%
Mexico	46.2%	46.2%	46.2%	46.2%	46.2%	23.1%	23.1%	23.1%	101.2%	32.3%	32.3%
Taiwan	49.7%	49.7%	49.7%	49.7%	49.7%	49.7%	49.7%	49.7%	96.6%	78.5%	78.5%

April 25, 2007

Prepared by the Quantitative Economics and Statistics Group, Emat & Yeung LLP

RESPONSE BY MARGO THORNING, PH.D., TO AN ADDITIONAL QUESTION FROM
SENATOR INHOFE

Question. Based on your testimony and the testimony of the other witnesses, is there anything else you would like to add?

Response. Executive Summary.—Impact of S. 2191 on U.S. Energy Use: A major stumbling block to the U.S.'s meeting the S. 2191 targets is projected increases in covered emissions and population growth over the next several decades. Forecasts of baseline covered emissions show emissions growing by 30 percent from 2012 to 2030, from 5,995 to 7,783 million metric tons of carbon dioxide equivalent (MMTCO₂e). Sharp cutbacks in U.S. energy use would be necessary to close the 55 percent gap (4,311/MMTCO₂e) in 2030 between projected emissions and the S. 2191 target.

Impact of S. 2191 on U.S. Per Capita Emissions: The projected 18 percent increase in U.S. population from 2010 to 2030 will make GHG emission reductions very challenging since more people means more energy is needed for home heating and cooling, job growth and transportation. Over the entire decade between 1990–2000, per capita emissions in the U.S. fell by only 0.8 percent and they are projected to decline by only 0.6 percent between 2000 and 2012. To meet the emission reduction targets in S. 2191, U.S. per capita emissions would have to fall by 50 percent from 2000 to 2030. S. 2191's required reductions in per capita emissions are about 25 to 35 times greater than what occurred from 1990 to 2000. The technologies simply do not exist to reduce emissions over the next 17 years by the amounts mandated in S. 2191 without severely reducing the growth in the U.S. economy and in employment.

The European Union's Emission Trading System: Many policymakers, the media and the public believe that the European Union's Emission Trading System (ETS) has produced reductions in GHG emissions and that their system could serve as a model for the U.S. Projections show that the major EU countries will be 7 percent above 1990 levels of emissions in 2010 (instead of 8 percent below). The mandatory ETS system as currently structured is not providing the desired results and much stronger measures will be required to meet the Kyoto Protocol target as well as the new post-2012 target.

Strategies to Reduce Global and U.S. GHG Emission Growth: Slowing the growth of global GHG emissions will depend on factors such as increased energy efficiency, technology developments in both fossil fuels (carbon capture and storage, for example) and renewable fuels (wind and solar, in particular) and on increased reliance on nuclear power for electricity generation. In addition to reducing GHG growth in the developed countries, it will be necessary to increase energy efficiency and reduce the growth of greenhouse gas emissions in the developing world since that is where the strong growth in emissions is coming from. Initiatives like the Asia-Pacific Partnership on Clean Development and Climate and reforms to the U.S. federal tax code to reduce the cost of capital for new energy investments as well as programs designed for non-profit energy service providers could accelerate the uptake of cleaner, less-emitting technologies as well as strengthen U.S. economic growth.

[See pages 115–147.]

Senator BOXER. Mr. Barbour, please try to keep yourself within the limit. I should say, you are the executive director of Environmental Resources Trust.

**STATEMENT OF WILEY BARBOUR, EXECUTIVE DIRECTOR,
ENVIRONMENTAL RESOURCES TRUST, INC.**

Mr. BARBOUR. Thank you, good morning, Madam Chairman and distinguished members of the Committee. My name is Wiley Barbour, I am the executive director of the Environmental Resources Trust, a non-profit organization dedicated to pioneering markets to protect and improve the global environment.

I am here today to talk about the design of a greenhouse gas emissions cap and trade market that can deliver real results in emission reductions, cost effectively, real value to market participants and real progress in delivering low-carbon technologies and energy alternatives. I am a licensed professional environmental engineer. In my earlier life, I spent 6 years at the U.S. EPA in the

policy office and in the Clean Air Markets Division. I coordinated an interagency team that was responsible for compiling the Federal Government's annual inventory of emissions by sources and removals by sinks of greenhouse gases and reporting that to the United Nations under the terms of the Framework Convention on Climate Change.

I believe we succeeded in completing a policy relevant by policy neutral analytic framework which is used today by modelers, climate modelers, economists and policy makers on both sides of the issue. Our expertise is in the measurement of greenhouse gas emissions and the verification of corporate and project level emission reductions. We also own a portfolio of Government-issued allowances and credits. We have engaged in multi-million dollar trades of these as we have grown our portfolio of these emission allowances over time. I can tell you from first-hand experience that these markets work and can achieve real environmental benefit.

We are not an advocacy group. We are an implementation shop, if you will. We work with a broad spectrum of companies that are serious about getting the numbers right about their carbon footprint. We work with Google, Wal-Mart, NewsCorporation, the owner of Fox News, Entergy Corporation, AIG, amongst many others. Many of these companies and private groups that we work with are actively participating now in environmental markets and emissions trading. Their motivations are as diverse as the companies themselves. Some of them are interested in purchasing emission reductions in order to offset their emissions and become carbon neutral; some of them are trying to sell these as part of a sustainable business practice. Some companies we work with are large emitters and they are purchasing these types of greenhouse gas offsets because they are likely to be regulated. They want a clear policy signal from Washington on what counts and what doesn't.

Also leading exchanges are listening very carefully from these statements from companies and trying to figure out what types of services they can provide. The New York Mercantile Exchange, for example, is working extensively with utilities, hedge funds, investment banks, environmental brokers to establish a set of contracts that market participants need to effectively manage the risk and gain exposure to these markets. NYMEX has chaired an environmental market steering committee, which I chair, and reached out to leading experts in order to foresee and prepare for the needs of a future mandatory compliance system.

I believe the lessons we have learned in this country on existing markets can serve as a model for the design of future markets. A professional community has developed in this country that understands how to support this trading system. We have the talent pool here that understands, how do we measure and monitor and verify these types of emission estimates. Based on that, we can create a fully fungible commodity of greenhouse gas reductions suitable for exchange in an environmental market, markets that will encourage real greenhouse gas reductions across the country in an effective manner.

I am here today to testify to the feasibility of that market and the accounting systems that would be required to make that work. The one critical piece we are missing is the law that mandates that

cap. The cap creates the constraint which ultimately drives demand. To put it another way, only a cap on emissions can create the robust demand for allowances and credits that is needed to start and rev this market engine. For the last 20 years, we have tried to use voluntary programs in the United States, and despite all that outreach and participation and consultation of numerous public and private groups, the voluntary approach has failed to deliver at the national level absolutely reductions, or to even change the trend of our growing greenhouse gas emissions.

I think that we have learned a lot from the acid rain program. In the interest of time, I will be very brief. We have found that this market-based approach works. It has reduced acid rain emissions by 5.5 million tons from 1990 levels. NOx emissions are down 3 million tons, and at cost savings of \$3 billion a year as opposed to a typical command and control approach, as the Government Accountability Office has recently found. This experience that we have gained from the acid rain program I think stands us in good stead. We have learned some of the provisions from that that I see reflected in the Senate Bill before us today. I believe that the greenhouse gas cap and trade system will be more complicated and will require participation from a larger number of sectors. But many of the mechanisms that we have learned apply, and I think we understand the core elements. I know given in the interest of time, I should probably stop there. So we stand ready to answer questions.

[The prepared statement of Mr. Barbour follows:]

STATEMENT OF WILEY BARBOUR, EXECUTIVE DIRECTOR OF ENVIRONMENTAL RESOURCES TRUST, INC.

Good morning Mr. Chairman and distinguished members of the Committee on Environment and Public Works.

My name is Wiley Barbour, and I am the Executive Director of Environmental Resources Trust, a program of Winrock International.

I'm here today to talk about how to design a greenhouse gas emissions cap and trade market that will deliver real results in emissions reductions, real value to market participants, and real progress in developing low-carbon technologies and energy alternatives.

I am a licensed professional environmental engineer. In my earlier life I spent six years at the U.S. EPA working in the Policy Office and in the Clean Air Markets Division. I coordinated an interagency team that was responsible for compiling the Federal Government's annual inventory of GHG emissions and reporting that to the United Nations under the terms of the Framework Convention on Climate Change. I instituted an expert and public peer review process which is still in use today to allow scientific and technical input into the development of the GHG emission calculations and I believe we succeeded in creating a policy relevant but policy neutral analytic framework which is widely used today by climate modelers, economists, and policymakers.

Environmental Resources Trust is a politically neutral 501 (c)(3) nonprofit organization and we have been working on climate change and energy policy since our creation in 1996. Our mission is to pioneer and catalyze markets to protect and improve the global environment. Our expertise is in the measurement of greenhouse gas emissions, the verification of corporate and project level GHG emission reductions, and in the provision of registry services to companies who wish to buy or sell high quality greenhouse gas emission offsets. ERT owns a portfolio of emission allowances and credits and we have engaged in multimillion dollar trades as we have grown our portfolio over time, so I can tell you from firsthand experience that these markets work and can achieve real environmental benefit.

ERT is composed primarily of scientists and engineers; we are not an advocacy group—we are a market implementation shop offering a variety of technical services to government agencies, private companies and multinational corporations who are serious about engaging in emerging environmental markets. We work with a broad

spectrum of companies that are serious about getting the numbers right—about accounting for their carbon footprint with the highest integrity. Amongst the companies that have engaged ERT to verify their global greenhouse gas emissions are Google, Wal-Mart, NewsCorporation (the owner of FoxNews), Entergy Corporation, and AIG.

Our firm also owns 16,000 SO₂ allowances and participates in the Acid Rain trading program.

Many of the companies and private groups we work with are interested or actively participating in environmental markets and emissions trading. Their motivations are as diverse as the companies themselves; some are interested in purchasing verified emission reductions in order to offset their own emissions and thus become “carbon neutral.” Some are seeking to sell offsets as part of a sustainable business practice. Some of the companies we work with are large emitters who are purchasing greenhouse gas reductions because they are likely to be regulated under a climate change bill and want to gain experience with market mechanisms. These companies are seeking a clear policy signal from Washington.

Leading exchanges are also listening carefully to the statements from corporations and trying to foresee how the market can provide services. The New York Mercantile Exchange (NYMEX), for example, has worked extensively with utilities, hedge funds, investment banks, environmental brokers and environmental groups since March, 2007 to establish a set of contracts that market participants need to effectively manage risk and gain direct exposure to the emissions markets. NYMEX has created an Environmental Markets Steering Committee, which I serve on, and reached out to leading experts in an effort to foresee and prepare for the needs of a future compliance system.

At ERT, we responded to the demand from the private sector and created the GHG Registry®, the world’s first on-line registry of greenhouse gas emissions and reductions. For over a decade, the GHG Registry Program has provided the tools, protocols, guidance, and infrastructure needed to create a fungible commodity for bilateral trading in voluntary environmental markets. The GHG Registry currently contains almost 17 million tons of tradable GHG offsets and members of the GHG Registry have traded over 1.3 million tons of GHG offsets so far this year.

I believe that the lessons we have learned in the operation of our programs are valuable and can serve as a model for the design of mandatory markets. ERT’s experience demonstrates that a professional community has developed in this country that understands how to support a trading system. We now have a talent pool in this country that understands how verification and monitoring under appropriate rules and guidelines can measure real environmental improvements. Based on that knowledge, we know that we can create a fungible commodity of greenhouse gas emissions, suitable for exchange in an environmental market, markets that will encourage real greenhouse gas emission reductions across the economy in the most efficient manner.

I’m here today to testify to the feasibility of a carbon market here in the United States. My colleagues in the GHG accounting business are doing everything we can to make a market function, but one critical piece is missing and that’s the law that mandates the cap, which creates the constraint, and ultimately drives demand. To put it another way, only a cap on emissions will create robust demand for allowances and credits that is needed to start the market engine.

If there is any doubt over this observation, market activities over the last few decades should provide sufficient evidence. For the last 20 years we have tried to use voluntary programs in the United States to reduce our GHG emissions. Despite the outreach, consultation and participation of numerous public and private groups, the voluntary approach has failed to deliver at the national level absolute reductions or to change the trend of our ever increasing emissions.

For all the activity in the voluntary markets, it is nowhere near the volume and capitalization we would see under a mandatory system—that volume would result in real emissions reductions, and would mobilize private sector players to develop low carbon alternatives in a way that we’re not seeing now.

II. OBSERVATIONS

I’m sure that you have heard in previous testimony of the success of EPA’s Acid Rain Program, which has achieved significant environmental and public health benefits through use of a market-based approach similar to the cap-and-trade provisions of the Climate Security Act of 2007.

In the eleven years that the program has operated, the Acid Rain Program has reduced SO₂ emissions by more than 5.5 million tons from 1990 levels, or about 35 percent of total power sector SO₂ emissions. NO_x emissions are down by about 3

million tons from 1990 levels, so that emissions in 2005 were less than half the level anticipated without the program.

The General Accounting Office recently confirmed the benefits of this market approach to reducing acid rain pollution, finding that the SO₂ allowance trading system has saved as much as \$3 billion per year—over 50 percent—compared with a command and control approach typical of previous environmental protection programs.

The SO₂ program has provided valuable market experience for the electric generating industry, virtually all of which will be participants in a greenhouse gas emissions trading market. The SO₂ program is a closed system that affected 3,456 operating electric generating units as of 2005 with most emissions produced by only about 1,100 coal-fired units. Over 16 million allowances have been issued under the Acid Rain program and of those almost 7 million are “banked” by participants seeking the flexibility to use them in the future, giving them price certainty and operational flexibility.

Banking is an important feature of a well designed market based system—it incentivizes companies to over comply today and bank their unused allowances for later use. Participants in that program have expressed enthusiasm for the flexibility this mechanism provides. It’s often referred to as the “when/where” flexibility of the program—allowing individual firms to determine when and where it is best for them to make the required reductions.

The program contains a robust trading market with multiple facilitators participating—including brokerage firms, traders, and bilateral, or firm to firm, trading. Despite early concerns about companies having to become more savvy about trading, the regulated companies have figured out how to do it, and have enjoyed greater efficiency in their compliance approaches as a result.

The success of this program is a direct result of its excellent design. We can design a larger greenhouse gas emissions market to engage the same mechanisms to create similar efficiencies and flexibility—leaving it up to companies to decide how best to meet their emissions reduction targets.

Admittedly, a cap-and-trade program for GHGs will be more complicated and require participation of a larger number of sources, but many of the same mechanisms apply. The experiences and lessons learned from existing greenhouse gas emission—or “carbon”—markets, both here in the US as well as in Europe, will serve us well as we develop our own solutions. I’d like to talk a little bit more about:

- What are core elements that make the market work?
- What are the core things you have to watch out for?
- (And I will get into the EU experience on both topics, which is very helpful for us.)

BUILDING ENVIRONMENTAL MARKETS

The foundation for a successful market is built on our ability to measure, report, and verify GHG emissions by each source and to track these emissions over time. A market requires a set of rules governing the creation and ownership of allowances and credits and a system to track these as they are created, allocated, traded, and ultimately used and retired from the system.

Fortunately, this market infrastructure is largely now in place. Based on our experience here in the U.S. with voluntary markets, and drawing on the experiences and lessons we have taken away from the Acid Rain program, the EU emissions trading program and the international GHG market, we now have in place the fundamental building blocks for successful environmental markets.

First, the accounting of emissions and their reductions needs to be established and scientifically based.

We have a scientific basis, grounded in peer reviewed literature, for quantifying emissions by sources, and removals by sinks, of greenhouse gases. These methods are described and documented in guidelines developed by the Intergovernmental Panel on Climate Change with extensive input and leadership by U.S. scientists and experts. We understand the processes that create greenhouse gas emissions. We have accepted methodologies for quantifying emissions of GHGs from combustion of fossil fuels, responsible for over 85% of total U.S. emissions of GHGs. In addition, we can quantify these emissions with very high degrees of certainty, often with a confidence level of plus or minus two percent or less.

Offsets particularly fall into this category. What’s needed is to match or marry these scientific principles with clear policy guidance on what counts, such as: what’s the appropriate baseline to count emissions reductions against, how to account for non-permanent “sinks”, such as forests, create specific rules for offset project accounting, such as how long the crediting period would last and how to distinguish

projects that create additional emissions reductions, and the rigor and frequency. A number of entities, including the USDA, EPA, and prominent universities have established standards for offset projects.

These measurement protocols and methodologies allow for the creation of a standardized, fungible commodity that can be efficiently traded.

Second, establish the mechanisms that will allow this accounting to take place. We have software systems, clearing mechanisms, measurement techniques, and ways to track ownership of allowances that could be rather quickly deployed to support the needs of the GHG cap and trade market. Some of these exist within the EPA as a result of the Acid Rain program; others, such as the financial clearing mechanisms, have been developed in the private sector and stand ready to be used in this market.

Third, establish clear and consistent rules to allow all market participants to plan, make decisions, and allocate capital with a degree of certainty that the program goals are not going to change, such as:

- Reporting requirements need to be clearly stated as soon as possible.
- Information about how to apply for early action credits needs to be clear.
- Provide requirements for auditing or verification of emissions.
- Establish procedures for establishing non-compliance. The rules should incentivize compliance, being set up in such a way that the penalty for non-compliance exceeds the cost of compliance.

These rules need to be articulated for the non-electric energy sector also, including the agriculture, transportation, and commercial sectors of the economy—basically anyone you would expect to be participating.

Fourth, establish market mechanisms, exactly as outlined in the legislation, including banking, borrowing, and trading. These mechanisms are essential to allowing individual regulated entities the most flexibility, including the ability to manage their capital investment decisions, in pursuing emissions reduction goals.

Fifth, allow broad intermediaries, service providers, agregators, and other entrepreneurs to participate, harnessing the creativity of the private sector. Those participants should be engaged unless there were some specific restriction.

Now I will turn to the core things you need to watch out for.

One of the things we learned from the earliest phase of the EU ETS, the European GHG cap and trade market, was that the allocation process itself is a critically important component of both creating a robust trading system and achieving the desired environmental outcome.

In the first phase of the EU ETS, they overallocated allowances, and did not allow the value of permits to exist across allocation periods—in other words, there was no banking allowed across periods. As a result the price, and therefore the value, of those allowances, plummeted in the months before the end of the first trading phase.

This brings up an important point: once regulated entities are participants in the market, they will not only be concerned with high prices, but they will also be concerned with making sure their allowances maintain value—they don't want watch those credits turn into "Monopoly money". We can easily avoid this problem by allowing banking, as the EU now does, and through carefully constructed allocation schemes.

Allocation to individual regulated entities should be conducted fairly, but in accordance with the desired environmental outcome; allocation at the beginning of a compliance period should be consistent with the desired environmental outcome to maintain their value.

What we need now are clear market signals from policy makers, and clear guidance from the federal government on the rules of the road. In the absence of federal leadership on these issues, a host of NGOs, states, and industry groups have waded into these waters. The result has been some disagreement over what counts but this is not an intractable problem.

I believe that S. 2191 contains many the most important elements and provides an excellent framework for developing a robust U.S. greenhouse gas emissions trading market.

Once we have clear rules of the road the market will function and help identify the least cost approaches to reducing GHG emissions. I look forward to working with the Committee, EPA, DOE, and my colleagues in the private sector to assist in the transition to mandatory markets. I thank you for your time.

Senator BOXER. Mr. Barbour, thank you very much.

I will start right away. Ms. Smith, you are sort of the voice of the doom and gloom on this today, laying out what horrible things are

going to happen to us if we adopt this environmental landmark legislation. I looked over a list of your clients, and I want to make sure I have it right. Is OPEC one of your clients, ma'am?

Ms. SMITH. Not one of mine.

Senator BOXER. No, one of the firm's.

Ms. SMITH. I don't know.

Senator BOXER. Well, it is in the list of your clients. Is ARCO one of the firm's clients, ma'am?

Ms. SMITH. It has been in the past.

Senator BOXER. How about American Petroleum Institute, Chevron, ConocoPhillips, ExxonMobil, Halliburton, Occidental Oil and Gas, and Shell Oil? Are they your clients, the firm's clients as well?

Ms. SMITH. Anything listed on our web site are previous clients of ours. We have acknowledged that we worked for them publicly on some issue. We work in many areas far beyond environmental—

Senator BOXER. Well, I am just trying to make a point. Because I think when witnesses come before us and give us "independent analyses" I think it is really important to know, just as you want to know what our views are, and we are an open book on that, who you have represented in the past. The Natural Gas Supply Association, it goes on and on and on.

So I am going to place the list of clients into the record, and I think the people need to put—

Ms. SMITH. That is the nature of working for business, to help—that is the nature of working for business, is to help them do a better job meeting their requirements.

Senator BOXER. Well, there is business and there is business when it comes to global warming. We have had many businesses here that are very much in favor of moving, I mean, I don't need to name them all. So I want to make sure people know who your clients are when you come up and you give us these analyses.

Ms. SMITH. Among them are some who are supporting legislation for climate policy.

Senator BOXER. Excellent.

Now, I want to know, Ms. Smith, when you made your analysis, did you go look at what is going on in California? Do you believe in general that environmental laws are in conflict with a strong economy? Is that your underpinning belief?

Ms. SMITH. No, I do not believe that. I don't believe the economy could not reduce emissions, I said that the timing of these caps is too tight in the near term to achieve the caps without disruption in the near term. I did not say that we can't achieve large emission reductions and economic growth.

Senator BOXER. Well, excuse me, I listened to you and you talked about reductions in GDP, reductions in GDP, you said overall there will be all these job losses, even though we will have some growth. I asked you if you looked at the California experience, because on a bipartisan way, we have led the way. Do you know we'd be the fifth largest economy in the world if you looked at our State GDP? Are you aware of that, in California?

Ms. SMITH. Yes, I am, and I am aware that California has achieved enormous reductions in energy intensity in its economy. I am also aware that this has in large part occurred as much of

the energy intense manufacturing has moved to other parts of the United States.

Senator BOXER. Well, ma'am, I would like to tell you if you want to check out job growth in California, increase in incomes, and what has happened there, particularly in a bipartisan way as we have moved toward environmentally friendly legislation, including basically the Sanders-Boxer bill, with those goals, the excitement there, I would just say to both of the economists here, I would be happy to work with you on meeting some of our economic leaders in California. Because I think Mr. Barbour made the point very clearly that in fact, there is very good news on the horizon.

Now, what I am going to do now is hand my questions over for another round to Senator Lieberman, hand him the gavel. I want to thank members of the panel very, very much for your testimony.

Senator Inhofe.

Senator INHOFE. Thank you, Madam Chairman. I think this is going to work, she is going to go down and take the first 7½ minutes and I will be right behind you.

Very quickly, let me just ask two yes or no questions to you, Mr. Darbee, and to you, Mr. Pershing. First of all, Mr. Darbee. If your company could not receive free allowances initially, would you still support the bill, yes or no? Time is getting by us here.

Mr. DARBEE. I would have to look at the whole structure, but probably not.

Senator INHOFE. All right, thank you very much.

Mr. Pershing, would your organization support significant increases in nuclear power?

Mr. PERSHING. My expectation is that we might, depending on the circumstances.

Senator INHOFE. Ms. Smith, let me ask you a question. The organization CRA, have they ever in the past represented any environmental companies or organizations or any cap and trade organizations?

Ms. SMITH. Yes, we have.

Senator INHOFE. Now, I would like to ask you a question, and put it in some words that we can understand. I would like to ask you, how large are the costs to American consumers? Would they absorb? Can you kind of put these numbers in terms of a family budget, so we have some idea of what we would be talking about? Quickly.

Ms. SMITH. Yes. We are estimating in 2015 between \$800 and \$1,300 per household per year. It rises after that.

Senator INHOFE. Very good. Ms. Thorning, you heard the answer or the statement that was made by Ms. Smith about the targets in this bill getting out ahead of the likely availability of technology. Do you want to comment on that, targets and then technology?

Ms. THORNING. The targets are very, very right, and the capital stock turns over very slowly. I think many policy analysts, many politicians need to be aware that the average appliance may last 10 to 12 to 15 years, the average car lasts 8 years, the average production facility in a factory may last 25 to 35 years. Utility plants maybe 60 years or longer. So the slowness of the capital stock turnover means that it is much more cost effective to replace capital during the normal replacement cycle, and that is why more time

to meet tight targets would substantially reduce the cost of these targets.

Senator INHOFE. Very good. Ms. Smith, I wrote down a statement that was made by the chairman of the subcommittee, Senator Lieberman, that we should not expect fuel switching under this bill, because it won't happen until the price of an allowance hits \$50 a ton. Comment, please?

Ms. SMITH. That is about right, and we see prices of allowances hitting about that level earlier. We see the fuel switching because in the early years, the cap that is stated in the bill is extremely tight. In fact, it does not even appear to match 2005 emissions, even though that is its purported level. There is a lot of confusion in our minds. We have looked at analyses where the cap is looser, and of course the costs are lower. That is the issue of the timing.

Senator INHOFE. What would happen to U.S. industries like steel, cement, if this bill should pass and we were to comply with these emission requirements?

Ms. SMITH. I am sorry, I missed—

Senator INHOFE. What would happen to U.S. industries like iron and steel and cement? Do you have any comments on that?

Ms. SMITH. I was mentioning leakage when I had to end my testimony. Our industries that compete in international markets, both those who compete in export and import markets, are extremely exposed by the high prices, not just of their own emissions, but of the electricity that they will have to use in their production processes. Some of these industries are so far on the edge that if there are not border tax adjustments, which are not in this bill, in a timely manner, they will likely suffer huge losses in their market shares.

Senator INHOFE. All right, and Ms. Thorning, can households and businesses change their stocks of energy using appliances and factory equipment quickly, and how long does the average piece of equipment last?

Ms. THORNING. People would be surprised that the average auto is probably kept in service 8 years or longer. Appliances last 10 to 15 to 20 years, and of course, plant and equipment in factories may often last 35 to 40 years. Utility plants, 50, 60 years or even longer. So capital turns over very slowly.

When we put premature requirements to curb emissions, we make the existing capital stock obsolete.

Senator INHOFE. With 10 seconds here, I would like to ask you, I have commented several times, Ms. Smith, that I think a carbon tax is a more honest approach to it, and I would like to know why wouldn't a carbon tax be better than the cap and trade?

Ms. SMITH. I believe it is far more suited to this particular issue of climate policy.

Senator INHOFE. Thank you. Thank you, Mr. Chairman.

Senator LIEBERMAN [presiding]. Thanks, Senator Inhofe.

I think I am next in the order. Senator Warner would then be next after me. Because he can't be here, he has given me some questions.

I think what I will do is try not to take the full 10 minutes, but rotate back and forth and ask a sampling of questions from each of us.

Let me go first to Mr. Darbee, because I thought you had a good statement and a very important exchange with Senator Inhofe, where he asked you if you would support the bill if the power sector didn't get any allowances free. You said you would think about it, but probably not. I understand that, that is part of the balance that we put in the bill.

But meeting these tough standards, particularly by 2020, to take us back below 1990 emissions, is going to cost the power plant sector of our economy hundreds of billions of dollars. Incidentally, where else would you get that except to raise rates? So one of the reasons why the rate impact is ultimately so low, as you pointed out in your testimony, is because you are getting those allowances for the initial years and of course, you are also getting some of the proceeds of the auctions.

I just want to briefly ask you to comment, because you made an interesting suggestion, that you would like to see more detail in the Carbon Market Efficiency Board, which is the other kind of emergency mechanism we built in here to protect the economy. Just give us an idea of one or two of the things you would like to see the Market Efficiency Board have.

Mr. DARBEE. Certainly, Senator. We have been giving this a lot of thought. One of the concerns on the part of business has been about possibly a mystical Fed-like mechanism. Therefore, we felt it would be better if there was more transparency. So what PG&E is recommending is the idea of a collar. That is that we would establish a ceiling for the price of carbon which would rise over time, as well as a floor for the price of carbon that would rise over time. The effect of this would provide assurance to policy makers and to businesses that the costs would not run up unexpectedly to high levels, somewhat like what we saw in California, with high energy prices, they went up much higher than people anticipated they ever would with deregulation.

At the same time, the positive for perhaps the environmental community and certainly for venture capitalists and industrialists, is with the floor price of carbon, there would be certainty as to what the range of the price of carbon would be over a series of years. So we think that this balances both the concerns for the environment as well as pragmatic concerns about moderating the impact on the economy as well as providing certainty for investment. So we are intrigued by that, and we think that if those standards and prices were public and the Fed mechanism were required to enter the market, engaged in open market operations to stabilize the price of carbon and keep it in that area, that band, we think it would be very constructive.

Senator LIEBERMAN. Very interesting ideas. We will continue to talk about them.

Senator Warner's first question was to you, too. I will ask you this part of it. How can we expedite the availability of the technologies needed to reduce greenhouse gas emissions, from your point of view?

Mr. DARBEE. We think this cap and trade program would be the best solution in that respect. Because what is necessary is to put a price on carbon. Therefore, some technologies which might be

otherwise more expensive in effect are advantaged by this, and certainty is created for venture capitalists as well as for industrialists.

So we think that the thing that could promote the development of these technologies best is to internalize the externality which now exists. That externality is the ability to spew carbon into the atmosphere at no cost.

Senator LIEBERMAN. Thanks. I will go back to my next question, which is for Dr. Pershing. You mentioned in your testimony three separate modeling studies by the Nicholas Institute at Duke, MIT and the Clean Air Task Force. Dr. Smith's testimony presents modeling results that differ greatly from those three others. What do you think is the reason for that? Can you suggest anything in her analysis and theirs that might have led to such different predictions?

Mr. DARBEE. I think there are a number of things that do that. Always, when one does models, the issues that one assumes and the inputs have enormous implications on the outputs. In this particular instance, it is always a question of where you start.

These particular studies sought to start with what I think of as fairly standard projections. They began with some historical trends and projected forward using the Energy Information Administration, systems like EPA has run out going forward. They assume, for example, that the technology that we may have going forward has a trend looking like that of the past. You can go fairly quickly, new technologies can penetrate. As I understand Dr. Smith's testimony, there are some limits on what technology might happen and the rate.

These assessments assume that you can look at all sectors. They assume that you can look at the energy sector, at the transport sector, multiple options, multiple directions. As I understand again, although I have not seen her model in detail, it does not include all options in all sectors. My sense, finally, is that you get some change in the expected GDP and how things are recycled through the system. If you assume that there is going to be some benefit in terms of reducing those overall costs, for example, returning the revenues back to technology, which might reduce the price, returning the revenues back to the economy for distribution, you again get lesser impacts on the overall economy.

Senator LIEBERMAN. That is very helpful. I thank you for that.

Let me go back to a question from Senator Warner. A second question was to Mr. Barbour. We are all wanting to say, so I have to get it off my chest, if you are Haley Barbour's wiley cousin. Because we always thought that Haley was fairly wiley.

Mr. BARBOUR. Only if there might be a significant inheritance. But no, no family connection that I am aware of.

Senator LIEBERMAN. Just re-elected Governor of Mississippi, so we congratulate him.

Here is Senator Warner's question. In your written testimony, you write, I believe that S. 2191 contains the most important elements and provides an excellent framework for developing a robust U.S. greenhouse gas emissions trading system. Senator Warner's question is this. Of the criteria you listed, what are the components of this legislation, America's Climate Security Act, that you think are most important for market efficiency?

Mr. BARBOUR. Thank you, Senator. I think the fundamental design element of a cap and trade system is the when and the where flexibility. That is really from my experience working for many years as a consultant to industry a very desired feature from industry. They want the flexibility to decide the schedule and the timing and the location of the reductions, so that they can achieve the least cost reductions at the most efficiency way possible. I think that is inherent in the design of a system.

I also think that the banking provisions are very, very important. Under the current SO₂ allowance trading program, about 16 million SO₂ allowances have been issued.

Seven million of those have been banked by participants seeking the flexibility to use those in the future, give them price certainty and some operational flexibility. This banking is an extremely important feature of a well-designed system. It incentivizes companies to over-comply today so that they can bank these unused allowances for later use. It incentivizes companies like my own to purchase these to send a signal of scarcity, so in essence, I can put money to bear in the most cost-effective way possible to get SO₂ allowances. I can buy the permits.

I think that this is an essential feature that has been well-represented and it is probably, as we look at some of the problems that we have seen in the European Union trading system, it is that failure of banking, the initial phase by definition did not allow the allowances to transfer into the next phase, and their value rapidly went to zero as we approached the end of the period.

Senator LIEBERMAN. Thanks very much.

I think I am going to submit the other questions that both Senator Warner and I have for the record to you, so we can give everyone else here a chance to ask questions. This may suggest a new way of questioning. If you ask one question, one Senator to ask questions for himself and another, you actually take less time.

[Laughter.]

Senator LIEBERMAN. I can't figure that out economically. Maybe somebody here on the panel could help me.

Senator Carper, you are next, and then Senator Voinovich.

Senator CARPER. Thank you, Mr. Chairman.

I want to ask really a question, I thought I heard Mr. Barbour and also Mr. Darbee talk about offsets, and to speak in terms that said offsets are an important way to help hold down reducing CO₂ emissions. I would like to ask each of you to take just a minute and explain why, then I am going to ask each of our other three witnesses to let us know whether or not they agree or disagree. One of the things I like to do with a diverse panel like this is to find consensus. This is an issue that we need to broaden consensus, not diminish it. My hope is that this is one of the areas we can do that.

So Mr. Barbour, and then Mr. Darbee, your thoughts again on the value of offsets, holding down the costs as we try to reduce CO₂ emissions.

Mr. BARBOUR. Thank you, Senator. I think the provision of the use of offsets to meet compliance is very wise, and if anything, I think I am a proponent of even greater use of offsets. I think this provides really a unique opportunity to capture the entrepreneurial spirit, the engineering know-how of our country and our problem

solvers here. The offset provisions allow project developers to go into areas that might not be covered directly by a cap, areas such as going into dairy operations, hog farms, landfills, abandoned coal mines, a variety of parts of the economy that are difficult to capture as a point source. It allows the project developers to invest capital in ways they can reduce greenhouse gas emissions. Fortunately, we have a system in place, as I had described in my testimony, a well-developed set of scientifically based, empirically based methodologies and procedures to capture and measure those greenhouse gas emissions and to do so efficiently, to report those and to track those over time, so that those reductions we can be assured of, they are real, they are measurable and they can become part of the overall compliance system.

Senator CARPER. Thank you, sir.

Mr. Darbee, your thoughts, please.

Mr. DARBEE. The offset mechanism actually is one of the reasons that a cap and trade program is better than a tax. Because if you are a company, let's say, like Pacific Gas and Electric Company, where it would cost you \$15 to eliminate the need for, to reduce a ton of carbon, the alternative that they have is we might be able to go out and buy an offset which would accomplish the same for \$5. Therefore, we would opt, by the \$5 solution rather than the \$15 solution.

So in short, offsets unleash the creativity and the innovation of the free market place, and therefore it delivers the opportunity to solve this problem of global warming more cost effectively than other alternatives.

Senator CARPER. Thank you.

Mr. Pershing, Ms. Smith, Ms. Thorning, your thoughts?

Mr. PERSHING. I would agree with both of those two comments. I would add only that the need to ensure careful monitoring, verification, transparency, those kinds of questions, verifiability, must be assured or you don't have the value of the offsets. But I very much agree.

Senator CARPER. Thank you.

Mr. Barbour, do I understand, and I am going to come back to Ms. Smith and Ms. Thorning, do I understand that your company actually validates offset projects, is that what you do?

Mr. BARBOUR. Yes, sir, we do. We have developed greenhouse gas monitoring, reporting and verification protocols for a number of different sectors. We are also working with U.S. EPA and the Department of Energy on ways to measure and develop and quantify these things.

Senator CARPER. Good. Ms. Smith, back to you, please.

Ms. SMITH. A couple of points. Offsets are a good thing to add. They do help reduce the cost of the program. The limits on the offsets in the bill have something to do with the high cost, and it actually explains some of the differences between our cost estimates and those of the Nicholas School paper.

But I also want to note that you can do offsets under carbon tax. There is no reason that can't happen as well.

Senator CARPER. Thank you.

Ms. Thorning.

Ms. THORNING. I would just like to add the point that verifying the offsets can be a sticky issue. We have seen the issue with the Chinese offsets apparently being fraudulently generated and the carbon footprint initiative, a lot of that has been apparently not substantial offset. So you do need a real bureaucracy to monitor this sort of initiative.

Senator CARPER. Thank you. As I recall, the offsets that are permitted or allowed under this bill have to be found within the United States, which I think is important, an important point. Let me just say how much we appreciate your being here and your providing this testimony and your willingness to respond to our questions. Frankly, to a number of you for your help in trying to chart these difficult waters and to come to a consensus.

Mr. Darbee, I think both Senator Lautenberg and I mentioned earlier in our statements that allowances, we favor an approach which provides allowances on the basis of output. The idea is to reward those who produce the most electricity with the least amount of pollution. I believe a number of my colleagues believe it is important to incentivize renewables, including solar, wind, geothermal and so forth. I say that as an advocate of nuclear, too.

Could you just explain for us briefly in ways that people can understand it, how output based allowances would do this? Can you give this a shot?

Mr. DARBEE. Yes, I can, Senator. The way the allowances would work under an output basis is a company would receive a certain amount of allowances which they would apply to the kilowatt hours or megawatt hours that they would sell. The beauty of this is the contrast with applying or allocating allowances by historical standards. If one were to give allowances to, let's say coal generators that had emitted a lot of carbon in the past, then there wouldn't be an incentive for them to change. In fact, they might continue at the extreme producing electricity with coal for decades.

Whereas if you provide allowances to those people that have low carbon emissions and it is based on output, you in effect are rewarding that kind of behavior and promoting more of it. The same would go with renewables as well as new cleaner technologies. So allocating allowances on the basis of output promotes the kind of behavior that we want to see out of the economy. It in effect provides economic advantage to those people who produce no carbon at all as they generate electricity or very low levels of carbon, such as natural gas-fired generation.

Senator CARPER. Good. Thank you very much for that response.

Senator LIEBERMAN. Thanks, Senator Carper.

Senator Voinovich.

Senator VOINOVICH. Thank you, Mr. Chairman.

Ms. Thorning, could we put your charts up on the—the charts that showed China—yes, that is the one right there. Associated Press, November 7, Beijing: China will reject any agreement that calls for binding limits on carbon dioxide limits that will replace the Kyoto Protocol, EU officials said Wednesday. Today, London, the Economic Times: India will become the third biggest emitter of carbon dioxide by 2015, and rapid economic growth of the country and its neighbor China will have devastating consequences for the world's energy supply unless the two Asian giants make efforts to

curb demand and greenhouse gas emissions, the International Energy Agency warned on Wednesday.

There are those that look at what we are doing and conclude that unless we understand that it is a global problem and that we do something about it, that is more rapid than frankly what this bill provides, that in terms of making a difference and reducing greenhouse gases and climate change it is just fruitless. I for one think that what should drive this issue is technology, the technology to capture carbon, sequester the carbon. I think members of this Committee know we had a FutureGen project that we tried to get in Ohio. They are going to build that in 2012.

My concern is that there is an urgency for us to move as quickly as possible to fast track this technology so that we get it right here, and then it is available for us to sell to other places in the world. That should be the thing that drives this. Mr. Chairman, I feel that this may not get the job done, this cap and trade. My feeling is that we ought to come up with some idea where we can look at the status of where our technology is, where can we find the money to move this along much quicker than what we anticipated.

We talked earlier about a Manhattan Project, we talked about responding to Sputnik. I would like your comments on that, and I think it was you, Ms. Smith, who talked about a 70 percent increase in natural gas costs as we try to ramp this thing up and get the technology. I have to tell you, and maybe I look at things differently than some of the members of this Committee, but we have lost jobs in our State, substantially, because of high natural gas costs. I live in Cleveland, OH. My heating bill is up over 300 percent over what it was in 2000. I have people in my town that are poor and the elderly that are really hurting because of these high energy costs.

One example, the chemical industry. We were number one in plastics when I was Governor, \$19 billion exported in 1997. Now we import chemical products. I would just like your comments about the reality of what we are talking about here and are we moving fast enough and have we given enough consideration to the economic impact that it would have on this Nation.

Ms. SMITH. We need to time the stringency of the caps to be consistent with the availability of the technologies. We also need, and S. 2191 fails to do that at this point. That is why there is such a shift in gas in some of the projections. A looser cap in the near term made up perhaps by a tighter cap in the long term could reduce the cost because it would be timed better with the technology.

But also really importantly, there is no emphasis in this bill on establishing funding for research and development to actually bring down the costs of these technologies. While we may be able to get them out in the 2020 to 2050 time frame, they are still quite costly. Something needs to be done to bring those costs down to make us want to incur those costs as well later in time.

Senator VOINOVICH. Ms. Thorning.

Ms. THORNING. I would just like to add that the Asia Pacific Partnership which was put in place in 2005 is designated to do exactly what you are asking, how to get technology transferred to developing countries. Of course, the Major Economies Initiative that is a follow-up to the G8 meetings is an attempt to broaden that.

The Asia Pacific Partnership, the goals of that are to encourage business to business transactions, so that technology can be transferred. The study that we released last year by CRA International looked at what are the barriers to getting this technology transferred in places like India and China. In China, a key barrier is lack of protection for intellectual property rights, corruption, inability to get money in and out. In some cases, like India, a key problem is government ownership of major industrial sectors.

So changing the institutional framework in developing countries can promote the kind of business to business transactions that will enable them to get access to our technology and Western technology without requiring huge Government subsidies. The Asia Pacific Partnership already has 130 program in effect, including one by Caterpillar Tractor, where they are capturing methane at Chinese coal plants and using it to produce electricity.

So there is a lot going on, and I think we need to build on these types of programs.

Senator VOINOVICH. Thank you.

Senator LIEBERMAN. Thanks, Senator Voinovich.

Senator Lautenberg, let me just mention that we are about 6 to 7 minutes into a vote. I believe that Chairman Boxer's intention was to have one round and then adjourn the hearing. So I will stay a while and then leave, and turn the gavel over to—I think she intended to adjourn it. So people who want to go and come back, and I will pass the gavel to the next sitting Senator.

Senator Lautenberg.

Senator LAUTENBERG. Yes, I would ask any of our friends on the panel, we thank you for your testimony, even though we have substantial agreement with some of you and disagreement, and agreement with others. So I will try to ask the questions quickly and if you could respond fairly quickly.

One thing I want to get off the table here is we constantly refer to the specter that India, China, et cetera, these giant developing countries bring as dangerous to us with the greenhouse gas production. But in some cases, we invited that. Our automobile industry didn't compete in the marketplace while cars came from Japan and took over the market, and make them more efficient, et cetera. So when we look and see what happened to us, and our profligate use of fossil fuels and without regard cost us our leadership. We can't ask these things of these countries because we don't deserve it. It was the talk, not the walk, that we provided.

I want to ask Ms. Smith, do you think that our pace as presently structured in the Lieberman-Warner bill would be too rapid an attempt to reduce greenhouse gases, endangering our economy, et cetera?

Ms. SMITH. It depends on how rapidly you want to go, you take on more costs. What I am presenting is that the rapid pace that occurs in the time period 2012 out through about 2020 to 2025 is so tight that it gets ahead of the technology. That doesn't mean that it will be cheap to do it later, but at least it is doable later without the disruption.

Senator LAUTENBERG. How about the longer term target that is tentatively listed here, 60, somewhere between 60 and 80 percent reduction in the year 2050? Is that too aggressive?

Ms. SMITH. It is extremely costly to meet, but it can be met without the disruption if we have a slower transition to it.

Senator LAUTENBERG. OK. Do you see any dangers to society, humankind, wildlife, et cetera, as a result of global warming impact?

Ms. SMITH. For the differences in a cap that is half as tight or as tight as the one in the bill currently, there would be no differences environmentally in the near term, from those near term differences.

Senator LAUTENBERG. No, your view, apart from what is in front of you at the table. Do you think that, are there real dangers that come from having growth in global warming?

Ms. SMITH. There is a serious risk issue that needs to be dealt with as a risk management situation.

Senator LAUTENBERG. OK, so it is not like a fire in the forest or the town or anything like that? You don't see an immediate need to get on these things, start squeezing down, et cetera?

Ms. SMITH. Immediate reductions by the United States of this degree will not do anything to the rate of change. What is needed is global action, concerted, unified global action over the long haul.

Senator LAUTENBERG. OK. Does the rapid ice melt around the world, do you believe that is taking place?

Ms. SMITH. I am not an expert on the science, but I don't doubt that there is melting in some parts—

Senator LAUTENBERG. You don't have enough knowledge from things that you see, from reports that we get, that there is rapid ice melt?

Ms. SMITH. There is ice melt in parts and there is ice build-up in others. But I am not debating that there is warming going on, not at all.

Senator LAUTENBERG. I see enormous danger to sitting by, again, I used the example once before here, and that is that we are the doctor, and we know that we have to administer medicine, the question is how strong and how soon.

Mr. Pershing, under this bill, new coal plants, coal power plants, can still be built without deploying any new technology to make them cleaner or more efficient. State of Kansas recently denied a permit for a coal plant because of global warming. Do you think Congress ought to require that all new coal plants use the most effective technology available as they produce these facilities?

Mr. PERSHING. I think there is a very strong case to be made for requiring significant additional obligations on coal-fired plants, which tend to yield substantial portions of the total greenhouse gas emissions globally. If we do that, we are likely to make the technology penetrate more quickly. You can increase over time the level of stringency of those obligations. The cap and trade program essentially does that by providing a price and an incentive through a price mechanism to make that case. But additional resources could usually be also provided to promote the technology and create standards.

Senator LAUTENBERG. Mr. Chairman, I make the observation, and I will steal seconds here, that the large percentage of view, the largest percentage coming from the table is that cap and trade works, contrary to some of the opinion that we have heard from the table here. Thank you.

Senator LIEBERMAN. Thanks, Senator Lautenberg. I must say that we have worked on this a lot, but it is a real pleasure to hear those who have thought about this a lot and lived within the system in some places as it has been carried out, certainly in the acid rain area, to hear you talk about it, because it has a vitality to it. This is a classically American, entrepreneurial market-based response to a mega environmental problem. I just don't think there is, you can have debates about whether we are doing it exactly right, whether we can fix it in some ways, how much it will cost. But I don't think there is a better way to deal with this problem than the way we are doing it. The contributions you have all made are great.

Perfect timing, Senator Craig. Let me indicate how we are going to proceed. I want to thank the witnesses, all of you, for your testimony. I appreciate it very much. It has been helpful to the Committee. I am going to depart to vote; I cannot return. I know a couple of the other Senators are coming back, I know Senator Sanders is coming back. So Senator Craig, I am giving you the liberty to question until one other Senator comes back. This could be, this is a very open, participatory committee.

The last Senator here who has not had questions yet will have the authority to adjourn the hearing. I thank you again very much, and call on my colleague, Senator Craig.

Senator CRAIG [presiding]. Mr. Chairman, thank you very much. I shall try to do you no harm.

[Laughter.]

Senator CRAIG. Like all of us, we thank all of you for being with us today and the thought that you have put into it. I think all of us recognize that getting this issue right has all the right impacts on our world and our economy, and getting it wrong could have all the wrong impacts in a very severe way. I am very slow to move in shaping public policy until I am convinced that the modeling we use, the science we use and all of those things are as accurate as we can get it. I have looked at this issue for many years; I have traveled the world to most of our climate change conferences. I recognize concerns and urgencies. I also recognize in some instances the near impossibility of getting where some of us think we ought to go.

Mr. Darbee, let me start with you. In 2006, 24 percent of PG&E's total electrical output or generation was nuclear power. In your view, can this type of cap and trade legislation be implemented without a significant commitment to new nuclear?

Mr. DARBEE. We have taken a look at the growth with respect to energy needs through the period 2030 through the EPRI organization which represents the electric utility industry. What is clear from that is that America's energy needs are going to grow very substantially on all fronts.

So what EPRI looked at was how much energy efficiency we will need, which is substantial, how much in the way of renewables, that amount is substantial, clean carbon technologies, IGCC with sequestration, very substantial. There remains a very significant gap beyond that. We believe at this time because of the size of that gap that nuclear needs to be on the table as an option.

But I do want to say that we also see great opportunity in the solar-thermal technology. Therefore, there is the possibility in many parts of the United States that if that technology grows sufficiently strongly as we anticipate it might, that could substitute for a substantial amount of nuclear power. So we think that the United States needs to keep its options open until that technology proves itself. But even with that, because of different climate differences in the United States, some amount of nuclear power may be required.

Senator CRAIG. In all of those instances, to bring a new unit of any type of production online, what is the average cost per kilowatt hour? Well, let's say photovoltaic, or solar in the instance that you are looking at and building.

Mr. DARBEE. Let me give you, if I may, the whole spectrum. In terms of, we translate it through to the cost to the customer. So with respect to, let's say, coal today from existing facilities, probably 3, 4 cents. Nuclear today from existing facilities, 4 cents; hydroelectric today, existing, 3 cents.

If you look at the costs of solar-thermal that was mentioned today, 10 to 12 cents seems to be the range, with the opportunity going toward 8. If you look at photovoltaic, it is pretty expensive, it is about 30 to 40 cents a kilowatt hour before you look at installation costs. So I think that probably gives you the spectrum.

Senator CRAIG. It does, it is an irony, or I should say a uniqueness of market in place at this moment in time. My State of Idaho is growing very rapidly. We are also fortunate that we have a largely hydro-based electrical economy, so we have the lowest cost power in the country. About 40 percent of our in-migration is coming out of California and they are retirees who are seeking our State for a variety of reasons, and clearly in the cost of all their dialogues is the cost of living and energy.

My frustration, because the Chairman was talking about the dynamics of a California economy, it may be a dynamic place if you are alive, middle-aged and working hard. If you are retired or poor, a problem begins to happen. We see a substantial migration out of California today into Idaho and other places where there are different attributes, but one of them being cost of living. Energy is a very real factor there.

Now, that leads me to you, Mr. Pershing, as it relates to how we allocate. Because we are a clean State, we don't have a carbon footprint of any kind, we don't have that kind of legacy. So it is not clear to me that a cap and trade system can be implemented without causing severe regional economic impacts. Idaho does not want to lose its advantages. Clearly, new energy in Idaho is going to be more expensive. We all know that all new energy is more expensive than old energy. It is also cleaner; we also understand all of those arguments. Idaho, as I have said, is one of those States that is the cleanest and least cost.

So I guess my thoughts to you are one, WRI's allocation preference, free or not free?

Mr. PERSHING. WRI would propose that there be some mix. We believe that in the initial phase, it doesn't seem politically possible to manage it with an entire auction, so we would start off with some share of being freely allocated. We do believe the auction

should be phased out over time. The more quickly it can be done the more quickly you get to an economic efficiency.

But I would note that there is a space in this whole area for something to be done with the revenues, and with the allowances. This could provide partly, for example, mechanisms that are allocating allowances to the States, for some way to offset some of the costs that you have identified. There also is quite a lot of information in the economic literature and various studies being done for the States individually that suggests that some of these outcomes may not be as negative as you suggest. For example, while the electricity price that you pay may go up, the total electricity that you consume may go down. The balance between those may actually lead to a stable or even a marginal reduction in the price.

The State of Illinois did this kind of analysis and showed that.

Senator SANDERS [presiding]. Thanks. I guess I am acting Chair here.

Larry, you were about 2 minutes over, as I understood it. Is that right? He had about 7 minutes, I think.

Senator CRAIG. OK, fine, thank you.

Senator SANDERS. It doesn't look like a whole lot of us here, so—

Senator CRAIG. Why don't we do that, I will stay for a couple more minutes. There are a few more questions I would like to ask. Thank you.

Senator SANDERS. OK. Let me ask Mr. Darbee a question. Mr. Darbee, on page 12 of your written testimony, you mentioned, you discuss a study from the Federal Government's own National Renewable Energy Lab solar plants to be?

Mr. DARBEE. Well, absolutely, Senator. I might say one thing, before when we were talking about different technologies, I failed to mention that new clean coal technologies cost about 8 cents a kilowatt hour as we expect nuclear about 10 cents.

Senator SANDERS. We are not really sure about clean coal, are we?

Mr. DARBEE. We are not, indeed. So going to your point about solar-thermal technology, we as a company are very excited about that, because it is significantly cheaper than photovoltaic. So we are seeing the prices in the areas that you have mentioned 10 to 12 cents right now and likely, hopefully will go to 8 cents. That is what the vendors are telling us.

Senator SANDERS. I am not an expert on this, but everything being equal in terms of gas and other forms of energy, one assumes over a 25-year period that is going to go up pretty steep. If one were looking at 8 cents per kilowatt hour, in the year 2035 or whatever, am I wrong in saying that would be really quite cheap electricity?

Mr. DARBEE. You are absolutely right. One of the things is with solar power, there is no input cost and no input uncertainty as there is, say, with natural gas, coal, things like that. So that is the case. The other thing is the technology is pretty simple and practical. You are basically taking the sun, concentrating it with mirrors, putting it on a pipe, turning water to steam and turning a turbine.

Senator SANDERS. Let me ask you this. You have signed a contract with a company called Solel for a 553 megawatt plant, is that right? I understand that in your part of the world, you and other utilities have a number of plants—you are thinking about developing a whole number of plants. What is the potential out there? How much electricity can we be generating, do you think, through solar plants?

Mr. DARBEE. We are setting a target of 2,000 megawatts over the next number of years, 5 to 10 years. So the potential actually in the sunny parts of the United States, southwest and west in particular, what we are seeing is, we could deliver more solar-thermal power than nuclear plants, because frankly a nuclear plant takes 10 years to build, at least, probably.

Senator SANDERS. Sorry to be interrupting you—

Mr. DARBEE. So, very substantial.

Senator SANDERS. Again, going back to this National Renewable Energy Lab, they are talking about the possibility of solar plants producing upwards of seven times the energy needed to serve the State of California. That sounds like an enormous amount of electricity and huge potential out there. Is that correct?

Mr. DARBEE. That is, and that is conceivable, yes.

Senator SANDERS. The other point that I want to make, when you talk about whether it is 8 cents or whatever it may be per kilowatt hour, as I understand it, you are just including now the investor production tax credit as your Federal assistance here?

Mr. DARBEE. That is correct.

Senator SANDERS. Now, our friends in coal, and I am not against coal, I want to explore the potential of clean coal, they are talking about getting hundreds and hundreds of billions of dollars in subsidies. Now, if we said to you that the Federal Government would build one of your \$2 billion plants, we would put 50 percent of the cost in, am I wrong in saying that you could drive the price down to consumers to perhaps 4 or 5 cents per kilowatt hour?

Mr. DARBEE. You are correct, Senator.

Senator SANDERS. So I would simply say that before we talk about spending, I mean, this is a huge and significant statement that Mr. Darbee is making. This is not an unknown technology. This is a technology that is online now and will be only growing. It seems to me incumbent upon the Federal Government to strongly support it.

My last question, Larry, I am going to take just two more minutes then give it over to you, is that I noticed in your remarks you talked a little bit about the provision regarding new sources for energy production. You noted in your testimony, basing allowance allocations solely on historic emissions only serves to reward and encourage the highest-emitting resources and discourages rapid development in deployment of clean or lower-emitting technologies. Can you elaborate on that, please?

Mr. DARBEE. Basically, if one allocates enough allowances to existing old coal plants, the incremental cost of running those plants in a carbon-constrained environment will be zero. Therefore, people will continue to run the plants; in effect they are subsidized.

So we believe that by shifting the allowance allocation to relatively clean fuels or non-emitting forms of generating energy, that

will promote the right behavior of rewarding those people that produce the cleanest technology.

Senator SANDERS. I should just say that we are going to offer an amendment dealing just with that issue in the subcommittee. We will probably revisit that later on.

Senator Craig.

Senator CRAIG. Mr. Chairman, thank you very much.

Mr. Pershing, you were completing a thought when time ran out. Let me ask this question, because I said it in my opening statement, and it frustrates me a great deal as we begin to move dollars around the country that actually don't produce clean energy. I use the phrase, a transfer of wealth.

Is not the allocation process, and you talked about rewards and benefits, is that not a transfer of wealth so legislated?

Mr. PERSHING. To a certain extent, of course it is, yes. The issue in part is with what end and to what purpose. So in this instance, what we are seeking to do is to move revenues from systems, energy-generating systems that are highly carbon-intensive to those that are low carbon-intensity. Those should in theory be managed through a price mechanism and a structure. But it will move money from one place to another.

Senator CRAIG. Thank you.

Dr. Smith, 2191 attempts to aggressively cut domestic greenhouse gas emissions, so your testimony indicates that it will only be achieved through the transfer of domestic manufacturing activities from the United States to international competitors. We know that many of those international competitors will not be in any form of compliance until technology reaches them that allows them to comply. Under this scenario, what are the impacts to the economy, jobs, and frankly, to the global environment?

Ms. SMITH. What you have described is what we call leakage, it is leakage of emissions from the United States to another country. When either United States or foreign sources supply our demand, our needs, with goods and services, emissions occur. We can either produce them ourselves and emit it here, or we can try and cap our emissions here. If the result of that is to create competitive disadvantage so that in fact we start to buy imports, all we have done is move the emissions from the United States to another part of the globe. The environment gains nothing if that occurs.

I would like to correct something you said, I did not say that the entire cap is met through leakage. I did say that a cap with this degree of price increase, without protections at the border for our industry, which are not in the bill, those protections, would create tremendous amounts of leakage that would just be a perverse consequence of the bill. It would hurt our economy and do nothing for the environment.

Senator CRAIG. Thank you.

Dr. Thorning, I am not sure whether this fits, but I find it a fascinating idea. On October 20 of this year, San Francisco turned out their lights. They were out for an hour in an attempt to save electricity. I am told that to some it was a very frightening experience, because they didn't have the security that lights and energy brought them.

You indicate that we would have to reduce our energy usage by significant amounts to meet the goals of 2191 based on the timing that all of you have spoken to. Can you give us an idea how realistic this energy savings approach is and would California have to go from 1 hour to 2 hours? Or I should say San Francisco. California didn't do it all.

Ms. THORNING. The targets on S. 2191 are so tight that it would clearly impinge on consumers' lifestyles. I think it would require, as my testimony suggested, by 2030, reducing emissions by approximately 50 percent on a per capita basis. Stop and think what that means to what kind of appliances, what kind of house, what kind of transportation system you have. It would require much dimmer lighting, much more emphasis on building efficiency and so forth. All of those changes can be made in time. But because of the length of life of our capital stock, it is very, very costly, as Dr. Smith's analysis suggests, to make these transitions in a matter of 15, 20 or even 25 years.

So I think we need to look very carefully at the kind of challenge we are putting in front of consumers and business with the targets in this bill.

Senator CRAIG. Thank you, 36 seconds left, quick question of you, Mr. Barbour. How can we be certain that any cap and trade system employed here in the United States can in fact avoid the volatility that the European experience has had, and when it was established over there, the reaction to it?

Mr. BARBOUR. Senator, I think there were several lessons to be learned from that experience. Certainly there was an over-allocation of allowances to industry, which, once that was discovered, that really diminished their value over time. So the allocation needs to be tightly matched to the desired environmental goal, not only to reach that goal, but also to preserve their value over time. Secondly, as I had mentioned, there was no provision for banking into the next period. It simply ended, and that really drove the value to zero. I think we still have yet to discover how well the system will work. The Kyoto Protocol's first compliance period actually begins in 2008, 2012. So it is a little premature to judge. Maybe in 2012 we will know how well the system works. But it hasn't even started yet.

Senator CRAIG. Thank you all very much for your time with us. We appreciate it.

Senator SANDERS. Senator Whitehouse.

Senator WHITEHOUSE. Thank you all for staying with us. I appreciate the time that you have given us. It is important work that we are embarked on, and it is important to get it right.

I would be interested in anybody's thoughts on how to police the integrity of the auction and trade system. I think the concept that we are getting at is the right one. But we are almost still at the position paper level. We have seen over and over again markets that overheated, we have seen markets that were taken advantage of by people who were out to game the system. We have an entire Securities and Exchange Commission set up to police our capital markets. We have had unpoliced markets in, for instance, electric energy in California that created disastrous outcomes. Enron trade

in a sort of quasi-market in energy futures and was a phony and fraud, it was a nightmare for people who were involved with that.

So I think between where we are now and where we need to get when this bill emerges, there have to be some pretty serious safeguards built into that process to make sure that it is not captured. Particularly you consider that billions and over time perhaps even trillions of dollars of carbon or greenhouse gas credit might very well flow through the entity that markets them. There is an enormous motivation, just as there is in this building, of people to try to get their hooks into that money for ulterior purposes than just the public benefit.

When you consider the safeguards that are set up here, the safeguards that are set up in our judicial system, the safeguards that are set up for the stock market, the safeguards that are set up everywhere, this thing right now looks like the wild west. Where would you recommend that we go for models? We could probably try to think this thing through from scratch, but usually it is better to try to get some tested ideas that have withstood some practical experience in their areas. Where should we go to fill in that concern about these markets either being run out of control or corrupted or gamed by speculators?

Mr. Darbee.

Mr. DARBEE. Senator, that is something we have given a lot of thought to. Having been in California at the time that Enron was taking advantage of it, we had a fair amount of experience. We have several thoughts in that regard.

Senator WHITEHOUSE. One quick interruption. You can agree with me that if there is a market failure of some kind happening, relying on the market to sort it out doesn't help?

Mr. DARBEE. Exactly right. I think in general, the SEC is a good model. Many people think that we have gone possibly too far with Sarbanes-Oxley and put a lot of cost on it. But certainly prior to Sarbanes-Oxley I think the SEC regulation of the security markets was viewed as really the model in the word. So the SEC is very capable of identifying market manipulation. That is certainly what we saw in the energy crisis in California, where Enron and others, it would appear, took advantage of the market. Of course, those players have settled and paid hundreds of millions, if not billions of dollars, to rectify that.

So I think we would want to take a look at how the SEC monitors the securities markets, and establish a similar methodology with respect to the energy markets, and also monitoring the financial instruments that are synthetic alternatives to the real-time market there. So that is the first.

Second, as I mentioned earlier, and I am not sure if you were here at the time, we would like to propose extending on the Fed model that is embedded in the Lieberman-Warner legislation and have the Fed-like entity that is created work with a collar on prices that would rise over time. Specifically, there would be a proposed ceiling for the price of allowances, a proposed floor for it. What would happen is when the prices started to go above market, the Fed-like entity would borrow from the future allowances to provide supply into the market, to handle that pressure. Because we saw in California, when the markets went out of control on energy, the

price of energy went up far more than anybody expected. I think as policymakers, you want to be concerned to protect against things like that. That wouldn't be good for the environment, this policy, or for the economy.

At the same time, by creating both the floor and the ceiling, which would rise over time, what would happen is there would be increased certainty on the part of venture capitalists and industrialists to create new technology as they go down, because they will know what the price of carbon is within a range over a period of time. So we think that that would be very helpful to resolving this problem. So those are just a couple of suggestions.

Senator SANDERS. Why don't you take another minute, if you need?

Senator WHITEHOUSE. I don't need another minute, I just would wish to hear from the other witnesses, to the extent that others have something to add.

Senator SANDERS. Sure.

Senator WHITEHOUSE. Mr. Pershing.

Mr. PERSHING. Thank you very much. Just one comment to add to Peter Darbee's, which is the other side of the equation, how can you monitor it effectively. We actually have a whole series of techniques that would enable us to do that. One of the best examples clearly is the continuous emissions monitor that comes at the end of the smokestack. But there are others that could be applicable and parallel for almost all sectors.

Then we need a registry. We have to have a place to record this information and to allow for full transparency in that. I would note that there are now more than almost 40 States that have been working collectively to design exactly that kind of registry. That provides a very good model for a place to start.

Senator WHITEHOUSE. Ms. Smith.

Ms. SMITH. I would just like to comment on the idea of a price ceiling and the idea of a collar. That will be the mechanism that will provide some certainty in the market, will reduce the degree to which businesses face huge risks in the face of uncertain auctions and the volatility in prices that will occur in the market, which really undermine the ability of businesses to plan against a long-term future cap.

The only problem I would like to point out is that a collar, where there is a price ceiling and a price floor that is pre-established will not be viable to sustain over the long period, unless those prices that are established are consistent with the cap and what the CPA will cost to achieve. So one can resolve the volatility and should through a price ceiling. But the only way to ensure that certainty on the prices over the long run will be a price ceiling, more in the form of a safety valve. But that is necessary in order to make this a viable policy going forward, to provide protection against the kinds of risks, economic risks in the short run that I was talking about.

Senator WHITEHOUSE. Ms. Thorning, would you like to say something?

Ms. THORNING. I would just like to make one observation about the idea that the SEC might be a model for this. With the SEC, you have buyers and sellers on opposite ends of the transaction.

They each have an interest in policing the accuracy of the information, because if one cheats, the other one loses, it is a zero sum game. But when you have an ETS, it could be in both parties' interest to collude, and it is not a zero sum game. So I think using SEC as a regulatory model may not hold in this type of situation.

Senator WHITEHOUSE. Mr. Barbour.

Mr. BARBOUR. I appreciate the concern. I think the Carbon Market Efficiency Board has implemented in the legislation, I think it addresses that as well as we can.

Mr. DARBEE. If I can just add one other thing. People look to Europe and say, gee, that is an example of where the cap and trade system didn't work too well. As people recall that experience, the price of allowances went up very, very high and then came down and were very low. The idea of a collar would protect against both instances.

So if allowances were issued, additional ones at the time that there was a lot of demand and prices were heading up, the benefit of the collar is that the Fed-like mechanism would be in purchasing allowances if in fact we saw the prices go back down. That purchase of allowances would bring them into the collar range, and therefore avoid a problem like we saw in Europe.

Senator SANDERS. Thank you, Senator.

Let me just very briefly ask what will be the last question. Ms. Thorning a moment ago indicated that if we move forward vigorously in cap and trade the result might be a significant lowering of our standard of living and cutbacks in electric consumption and so forth. I would simply say that in my city of Burlington, Vermont, we have grown reasonably well over the last 15 or 16 years. The city is, because of strong energy conservation, approaches, we are consuming no more electricity than we did 16 years ago. I think in California, over a 30-year period, as I understand it, per capita electric consumption has remained fairly level. I am not aware that the people in California are living in caves and huts and seeing a major decline in their standard of living.

So my question that I throw out is, what is the potential of energy conservation? Maybe Mr. Pershing, do you want to start that off, and is there great potential out there?

Mr. PERSHING. I think there is enormous potential. The models range quite substantially. In addition to the examples that you cited, there are clearly equivalent examples in Europe. I would note that even countries like China, which was raised earlier by Senator Craig, has a very aggressive energy efficiency program precisely for this reason. In fact, it is driven partly by climate change, but even more by energy security. It is that dynamic that reduces the total costs at very modest overall effort with side benefits, benefit for local pollution, benefits for jobs and the local economy, which are things like installation of insulation and things like new technologies around efficient lighting.

We had a comment earlier that you couldn't do much for your lighting, you would have to have dim lights. Well, we went to a compact fluorescent and got a 50 percent improvement. We can go now to an LCD and we can get an additional 70 percent improvement. I don't believe that the problem is insurmountable. Efficiencies are huge.

Senator SANDERS. Mr. Darbee, did you want to comment on that?

Mr. DARBEE. Senator, I have heard people in our industry suggest, as we have heard here today, that the technology doesn't exist and we need to wait until it does. My reaction to that is that it is nonsense. The experience you cited in Burlington, VT, the experience that we have shown in California is that with just energy efficiency alone, there are great strides that can be made.

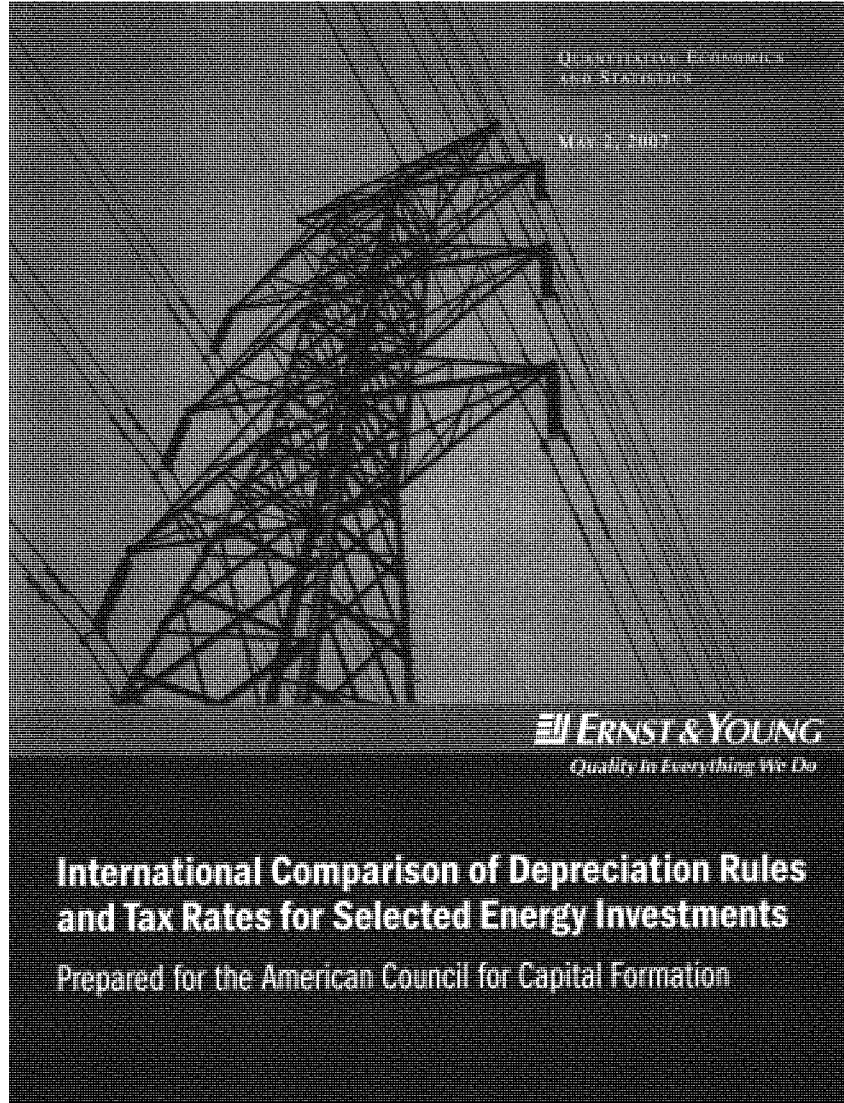
We have actually entertained delegations from China looking at the experience of energy efficiency in California. They are gobbling up that information and taking it back and applying it to China, because they know that they are using energy in a wasteful fashion and that not only is that bad for the environment, but they want to be even more competitive than they are today. They know that energy efficiency will make them more competitive.

So there is a lot we can do today with just energy efficiency. Of course, technology is developing all the time. So the time for action is now, and waiting is not the appropriate course of action.

Senator SANDERS. OK, maybe on that tone we will wrap it up. On behalf of the Chair, let me thank all of you very much. It has been a very productive hearing. Thank you.

[Whereupon, at 12:30 p.m., the committee was adjourned.]

[Additional material submitted for the record follows.]



**International Comparison of Depreciation Rules
and Tax Rates for Selected Energy Investments**

Prepared by
The Quantitative Economics and Statistics Group, Ernst & Young LLP

Prepared for
The American Council for Capital Formation

May 2, 2007

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International Comparison of Depreciation Rules and Tax Rates for Selected Energy Investments

Executive Summary

The American Council for Capital Formation requested from the Quantitative Economics and Statistics group of Ernst & Young LLP an analysis comparing the tax depreciation rules for various energy investments between the United States and selected foreign countries.

The analysis examined eleven asset types used in the energy sector across twelve countries. The analysis examined the tax depreciation in several ways: 1) the percentage of the original investment recovered during the first five years, 2) the percentage of the original investment recovered during the first ten years, 3) the net present value of the depreciation deductions over the life of the asset, and 4) the effective tax rate of the investment taking into account depreciation, tax credits and the countries' marginal tax rate.

The results of the study are:

- The United States generally has less favorable tax depreciation rules for electric generation, electric transmission and distribution, and petroleum refining than many other countries, including a number of the U.S.'s major trading partners.
- The U.S. generally has slower cost recovery during the first five and ten years after the investment than the comparison countries. For example, investments in electric generation fueled by natural gas, nuclear and coal recovers less than 38% of the original investment during the first five years and 68% during the first ten years in the U.S., compared to 80% and 97%, respectively in Canada.
- When the time value of money is taken into account, the U.S. depreciation rates remain less favorable than most of the competitor countries. Again, an investment in electric generation fueled by natural gas, nuclear and coal has a net present value of depreciation over the entire recovery period of less than 66% of the original investment in the U.S. compared to 84% in Canada.
- Because the United States has the second highest statutory corporate marginal tax rate among OECD countries combined with generally less favorable tax depreciation rules, the differences in effective tax rates are even greater. Based on a number of assumptions including economic depreciation, we estimate the corporate effective tax rate on investments in electric generation fueled by natural gas, nuclear and coal at 27-31% in the U.S., compared to 14% in Canada.

- These findings are consistent across all of the energy assets studied, including different types of electric generation, electricity transmission and distribution, pollution control equipment, and petroleum refining.
- Cross-country comparisons require a number of assumptions and limitations to summarize the complex tax treatment of multiple investments across multiple countries. The analysis makes note of the assumptions and limitations.

International Comparison of Depreciation Rules and Tax Rates for Selected Energy Investments

Introduction

The American Council for Capital Formation requested from the Quantitative Economics and Statistics group of Ernst & Young LLP an analysis comparing the tax depreciation rules for various energy investments between the United States and selected foreign countries.

The analysis examined eleven asset types used in the energy sector across twelve countries. The analysis examined the tax depreciation in several ways: the percentage of the original investment recovered during the first five years and during the first ten years, the net present value of the depreciation deductions over the life of the asset, and the effective tax rate of the investment taking into account depreciation, tax credits and the countries' marginal tax rate. The net present value and effective tax rate analyses are presented with a constant inflation rate across countries. The analysis uses the tax rules in effect in 2006.

The eleven countries besides the United States the American Council for Capital Formation has selected include many important trading partners of the United States. According to OECD statistics, in 2005, the selected countries accounted for more than 65% of United States imports and more than 60% of United States exports.¹

Energy Investments Analyzed

The eleven energy investments analyzed range from electric generation, transmission and distribution, to pollution control equipment and petroleum refinery equipment. The specific assets evaluated are:

Electric Generating Facilities: Gas – Includes assets used in the production of electricity for sale fueled by gas. In the United States, these assets are in Asset Class 49.15 (IRS Revenue Procedure 87-56) with a class life of 20 years, and a recovery period of 15 years.

Electric Generating Facilities: Coal – Includes assets used in the production of electricity for sale fueled by coal. In the U.S., these assets are in Asset Class 49.13 with a class life of 28 years and a recovery period of 20 years.

Electric Generating Facilities: Nuclear – Includes assets used in the nuclear power production of electricity for sale, but does not include nuclear fuel assemblies which have a five year recovery period. In the U.S., these assets are in Asset Class 49.12 with a class life of 20 years and a recovery period of 15 years.

¹ Organisation for Economic Co-operation and Development, Source OECD 2005 Annual Statistics of International Trade

Combined Heat and Power Using Conventional Fuel – These assets include co-generation facilities that use a heat engine or power station to generate both electricity and useful heat. In the U.S., these assets are in Asset Class 49.13 with a class life of 28 years and a recovery period of 20 years.

Distribution of Electrical Heat and Steam Generated for Self Use – These assets are used in the production and/or distribution of electricity for use by the taxpayer in its industrial manufacturing process or plant activity and not ordinarily available for sale to others. In the U.S., these assets are in Asset Class 00.4 with a class life of 20 years and a recovery period of 15 years.

Electric Transmission Lines – Includes assets used in the transmission of electricity for sale. In the U.S., these assets are generally in Asset Class 49.14 with a class life of 30 years and a recovery period of 15 years.

Electric Distribution Lines – Includes assets used in the distribution of electricity for sale. In the U.S., these assets are in Asset Class 49.14 with a class life of 30 years and a recovery period of 20 years.

Electricity Smart Meters – Includes assets that are a general class of meter which not only measures the quantity of kilowatt hours but also the “quality of supply” functions and is capable of being read remotely. Smart meters communicate electricity consumption data automatically to and from a central computer, usually by radio frequency or power line communication. In the U.S., these assets are currently treated as part of the electric distribution system, and are included in Asset Class 49.14 with a class life of 30 years and a recovery period of 20 years.

Pollution Control Discharge Modification Equipment: These assets include pollution control equipment that modifies the outputs (e.g., thermal discharge control) rather than modifying inputs (e.g., scrubbers). In the U.S., these assets have a recovery period of seven years.

Petroleum Refining Crude Unit (Distillation): Includes assets used for the distillation of crude petroleum into gasoline and its other components. In the U.S., these assets are in Asset Class 13.3 with a class life of 16 years and a recovery period of 10 years.

Petroleum Refining Fluid Catalytic Cracking Unit: Includes assets used for the catalytic cracking of crude petroleum and its other components. In the U.S., these assets are in Asset Class 13.3 with a class life of 16 years and a recovery period of 10 years.

Methodology

Ernst & Young used its foreign tax desk network to collect information from the non-U.S. countries. Tax specialists for each of the countries provided information about the tax depreciation rules, any special credits, and any other special tax rules applying to the

specific assets. For purposes of this analysis, a number of assumptions and limitations needed to be made to summarize the comparative tax treatment of multiple assets across many countries.

Tax depreciation rules require the classification of many assets into different recovery periods. The U.S. assignment of cost recovery allowances may depend on the particular asset or the particular industry activity in which the asset is used.² For example, the U.S. has a single recovery period for assets used in electric generating facilities, whether they are structures or machinery. Some countries, such as Germany, have different recovery periods depending on the specific assets used within the electric generating facility. In such cases, a single asset recovery period representing a significant asset was chosen rather than attempting to estimate an average recovery period or estimating multiple recovery periods for multiple assets for a single facility.

Many countries have special tax rules (accelerated depreciation, credits, or lower rates) for certain types of activities or fuels. For example, the U.S. and several of the comparison countries have favorable tax treatment for renewable fuels. A number of countries have more favorable tax treatment for economic activity occurring in special economic zones. For purposes of this study, the estimates are based on tax rules for general activity rather than targeted geographic or targeted input incentives.

The estimates assume the investments were put in place July 1, 2006. Many countries have half-year or monthly conventions for tax depreciation. The tax rules are those applicable in 2006. Some of the tax provisions are temporary and will change in future years.

Where there is an option of depreciation rules, the estimate calculates the most favorable tax rule. For example, if companies have the choice between straight-line depreciation and double-declining balance depreciation, the double-declining balance depreciation is used. Some companies may choose to use straight-line depreciation due to otherwise expiring net operating losses or some other reason.

Some countries have more favorable tax rules that are available under certain circumstances including approval by the tax administrator. If the tax provision is not automatic and generally available, then that special provision is not included in the estimate.

Net Present Value of Depreciation Deductions.

Depreciation deductions generally are taken over multiple years. Deductions taken in future years do not have the same financial value as deductions taken in the year of the investment, due to the time value of money. Net present values adjust a stream of future deductions into the current period equivalent. Calculating net present values requires an assumption about the discount rate used to value future income or expenses. Most

² U.S. Department of the Treasury, Report to The Congress on Depreciation Recovery Periods and Methods, July 2000, p. 31.

financial analysts use a weighted average of the returns to debt and equity. This can vary by a number of factors across firms and countries, by the debt/equity ratio, the statutory marginal tax rate, real rates of return, and inflation rates.

A recent Congressional Budget Office study³ estimated the weighted average cost of funds was 6.63%. We have rounded up to 7% to calculate the net present value based on a U.S. weighted average cost of funds, which might be most applicable to a U.S. based multi-national corporation. In comparison, Michael Devereux in a recent analysis of international tax rules assumed a 10% interest rate and a fixed inflation rate of 3.5%.⁴ A higher discount rate would lower the net present value more for longer-lived assets.

Effective Tax Rate on Energy Investments

An additional measure comparing the effect of tax systems on investments across time, assets, and/or countries is a measure of an effective tax rate. An effective tax rate takes into account not only tax depreciation but also statutory marginal tax rates and tax credits.

An effective tax rate measures the difference between the pre-tax rate of return and the after-tax rate of return as a percentage of the pre-tax rate of return. There are numerous potential effective tax rates.⁵ For purposes of this analysis, we have calculated the effective corporate tax rate on investment, after-corporate income tax and before personal income taxes.⁶ For purposes of this analysis, the estimates assume that multinational corporations provide an after-corporate tax, but pre-individual investor tax, rate of 7.0% real, which is the long-term historical U.S. average on corporate equities.

The Appendix I describes the calculation of the effective tax rate measures.

Results

The international comparison results are presented in four tables.

International Comparison of Nominal Capital Costs Recovered After Five Years for Selected Energy Investments

Table 1 shows the amount recovered during the initial five years of cost recovery deductions in the U.S. for the selected energy investments ranges from 30% for coal electric generation facilities, distribution lines and smart meters to 64% for pollution control equipment. Coal electric generation facilities are recovered over 20 years under

³ Congressional Budget Office, Computing Effective Tax Rates on Capital Income, December 2006.

⁴ Devereux, M.P., R. Griffith, and A. Klemm, "Corporate Income Tax Reforms and International Tax Competition", June 2002

⁵ CBO, *ibid.*

⁶ CBO, *ibid.*, King, M.A. and Don Fullerton, The Taxation of Income from Capital, A Comparative Study of the United States, the United Kingdom, Sweden and West Germany (1984), Jorgenson, D.W., and Ralph Landau, Tax Reform and the Cost of Capital: An International Comparison (1993).

a double declining balance method with a half-year convention in the first year. Pollution control equipment is recovered straight-line over seven years.

Other countries' capital cost recovery in the first five years ranges from 21% for electric transmission and distribution lines in Brazil to immediate write-off of 100% for all of the selected assets in Malaysia plus a number of other assets in several other countries. Mexico allows over 100% of the historical nominal cost for pollution control equipment during the first five years, because it provides an inflation adjustment plus a short recovery period. Table 1 compares nominal capital costs recovered after five years as percent of total asset value for selected energy investments.

Table 1: International Comparison of Nominal Capital Costs Recovered After Five Years for Selected Energy Investments, 2006

	Electric Generation					Electric Transmission & Distribution Lines			Pollution Control Equipment	Petroleum Refining	
	Gas	Coal	Nuclear	Combined Heat & Power Generation	Self-Generated Electricity	Transmission Lines	Distribution Lines	Smart Meters	Discharge Modification	Crude Unit (Distillation Unit)	Fluid Catalytic Cracking Unit
United States	37.7%	29.5%	37.7%	29.5%	37.7%	37.7%	29.5%	29.5%	64.3%	63.1%	63.1%
Brazil	37.7%	47.5%	N/A	37.7%	63.1%	20.6%	20.6%	31.2%	89.6%	63.1%	63.1%
Canada	79.6%	79.6%	79.6%	79.6%	79.6%	31.2%	31.2%	63.1%	79.6%	79.6%	79.6%
China	39.8%	39.8%	39.8%	39.8%	39.8%	39.8%	39.8%	39.8%	41.3%	39.8%	39.8%
Germany	30.0%	30.0%	37.5%	30.0%	30.0%	33.1%	33.1%	63.1%	79.6%	72.3%	79.6%
India	55.6%	55.6%	55.6%	55.6%	55.6%	55.6%	55.6%	100.0%	100.0%	66.1%	66.1%
Indonesia	45.0%	45.0%	45.0%	45.0%	45.0%	45.0%	45.0%	45.0%	45.0%	45.0%	45.0%
Japan	49.7%	49.7%	49.7%	49.7%	45.6%	37.4%	37.4%	49.7%	76.9%	72.3%	72.3%
Rep of Korea	57.7%	57.7%	57.7%	57.7%	57.7%	57.7%	57.7%	57.7%	89.0%	89.0%	89.0%
Malaysia	100.0%	100.0%	100.0%	100.0%	100.0%	90.0%	90.0%	90.0%	100.0%	90.0%	90.0%
Mexico	46.2%	46.2%	46.2%	46.2%	46.2%	23.1%	23.1%	23.1%	101.2%	32.3%	32.3%
Taiwan	49.7%	49.7%	49.7%	49.7%	49.7%	49.7%	49.7%	49.7%	96.6%	78.5%	78.5%

Table 2 compares the nominal capital costs recovered after five years to the proportion recovered under United States' tax depreciation rules. In addition to the number of countries with greater, similar and lower amounts recovered after five years, the table also shows the percent of United States international trade with countries in each of the three groups.⁷

Table 2: Countries where Nominal Capital Costs Recovered After Five Years are Greater, Similar, and Less than under United States' Tax Depreciation Rules, 2006

Asset Group	Asset	Number of Countries			Percent of International Trade		
		Greater	Similar	Less	Greater	Similar	Less
Electric Generation	Gas	9	1	1	58%	2%	5%
	Coal	10	1	0	59%	5%	0%
	Nuclear	9	1	0	58%	5%	0%
	Combined Heat & Power Generation	10	1	0	59%	5%	0%
	Self-Generated Electricity	10	0	1	59%	0%	5%
Electric Transmission & Distribution Lines	Transmission Lines	6	1	4	19%	8%	37%
	Distribution Lines	9	0	2	51%	0%	13%
	Smart Meters	10	0	1	53%	0%	11%
Pollution Control Equipment	Discharge Modification	9	0	2	52%	0%	12%
Petroleum Refining	Crude Distillation Unit	7	1	3	39%	2%	23%
	Fluid Catalytic Cracking Unit	7	1	3	39%	2%	23%

International Comparison of Nominal Capital Costs Recovered After Ten Years for Selected Energy Investments

Table 3 shows the amount recovered during the initial ten years of cost recovery deductions in the U.S. for the selected energy investments ranges from 53% for coal electric generation facilities, distribution lines and smart meters to 100% for pollution control equipment. Coal electric generation facilities are recovered over 20 years under a double declining balance method with a half-year convention in the first year. Pollution control equipment is recovered straight-line over seven years.

⁷ Percent of international trade is calculated by dividing the sum of imports and exports with each country by total United States imports and exports. The countries under consideration account for 64% of total imports and exports combined, so the total for each row equals 64%. The figures for nuclear generation are slightly lower because Brazil is excluded since it does not have any nuclear generating facilities.

Table 3: International Comparison of Nominal Capital Costs Recovered After Ten Years for Selected Energy Investments, 2006

	Electric Generation					Electric Transmission & Distribution Lines			Pollution Control Equipment	Petroleum Refining	
	Gas	Coal	Nuclear	Combined Heat & Power Generation	Self-Generated Electricity	Transmission Lines	Distribution Lines	Smart Meters	Discharge Modification	Crude Unit (Distillation Unit)	Fluid Catalytic Cracking Unit
United States	67.5%	53.2%	67.5%	53.2%	67.5%	67.5%	53.2%	53.2%	100.0%	96.7%	96.7%
Brazil	63.2%	74.4%	N/A	63.2%	87.9%	38.6%	38.6%	54.7%	99.2%	87.9%	87.9%
Canada	96.6%	96.6%	96.6%	96.6%	96.6%	54.7%	54.7%	87.9%	96.6%	96.6%	96.6%
China	84.8%	84.8%	84.8%	84.8%	84.8%	84.8%	84.8%	84.8%	67.2%	84.8%	84.8%
Germany	63.3%	63.3%	79.2%	63.3%	63.3%	57.3%	57.3%	87.9%	96.6%	93.4%	96.6%
India	80.3%	80.3%	80.3%	80.3%	80.3%	80.3%	80.3%	100.0%	100.0%	84.9%	84.9%
Indonesia	71.8%	71.8%	71.8%	71.8%	71.8%	71.8%	71.8%	71.8%	71.8%	71.8%	71.8%
Japan	76.6%	76.6%	76.6%	76.6%	72.4%	62.8%	62.8%	76.6%	95.0%	93.4%	93.4%
Rep of Korea	83.8%	83.8%	83.8%	83.8%	83.8%	83.8%	83.8%	83.8%	100.0%	100.0%	100.0%
Malaysia	100.0%	100.0%	100.0%	100.0%	100.0%	100.0%	100.0%	100.0%	100.0%	100.0%	100.0%
Mexico	103.7%	103.7%	103.7%	103.7%	103.7%	51.8%	51.8%	51.8%	101.2%	72.5%	72.5%
Taiwan	76.6%	76.6%	76.6%	76.6%	76.6%	76.6%	76.6%	76.6%	100.0%	96.2%	96.2%

Other countries' capital cost recovery in the first ten years ranges from 39% for electric transmission and distribution lines in Brazil to immediate write-off of 100% for most of the selected assets in Malaysia. Table 3 compares nominal capital costs recovered after ten years as percent of total asset value for selected energy investments.

Table 4 compares the nominal capital costs recovered after ten years to the proportion recovered under United States' tax depreciation rules. The table shows both the number of countries with greater, similar and lower amounts recovered and the percent of United States international trade with countries in each of the three groups.

Table 4: Countries where Nominal Capital Costs Recovered After Ten Years are Greater, Similar, and Less than under United States' Tax Depreciation Rules, 2006

Asset Group	Asset	Number of Countries			Percent of International Trade		
		Greater	Similar	Less	Greater	Similar	Less
Electric Generation	Gas	9	0	2	58%	0%	6%
	Coal	11	0	0	64%	0%	0%
	Nuclear	10	0	0	62%	0%	0%
	Combined Heat & Power Generation	11	0	0	64%	0%	0%
	Self-Generated Electricity	10	0	1	59%	0%	5%
Electric Transmission & Distribution Lines	Transmission Lines	6	0	5	19%	0%	44%
	Distribution Lines	9	0	2	51%	0%	13%
	Smart Meters	10	0	1	53%	0%	11%
Pollution Control Equipment	Discharge Modification	1	5	5	11%	9%	43%
Petroleum Refining	Crude Distillation Unit	2	2	7	4%	22%	38%
	Fluid Catalytic Cracking Unit	2	3	6	4%	26%	33%

International Comparison of the Discounted Present Value of Capital Costs Recovered Over the Entire Asset Life for Selected Energy Investments

Table 5 shows the discounted present value of cost recovery deductions over the entire asset life in the U.S. for the selected energy investments range from 58% for coal electric generation facilities, distribution lines and smart meters to 79% for pollution control equipment. Other countries' discounted present value of depreciation deductions ranges from 43% for electric transmission and distribution lines in Brazil to 100% for pollution control equipment in India. Table 5 compares the net present value of capital costs recovered as percent of total asset value for selected energy investments.

Table 5: International Comparison of the Discounted Present Value of Capital Costs Recovered for Selected Energy Investments over the Entire Asset Life, 2006

	Electric Generation					Electric Transmission & Distribution Lines			Pollution Control Equipment	Petroleum Refining	
	Gas	Coal	Nuclear	Combined Heat & Power Generation	Self-Generated Electricity	Transmission Lines	Distribution Lines	Smart Meters	Discharge Modification	Crude Unit (Distillation Unit)	Fluid Catalytic Cracking Unit
United States	65.9%	58.2%	65.9%	58.2%	65.9%	65.9%	58.2%	58.2%	78.6%	79.7%	79.7%
Brazil	60.9%	68.0%	N/A	60.9%	76.7%	43.0%	43.0%	55.2%	88.1%	76.7%	76.7%
Canada	83.9%	83.9%	83.9%	83.9%	83.9%	55.2%	55.2%	76.7%	83.9%	83.9%	83.9%
China	73.5%	73.5%	73.5%	73.5%	73.5%	73.5%	73.5%	73.5%	73.5%	81.5%	73.5%
Germany	62.8%	62.8%	68.5%	62.8%	62.8%	56.9%	56.9%	76.7%	83.9%	80.9%	83.9%
India	73.0%	73.0%	73.0%	73.0%	73.0%	73.0%	73.0%	98.4%	100.0%	79.3%	79.3%
Indonesia	71.3%	71.3%	71.3%	71.3%	71.3%	71.3%	71.3%	71.3%	71.3%	71.3%	71.3%
Japan	69.6%	69.6%	69.6%	69.6%	67.0%	60.9%	60.9%	69.6%	95.0%	93.4%	93.4%
Rep of Korea	74.1%	74.1%	74.1%	74.1%	74.1%	74.1%	74.1%	74.1%	87.9%	87.9%	87.9%
Malaysia	93.5%	93.5%	93.5%	93.5%	93.5%	94.7%	94.7%	94.7%	98.3%	94.7%	94.7%
Mexico	79.2%	79.2%	79.2%	79.2%	79.2%	64.1%	64.1%	64.1%	97.3%	72.2%	72.2%
Taiwan	69.3%	69.3%	69.3%	69.3%	69.3%	69.3%	69.3%	69.3%	91.5%	83.5%	83.5%

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Table 6 compares the net present value of capital costs recovered during the first fifty years of the asset life to the proportion recovered under United States' tax depreciation rules. The table shows both the number of countries with greater, similar and lower amounts recovered and the percent of United States international trade with countries in each of the three groups.

Table 6: Countries where the Net Present Value of Capital Costs Recovered is Greater, Similar, and Less than under United States' Tax Depreciation Rules, 2006

Asset Group	Asset	Number of Countries			Percent of International Trade		
		Greater	Similar	Less	Greater	Similar	Less
Electric Generation	Gas	9	0	2	58%	0%	6%
	Coal	11	0	0	64%	0%	0%
	Nuclear	10	0	0	62%	0%	0%
	Combined Heat & Power Generation	11	0	0	64%	0%	0%
	Self-Generated Electricity	10	0	1	59%	0%	5%
Electric Transmission & Distribution Lines	Transmission Lines	6	0	5	19%	0%	44%
	Distribution Lines	8	0	3	38%	0%	26%
	Smart Meters	10	0	1	62%	0%	2%
Pollution Control Equipment	Discharge Modification	9	0	2	52%	0%	12%
Petroleum Refining	Crude Distillation Unit	7	1	3	49%	1%	13%
	Fluid Catalytic Cracking Unit	6	1	4	38%	1%	25%

International Comparison of the Corporate Effective Tax Rate for Selected Energy Investments

Table 7 shows the corporate effective tax rates in the U.S. for the selected energy investments range from 22% for petroleum refining assets to 51% for electric distribution smart meters. Corporate effective tax rates incorporate not only depreciation deductions, but also marginal tax rates and tax credits.

Other countries' corporate effective tax rates range from -19% for pollution control equipment in Taiwan to 47% for electric distribution smart meters in Brazil. Table 7 compares effective tax rates for selected energy investments.

Table 7: International Comparison of the Effective Tax Rate on Selected Energy Investments, 2006

	Electric Generation					Electric Transmission & Distribution Lines			Pollution Control Equipment	Petroleum Refining	
	Gas	Coal	Nuclear	Combined Heat & Power Generation	Self-Generated Electricity	Transmission Lines	Distribution Lines	Smart Meters	Discharge Modification	Crude Unit (Distillation Unit)	Fluid Catalytic Cracking Unit
United States	26.7%	30.8%	26.7%	30.8%	26.7%	27.5%	31.7%	51.1%	23.4%	21.6%	21.6%
Brazil	25.7%	22.0%	N/A	25.7%	17.1%	33.5%	33.5%	47.1%	13.0%	19.9%	19.9%
Canada	13.5%	13.5%	13.5%	13.5%	13.5%	30.3%	30.3%	33.7%	18.1%	15.8%	15.8%
China	19.0%	19.0%	19.0%	19.0%	19.0%	19.0%	19.0%	34.6%	25.0%	22.1%	22.1%
Germany	28.3%	28.3%	25.1%	28.3%	28.3%	31.4%	31.4%	35.8%	19.5%	19.8%	17.1%
India	16.6%	16.6%	16.6%	16.6%	16.6%	16.6%	16.6%	2.6%	0.0%	15.5%	15.5%
Indonesia	18.4%	19.0%	19.0%	19.0%	19.0%	19.0%	19.0%	34.6%	25.0%	22.1%	22.1%
Japan	25.5%	25.5%	25.5%	25.5%	27.1%	30.6%	30.6%	43.6%	21.3%	20.4%	20.4%
Rep of Korea	5.2%	5.2%	5.2%	5.2%	5.2%	5.2%	5.2%	11.0%	-9.7%	-9.7%	-9.7%
Malaysia	4.8%	4.8%	4.8%	4.8%	4.8%	3.9%	3.9%	8.3%	1.8%	7.1%	7.1%
Mexico	12.7%	12.7%	12.7%	12.7%	12.7%	20.1%	20.1%	36.1%	2.6%	19.0%	19.0%
Taiwan	14.9%	14.9%	14.9%	14.9%	14.9%	14.9%	14.9%	23.3%	-18.8%	10.2%	10.2%

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Table 8 compares the effective tax rates on capital investments to the proportion recovered under United States' tax rules. The table shows both the number of countries with lower, similar and higher effective tax rates and the percent of United States international trade with countries in each of the three groups.

Table 8: Countries where the Effective Tax Rate on Capital Investments is Lower, Similar, and Higher than under United States' Tax Rules, 2006

Asset Group	Asset	Number of Countries			Percent of International Trade		
		Lower	Similar	Higher	Lower	Similar	Higher
Electric Generation	Gas	9	1	1	58%	2%	5%
	Coal	11	0	0	64%	0%	0%
	Nuclear	10	0	0	62%	0%	0%
	Combined Heat & Power Generation	11	0	0	64%	0%	0%
	Self-Generated Electricity	9	1	1	52%	8%	5%
Electric Transmission & Distribution Lines	Transmission Lines	7	0	4	31%	0%	33%
	Distribution Lines	9	1	1	58%	5%	2%
	Smart Meters	11	0	0	64%	0%	0%
Pollution Control Equipment	Discharge Modification	9	0	2	52%	0%	12%
Petroleum Refining	Crude Distillation Unit	9	2	0	52%	12%	0%
	Fluid Catalytic Cracking Unit	9	2	0	52%	12%	0%

Appendix Tables 3-14 show the same results presented separately for each country individually.

Appendix I: Calculation Methodology

Calculation of Effective Tax Rates

Effective tax rates are computed by dividing the difference between the before tax rate of return on an investment and the after tax rate of return on an investment by the before tax rate of return on an investment. At the margin, a firm will make an investment if the after tax rate of return is at least equal to the interest payments required for such an investment plus inflation. This rate is the real interest rate, r . The real interest rate is composed of the nominal interest rate and inflation in the following form:

$$r = i + \pi$$

Where i is the nominal interest rate and π is the rate of inflation. Our estimates assume a nominal interest rate of 5% and an inflation rate of 2% for a total real interest rate of 7%.

The before tax rate of return necessary to reach a sufficient after tax return may be expressed with the following expression:

$$p = \frac{(r + q)}{1 - u} (1 - uz - k) - q$$

Where p represents the before tax rate of return equal to the real interest rate, q represents the economic depreciation of the asset, u represents the corporate income tax rate, z represents the net present value of tax depreciation allowances, and k equals the present value of any tax credits or incentives available for the investment.

The net present value of depreciation allowances, z , is the discounted sum of depreciation allowances. We calculate the net present value of depreciation allowances using the following formula. We examine depreciation allowances during the first fifty years after an investment:

$$z = \sum_{j=1}^{50} \frac{z_j}{(1+r)^{j-1}}$$

Where j is the year starting with year 1, the first year of the investment, and z_j is the depreciation allowance credited in year j .

The marginal effective tax rate, ETR , may thus be expressed in the following manner:

$$ETR = \frac{p - r}{p}$$

Rates of Economic Depreciation

For this study, we assume electric generation and transmission equipment other than smart meters depreciate at a rate of 5% per year, petroleum refining equipment depreciates at a rate of 7.5% per year, pollution control equipment depreciates at a rate of 10% per year, and smart meters depreciate at a rate of 20% per year.

The rates applied for each investment are derived from the following asset classes from the U.S. Bureau of Economic Analysis:⁸

Appendix Table 1: Rates of Economic Depreciation

Investment	BEA Asset Class	BEA Rate of Depreciation	Assumed Rate
Electric Generation	Steam engines and turbines	5.16%	5%
Electric Transmission (other than smart meters)	Electrical transmission, distribution, and industrial apparatus	5.00%	5%
Electric Transmission (smart meters)	Other electrical equipment	18.34%	20%
Pollution Control Equipment	Special industrial machinery, n.e.c.; General industrial and materials handling equipment	10.31%-10.72%	10%
Petroleum Refining	Petroleum and natural gas exploration, shafts and wells	7.51%	7.5%

⁸ Bureau of Economic Analysis, "BEA Rates of Depreciation, Service Lives, Declining-Balance Rates, and Hulten-Wyckoff Categories" (1997) available at <http://www.bea.gov/bea/an/0797fr/table3.htm>, this table is found in Fraumeni, Barbara, "The Measurement of Depreciation in the U.S. National Income and Product Accounts," (1997) available at <http://www.bea.gov/bea/an/0797fr/maintext.htm>

Corporate Income Tax Rates

Below are the corporate income tax rates applied in the effective tax rate calculations:

Appendix Table 2: Corporate Income Tax Rates, 2006

Country	Tax Rate
United States	39.3% ⁹
Brazil	34.0%
Canada	36.1%
China	33.0%
Germany	38.3%
India	30.0%
Indonesia	30.0%
Japan	39.7%
Rep of Korea	35.0%
Malaysia	28.0% ¹⁰
Mexico	29.0%
Taiwan	25.0%

Source: OECD and Ernst & Young Corporate Tax Guide

⁹ Section 199 ("production deduction") reduces the combined federal and state marginal corporate income tax rate from 39.3% to 38.3% in 2006 for electric generation, pollution control and petroleum refining assets.

¹⁰ The Malaysian corporate income tax for firms in the petroleum industry is 38%, for other firms the corporate income tax is 28%.

Appendix II: Individual Country Results

**Appendix Table 3: Value of Depreciation Deductions and Effective Tax Rates
on Selected Energy Investments, 2006
United States**

		Percent of Cost Recovered		Net Present Value of Depreciation Deductions	Effective Tax Rate
		Five Years	Ten Years		
Electric Generation	Gas	37.7%	67.5%	65.9%	26.7%
	Coal	29.5%	53.2%	58.2%	30.8%
	Nuclear	37.7%	67.5%	65.9%	26.7%
	Combined Heat & Power Generation Facilities Using Conventional Fuel (assumes power for sale)	29.5%	53.2%	58.2%	30.8%
	Distribution of Industrial Steam & Electricity Generated for Self-Use	37.7%	67.5%	65.9%	26.7%
Electric Transmission & Distribution Lines	Transmission Lines	37.7%	67.5%	65.9%	27.5%
	Distribution Lines	29.5%	53.2%	58.2%	31.7%
	Smart Meters	29.5%	53.2%	58.2%	51.1%
Pollution Control Equipment	Discharge Modification (e.g. thermal discharge control)	64.3%	100.0%	78.6%	23.4%
Petroleum Refining	Crude Unit (Distillation Unit)	63.1%	96.7%	79.7%	21.6%
	Fluid Catalytic Cracking Unit	63.1%	96.7%	79.7%	21.6%

**Appendix Table 4: Value of Depreciation Deductions and Effective Tax Rates
on Selected Energy Investments, 2006
Brazil**

		Percent of Cost Recovered		Net Present Value of Depreciation Deductions	Effective Tax Rate
		Five Years	Ten Years		
Electric Generation	Gas	37.7%	63.2%	60.9%	25.7%
	Coal	47.5%	74.4%	68.0%	22.0%
	Nuclear	N/A	N/A	N/A	N/A
	Combined Heat & Power Generation Facilities Using Conventional Fuel (assumes power for sale)	37.7%	63.2%	60.9%	25.7%
	Distribution of Industrial Steam & Electricity Generated for Self-Use	63.1%	87.9%	76.7%	17.1%
Electric Transmission & Distribution Lines	Transmission Lines	20.6%	38.6%	43.0%	33.5%
	Distribution Lines	20.6%	38.6%	43.0%	33.5%
	Smart Meters	31.2%	54.7%	55.2%	47.1%
Pollution Control Equipment	Discharge Modification (e.g. thermal discharge control)	89.6%	99.2%	88.1%	13.0%
Petroleum Refining	Crude Unit (Distillation Unit)	63.1%	87.9%	76.7%	19.9%
	Fluid Catalytic Cracking Unit	63.1%	87.9%	76.7%	19.9%

**Appendix Table 5: Value of Depreciation Deductions and Effective Tax Rates
on Selected Energy Investments, 2006
Canada**

		Percent of Cost Recovered		Net Present Value of Depreciation Deductions	Effective Tax Rate
		Five Years	Ten Years		
Electric Generation	Gas	79.6%	96.6%	83.9%	13.5%
	Coal	79.6%	96.6%	83.9%	13.5%
	Nuclear	79.6%	96.6%	83.9%	13.5%
	Combined Heat & Power Generation Facilities Using Conventional Fuel (assumes power for sale)	79.6%	96.6%	83.9%	13.5%
	Distribution of Industrial Steam & Electricity Generated for Self-Use	79.6%	96.6%	83.9%	13.5%
Electric Transmission & Distribution Lines	Transmission Lines	31.2%	54.7%	55.2%	30.3%
	Distribution Lines	31.2%	54.7%	55.2%	30.3%
	Smart Meters	63.1%	87.9%	76.7%	33.7%
Pollution Control Equipment	Discharge Modification (e.g. thermal discharge control)	79.6%	96.6%	83.9%	18.1%
Petroleum Refining	Crude Unit (Distillation Unit)	79.6%	96.6%	83.9%	15.8%
	Fluid Catalytic Cracking Unit	79.6%	96.6%	83.9%	15.8%

**Appendix Table 6: Value of Depreciation Deductions and Effective Tax Rates
on Selected Energy Investments, 2006
China**

		Percent of Cost Recovered		Net Present Value of Depreciation Deductions	Effective Tax Rate
		Five Years	Ten Years		
Electric Generation	Gas	39.8%	84.8%	73.5%	19.0%
	Coal	39.8%	84.8%	73.5%	19.0%
	Nuclear	39.8%	84.8%	73.5%	19.0%
	Combined Heat & Power Generation Facilities Using Conventional Fuel (assumes power for sale)	39.8%	84.8%	73.5%	19.0%
	Distribution of Industrial Steam & Electricity Generated for Self-Use	39.8%	84.8%	73.5%	19.0%
Electric Transmission & Distribution Lines	Transmission Lines	39.8%	84.8%	73.5%	19.0%
	Distribution Lines	39.8%	84.8%	73.5%	19.0%
	Smart Meters	39.8%	84.8%	73.5%	34.6%
Pollution Control Equipment	Discharge Modification (e.g. thermal discharge control)	41.3%	67.2%	73.5%	25.0%
Petroleum Refining	Crude Unit (Distillation Unit)	39.8%	84.8%	81.5%	22.1%
	Fluid Catalytic Cracking Unit	39.8%	84.8%	73.5%	22.1%

**Appendix Table 7: Value of Depreciation Deductions and Effective Tax Rates
on Selected Energy Investments, 2006
Germany**

		Percent of Cost Recovered		Net Present Value of Depreciation Deductions	Effective Tax Rate
		Five Years	Ten Years		
Electric Generation	Gas	30.0%	63.3%	62.8%	28.3%
	Coal	30.0%	63.3%	62.8%	28.3%
	Nuclear	37.5%	79.2%	68.5%	25.1%
	Combined Heat & Power Generation Facilities Using Conventional Fuel (assumes power for sale)	30.0%	63.3%	62.8%	28.3%
	Distribution of Industrial Steam & Electricity Generated for Self-Use	30.0%	63.3%	62.8%	28.3%
Electric Transmission & Distribution Lines	Transmission Lines	33.1%	57.3%	56.9%	31.4%
	Distribution Lines	33.1%	57.3%	56.9%	31.4%
	Smart Meters	63.1%	87.9%	76.7%	35.8%
Pollution Control Equipment	Discharge Modification (e.g. thermal discharge control)	79.6%	96.6%	83.9%	19.5%
Petroleum Refining	Crude Unit (Distillation Unit)	72.3%	93.4%	80.9%	19.8%
	Fluid Catalytic Cracking Unit	79.6%	96.6%	83.9%	17.1%

**Appendix Table 8: Value of Depreciation Deductions and Effective Tax Rates
on Selected Energy Investments, 2006
India**

		Percent of Cost Recovered		Net Present Value of Depreciation Deductions	Effective Tax Rate
		Five Years	Ten Years		
Electric Generation	Gas	55.6%	80.3%	73.0%	16.6%
	Coal	55.6%	80.3%	73.0%	16.6%
	Nuclear	55.6%	80.3%	73.0%	16.6%
	Combined Heat & Power Generation Facilities Using Conventional Fuel (assumes power for sale)	55.6%	80.3%	73.0%	16.6%
	Distribution of Industrial Steam & Electricity Generated for Self-Use	55.6%	80.3%	73.0%	16.6%
Electric Transmission & Distribution Lines	Transmission Lines	55.6%	80.3%	73.0%	16.6%
	Distribution Lines	55.6%	80.3%	73.0%	16.6%
	Smart Meters	100.0%	100.0%	98.4%	2.6%
Pollution Control Equipment	Discharge Modification (e.g. thermal discharge control)	100.0%	100.0%	100.0%	0.0%
Petroleum Refining	Crude Unit (Distillation Unit)	66.1%	84.9%	79.3%	15.5%
	Fluid Catalytic Cracking Unit	66.1%	84.9%	79.3%	15.5%

**Appendix Table 9: Value of Depreciation Deductions and Effective Tax Rates
on Selected Energy Investments, 2006
Indonesia**

		Percent of Cost Recovered		Net Present Value of Depreciation Deductions	Effective Tax Rate
		Five Years	Ten Years		
Electric Generation	Gas	45.0%	71.8%	71.3%	18.4%
	Coal	45.0%	71.8%	71.3%	19.0%
	Nuclear	45.0%	71.8%	71.3%	19.0%
	Combined Heat & Power Generation Facilities Using Conventional Fuel (assumes power for sale)	45.0%	71.8%	71.3%	19.0%
	Distribution of Industrial Steam & Electricity Generated for Self-Use	45.0%	71.8%	71.3%	19.0%
Electric Transmission & Distribution Lines	Transmission Lines	45.0%	71.8%	71.3%	19.0%
	Distribution Lines	45.0%	71.8%	71.3%	19.0%
	Smart Meters	45.0%	71.8%	71.3%	34.6%
Pollution Control Equipment	Discharge Modification (e.g. thermal discharge control)	45.0%	71.8%	71.3%	25.0%
Petroleum Refining	Crude Unit (Distillation Unit)	45.0%	71.8%	71.3%	22.1%
	Fluid Catalytic Cracking Unit	45.0%	71.8%	71.3%	22.1%

**Appendix Table 10: Value of Depreciation Deductions and Effective Tax Rates
on Selected Energy Investments, 2006
Japan**

		Percent of Cost Recovered		Net Present Value of Depreciation Deductions	Effective Tax Rate
		Five Years	Ten Years		
Electric Generation	Gas	49.7%	76.6%	69.6%	25.5%
	Coal	49.7%	76.6%	69.6%	25.5%
	Nuclear	49.7%	76.6%	69.6%	25.5%
	Combined Heat & Power Generation Facilities Using Conventional Fuel (assumes power for sale)	49.7%	76.6%	69.6%	25.5%
	Distribution of Industrial Steam & Electricity Generated for Self-Use	45.6%	72.4%	67.0%	27.1%
Electric Transmission & Distribution Lines	Transmission Lines	37.4%	62.8%	60.9%	30.6%
	Distribution Lines	37.4%	62.8%	60.9%	30.6%
	Smart Meters	49.7%	76.6%	69.6%	43.6%
Pollution Control Equipment	Discharge Modification (e.g. thermal discharge control)	76.9%	95.0%	95.0%	21.3%
Petroleum Refining	Crude Unit (Distillation Unit)	72.3%	93.4%	93.4%	20.4%
	Fluid Catalytic Cracking Unit	72.3%	93.4%	93.4%	20.4%

**Appendix Table 11: Value of Depreciation Deductions and Effective Tax Rates
on Selected Energy Investments, 2006
Rep of Korea**

		Percent of Cost Recovered		Net Present Value of Depreciation Deductions	Effective Tax Rate
		Five Years	Ten Years		
Electric Generation	Gas	57.7%	83.8%	74.1%	5.2%
	Coal	57.7%	83.8%	74.1%	5.2%
	Nuclear	57.7%	83.8%	74.1%	5.2%
	Combined Heat & Power Generation Facilities Using Conventional Fuel (assumes power for sale)	57.7%	83.8%	74.1%	5.2%
	Distribution of Industrial Steam & Electricity Generated for Self-Use	57.7%	83.8%	74.1%	5.2%
Electric Transmission & Distribution Lines	Transmission Lines	57.7%	83.8%	74.1%	5.2%
	Distribution Lines	57.7%	83.8%	74.1%	5.2%
	Smart Meters	57.7%	83.8%	74.1%	11.0%
Pollution Control Equipment	Discharge Modification (e.g. thermal discharge control)	89.0%	100.0%	87.9%	-9.7%
Petroleum Refining	Crude Unit (Distillation Unit)	89.0%	100.0%	87.9%	-9.7%
	Fluid Catalytic Cracking Unit	89.0%	100.0%	87.9%	-9.7%

**Appendix Table 12: Value of Depreciation Deductions and Effective Tax Rates
on Selected Energy Investments, 2006
Malaysia**

		Percent of Cost Recovered		Net Present Value of Depreciation Deductions	Effective Tax Rate
		Five Years	Ten Years		
Electric Generation	Gas	100.0%	100.0%	93.5%	4.8%
	Coal	100.0%	100.0%	93.5%	4.8%
	Nuclear	100.0%	100.0%	93.5%	4.8%
	Combined Heat & Power Generation Facilities Using Conventional Fuel (assumes power for sale)	100.0%	100.0%	93.5%	4.8%
	Distribution of Industrial Steam & Electricity Generated for Self-Use	100.0%	100.0%	93.5%	4.8%
Electric Transmission & Distribution Lines	Transmission Lines	90.0%	100.0%	94.7%	3.9%
	Distribution Lines	90.0%	100.0%	94.7%	3.9%
	Smart Meters	90.0%	100.0%	94.7%	8.3%
Pollution Control Equipment	Discharge Modification (e.g. thermal discharge control)	100.0%	100.0%	98.3%	1.8%
Petroleum Refining	Crude Unit (Distillation Unit)	90.0%	100.0%	94.7%	7.1%
	Fluid Catalytic Cracking Unit	90.0%	100.0%	94.7%	7.1%

**Appendix Table 13: Value of Depreciation Deductions and Effective Tax Rates
on Selected Energy Investments, 2006
Mexico**

		Percent of Cost Recovered		Net Present Value of Depreciation Deductions	Effective Tax Rate
		Five Years	Ten Years		
Electric Generation	Gas	46.2%	103.7%	79.2%	12.7%
	Coal	46.2%	103.7%	79.2%	12.7%
	Nuclear	46.2%	103.7%	79.2%	12.7%
	Combined Heat & Power Generation Facilities Using Conventional Fuel (assumes power for sale)	46.2%	103.7%	79.2%	12.7%
	Distribution of Industrial Steam & Electricity Generated for Self-Use	46.2%	103.7%	79.2%	12.7%
Electric Transmission & Distribution Lines	Transmission Lines	23.1%	51.8%	64.1%	20.1%
	Distribution Lines	23.1%	51.8%	64.1%	20.1%
	Smart Meters	23.1%	51.8%	64.1%	36.1%
Pollution Control Equipment	Discharge Modification (e.g. thermal discharge control)	101.2%	101.2%	97.3%	2.6%
Petroleum Refining	Crude Unit (Distillation Unit)	32.3%	72.5%	72.2%	19.0%
	Fluid Catalytic Cracking Unit	32.3%	72.5%	72.2%	19.0%

**Appendix Table 14: Value of Depreciation Deductions and Effective Tax Rates
on Selected Energy Investments, 2006
Taiwan**

		Percent of Cost Recovered		Net Present Value of Depreciation Deductions	Effective Tax Rate
		Five Years	Ten Years		
Electric Generation	Gas	49.7%	76.6%	69.3%	14.9%
	Coal	49.7%	76.6%	69.3%	14.9%
	Nuclear	49.7%	76.6%	69.3%	14.9%
	Combined Heat & Power Generation Facilities Using Conventional Fuel (assumes power for sale)	49.7%	76.6%	69.3%	14.9%
	Distribution of Industrial Steam & Electricity Generated for Self-Use	49.7%	76.6%	69.3%	14.9%
Electric Transmission & Distribution Lines	Transmission Lines	49.7%	76.6%	69.3%	14.9%
	Distribution Lines	49.7%	76.6%	69.3%	14.9%
	Smart Meters	49.7%	76.6%	69.3%	23.3%
Pollution Control Equipment	Discharge Modification (e.g. thermal discharge control)	96.6%	100.0%	91.5%	-18.8%
Petroleum Refining	Crude Unit (Distillation Unit)	78.5%	96.2%	83.5%	10.2%
	Fluid Catalytic Cracking Unit	78.5%	96.2%	83.5%	10.2%

AMERICAN FEDERATION OF LABOR AND CONGRESS OF INDUSTRIAL ORGANIZATIONS



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LEGISLATIVE ALERT!

(202) 637-5090

November 5, 2007

The Honorable Barbara Boxer, Chairwoman
Senate Committee on Environment and Public Works
456 Dirksen Senate Office Building
Washington, D.C. 20510

Dear Chairwoman Boxer:

I am writing to express the AFL-CIO's views on the America's Climate Security Act (S. 2191). We recognize that the original draft of S. 2191 responded to a number of the AFL-CIO's recommendations. However, the Subcommittee has adopted two amendments that add to our reservations about the impact of this legislation on industry, workers, and their communities. This letter identifies our specific concerns with the bill and offers solutions that we believe will improve it.

The AFL-CIO is on record in support of the bipartisan Bingaman-Specter climate bill, S. 1766. We have also openly and honestly participated in stakeholder meetings with the staff of Senators Lieberman and Warner regarding the development of America's Climate Security Act. Our July 24, 2007 testimony before the Environment and Public Works Committee, "A 21st Century Energy Policy for Environmental and Economic Progress," identified our recommendations regarding the Subcommittee's development of new legislation. We also provided every member of the Committee with a detailed written response to the Lieberman-Warner outline.

The AFL-CIO takes to heart the statement in S. 2191 that this legislation should achieve its purpose "while preserving robust growth in the United States economy and avoiding the imposition of hardship on United States citizens." The bill's inclusion of international language will help preserve this growth while taking an important step forward to engaging the developing world in seeking a solution to global warming. However, modest modifications to the international timeline and implementation process would strengthen this section.

We appreciate the fact that the original draft of S. 2191 incorporated many of our investment recommendations. The inclusion of bonus allowances will promote early technology deployment, and the early auction of allowances will enable the jump-start of the R&D agenda. Most important, the original draft of S. 2191 made critical long term commitments to technology development and deployment with an investment portfolio that includes zero or low carbon energy technologies (renewables and appliances), cellulosic biomass fuels, an advanced coal and sequestration program, and the advanced technology vehicles manufacturing incentive program.

Unfortunately, the latter two pieces of the investment portfolio were severely undermined by auto-related and coal-related amendments adopted by the Subcommittee. On November 1 the Subcommittee adopted an amendment by Sen. Sanders limiting the advanced technology vehicles manufacturing incentive

program to vehicles that get 35 miles per gallon or more, and an amendment by Sen. Barasso limiting the types of coal that can be used in projects. These amendments are counterproductive and actually undermine the technological transition this legislation is attempting to achieve.

Furthermore, we feel that the legislation falls short, in a number of other areas, of providing an assured basis that economic development and environmental progress can go hand-in-hand:

- An overly aggressive Phase I emission reduction target, now increased from a 10 percent to a 15 percent reduction of greenhouse gas emissions below 2005 levels by 2020, before the anticipated commercial availability of carbon capture and storage technologies;
- An unequivocal commitment to achieving a 70 percent national emission reduction below 2005 levels by 2050, regardless of the degree of subsequent participation of major developing nations like China and India in a global climate protection framework;
- The failure to identify “domestic economic development” as a finding of Congress, a purpose of the legislation, and the failure to require that funding from this legislation be dedicated to domestic investments for new technology and the creation of jobs - from production to construction and exports.
- The absence of an effective safety valve price for carbon dioxide allowances, which will have an adverse impact upon investment decisions and consumer and industry pricing.
- The need for a restricted and regulated market system that does not fall prey to predatory trading practices, hoarding of allowances, and the creation of carbon billionaires, which an open market and unlimited banking of allowances can lead to.
- The extent of the use of international allowances combined with offsets, and the possibility of double dipping with offsets by providing allowances for activities that would have been done anyway.
- Inappropriate allocations of emissions allowances, such as the 10 percent allocation to “wires companies” to encourage energy efficiency—a goal that may be better accomplished through direct legislation on energy efficiency standards, now incorporated in other provisions of the bill.

We look forward to working with Congress to achieve an energy policy for the twenty-first century that will result in a cleaner planet, greater energy efficiency, and the revitalization of our manufacturing base.

Sincerely,



William Samuel, Director
DEPARTMENT OF LEGISLATION

c: Members of the Senate Committee on Environment and Public Works

Appendix: AFL-CIO Recommendations for America's Climate Security Act**Advanced Technology Vehicles Manufacturing Incentive Program**

As previously indicated, the AFL-CIO strongly supports the thrust of the Advanced Technology Vehicles Manufacturing Incentive Program created under S. 2191. This program can help to accelerate the introduction of advanced technology vehicles, and thus to help our country make major strides in reducing greenhouse gas emissions and our dependence on foreign oil. At the same time, it can ensure that the vehicles of the future are built in this country, thereby creating tens of thousands of jobs for American workers.

However, we believe the language in these provisions needs to be improved in several respects. First, the language in Section 4405(b)(1) should be modified to clarify that awards under the program can only be made to manufacturers and components suppliers for re-equipping or expanding a manufacturing facility "in the United States" to produce qualifying advanced technology vehicles and components. Obviously, we should not be providing funds to subsidize investment in manufacturing facilities in other countries.

Second, during the Subcommittee markup, an amendment by Sen. Sanders was adopted by voice vote that requires all qualifying advanced technology vehicles to meet a 35 miles per gallon standard to be eligible for assistance under this program. Unfortunately, this amendment totally eviscerates the program. In order to make meaningful progress in reducing our dependence on foreign oil and greenhouse gas emissions, the auto industry needs to improve fuel economy across the entire spectrum of vehicles. It needs to put hybrid and advanced diesel technology into pickups, sports utility vehicles (SUVs), minivans, and larger passenger cars, as well as smaller vehicles like the Prius. Indeed, some of the greatest gains in reduced oil consumption and greenhouse gas emissions can come from improving the fuel economy of these bigger vehicles. However, because many of these vehicles would still be below the 35 miles per gallon level, even with the hybrid or diesel advanced technology, the Sanders amendment would effectively exclude them from being able to get any assistance under the manufacturing program. As a result, this would greatly reduce the effectiveness of the program in achieving the environmental goals, as well as its ability to generate jobs for American workers.

It is also important to note that the Sanders amendment directly conflicts with the CAFE provisions that were approved earlier this year by the Senate in the energy legislation, and that were supported by environmental groups. Those CAFE provisions specified that the fleet of vehicles for the entire industry must meet a 35 miles per gallon standard, not that each and every vehicle must meet this standard. Indeed, under the reformed, attribute-based CAFE system approved by the Senate, it was expressly recognized that different sizes and types of vehicles would have to achieve different fuel economy levels, depending on their particular attributes. Unfortunately, the Sanders amendment departs from this approach, and instead imposes a rigid, one-size-fits-all mandate on all vehicles.

Finally, Section 4405(c)(1) specifies that the manufacturing incentive program only applies to facilities and equipment placed in service before January 1, 2016. In our judgment, this time period is far too restrictive, especially since the CAFE provisions previously approved by the Senate have a far longer time period, stretching to 2020 and beyond.

Subcommittee Amendment: Coal Preference

We are concerned about the amendment approved by the Subcommittee concerning preferences for "low rank" coals with a heat content less than 10,000 BTU/pound. There should be no distinction among coal types in allowance allocations to electric generating units, or the distribution of auction revenues as incentives to promote clean coal technologies. This sets up a regional preference for coal.

This was a major flaw in the EPA's Clean Air Mercury Rule, which awarded extra allowances to low-rank western lignite and sub-bituminous coals, despite a growing body of evidence that controlling mercury from these coals costs substantially less than from eastern bituminous coals. While there are minor differences in the CO₂ emissions of coals of different rank, CO₂ emissions can be captured by a variety of emerging control technologies potentially applicable to all coal types at both new and existing units.

We believe that all coals should compete for incentives on a level playing field without regional preferences or exemptions. The bill should remain as originally drafted.

Timelines and Standards

Our most serious concern is the magnitude and timing of 2020 reductions (15 percent below 2005) compared to Bingaman-Specter (2006 levels). Reductions on the coal fired power generation will come from investments in increased efficiency in existing facilities, new IGCC (combined cycle technology that is only in the early developmental phase with a demonstration plant scheduled to be built in Ohio), and the development of carbon sequestration technology. Full development of these latter technologies will take a decade, and deployment to scale will take decades more.

There is insufficient time to develop and demonstrate CCS technology at commercial scale. 2020 is effectively 5 years from now in terms of corporate planning for investments. Meeting 2006 levels by 2020 is a major reduction given 1 percent population growth and 2-3 percent GDP growth. The bill suggests that the annual reviews will allow adjustments of the targets, but experience with the Clean Air Act does not support this view.

Economic Development and Domestic Investment

This legislation does have a dual purpose: environmental protection and economic development. The legislation needs to make explicit the implicit economic development goals embodied in the bill's investment strategy and its stated purpose of "preserving robust growth." We believe that this is in the national interest, and it is the intent of Congress to assure that investment dollars generated by this legislation recirculate in our domestic economy. The legislation needs to say so.

To fulfill its dual purpose, this legislation needs to promote domestic investment as an economic development strategy that runs from R&D to production and construction. The findings, purpose, and Climate Change Credit Corporation sections need to be explicit about this intent. For example:

- Finding: "The Congress finds prompt and decisive domestic climate change investments are an unprecedented economic development opportunity for the nation.

- Purpose: “to accomplish that purpose by making climate change investments in domestic technology development, production, and construction.”
- Climate Change Credit Corporation: “the financial resources of the corporation shall be dedicated to domestic investments so as to assure that the nation derives the maximum economic development return from those investments;
 - Climate Change Credit Corporation domestic investment program will be designed to capture intellectual property, encourage industry development, and to retain and create new jobs in production, construction and conservation of energy.
 - Existing facilities and populated areas shall be considered a strategic priority for manufacturing-related investments.
 - Energy incentives and investments by the federal government must not encourage off-shoring of manufacturing or the sale of assets.
 - The Climate Change Credit Corporation will report to Congress on an annual basis about the domestic economic and environmental impact of its investments.”

Safety Valves and Market Intervention

The AFL-CIO supported the cost control mechanism (the Technology Accelerator Payment) in the Bingaman-Specter bill because it provides pricing certainty for long-term investment decisions, assures a modest effect on fuel and electricity prices, and avoids short-term price spikes that can lead to fuel-switching. In this case, the legislation also sets a beginning price of \$12 per ton that rises 5 percent a year above inflation. *We are open to discussing alternative levels of a safety valve price.*

The proposed Carbon Market Efficiency Board (CMEB) also attempts to act as a cost control mechanism, but its open market system undermines this approach and its intervention tool is at best slow and of questionable value. The CMEB is empowered to act in cases where there are prolonged price hikes in allowances (180 or more days) that threaten economic damage to the nation. The CMEB will also have to determine what that “sweet spot” (price) is. With limited allowances that firms need to use annually, in 180 days the damage will already have been done. The issuance of “future” allowances to drop prices seems to be of dubious value and of real concern given how this market is structured.

Allowance borrowing from the future is not likely to work due to uncertainty about future allowance prices. With a \$10 current price, utilities would not borrow 10 years ahead unless there were certainty that prices would not be above \$25 at that time (using a typical utility weighted average cost of capital of 9.5 per cent).

Cap and Trade and the Open Market

We remain deeply troubled with a simple market-only approach. Today the so-called market has left the nation in a housing crisis and the world capital markets in turmoil. The nation is still dealing with the fallout of Enron and the deregulation of the utility industry, which will make any carbon emission legislation even more difficult to administer. We support a limited market approach, with regulatory mechanisms that act as a safety valve to prevent any serious long-term damage to the economy. If the point of a cap and trade

system is to move firms and utilities to change domestic behavior, then we need to be sure this market mechanism does that.

The open and “unlimited trading” of allowances means that anyone, not just firms that need to use them, can buy allowances from a limited and declining pool. In addition, purchasers are allowed to bank these allowances in perpetuity. This is not the stock market or a commodities market, nor should it be treated as such. The open access to allowances, and the banking of allowances, lend themselves to the kind of predatory and speculative behavior that leads to hoarding and to the creation of carbon billionaires. This would have a detrimental pricing impact on the public and the utilities and energy-intensive industries.

Imagine a scenario in which a major nation with over a trillion dollars in accumulated trade surpluses decides to create a carbon allowance shortage on the U.S. market to make our domestic firms less competitive and push them out of business. Or imagine a major hedge fund trying to corner the carbon market and to extract royalties from domestic industry. With limited allowances, one would only have to capture a limited portion to have control. That is not the intent of this legislation. This needs to be regulated:

- The trading of allowances should be regulated and should be done in such a way that it assures that allowances that are sold are used. In other words, market participants should be limited to firms that intend to use the allowances. With a declining pool of allowances, available prices will rise but not be artificially inflated by speculators.
- The banking of allowance for an unlimited time raises the same concerns about hoarding and predatory behavior that leads to price spikes and artificially elevated prices. If the point is to use a diminishing allowance system to effect real behavior change and to have a functioning market that fairly sets prices, then allowances need to have a deadline by which they must be used or expire.

Offsets and International Allowances

We are concerned about the legitimate use of offsets and international allowances; the ability to monitor their legitimacy, especially in the international market; and ways in which they could undermine domestic investment in industry. This proposal allows for up to 30 percent of the annual allowances that a covered entity must submit to be comprised of offsets (15 percent) and internationally purchased allowances (15 percent).

If the goal of this legislation is to change the behavior of domestic power producers and industry and to encourage the domestic investment needed to introduce new technology, this could prove to be a roadblock. One option is to limit their use in combination, or simply to lower the amount.

The expanded forestry/agriculture allowances under S. 2191 raise a broader question over potential double dipping with later offset provisions in the bill. For example, Oregon and other states already provide tax incentives for tree planting. In addition, the wood products industry is under legal and business obligations to plant trees year round. Will the offset provisions doubly reward already-existing behavior that has been backed by tax incentives or existing business imperatives? If a utility company helps underwrite a timber firm's required replanting of a logged area, could they then claim offset credits?

This simple example shows how existing tax incentives and business requirements could be used to create offsets that do not provide real value added to the environment. Offsets should be the result of creating

something new or in addition to what normally would have been done as a course of business. The ability to double dip should be prohibited.

International linkages

The AFL-CIO welcomes the inclusion of the Bingaman-Specter provisions on international trade within ACSA, providing a means to impose emission offset requirements on imported goods from major international trading partners that have not taken comparable action to protect the global climate. However, the language needs refinement. Implementation can and should take place far sooner than 2020.

The bill should require the President to open negotiations immediately upon passage. Once the regulations are in place and the cap and trade is in operation for two to three years, the international action can be implemented. This last step should be an administrative action, not something subject to presidential waiver.

In addition, the timetable and goals should be tied to the international language in S. 2191. It is now even more apparent than it was when the Kyoto Accord was negotiated that taking unilateral steps is not enough to engage the developing world. The Committee should include the five-year review provision included in Section 501 of S. 1766, with its requirement for presidential reviews and recommendations related to progress in international negotiations seeking commitments from major trading partners:

Presidential Recommendations to Congress. Subsection (b) provides that, during a period between April 15, 2017 and May 31, 2017, and every 5 years thereafter, the President shall submit to the House of Representatives and the Senate a report describing any recommendation of the President with respect to changes in the Act. The President shall make recommendations with respect to—

Whether the U.S. should change the allowance amounts for future allocation periods as necessary to ensure that the United States is undertaking its equitable share of the responsibility for reducing greenhouse gas emissions, and in any case will reasonably lead the United States to reduce its annual emissions to levels at least 60 percent below current emission levels by 2050.



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November 1, 2007

The Honorable Joseph Lieberman, Chairman
The Honorable John Warner, Ranking Member
Senate Subcommittee on Private Sector and Consumer
Solutions to Global Warming and Wildlife Protection
456 Dirksen Office Building
Washington, DC 20510

Dear Senator,

On behalf of API and its member companies, I write to you regarding "America's Climate Security Act" (ACSA, S.2191). In our view, this bill is deeply flawed and several key aspects require a substantial amount of revision or we will not be able to support this legislation. API represents nearly 400 member companies engaged in all aspects of the oil and natural gas industry, including exploration, production, refining, distribution, marketing, research and development.

API believes that global climate change is a very serious matter and we all have a role to play in addressing emissions. We urge you to insist that any climate change policy be environmentally effective; promote a positive investment environment that allows for rapid development and deployment of energy-efficient and emission-reduction technology; provide access to all domestic energy sources, including natural gas which will face increased demand; be transparent and understandable to consumers and all stakeholders; avoid severe damage to the U.S. economy; and keep U.S. energy production competitive in the global marketplace.

API supports the following principles as elements of a sound approach to the long-term challenge of potential climate change:

- Promoting advanced, energy efficient technologies and sequestration options as part of a long-term, cost-effective strategy, without government selection of "winners and losers";
- Encouraging the rapid development and adoption of energy-efficiency technologies and enabling accelerated capital stock turnover by addressing legal, fiscal and regulatory impediments to such technologies;
- Identifying and expanding cost-effective, near-term voluntary actions to mitigate GHG emissions;
- Providing assurance that companies will not be disadvantaged later for their current voluntary actions;
- Supporting economic growth and avoiding damage to the economy posed by in-effective policies involving unrealistic near-term emission targets and timetables;
- Exporting advanced, energy-efficient technologies to the developing world through financing incentives and reduced export barriers, while protecting property rights;
- Promoting global participation, including by developing countries, to address this challenge cost-effectively;
- Carefully weighing the potential consequences of any policy that would make energy producers responsible for emissions outside their control (i.e., consumer emissions);
- Equitably treating the emissions from all sources of greenhouse gases economy-wide, and ensuring that the burden of legislation does not fall disproportionately on any particular industry, source or group of sources of greenhouse gases; and

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- Continuing to advance scientific understanding of global climate change in order to calibrate and adapt future policies appropriately and effectively.

Oil and natural gas companies are addressing climate change in diverse ways, taking action to reduce greenhouse gas emissions now, and investing in technologies that will reduce them even more in the future. For example, we are five years into our 10-year goal under the *Climate Vision Program* to improve refinery energy efficiency. In the last year alone, the energy savings from this were equivalent to taking 525,000 cars off the road.

The Department of Energy (EIA) has reported that even with increased renewable sources, our growing economy will need an estimated 28% more oil and 19% more natural gas in year 2030 than in 2005. Any climate change policy must begin with improving our domestic sources of energy, including natural gas, which has the lowest emissions per btu of any fossil fuel.

However, many of the provisions in "America's Climate Security Act" would have a detrimental effect on the American economy, reliable and affordable domestic energy, and the growth of low- and zero-emission technologies.

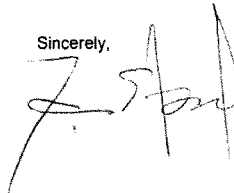
We are alarmed that the legislation in its current form could result in disproportionate impacts on the transportation sector that may have serious and potentially distorting economic effects. These include more volatility in future energy costs for investments and consumers, potential conflicts with emerging fuels requirements, non-harmonization with state and regional programs, decreased supply of clean-burning natural gas and competitiveness issues that will further hamper our domestic energy industry. This legislation could have very burdensome impacts on energy consumers and suppliers. We also want to emphasize the need for other economies, including developing nations, to share the burden in reducing greenhouse gas emissions.

Under a cap-and-trade system similar to this bill, industry analysis shows a likely decrease in U.S. energy production, including natural gas, as well as a decrease in U.S. refining capacity, thus resulting in increased fuel imports.

Senate consideration of the ACSA bill should be robust and deliberative in order to allow time for policymakers to be informed and to provide an opportunity to correct any unintended consequences of this particular piece of legislation. This complex cap-and-trade system covers a broad scope of activities and creates between \$70 billion and \$200 billion worth of required permits in its first year of operation and selectively allocates them to targeted industries. Economic impacts, including impacts on consumers, need to be fully understood with legislation of this magnitude. The proposed legislation should not be rushed; instead, it should be given the benefit of the full scope of regular legislative process so that a thorough, transparent and informed debate can occur.

Thank you for your consideration of our views and please do not hesitate to contact API if we can provide additional information.

Sincerely,



Detailed comments regarding "America's Climate Security Act"Transportation Allocation

API strongly believes that emissions from all sources should be treated equitably so that the burden of legislation does not fall disproportionately on any particular sector, such as transportation. A ton of CO₂ emissions that accumulate in the atmosphere would have the same effects regardless of their source; accordingly emissions from one source should not be treated differently than emissions from another. Under the ACSA bill, fuel producers (refineries) would be responsible for both their own operating emissions and the broader transportation or "tailpipe" emissions. Using referenced EPA reports, oil and natural gas operators would be allocated permits only for operating emissions, but no permits for tailpipe emissions, resulting overall in only 10% of the permits needed. This is a disproportionate and immediate burden when compared to some economic sectors which receive 77% of the permits needed. Climate policies need to be equitable in imposing costs and burdens on society.

Fuels Policy

The proposed bill ignores emerging policies on fuels. This bill would compound the difficulty of meeting mandatory policies underway on transportation emissions (specifically EPA drafting mandatory Low Carbon Fuel Standards) and the tightening environmental requirements for U.S. transportation fuels.

Fuel Imports

The ACSA bill will likely result in U.S. fuel production shifting to foreign refineries, resulting in increased fuel imports in order to meet energy demand from economic growth. Although analysis on ACSA is not completed, under the less stringent Lieberman-McCain climate bill, U.S. refinery throughput could be reduced by as much as 2 million barrels per day by year 2020 with a corresponding increase in refined product imports.

Natural Gas Supply

This legislation would likely decrease natural gas production due to both extending the coverage to suppliers and a resulting increase in abandoned marginal natural gas wells due to costs from methane emissions. In contrast, any climate change policy should begin by utilizing domestic sources of clean-burning natural gas, which has the lowest emissions per btu of any fossil fuel. Although ACSA analysis is not completed, under the less stringent Lieberman-McCain climate bill, U.S. natural gas production could drop by up to 11% by year 2030.

Federal Pre-emption

This proposal for U.S. climate policy lacks federal preemption of regional and state greenhouse gas reduction programs. Nationwide consistency is needed among programs to reduce regulatory uncertainty and increase the efficiency and effectiveness of federal climate change policy.

Carbon Market Efficiency Board

Meeting demand for reliable and affordable fuel requires billion dollar investments in facilities that provide energy for decades. The ACSA bill's "Carbon Market Efficiency Board" is intended to contain costs, but may create unstable conditions for energy infrastructure investments and consumer protections. The board does not provide any assurances against economic volatility.

Emission permits

Emission permits are not restricted to operators and governments, so third parties – including hedge funds, activists or foreign competitors or anyone - may buy auctioned permits. This adds

volatility and effectively decreases the available emission credits in an already constrained market.

Carbon Capture and Storage (CCS)

API supports the promotion of CCS and our industry is ready to contribute decades of experience in this area from oil recovery projects. While API supports the inclusion of CCS, we note that the program only provides incentives if the CO₂ comes from electric power generation. Climate policies should encourage emission reductions from all sectors, including refineries and production facilities.



GOVERNMENT AFFAIRS

Joseph M. Stanton
 Chief Lobbyist

October 31, 2007

The Honorable Joe Lieberman, Chairman
 Subcommittee on Private Sector and Consumer
 Solutions to Global Warming and Wildlife
 Protection
 410 Dirksen Senate Office Bldg.
 Washington, DC 20510

The Honorable John Warner, Ranking Member
 Subcommittee on Private Sector and Consumer
 Solutions to Global Warming and Wildlife
 Protection
 456 Dirksen Senate Office Bldg.
 Washington, DC 20510

Dear Chairman Lieberman and Ranking Member Warner:

On behalf of the 235,000 members of the National Association of Home Builders (NAHB), I write to express serious concerns with Section 5201 of S. 2191 – *America's Climate Security Act of 2007* that will be marked up by the Subcommittee on Thursday, November 1. As home builders, we believe the provisions in this section will not achieve the gains that Congress hopes to realize by imposing aggressive increases to State building codes coupled with federal intervention into the code development process.

Section 5201 focuses primarily on new construction, which is already substantially more energy efficient than existing homes. Data from the Energy Information Administration (EIA) shows that homes built between 1991 and 2001 consumed only 2.5% of the total energy in the residential sector compared to older homes (pre-1991) which accounted for 17.1%¹. The dramatic energy savings are principally a result of building code improvements that have resulted in significant efficiency gains in new homes.

If Congress hopes to achieve additional improvements in energy efficiency in the residential sector, it must address residential energy loss in existing homes rather than seek substantial increases from new construction, which may never materialize. Most importantly, these building code improvements have occurred within the existing framework of a voluntary consensus process that ensures that both the regulators and the regulated community have input. Further, these disparate parties must agree to implement agreed-upon benchmarks to improve health, safety, welfare, and of course, energy efficiency.

The power to enforce building and energy codes rests solely with the States, as provided for in the U.S. Constitution. This is important for many reasons, but in simplest terms, States are better equipped to address specific geographic needs and enforce codes that are uniquely appropriate for their jurisdiction. Energy efficiency means something different in Connecticut than it does in Florida. Homebuyers, builders, and the general public rely upon State and local governments to make determinations about

¹ U.S. Department of Energy, Energy Information Administration. *Annual Energy Review*. 2001 Residential Energy Consumption Survey.

appropriate code requirements in their specific areas. Congress should do everything in its power to preserve this oversight role for the States.

Government regulations that mandate market outcomes are the least effective tool for achieving energy efficiency. In practical terms, these rules simply increase construction costs (without reference to consumer demand), thereby reducing new home construction, and increasing the share of the nation's housing stock that is older and less energy-efficient. Furthermore, mandates and rules that demand compliance require substantial oversight. The Department of Energy (DOE), in order to comply with the provisions in this section, would have to ensure enough staff capacity to determine compliance rates, review reports, draft code change proposals or modifications to codes, and equip and train staff to act as enforcement officials. In terms of staffing and enforcement alone, this would add tremendous government cost in order to ensure that the goals Congress is setting are achieved.

Congress could achieve greater efficiency in the residential sector by providing incentives both to shift the market towards higher efficiency and to encourage consumers in existing (older) homes to upgrade for efficiency. The resources that the government would spend at DOE to enforce Section 5201 could have a much greater impact if they were directed at the largest component of residential energy loss: existing homes. Providing meaningful tax incentives to homeowners that choose high-efficiency windows with low-emissive glass or that upgrade older HVAC systems with a minimum SEER 13 compressor, for example, would have a much broader reach (120 million existing homes versus approximately only 1.2 million new homes built each year) and save more energy (17% energy loss in existing homes versus 2.5% energy consumed by newer homes).

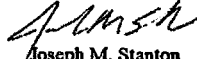
Congress should extend the Internal Revenue Code Section 45L New Energy Efficient Home Tax Credit program permanently. The *Energy Policy Act of 2005* established a tax incentive of \$2,000 for a home achieving 50% energy savings and it expires at the end of 2008. Because, the home building process is lengthy and requires substantial lead times, most builders are reluctant to pursue a tax credit with such a short and unpredictable duration. NAHB was disappointed that Congress did not extend this important incentive in either H.R. 6 or H.R. 3221 and recently signed a joint letter with a number of energy and environmental advocates (e.g., Alliance to Save Energy, National Resources Defense Council, to name a few) that are working collectively to urge Congress to extend the Section 45L credits for as long as possible. Additionally, Congress should extend and expand the Internal Revenue Code Section 179D Energy Efficient Commercial Buildings Deduction. The deduction provides a tax incentive to owners of commercial properties, including many multifamily apartment buildings, to install energy efficient systems. To increase the effectiveness of this provision, Congress should expand the definition of a qualifying building to include all multifamily properties used for business purposes (i.e. low-rise rental apartment properties).

It is likely that Congress will not realize the efficiency goals set forth in Section 5201 due to a number of practical, technical, and administrative issues that are not sufficiently addressed in this section. Because our members have real expertise in residential energy efficiency and are leaders in energy- and resource-efficient home construction, NAHB urges you to reconsider the approach laid out in Section 5201. Although some organizations have weighed in supporting these provisions, it is important to realize that many of these groups neither understand nor represent the interests of the building community at large, simply because they do not build anything. Therefore, NAHB cautions against haphazardly establishing requirements that are impractical, inappropriate, or that sideline States' rights as you attempt to address greenhouse gas emissions in the residential sector as part of S. 2191.

NAHB's members are proud of the strides that have already been made in residential energy efficiency for new homes, mostly achieved through building code improvements at the State and local level, but agree that Congress has an opportunity to encourage even greater energy savings. Like you, the nation's home builders are also concerned about energy efficiency and have gone above and beyond in many proactive ways to integrate greater energy and resource efficiency in home construction. To this

end, NAHB urges a removal of Section 5201 and an extension of the Section 45L New Energy Efficient Home Tax Credit. On behalf of our nation's home builders, I thank you for considering our views.

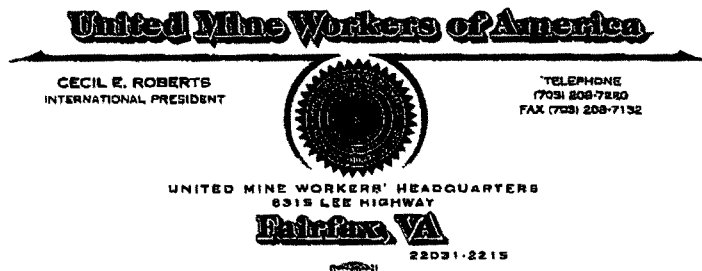
Sincerely,



Joseph M. Stanton

JMS/eo

cc: Senate Committee on Environment and Public Works



October 23, 2007

By Hand Delivery

Honorable Joseph I. Lieberman, Chairman
Subcommittee on Private Sector and
Consumer Solutions to Global Warming
And Wildlife Protection
410 Dirksen Senate Office Building
Washington, DC 20510

Honorable John Warner, Ranking Minority Member
Subcommittee on Private Sector and
Consumer Solutions to Global Warming
And Wildlife Protection
456 Dirksen Senate Office Building
Washington, DC 20510

Re: UMWA's Concerns with America's Climate Security Act

Dear Senators Lieberman and Warner:

As the Subcommittee prepares to address national climate change legislation, I am writing to express the initial concerns that the UMWA has with respect to America's Climate Security Act (ACSA). In its current form, the UMWA is not able to support this legislation due to its probable extreme adverse effects on coal mining and utilization, consumer energy prices, and the need for a balanced and secure national portfolio of energy supplies. We hope that Subcommittee action will improve the bill in key respects to alleviate the concerns expressed here and by others.

We, along with other member unions of the AFL-CIO, are on record in support of the bipartisan Bingaman-Specter climate bill, S. 1766. The UMWA already has communicated a variety of concerns about the initial outline of ACSA released last August. We are disappointed that the legislation introduced last week does not adequately reflect the concerns we and our colleagues have raised. In sum, our concerns include:

An overly aggressive Phase I emission reduction target, now increased from a 10% to a 15% reduction of greenhouse gas emissions below 2005 levels by 2020, before the anticipated commercial availability of carbon capture and storage technologies;

- Absence of an effective safety valve price for carbon dioxide allowances;
- Inappropriate allocations of emissions allowances, such as the 10% allocation to “wires companies” to encourage energy efficiency (better accomplished through direct legislation on energy efficiency standards, now incorporated in other provisions of the bill);
- Unequivocal commitment to achieving a 70% national emission reduction below 2005 levels by 2050 regardless of the degree of participation of major developing nations like China and India in a global climate protection framework.

Overly aggressive 2020 target

The proposed 2020 target of 15% below 2005 emissions is unrealistic and would impose severe disruptions on domestic energy markets. EIA’s 2007 analysis of the 2007 McCain-Lieberman bill (S. 280) underscores the risks in setting such an aggressive reduction target just 13 years from now.

We estimate ACSA’s 2020 target as 5.06 billion tons of CO₂ equivalent from the energy sector, given EIA’s 5.95 billion ton emission estimate for 2005. The controlled emissions achieved by 2020 in EIA’s S. 280 analysis amount to 6.12 billion tons, about 1.0 billion tons higher than ACSA’s target reduction. EIA’s findings for the fuel market impacts of S.280 are thus very conservative as a yardstick for comparison. EIA concluded (at page 35):

“To reduce its CO₂ emissions, the power industry, including generators in the industrial and commercial sectors, is expected to shift away from its historical reliance on coal generation. Coal generation in 2030 in the main S. 280 cases is below current levels, ranging from 7 percent below in the Fixed 30 Percent Offsets case to 70 percent lower in the No International case. Coal generation in the S. 280 Core case is 26 percent below the reference case level in 2020 and 69 percent lower in 2030, a reduction of 2,295 billion kilowatthours. Relative to the 2005 level, coal generation in the S. 280 Core case is 48 percent lower in 2030. In the reference case, coal accounts for 58 percent of total generation in 2030, but its share falls to between 11 percent and 35 percent in the main S. 280 cases.”

EIA’s findings are indicative of the potentially severe impacts on coal mining production and employment if aggressive reduction targets are set too soon, before CCS and related technologies are commercially available to capture, transport and sequester carbon from the electric generation sector. In order to bring an advanced coal generation plant with full CCS capability into commercial service by 2020, all applicable permitting should be substantially completed within the next year or two. This is simply impracticable given the substantial number of unresolved technical, legal and regulatory uncertainties confronting major CCS projects. For example, U.S. EPA just recently announced plans for developing regulations for CCS injection well permitting to meet Safe Drinking Water Act requirements. These regulations may not be finalized for two years or more.

While we welcome your inclusion of bonus allowances for CCS technologies in ACSA, along with other provisions intended to accelerate the commercial availability and regulatory framework needed to advance CCS, the aggressiveness of the 2020 target would force many utilities away from coal-based generation at both new and existing plants. There is no conceivable set of emission reductions from other major source sectors, such as the transportation fleet, that could avoid severe market disruptions in the electric generation sector, including a major shift to scarce natural gas or imported LNG that would force energy prices higher throughout the economy.

The intractable difficulties facing a truly global agreement on climate reinforce our view that the actions that Congress takes on climate change should be guided by the 2005 Sense of the Senate Resolution, and by Senate. Res. No. 98, the 1997 Byrd-Hagel resolution adopted unanimously prior to the negotiation of the Kyoto Protocol.

Each of these Senate resolutions emphasizes that any legally binding constraints on greenhouse gas emissions should not adversely impact the U.S. economy. The 2005 Senate Resolution recommended enactment of "market-based limits and incentives on emissions of greenhouse gases" that "will not significantly harm the United States economy" and "will encourage comparable action by other nations ..." (151 Cong. Rec. S7033, June 22, 2005).

Establishing an appropriate linkage of U.S. commitments to developing country actions is vital to the economic, trade and national energy security interests of the United States. The U.S. cannot reasonably assume that an aggressive unilateral commitment to greenhouse gas reductions would elicit comparable responses from major Asian trading partners. A more gradual course of U.S. commitments, conditioned to the responses of our major trade competitors – similar to the approach in S. 1766 - would help to preserve U.S. negotiating flexibility while international pressures mount for global actions to address climate change.

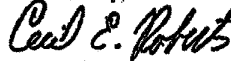
Federal preemption

The UMWA is concerned that the growing number of states enacting mandatory climate change legislation will produce a patchwork quilt of inconsistent state regulation, similar to the various state acid rain laws enacted prior to Title IV of the 1990 CAAA.

For example, states in the Northeast are moving ahead on emission allowance auction programs. Emitting sources should not be subject to duplicative state and federal requirements, with emission auctions potentially requiring sources to purchase one federal and one state allowance to cover the same ton of emissions. National climate legislation should contain limited preemption language to ensure a level playing field among states, eliminating conflicting state cap-and-trade and related allowance auction programs. Such an approach would preserve state climate initiatives in areas such as energy conservation and efficiency, renewable energy standards, agriculture, land use and transportation planning.

We will appreciate your consideration of our views as the Subcommittee proceeds with its work on climate legislation.

Sincerely,



Cecil E. Roberts

cc: Honorable Jeff Bingaman
 Honorable Arlen Specter
 Honorable Robert C. Byrd
 Honorable John D. Rockefeller IV
 Honorable John D. Dingell
 Honorable Rick Boucher
 Daniel J. Kane, International Secretary-Treasurer, UMWA
 Richard L. Trumka, Secretary-Treasurer, AFL-CIO

**AMERICA'S CLIMATE SECURITY ACT OF 2007,
S. 2191**

TUESDAY, NOVEMBER 13, 2007

U.S. SENATE,
COMMITTEE ON ENVIRONMENT AND PUBLIC WORKS,
Washington, DC.

The full committee met, pursuant to notice, at 11 a.m. in room 406, Dirksen Senate Office Building, Hon. Barbara Boxer (chairman of the full committee) presiding.

Present: Senators Boxer, Inhofe, Baucus, Lieberman, Carper, Cardin, Klobuchar, Whitehouse, Warner, Voinovich, Isakson, Alexander, Bond, Barrasso, and Craig.

**STATEMENT OF HON. BARBARA BOXER, U.S. SENATOR FROM
THE STATE OF CALIFORNIA**

Senator BOXER. The hearing will come to order.

We are holding this hearing to further consider the landmark global warming legislation of Senators Lieberman and Warner. They have been working on this comprehensive bill for several months. I cannot tell you how grateful I am for their continued leadership.

I also want to say thank you to the other members of the Committee and also to the staff on both sides. I think we showed last week when we had an open briefing that members were interested and staff was absolutely prepared to answer each and every question.

We are going to continue this, and I know Senator Alexander has some concerns about the schedule, and I want it to be noted that we already have moved to add hearings, briefings and also every day, all that any staffer of any Senator on the Committee has to do, or any Senator has to do is call here and they will have a private meeting set up with the appropriate staff. So thank you to all for your continued engagement as we move toward a markup.

The legislation before us provides a strong framework for global warming action. We are building upon this foundation and I am committed to making this the best bill that it can be. I remain dedicated to a deliberative and transparent process. We have had, as you know, over 20 hearings on global warming. This is our third hearing specifically on this bill. We have a fourth one on Thursday. We will continue to work on legislation in consultation with stakeholders, members and staff as we proceed.

I want to thank your witnesses for coming today. I look forward to your testimony. I know this was short notice, I really appreciate that you are here. And I face this challenge, as I have said many

times, with hope, not fear. By facing this challenge now, we can maximize our chances of avoiding the most dangerous effects of climate change, and we will position America to capitalize on the tremendous opportunities ahead.

I believe we have a moral obligation to do everything we can, starting now, to fight global warming. When we do, we will reinforce our role, America's role, as a beacon of hope to other nations who look to us on these important issues.

With that, I would yield to Senator Warner.

**STATEMENT OF HON. JOHN WARNER, U.S. SENATOR FROM
THE COMMONWEALTH OF VIRGINIA**

Senator WARNER. Thank you, Madam Chair.

I am still in a rapidly mending posture, but I am not able to bend or sit. But that doesn't keep the old brain from cranking away, and I will proceed to my office now where I take a more relaxed position to thereby take in every single bit of wisdom you will impart today. I thank this distinguished panel.

Madam Chairman, I have watched you and the distinguished Ranking Member and others on this Committee consult with Senator Lieberman and myself about procedural matters. I think we are doing everything we can to strike a balance in the sense of urgency to move on with this legislation against the need to allow members of the Committee to advocate their positions and to otherwise address it so that we can have a good understanding as we proceed toward markup.

Now, we certainly are all aware in this room about the potential economic impacts of this legislation. So last week, Senator Lieberman and I wrote the Department of Energy Information Administration and the EPA, and I will just read one of the letters: "We are writing to request that the EIA estimate the economic impacts of S. 2191, America's Climate Security Act," and a similar request being made to the Environmental Protection Agency. "We ask that these agencies begin this process by meeting with our staff as soon as possible to discuss the parameters, methods and duration of the analysis."

That I think will be a helpful step. Also, I want to thank several colleagues on my side of the aisle who, while they still have some very grave concerns about the legislation, are trying to offer cooperative suggestions by which we could perhaps in the markup session address with the thoroughness that they deserve, such issues as are of concern to them. I hope that the December markup session as now scheduled does have that much flexibility to add on time to allow colleagues on this side to have their issues addressed. I particularly want to thank my colleague from Tennessee.

With that, Madam Chairman, I yield the floor and return to my office off-campus, so to speak.

Senator BOXER. Senator Warner, thank you for your continued leadership. As you know, it was your strong words that led to this additional hearing and additional briefings, and yes, we are not going to rush a markup. We are going to start it and we are going to end it when everyone feels they have had a chance to offer their amendments and their comments. We will work with your staff and you on that so that you feel satisfied.

Senator WARNER. Thank you very much.

Senator BOXER. We are going to go in order of seniority, so we are going to go to Senator Baucus.

STATEMENT OF HON. MAX BAUCUS, U.S. SENATOR FROM THE STATE OF MONTANA

Senator BAUCUS. Thank you very much, Madam Chairman. Thank you for holding this very, very important hearing. You are showing great leadership, and this is a very important thing to do. I thank you for it.

And obviously, I thank my colleagues, Senators Lieberman and Warner, for all the work that you have put into this project. You have worked very, very hard, listened to a lot of people, various perspectives, and made your own judgment as to what you thought would be a good start. We all thank you for all of that.

Baseball great Wade Boggs once said, and I have chosen Wade Boggs, because he is both a Yankee and a Red Sox player, he said, "I didn't get over 1,300 walks without knowing the strike zone." Well, Madam Chairman, I think the Senators serving on this Committee have all played crucial roles in passing important pieces of legislation. We are fortunate to have such experienced and dedicated public servants seated on this Committee. I think we all know a strike when we see one. And I think most will agree that this ball is a strike, it is down the middle.

I am wary, however, of some of the proposals that have been made that would pull this bill too far one direction or another. America's Climate Security Act apparently hit the sweet spot. It once again makes the United States a leader in addressing climate change. It is very important that we do that, for the United States to be a leader by calling for emissions reductions of 70 percent below 2005 levels by the year 2050.

The bill also keeps the economy growing by including important incentives for carbon capture and sequestration technology. This technology will allow the United States to continue to use its most abundant and affordable energy source: coal. In my State of Montana alone, we have 120 billion tons of coal, that is one tenth of all the coal in the world. The bill also includes provisions allowing America's farmers and foresters to generate offsets. These provisions both contain the costs to the economy and create new sources of revenue for America's farmers and ranchers. Even if only half of Montana's feed growers switched to no-till farming, they could generate as much as \$48 million annually in revenue.

The balance Senators Warner and Lieberman have achieved in their bill is no small task. I have heard some of my colleagues say that the bill goes not far enough one direction or the bill does not go far enough. Some have said that caps should be tighter and allowances to industry phased out more quickly. I have heard other colleagues say that Congress should cede its authority to tighten the cap in future years to the Administration. I must respectfully disagree with these proposals.

We will not solve climate change with one bill. What we need is a Marshall Plan for America that aims to build a cleaner economy. The United States did not rebuild Europe after World War II in a

day. It took time. Likewise, addressing climate change will take years and multiple policies, such as a greening of the tax code, working with our trading partners, increasing competitiveness and efficiency of our economy.

I am also afraid that through a good intention shifting of allowances and auction revenue we may upset the delicate balance currently in the bill. I have heard some of my friends say the bill does not do enough to incentivize nuclear, renewable energy and natural gas. Clearly we will need all of these energy sources to meet the needs of our economy. But I must say under the bill as currently drafted, all of these energy sources are already eligible for incentives.

So my colleagues have also stated an interest in allocating allowances to existing power plants based on electricity output. I disagree. That approach would amount to subsidizing existing plants with no economic or environmental added value. Allowances should go to those power plants that need them in order to comply with regulations and invest in cleaner technologies.

America's Climate Security Act is a strong, balanced bill. We have the pitch we want and we ought to hit it out of the park. Thank you.

Senator BOXER. Thank you, Senator.

Senator Isakson.

**STATEMENT OF HON. JOHNNY ISAKSON, U.S. SENATOR FROM
THE STATE OF GEORGIA**

Senator ISAKSON. Thank you, Madam Chairman.

I will submit my entire statement for the record, as unanimous consent to submit the entire statement and I will be brief, just make a couple of points and move on so we can hear the testimony.

I believe that we should take proactive steps, both personally and as a Nation to reduce our Nation's footprint. One of those steps is addressing the carbon issue. The only way you reduce that is by addressing the burning of fossil fuel. The only way that you do that substantially is by looking at alternative sources and existing sources, particularly the enhancement of nuclear, cellulose-based ethanol and other renewable sources.

I don't see the emphasis in this legislation on nuclear that I would like to see. I think that is one of the main ways we do it.

I would like to welcome Dr. Greene and all the members who are here today. I read Dr. Greene's testimony earlier, and as a person interested in transportation, I look forward to his testimony on the effects of cap and trade as a carbon reduction policy for the transportation sector. I am especially interested in his thoughts on low-carbon fuels such as cellulose-based biofuels. While his testimony focuses on surface-based transportation, I am also interested in hearing his views on how cap and trade will affect other transportation sectors, such as the airline industry, which is a huge part of my State of Georgia's economy.

I welcome all of our panelists who are here today, and I think the Chairman for giving us this opportunity at this hearing.

Senator BOXER. Thank you, Senator. We will put your full statement in the record.

Senator Lieberman.

**STATEMENT OF HON. JOSEPH I. LIEBERMAN, U.S. SENATOR
FROM THE STATE OF CONNECTICUT**

Senator LIEBERMAN. Thanks very much, Chairman Boxer. Thanks for holding this hearing, a series of hearings in a very, what I think is a very deliberative process. I know some of our colleagues have been concerned about the time given it. We have had a lot of hearings in this Committee and we are going to continue to have a lot of hearings before we get to the markup.

And then as always happens with any major piece of legislation, and this is just about as just about as major as you can get, when we get to the Floor, there is going to be a lot of time to work together to try to find common ground. Senator Alexander made reference to former Senator Dirksen convening, opening up his office for deliberations on the Civil Rights Act when it got to the Floor during the 1960s; Senator Mitchell, former majority leader, did the same with the Clean Air Act. Those meetings went on for weeks and weeks and weeks, but finally reached resolution and progress. I believe we can do that here.

So there is a lot to do in this Committee, but this is not, if we are able to report it out, the end of the process. I want to come to Senator Baucus in this regard. I thought his opening statement was excellent; not the least reason for which was his mention of Wade Boggs to bring out this figure of reconciliation between these two deeply competitive forces, the Yankees and the Red Sox, and to evoke thereby the possibility of reconciliation across different points of view on climate change is inspirational. I thank him for that.

And look, as Senator Baucus said, some want it go further one direction, others want to pull it back. We want to do this thoughtfully, but let's be honest with one another, because most of us here recognize the reality that the globe is warming. We are in a race with time here. One can conjure, talk about Nero fiddling while Rome burned, one can conjure up a picture in one's mind where we continue to debate and pursue the perfect climate change bill while the waters are rising along the coasts of America and the rest of the world and the climate is adversely affected. We cannot let that happen.

In my statement opening the last hearing, I talked about the various projections of costs for America's Climate Security Act, which in my opinion are manageable and relatively minor, considering what we will achieve thereby, which is to avoid the potentially disastrous consequences of climate change. I just want to spend a moment to talk about a factor that is not calculated in those estimates of cost, which is, what are the costs of not doing anything? The IPCC has cited some factors here and real world consequences, and basically concludes that the United States will shoulder quite significant costs by mid-century unless we act now to reduce our greenhouse gas emissions.

Let me give you some of the examples. Warming in our western mountains will decrease the snow pack, causing more winter flooding, reduced summer flows and increased competition for already strained water resources. So we have the costs and conflict. Droughts and new invasions of insects will kill crops as well as forests and leave forests even more prone to fires, more costs and dis-

location. Coastal communities and habitats will be battered by intensified storms with the damage compounded by more erosion, again, enormous costs.

In March, the Government Accountability Office issued a report entitled *Climate Change: Financial Risks to Federal and Private Insurers in Coming Decades are Potentially Significant*. Madam Chair, I would ask unanimous consent to place that report in the record at this time.

Senator BOXER. Without objection.

[The referenced material follows on page 272.]

Senator LIEBERMAN. But here are some of the report's conclusions in brief. Storm-related economic losses will increase at an exponential rate as storm strength increases. Category 4 storms tend to cause 100 times the economic damage that category 1 storms cause. And real climate change will bring about more category 4 storms. One half to two thirds of the structures in U.S. flood plains do not have flood insurance at all.

The Federal Government's two main insurance programs, the National Flood Insurance Program and the Federal Crop Insurance Program, have grown markedly more exposed to weather-related losses since 1980. The impact of unchecked global warming on those two programs alone, according to the GAO, could substantially increase the annual budget imbalance, and therefore the overall deficit, of our Government.

Thus I would submit in closing, Madam Chairman, that the economic costs to this Country of unchecked global warming will be grievous by mid-century unless we act not to mandate significant reductions in greenhouse gas emissions as America's Climate Security Act does. I thank the Chair.

[The prepared statement of Senator Lieberman follows:]

STATEMENT OF HON. JOSEPH I. LIEBERMAN, U.S. SENATOR FROM THE
STATE OF CONNECTICUT

Thank you, Chairman Boxer. I would like to spend a few minutes discussing cost. Here are some of the costs—expressed in terms of real-world consequences—that the Nobel Prize-winning Intergovernmental Panel on Climate Change—the IPCC—finds the United States will shoulder by mid-century unless we act now to reduce our greenhouse gas emissions:

Warming in our western mountains will decrease the snowpack, causing more winter flooding, reduced summer flows, and increased competition for already strained water resources.

Droughts and new invasions of insects will kill crops as well as forests, and will leave forests even more prone to fires. Coastal communities and habitats will be battered by intensified storms, with the damage compounded by more erosion.

In March, the Government Accountability Office issued a report entitled, "Climate Change: Financial Risks to Federal and Private Insurers in Coming Decades are Potentially Significant." I seek unanimous consent to place that report in the record.

Here are some of the report's conclusions:

Storm-related economic losses increase at an exponential rate as storm strength increases. Category 4 storms tend to cause 100 times the economic damage that Category 1 storms cause.

One-half to two-thirds of the structures in U.S. floodplains do not have any flood insurance at all.

The federal government's two main insurance programs—the National Flood Insurance Program and the Federal Crop Insurance Program—have grown markedly more exposed to weather-related losses since 1980.

The impact of unchecked global warming on those two programs alone could, according to the GAO, substantially increase the annual budget imbalance and the overall deficit.

In 1999, the Agriculture Department's Risk Management Agency declared, "The risks of climate change, such as higher temperatures, changes in precipitation, increased climate variability, and extreme weather events can result in significant impacts on agriculture, forestry, and rural areas."

Thus, I would submit, Madame Chairman, that the economic cost to this country of unchecked global warming will be catastrophic by midcentury unless we act now to mandate significant reductions in greenhouse gas emissions.

On its own, America's Climate Security Act would, according to the Natural Resources Defense Council, reduce total U.S. greenhouse gas emissions by 18 to 24 percent below the 2005 level by 2020 and by 59 to 66 percent below the 2005 level by 2050.

According to the modelers at the Environmental Protection Agency, those reductions in U.S. emissions would keep atmospheric greenhouse gas concentrations below dangerous levels even if countries such as China and India did not start taking serious action until 2025.

I will digress to say that I believe those nations can and should start acting sooner. No one seriously believes, though, they will start until we do, considering that we are responsible for most of the global warming that is now irrevocably dialed into the climate system. Besides, I for one would prefer that we develop advanced energy technologies here, and export them there, rather than the other way around.

So the emissions caps in America's Climate Security Act are tight enough to avert the economic catastrophe this nation will face if we fail to take strong action now. What is the cost of implementing America's Climate Security Act?

At last week's hearing, I reviewed some of the findings that the Clean Air Task Force had reached using the Energy Information Administration's model.

First, the price of an emission allowance would not exceed \$50 until after 2030. According to EIA's October 29 report to Senators Inhofe, Voinovich, and Barrasso, fuel switching from coal to natural gas would not make any economic sense until the price of an allowance exceeds \$50. So one should not expect fuel switching to occur under America's Climate Security Act before 2030. By 2030, even the pessimists say we will have commercial deployment of carbon capture and sequestration technology for coal.

The analysis goes on to project that U.S. gross domestic product would more than double by 2030. The projected increase is only 1 percentage point lower than the increase projected in the absence of America's Climate Security Act.

Electricity and natural gas rates would, over 25 years, rise by about 18 and 5 percent, respectively.

However, because of the technology development and deployment and energy efficiency measures in the bill, energy usage would drop considerably. The drop in energy needed would result in reduced monthly electrical and natural gas bills for residential, commercial and industrial customers.

So, it turns out that the bill's cost is very manageable—and miniscule compared to the cost of inaction.

Thank you, Chairman Boxer.

Senator BOXER. Senator, thank you for that statement.

Senator Barrasso.

STATEMENT OF HON. JOHN BARRASSO, U.S. SENATOR FROM THE STATE OF WYOMING

Senator BARRASSO. Thank you, Madam Chairman. As I stated throughout the debate on this legislation, we must adapt, we must make changes to address the effects of global warming. We must be ready to put our money where our best hopes are. We cannot simply shut off current, traditional energy sources.

I have stated that the current language that requires any new coal-fired power plants to be able to capture 85 percent of its carbon emissions is not feasible today. We must, as a Nation, invest in the technology to let us make the best use of all of our energy resources.

Today we have incredible resources of coal in places like Wyoming and Montana. It is recovered there because of the investment of the infrastructure and the skilled work force. Now, those things

may not be there in 20 years if we prevent new coal-fired plants from being built because we require them to sequester 85 percent of the carbon today instead of a staged or stepped approach over time.

Now, I have heard members say that we should not let perfect be the enemy of good, and I think that applies here. There is also no doubt that we have to take care of those who are negatively impacted by this bill. Some of those will be Wyoming residents who have terrific jobs, they have retirement plans, they have health insurance. I am not yet satisfied with the answers that I have gotten regarding how many workers are going to be displaced by this Act. It seems fair that we have a real figure. American workers deserve no less.

I also believe that States will have to play a vital role in this regard. The Carbon Market Efficiency Board must address the significant harm not just to the Country, but to individual States. The bill, to me, as drafted, has still a one size fits all approach to the States. We must give each State flexibility to spend money to assist their people as they see fit.

Finally, let me reiterate that I do want to address this problem of global warming. We can get there, but only if we show China and India that we can pass a bill that strengthens our economy, that creates jobs, that looks after our workers, that develops the needed technology and then allows those nations to use that technology to address the problem on a worldwide basis, not just a national basis.

I would like to work with you, Madam Chairman, to make sure that the legislation we pass achieves those objectives. Thank you very much.

Senator BOXER. Thank you, Senator Barrasso.
Senator Carper.

**STATEMENT OF HON. THOMAS R. CARPER, U.S. SENATOR
FROM THE STATE OF DELAWARE**

Senator CARPER. Thank you, Madam Chair.

To our witnesses, welcome. It is good to see all of you. We appreciate your time with us today and your testimony and your responses to our questions.

Most of us had a chance last week to say our piece and we did. I am not going to say much today, but I just want to reiterate a couple of points if I could. I hope to support the legislation that is before us on which this hearing is being held. I want to support this legislation on which this hearing is being held. In order to be able to do so, I need to be assured on three points.

One is that we are not going to forget as we go through this process the problems that are created, particularly for those of us on the eastern side of the United States who suffer because of emissions of sulfur dioxide, nitrogen oxide and mercury. I need to be assured that the allocation of credits will be just somewhat better balanced, so that a few more credits can go to the producers of electricity producing that electricity with reasonably less input, less energy in the first place.

The third point, I want to make sure that as we pass this legislation, we don't do so in ways that punish companies that are al-

ready taking early action to help reduce the threats to our world and to our atmosphere.

I suggested last week that I thought we might be able to broaden support for our legislation by addressing three areas that are addressed, but I think not directly in our legislation. One of those is with respect to transportation. I think our focus should be on clean fuels, clean cars and trying to encourage ways to provide transportation options to people other than our cars, trucks and vans.

A second is to see if we can't put together an amendment that speaks to the potential that nuclear can provide in helping to address our dependence on foreign oil and the creation of these greenhouse gases. The third way I think we may be able to provide support for this bill in Committee or beyond Committee on the Floor is to better protect the U.S. industrial sector in a way that recognizes that they have already made significant CO₂ reductions. I think one of our witnesses will speak to that today, and we need to be mindful of that and reflect that in the legislation that we pass.

Thank you, Madam Chair.

Senator BOXER. Thank you, Senator Carper.

Senator Voinovich.

**STATEMENT OF HON. GEORGE VOINOVICH, U.S. SENATOR
FROM THE STATE OF OHIO**

Senator VOINOVICH. Thank you, Madam Chairman.

Starting from the flawed premise that trading programs are the only vehicles we can use to address climate change, we now begin the second of three hearings on yet another iteration of a cap and trade bill. The key variable in determining cost-effective carbon reductions is the extent to which the program can cause the development and deployment of research and development of transformational technology.

But aggressive caps and time frames are more likely to stimulate avoidance behavior in the form of fuel switching or buying carbon offsets instead of investment in needed R&D efforts. That is the opinion of many organizations that have looked at this legislation.

Moreover, the severe costs of the policy undermine economic growth and therefore starve capital markets of the true tools needed to invest in innovation. Indeed, this will be a very costly policy, and will do little to affect the problem of global climate change. This is demonstrated by EIA's analysis of S. 280, that was the Lieberman-McCain bill, a less aggressive predecessor to this legislation that predicted to the economy and standards of living, even while assuming increases in nuclear and biomass generation and a development time line for carbon and capture sequestration technology, that due to political, regulatory, financial and technical obstacles, achieving what we say we are going to achieve would almost be impossible.

If the results were adjusted to account for more realistic scenarios of our Nation's future energy future, as in the recent analysis that I requested along with Senators Inhofe and Barrasso, the results are staggering. Among other things, the analysis predicted that by 2030, the policy could increase natural gas prices by 49 to 72 percent; increase electricity prices by 38 to 45 percent; reduce

GDP by a factor of well over a trillion dollars. Of course, EIA's use of discounting and their inability to accurately account for costs beyond 2030 masks the policy's true costs due to rapidly escalating impacts that are expected beyond this period.

Now, many engaged in this debate will downplay the impacts described above. But increasing home heating costs by 38 to 45 percent would have real impact outside of the beltway, especially those who are on fixed incomes. One of last week's witnesses suggested that job losses in certain sectors would simply be made up by shifting jobs to other sectors. But the witness failed to recognize that we are talking about real people, real families and real communities. What am I supposed to say to the men and women, families and communities that find themselves on the wrong end of the shift? I think Senator Barrasso made a good point of that in terms of the people that are already working.

The impact is particularly troubling when one considers that this wealth transfer will move resources from areas like the South and Midwest, whose States' per capita income largely fall below the national average, to other areas of the Country.

Madam Chairman, I think it is time to focus on American strengths of entrepreneurship and innovation. If we do so, we can create appropriate incentive for the development and deployment of new technologies. We will master the carbon challenge and lower the costs of control to the point where the developing world won't view these continued emissions as a source of competitive advantage. In a real sense, such a new way of viewing the challenge of carbon emissions is our only valuable chance of success.

Basically what I am saying is, we are going into a new regime. One of the things that I am going to ask in my letter to EPA be included in the record—

Senator BOXER. Without objection.

Senator VOINOVICH [continuing].—is asking them to look at the administration of this program, the number of people that are going to be involved in administering it, the number of new boards and commissions that we are going to be setting up in this legislation. I just came from the Oversight and Government Management Homeland Security, and Senator Lieberman is familiar with it, 22 agencies, a gigantic management challenge that has not been met. That place is still—pardon me—screwed up. It seems to me that when we talk about a brand new regime, new responsibilities for the Environmental Protection Agency and moving some things out of USTR there, and out of the Department of Energy, that we should look at some other options. That option, in my opinion, is trying to figure out, as the Chairman of this Committee and I talked about 4 months ago, is some type of response like we had to Sputnik, to find the resources that we have to jump start the technology initiative here in this Country so that we can solve the problems that we have here in the United States and at the same time then sell that technology to the Chinese and to the Indians and whoever else is out there in these emerging economies that we have throughout the world.

For us just to do this and adopt this regime without being realistic about the impact that it is going to have on reducing greenhouse gases and on our competition, I think is naive. I am hoping

that somewhere, somehow between the time that we mark up this bill, that we will have an opportunity to look at my suggestion in terms of how do we get that done.

Senator BOXER. Thank you, Senator.

Senator Klobuchar, welcome.

**STATEMENT OF HON. AMY KLOBUCHAR, U.S. SENATOR FROM
THE STATE OF MINNESOTA**

Senator KLOBUCHAR. Thank you very much. I was sitting here trying to think of my own sports analogy, Chairman, after I heard Senator Baucus. After our weekend at home with the Gophers having their worst season ever and the Packers shutting out the Vikings, I decided to stay away from those.

But I will say that I did visit with some third graders yesterday as well as some fifth graders and high school classes at three different schools, one in a more suburban area, one in greater Minnesota and one in an urban area. These kids are ready to go. I asked them why they thought that they were so focused on climate change and doing something about it, and that some of the grown-ups weren't. They said, well, that is because the grown-ups aren't going to be around when we have kids. They seemed very, actually quite educated on the topics of what is going on. It brought me back here promising them that I would give their thoughts to this Committee.

I believe that at its core, the America's Climate Security Act of 2007 offers an incredibly strong framework for addressing climate change. I think that is because there is no single industry or source that is responsible for greenhouse gas emissions, and because of that, there is no single policy or technology that is going to solve global warming. That is why I like the idea of this comprehensive approach. As someone once said, we don't need a silver bullet, we need a silver buckshot.

This is more than just a cap and trade bill. It provides support for the research and development of clean technologies. It provides direct incentives for energy-efficient products and develops a wide range of climate adaption programs. I also think it is important to note that it is not a cure-all. It is meant to work in tandem with other policies that we have developed and that we are developing. That is why I am glad, when I read your testimony, Dr. Greene, your written testimony, and I couldn't agree with you more that cap and trade works best in combination with other measures.

As members of the Commerce Committee, a number of us on this Committee have worked hard to increase the fuel efficiency standards of the Nation's cars and trucks. In my opinion, you cannot view the increase in the CAFE standards in a vacuum, that it can't be a separate policy. I believe that together, the upstream cap on greenhouse gas emissions in the transportation section of this bill, along with the 35 mile per gallon CAFE standard, will significantly reduce greenhouse gas emissions.

I believe we also can't separate out what the States are doing now. I have told this Committee several times about how aggressive on a bipartisan basis our State has been with a Republican Governor and a Democratic legislature. States already implementing greenhouse gas reduction strategies and/or renewable elec-

tricity standards make it easier to achieve the targets in this bill. I think that is why it is important to make sure that we facilitate these interrelated policies as much as possible.

I believe it is important that we recognize the leadership certain States have taken. We should also recognize States that are working hard to meet their own aggressive renewable energy standards when allocating allowances. We should also set the baseline for allocations at an appropriate point in time, so as not to penalize these States for their farsighted action.

This is a hearing to examine the nuts and bolts of America's Climate Security Act of 2007. So I look forward to hearing from our panelists on not only the nuts and bolts of this bill, but how it interacts with other policies that we already have in place or that we are considering now before this Congress, including the renewable electricity standard that is in the House side of the Energy Bill and the CAFE standard increase that is in the Senate side of the Energy Bill.

Thank you, Madam Chairman, and I look forward to working with you and all my EPW colleagues on reporting a strong bill to the Senate Floor.

Senator BOXER. Thank you, Senator.

Just in terms of how we are going to proceed, Senator Craig is next and then Senator Cardin has graciously said, Senator Whitehouse, since you have been here for so long, that you will go next and then he will be the next Democrat.

So we will go to Senator Craig.

STATEMENT OF HON. LARRY CRAIG, U.S. SENATOR FROM THE STATE OF IDAHO

Senator CRAIG. Madam Chairman, thank you very much.

The hearings of last week, the questioning sessions, the hearings this week and more to come with the questioning sessions are extremely valuable. If anybody doesn't believe that this is a complex bill, then they ought to start trying to read it and understand it. That is going to be critically important for us to even attempt to get it halfway right. To understand the complexities and broad implications of capping an entire economy is really beyond any of our talents or our abilities. So to try to understand that, the letter that we have sent, the letter that Senator Warner mentioned that he and Senator Lieberman have sent to EIA and EPA are critical. That is part of the overall understanding that we have to have before we can vote responsibly on this kind of policy.

So in all fairness, Madam Chairman, I am glad the Bali or Bust idea is out. I am glad we are going to take now a sit-down, roll up our sleeves approach instead of trying to get an awfully good byline in a statement coming out of Bali in December. It may be good for international politics, but it would be very bad for our policy. So thank you.

We still stay at it, we will stay diligent. Just beginning to peel back the pieces here, the page after page, is reflective of some 25 or 30, 40 amendments that my staff and I feel would be necessary to offer in a responsible way. Or we could do the Markey approach to the EPAC policy of 2005 and we could do hundreds of amend-

ments which would be deleterious. But we will look at a good number.

Cap and trade approaches of the kind that we are now referencing, oh, well, we did SO₂, and therefore we can do this, that is pretty wrong-headed in my opinion, and I think a very poor analogy when you are addressing carbon in every sector of the U.S. economy. What is it Senator Barrasso just said? Here is the impact we think could happen to Wyoming, because they are a coal-producing State. Idaho is not a coal-producing State. We happen to be the cleanest State in the Nation as it relates to particulates in the air.

And we happen to be largely a renewable energy State, which means our power bills go up fairly dramatically because we gain no benefit from this bill. Whereas in Wyoming, their power bills go up at the same rate, but they lose jobs in the meantime, potentially. Those are the realities on a State by State basis that clearly we have to grasp and understand, if we are going to be not only responsible to our environment on the long term, but responsible to our environments, and that includes working environments and economies, in the short term.

The bill is not ready for prime time, even though the advertisements have been top of the line. And it won't be ready for prime time until we do exactly what you have outlined that we are going to now do, Madam Chair, and I truly appreciate that. This is a piece of work, a potentially major public policy that demands scrutiny of the closest order, and I am glad you are now willing to allow us to do that in a way that I think the Senate best operates. I thank you.

Senator BOXER. Senator, I just want to be clear, I was always intending to allow the longest possible time for a markup. You will have 40 amendments, I am sure that Senator Bond will raise you one, and Senator Alexander, and we are ready. We are ready to stay as long as it takes.

Senator CRAIG. That is very productive, thank you.

Senator BOXER. We are absolutely prepared for that and we expect that. We will start on December 5, and we will go as long as it takes to deal with all amendments that are offered.

Yes, Senator Lieberman?

Senator LIEBERMAN. I was just—thank you, you just clarified that we are going to go ahead in December, which is very important.

Senator BOXER. Yes.

Senator LIEBERMAN. I do want to, on the Bali or Bust idea, I want to encourage Senator Craig and others to think more in favorable terms of Bob Hope and Dorothy Lamour in the Road to Bali, a very happy ending.

[Laughter.]

Senator CRAIG. Oh, if it was only Bob Hope again. Thank you.

Senator BOXER. Senator Whitehouse, we look forward to your remarks.

**STATEMENT OF HON. SHELDON WHITEHOUSE, U.S. SENATOR
FROM THE STATE OF RHODE ISLAND**

Senator WHITEHOUSE. Thank you, Chairman. I will be very brief. I appreciate Senator Cardin yielding his hard-earned seniority to me very briefly for this.

Senator KLOBUCHAR. Yes, but he made a deal that you had to mention Chesapeake Bay.

Senator WHITEHOUSE. I was just about to say, it is something he learned, no doubt, on the shores of the Chesapeake Bay.

[Laughter.]

Senator WHITEHOUSE. As we go forward, I would be very interested in hearing from the witnesses about three areas where I think there is still work to be done. Let me put this in the context of saying that I think what Chairman Boxer has accomplished here is extraordinarily significant. I think the sponsorship of Senator Warner and Senator Lieberman is extraordinarily significant. We have come an enormously long way. But as I said before, we may be standing on the shoulders of these giants, but there is yet work to be done. I think that the areas in which there is work to be done is to inquire into whether the standards that we have set for ourselves are truly adequate. Unlike the sort of traditional haggling, split the baby school of legislation, there is a bar here. If we miss it, it is going to be very unfortunate. So the adequacy of the standards and the ability to enforce them, or the actions that are triggered if it looks like they are not going to be met I think are a significant piece.

The second significant piece to me is the integrity to market. We are putting an awful lot of this Nation's wealth through the cap and trade process. I am at this point not yet satisfied with the governance. I am at this point not yet satisfied with the protection of that entity from market manipulation by crooks and speculators. And at this point I am not yet satisfied that we can distinguish real from counterfeit savings in this process. So there are at least three layers of integrity protection that I think that facility needs. As important as that facility is, we have to get it right.

And the third is, I think the concern of fairness to low-income folks who are not a part of this discussion is very important. An enormous amount, as I said, of our Nation's wealth is going to be put through this process. That creates an enormous motivation for special interests to line up and get their grab on all of that. I think it is very important for all of us to sequester whatever we need to for designated purposes to try to balance the economy and so forth.

But really the bulk of the return on this has to go back to the people who are going to pay it in the end, which is the American consumer, and the low-income American consumer will take the hit harder than anybody else. So I am interested in issues like the CBPP's ideas for flowing it through EITCs, through the electronic benefit transfer, through the withdrawal, so that it is more automatic and flows back to folks. But I think it is vitally important what you have accomplished, and I appreciate it, Chairman.

Senator BOXER. Senator, we are as you know working with you and your staff on these matters.

I just wanted to, while we have the maximum number of people here, go through what we are doing on this bill so you can make

some notes. We have of course this hearing. Then we have a briefing today, 2:30 to 3:00 is closed for members, and then 3:00 is open. Hearing on Thursday morning on the bill at 10 a.m. There is regular staff level meetings all through the week on demand for whoever wants them, members and staff. And then a modeling briefing on Wednesday for staff and Senators, if they wish to come. So I wanted to announce that, while everybody is here.

And now, Senator Alexander, the floor is yours.

**STATEMENT OF HON. LAMAR ALEXANDER, U.S. SENATOR
FROM THE STATE OF TENNESSEE**

Senator ALEXANDER. Thank you, Madam Chairman. And thank you for the extra hearings, extra briefings, extra time. That is a big help.

I want to especially welcome David Greene from the Oak Ridge Laboratory, a real expert on many things, including fuel efficiency. I would like to state my view as clearly as I can. I want a bill. I want to be able to vote for a bill on climate change. I think the time to act is now. From my first year in the Senate, Senator Carper and I offered legislation that put cap and trade on power plants, that is 40 percent of the carbon dioxide, 33 percent of greenhouse gases. We still agree on every part of that except allocation. Senator Lieberman and I are now co-sponsoring of that bill. So I want a bill.

My respectful suggestion to the Chairman and to the sponsors, and they have big decisions to make on how to proceed, I know they don't want to lose momentum, are two. One is, I think we would be better off with a sector by sector approach, rather than the current structure. And two, I think it is very important that we take sufficient time in the markup process to bring a bill toward the Floor that can get 60 votes.

Let me describe what I mean by sector to sector. I am looking for the lowest cost, simplest, easiest to explain, fewest surprises piece of legislation that will address climate change in this session of Congress. There is a danger of this becoming like the comprehensive immigration bill, which started out great but ended up not passing, because there were so many problems with it.

I would rather start out with the other end. What steps would I suggest? One would be the electricity step and two would be the transportation step. And that would be it. That would be two thirds of the carbon produced in our economy today. We might even get more out of those two segments, depending upon what the standards are. With electricity, I am ready to vote for a cap and trade program for power plants. We have had 16 years experience on that with acid rain, we know what we are doing. We can measure it. I think it would make sense. We can explain it.

Two, I would add to that everything we can think of that has to do with green buildings. Japan has said it has had its biggest problem reaching its own standards since Kyoto because of buildings. And we can a lot with buildings, so we could take just the electricity sector and get at least a third of the carbon.

Second, with transportation, how would we do that? Well, the easiest thing and the first thing to do would be for the House to pass the Senate Energy Bill, which has a CAFE standard that is

far-reaching and that would require 35 mile per gallon standard by 2020. The second thing to do is also in that bill, which is to go from 7 to 36 billion gallons of renewable fuels. A third thing to do would be a low-carbon fuel standard for all fuels. The Chairman has proposed that, others have as well. I think it might be better than a so-called upstream cap on fuel, which I don't fully understand. I am afraid the upstream cap on fuel might simply add a cost to gasoline without changing behavior.

One of the examination of the McCain-Lieberman bill suggested that such a cap on gasoline would add 25 cents to the cost of a gallon of gas. And that is a big increase. So a low-carbon fuel standard might be better. So then we could explain we are stepping out with electricity and then with transportation. Those are two big steps, 65 or 70 percent of the economy, rather than the 80 or so which I understand this structure is. I think it is more likely to get 60 votes, and then we could take other steps as they seem to make sense.

The problems and issues that I would like to see discussed by the witnesses include the low-carbon fuel standard, they include the auction, most auctions in Tennessee are designed to get the highest price. I think we want the lowest price. I would like to know what we are going to do with all this money. Nothing is more dangerous in Washington, D.C. than a pile of unallocated money that Congress can get its hands on.

The allocation system is a very difficult problem and will be in the Committee. It seems to me that the one here encourages the use of natural gas. That is bad for farmers, homeowners and manufacturers, and causes those in fossil fuel States to pay twice.

So I agree with Senator Carper that we ought to also deal with sulfur, nitrogen and mercury. That is as important to me as carbon in this bill. And I agree with Senator Isakson that we ought to be dealing with nuclear. That is an inconvenient truth as well. That is most of the solution, along with conservation and efficiency.

So I hope, Madam Chairman, to be able to vote in the end for the bill. I thank you for the extra time, and I look forward to attending all the briefings.

Senator BOXER. Thank you so much, Senator.
Senator Cardin.

**STATEMENT OF HON. BENJAMIN L. CARDIN, U.S. SENATOR
FROM THE STATE OF MARYLAND**

Senator CARDIN. Thank you, Madam Chair. It is nice to get my seniority back.

[Laughter.]

Senator CARDIN. First, let me agree with some of the comments of Senator Alexander, but let me point out that the immigration bill was not marked up in Committee. I think that was one of the problems we had. I am going to thank the Chairman of our Committee for an open process that has been used on this very important legislation. Many members introduced legislation. The Chairwoman then gave us a chance to come together and allow the Chairman and Ranking Member on the Subcommittee to come up with a bill and I feel very confident with Senator Lieberman and Senator Warner's leadership that hopefully, Senator Alexander, we

can reach that 60 vote threshold. Because I think that would make life a lot easier.

In order to accomplish that, we all have to listen a lot more and be willing to come to a bill that can pass but can also be a meaningful bill and not just insist on our specific revision being included in that bill. I hope we will be able to do that, because I think the issues are very important to our Country and very important to our international leadership. Again, I congratulate our Chairman Boxer and Senator Lieberman and Senator Warner for giving us the leadership.

Now that I said we have to listen, let me tell you what I think needs to be in the bill. Let me just use my time to talk about one specific issue that I hope we can strengthen, and that is the use of public transit. I particularly want to comment on Dr. Greene's testimony. He makes a very interesting point. He notes that we burn 6,300 gallons of oil every second to fuel our transportation sector. So it is no wonder that we have to look at a more responsible transportation policy. That sector is responsible for one quarter of the greenhouse gas emissions, according to the EPA's study for 2005. I think the funding that is provided in the bill that we have before us is allowable activities for State funds to be able to use for transit.

But I think we need to be stronger. Because I don't think that is strong enough to make the type of progress that we need in public transit. We need to get people out of their cars into fast, convenient and reliable mass transit systems. We need that to reduce greenhouse gases; we need that to become energy independent. We need that to improve the quality of life, and anyone in this region knows all too well how difficult gridlock becomes as you try to move around the Washington area. Not only just during rush hours, during just about any time of the day. So we need to make a more significant investment in public transportation.

Operating costs for transit systems are already skyrocketing as fuel prices have increased. That is only going to continue. We need to rebuild our aging transit infrastructures in many of our cities as well as new systems to meet growing demands.

So for all of those reasons, I would hope that we would find a way to have more specific funds available through this legislation to help absorb the problems that will be confronted by our constituents. One of the things that Senator Whitehouse talked about is the economic impact of this bill, who is going to be adversely affected by the additional cost of energy. Well, public transportation allows us to deal with the social needs of the people in our community. I think it is very appropriate that we do more to help provide that alternative to transit users.

The problem is not only because of large rises in fuel prices, it is also increased ridership. It has been its own problem in getting the type of funds in order to keep the system in the condition that is needed to meet increased demands.

So I will be interested in listening to our witnesses today. I can assure you I am very much interested in working with the leadership of this Committee and every member of this Committee in the Senate to achieve a meaningful bill, a bill that really will move us in the necessary directions to deal with global climate change, that

will provide the credibility for U.S. leadership internationally and one that we can be proud of to have been able to get enacted into law.

Thank you, Madam Chair.

[The prepared statement of Senator Cardin follows:]

STATEMENT OF HON. BENJAMIN L. CARDIN, U.S. SENATOR FROM THE
STATE OF MARYLAND

Madame Chairman, thank you.

Given our late starting time today, I will keep my remarks to a minimum.

There are a number of facets to dealing with the global greenhouse gas emissions issue. Our complex economy will be affected in numerous ways. I want to take a moment to focus on one of them: transit.

In Dr. Greene's testimony today, he notes that we burn 6,300 gallons of oil every second to fuel our transportation sector. It is no wonder that this sector is responsible for more than one-quarter of all U.S. greenhouse gas emissions in 2005, according to the EPA.

Although funding for transit systems is one of the allowable activities for state funds in the legislation we are considering, I am concerned that it is not sufficient. We need to get people out of their cars and into fast, convenient, and reliable mass transportation systems. That will take a major investment.

Operating costs for transit systems are already skyrocketing as fuel prices have increased. That's only going to continue. And we need to rebuild aging transit infrastructures in many of our cities as well as new systems to meet our growing needs.

The bill currently envisions a mechanism to cushion the rate increases low- and middle-income Americans are likely to feel from rising utility rates as we reduce our carbon emissions. But the legislation does not provide a similar cushion for someone who rides the bus or subway to work everyday to absorb the rising costs of transit.

Here in the Washington metropolitan area, the Metro system is considering a record rate increase. This is due in large part to rising fuel costs and increased ridership. We should be encouraging more people to take the bus and subway, but if they are faced with rapidly rising costs, we may be squandering a great opportunity to reduce greenhouse gas emissions from the transportation sector.

I will be interested in hearing from today's witnesses on this crucial aspect of climate change legislation. And I look forward to working with the bill's sponsors and the members of this Committee to craft a stronger commitment to transit in the bill as we move toward markup.

Thank you.

Senator BOXER. Thank, Senator Cardin.

Senator BOND. Last but absolutely not least.

**STATEMENT OF HON. CHRISTOPHER BOND, U.S. SENATOR
FROM THE STATE OF MISSOURI**

Senator BOND. Thank you, Madam Chair. It is a pleasure to join you for another one of these hearings and raise concerns as you may expect I will about what I think are some of the untoward impacts of a cap and trade bill.

I raise these in the sincere hope that the Committee will consider them carefully. In the past, I have talked about how the poor will suffer from higher heating and power costs. Last week, I expressed the views of the agricultural community on how farmers would be hurt under this particular cap and trade system. Today, I address how blue collar jobs across America are at risk under the bill my distinguished friends from Connecticut and Virginia have offered. Middle class families, supported by blue collar breadwinners, those aspiring to the middle class or those hanging on to their middle class lives, their health care, their meager retirement savings, can all suffer under this bill. Many of the blue collar jobs depend on energy-intensive manufacturing.

Now, we know that natural gas is a key raw material and electricity and natural gas are both essential to power manufacturing. I said last week how important natural gas was in fertilizer for farmers and in the farming operation. But rising energy prices from this bill, I believe, will threaten blue collar jobs in automotive assembly, steel, aluminum, cement, plastics and fertilizers. These manufacturers will flee high prices, as they have already done. They have fled the United States and taken the jobs with them to lower energy cost countries as close as Mexico or as far as China. No matter how far away they go, they will find cheaper energy there and we will feel the pain here.

Here is a picture of an aluminum smelter, not the one in my State, but that is an aluminum smelter. One just like it on the banks of the Mississippi River in New Madrid, Missouri. The plant employs 1,100 people with a payroll of over \$43 million annually. This is a critically important industry and thousands of middle class families depend on that payroll. Just like New Madrid, dozens of communities' school budgets and fire departments would be decimated without the payrolls of those smelters.

Now, here is a picture of Main Street of New Madrid, Missouri. It is a wonderful town. But there is not a whole lot there. The average family income in New Madrid is \$27,400. Outside of the town, where they don't have the jobs and the smelter, poverty runs as high as 30 percent. Middle class employment supporting jobs are few and far between. If higher energy prices under Lieberman-Warner force these aluminum jobs overseas, New Madrid families as well as families across the Country will join the poverty rolls.

We have another key hiring industry in Missouri, cement. It is a carbon producer. Limestone is a key component. Processing the limestone releases carbon dioxide. Firing the kiln to make cement requires energy either from natural gas or coal, and that releases carbon. So much carbon that a ton of carbon emissions produces only enough cement to generate a \$10 profit.

Now, let me give you basic economics here. A new cost of \$15 per ton for that ton of carbon, when they are only making a \$10 profit, would erase the profit and put that maker of cement out of business, in the hole. Instead of losing money, American producers would choose, rationally, to benefit, take the benefit of cheaper energy sources in Mexico, Korea or China.

Missouri has cement plants, but its communities will not be the only ones to lose those blue collar jobs. Thirty-nine States across America also risk losing their cement jobs to overseas competition. All of the orange States, States like Oklahoma, Virginia, Ohio, Georgia, Tennessee, Wyoming, and Idaho are all in the cement job chopping block.

My friends on the other side of the aisle will not be spared. California, Montana, New York and Maryland are all in the cement job loss cross-hairs. It doesn't have to be this way. We can do, as my colleague from Montana said, have a Marshall Plan for clean energy. Get nuclear power, which legislation and Governmental action has stalled too long, but which is a very significant part of the solution. We can get a clean portfolio standard.

I support an aggressive but achievable auto emissions standard or CAFE standard. And we need clean coal technologies and se-

questration. This is where we should be putting our money rather than expecting to mandate draconian standards for cap and trade that will do nothing. They will not produce the technology we need, and they will drive jobs overseas and have a devastating impact on our economy.

I thank you, Madam Chair.

Senator BOXER. Thank you very much.

Well, now we are on to our panel. Thank you for your patience.

So let me welcome all of you again. David Hawkins, Director, Climate Center, NRDC. I will be able to stay for the first panelist, then I have to fulfill an obligation and I will be back. Senator Lieberman is going to hold the gavel until I get back. So please proceed, Mr. Hawkins.

**STATEMENT OF DAVID HAWKINS, DIRECTOR, CLIMATE
CENTER, NATIONAL RESOURCES DEFENSE COUNCIL**

Mr. HAWKINS. Thank you, Madam Chairman.

My primary message today is that we have no time left for delay. We are already seeing the kind of damage that a disruptive climate can inflict: drought, floods, fires, insect infestation, stronger storms, killer heat waves. The problem with climate disruption is that it is a front-loaded problem. What I mean by that is, we create the harm long before we can see it around us. The global warming pollution that we have put up in the last 25 years has already locked in additional climate disruption. It is already in the pipeline. That added disruption is like an armed missile, and we have already pushed the button to launch the missile. We don't know how much damage the missile will do, but it is speeding toward us.

The job for us today is to stop launching more missiles. Now, the good news is we have the ability to solve this problem by creating the conditions where clean energy solutions get built and get rewarded in the marketplace. America's Climate Security Act will bring these solutions forward, showing U.S. leadership, proving we can act to protect the climate, creating new business opportunities in a world that will reward low-polluting products and services.

We have all heard the claims that the bill will be too costly. Well, these claims are made with broken calculators. They are based on an imaginary future, a future where climate disruption is assumed to have no impact on the performance of the economy. That is not the real world. As Sir Nicholas Stern's study has pointed out, in the real world, climate disruption will harm economic growth. The growth-maximizing strategy is to protect the climate, not to poison it.

The critics' imaginary business as usual future is like a plan for a new airliner, an airliner that has no air conditioning, nothing to eat or drink, a 50 percent chance of being grounded every time it gets out on the tarmac for mechanical problems, and a 10 percent chance of crashing on every flight. When presented with a better design that will get us to our destination safely, and with reasonable comfort, they argue, we can't afford it. Well, the truth is, the modeling that they are peddling is no bargain: it won't work.

Now, the bill before you contains numerous provisions to allow its pollution reduction targets to be achieved efficiently and at low overall costs. Let me quickly list them. First, trading. Trading of

emission control obligations under the bill will allow the lowest cost opportunities to be pursued first. Second, banking. Banking of emission reductions allows firms to make hay while the sun shines, and used the banked reductions to reduce costs later. Third, public purpose investments, by gradually shifting all allowance allocations to public purposes through auctions and public purpose allowance accounts, the bill recognizes the power of emission allowances to drive new technology, promote efficiency, protect consumers and vulnerable firms, such as cement and smelters.

Fourth, offsets. The offsets provisions of the bill balance the risk that some offsets may be of questionable value in reducing the emissions against the benefit of creating incentives for additional low-cost reductions in areas that are too complex to regulate directly. In addition, the bill allows borrowing of allowances from future years to deal with tight market conditions or periods before new technologies come online.

The Carbon Market Efficiency Board, with broad powers to adjust terms to create market conditions that enable us to smoothly transition from the unsustainable business as usual path to one that protects the climate. And finally, the bill addresses the concern about international competitiveness by establishing a program that ensures countries which fail to act to cut emissions will not gain a market advantage over our domestic economy.

Now, in each of these key areas, reduction targets, allowance allocations, cost containment, complementary policies, international issues, protection of the vulnerables, you have heard expressions of concern. And NRDC shares a number of those concerns, as I note in my testimony. But we are ready to work to address those issues that the bill moves forward and hope others will participate in that same spirit of cooperation.

Finally, no one is under the illusion that the bill reported from this Committee will go immediately to the President's desk for signature. There will be continuing negotiations over key issues at every step in the process. But the imperative now is to take the next step so that the later steps are possible. So we ask the Committee to approve critical strengthening amendments and then to report a bill to the full Senate this year.

The world is watching what this body does. The opportunity to make a positive impact on the pace of required action is enormous, and we urge you to seize it. Thank you.

[The prepared statement of Mr. Hawkins follows:]

STATEMENT OF DAVID HAWKINS, DIRECTOR, CLIMATE CENTER, NATURAL RESOURCES DEFENSE COUNCIL

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 glob-

al 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 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, 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;

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/global_07102401A.pdf.

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.

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>.

- 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.

“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

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>

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 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-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

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>.

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>

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 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

⁹B.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>.

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

the auction of allowances under this legislation, increasing over the years of the program.¹¹

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 con-

¹¹S. 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

sumed, 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 (MMTCO _{2e})	Estimated Total Emissions Pessimistic Case (MMTCO _{2e})	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%

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.

Year	Emissions of Covered Sources	Estimated Total Emissions Optimistic Case (MMTCO _{2e})	Estimated Total Emissions Pessimistic Case (MMTCO _{2e})	Reductions in Emissions from Covered Sources (2005 Baseline)	Estimated Range of Reductions in Total Greenhouse Gas Emissions (2005 Baseline)
2040	2,789	3,501	3,945	54%	46–52%
2050	1,732	2,499	2,966	72%	59–66%

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 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.

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.

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 CO₂ 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 CO₂ 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 CO₂ 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 CO₂ 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

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 50-year lifetime, one such plant would inject about a billion

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 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

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 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.

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
Darwin Hall, California State University, Long Beach
Jane Hall, California State University, Fullerton
Farzin Hossein, University of California, Davis
Richard Howarth, Dartmouth College
William Jaeger, Oregon State University
Neha Khanna, State University of NY, Binghamton
John "Skip" Laitner, American Council for an Energy Efficient Economy

David Levy, University of Maryland, Baltimore
Roz Naylor, Stanford University
Richard Norgaard, University of California, Berkeley
Astrid Scholz, Ecotrust
Juliet Schor, Boston College
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.

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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

Eban Goodstein, Ph.D.

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Eban Goodstein is Professor of Economics at Lewis and Clark College in Portland Oregon. He is the author of a college textbook, *Economics and the Environment*, (John Wiley and Sons, 2004) now in its fourth edition, as well as *The Trade-off Myth: Fact and Fiction about Jobs and the Environment* (Island Press, 1999). His current research focuses on the economics of global climate change, a subject on which he has spoken widely. Articles by Goodstein have appeared in the *Journal of Environmental Economics and Management*, *Land Economics*, *Ecological Economics*, and *Environmental Management*.

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 initiative on global warming solutions for America, Focus the Nation.

John A. "Skip" Laitner

Visiting Fellow and Senior Economist
American Council for an Energy-Efficient Economy

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.

Astrid Scholz, Ph.D.

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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

member of Oregon State University's College of Oceanic and Atmospheric Sciences, and is the co-editor of a book on integrated marine geographic information systems, *Place Matters* (OSU Press, 2005). She serves on the boards of the Pacific Marine Conservation Council, Habitat Media, and the Living Oceans Society, and is a member of the Science Advisory Team to the Marine Life Protection Act in California. She received her M.A. in Economics and Philosophy from the University of St. Andrews, her M.Sc. in Economics from the University of Bristol, and her Ph.D. in Energy and Resources from the University of California, Berkeley.

Kristen Sheeran, Ph.D.

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Kristen Sheeran is an Associate Professor of Economics at St. Mary's College of Maryland, Maryland's public honors college. While on sabbatical, Kristen will serve as executive director of Economics for Equity and Environment Network. A political economist by training, her research focuses on the political economy of climate change; specifically the tension between equity and efficiency in international climate control efforts. Articles by Sheeran have appeared in *Environmental and Resource Economics*, *Ecological Economics*, *Eastern Economic Journal*, and *The International Journal of Economic Development*. She has worked as an economist for the World Resources Institute and the U.S. Department of Agriculture. She works with environmental organizations in Maryland, including the Chesapeake Climate Action Network, Maryland Public Interest Research Group, and the Maryland Sierra Club. She graduated summa cum laude with her B.A. in economics and political science from Drew University. She completed her Ph.D. in economics from American University.

APPENDIX C**Is Carbon Capture and Disposal (CCD) Ready for Broad Deployment?****David Hawkins****Director, Climate Center****Natural Resources Defense Council****Key Questions about CCD**

I started studying CCD in detail ten years ago and the questions I had then are those asked today by people new to the subject. Do reliable systems exist to capture CO₂ from power plants and other industrial sources? Where can we put CO₂ after we have captured it? Will the CO₂ 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 CO₂.

CO₂ Capture

The IPCC special report groups capture or separation of CO₂ 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 CO₂ in large amounts but in low concentrations and low pressures. Commercial post-combustion systems exist to capture CO₂ 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 CO₂ annually) from a few coal-fired power plants in the U.S. that sell the captured CO₂ 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 CO₂ and then separating the CO₂, primarily through the use of solvents. These same techniques are used in industrial plants to separate CO₂ from natural gas and to make chemicals such as ammonia out of gasified coal. However, because CO₂ can be released to the air in unlimited amounts under today’s laws, except in niche applications, even plants that separate CO₂ 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 CO₂ 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 CO₂ 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 CO₂ 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 CO₂ 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 CO₂ to the air rather than capturing it. Enacting laws to limit CO₂ 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 CO₂ capture that may emerge if

laws creating a market for CO₂ 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 CO₂ 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 CO₂ emissions by about 90 percent. Adoption of policies that set a CO₂ 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 CO₂ 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 CO₂ 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 CO₂ 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 CO₂ 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 CO₂ 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 CO₂ into geologic formations. For several decades oil field operators have received high pressure CO₂ 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 CO₂ are injected annually in more than 70 projects. (Unfortunately, due to the lack of any controls on CO₂ emissions, about 80 per cent of that CO₂ is sources from natural CO₂ formations rather than captured from industrial sources. Historians will marvel that we persisted so long in pulling CO₂ 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 CO₂, 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 CO₂ 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 CO₂ 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 CO₂ 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 CO₂. 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 CO₂ 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 CO₂ 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 CO₂ capture, new coal plants built during any “delay and research” period will put 100 per cent of their CO₂ 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 CO₂ capture at new coal plants to await further research would result in cumulative CO₂ 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 CO₂ 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 CO₂ capture equipment on the ground that we need more large scale injection experience will always result in significantly greater CO₂ releases than starting CO₂ capture without delay for new coal plants now being designed.

The IPCC also made estimates about global storage capacity for CO₂ 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 CO₂ 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.

RESPONSE BY DAVID HAWKINS TO AN ADDITIONAL QUESTION FROM
SENATOR LAUTENBERG

Question. You state that free allowances should be phased out significantly faster—between 10–15 years of enactment. I also believe that we should move to full auction significantly earlier. What are the benefits from an earlier full auction date? How could we use the greater auction proceeds to minimize any economic dislocation?

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

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 you indicate in your question, 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.

In assessing the merits of any allocation proposal, it is important to recognize that regardless of whether allowances are auctioned or given away for free, in either case, the resulting revenue stream can be directed toward public or private purposes. Moreover, while phasing out of free allocations as soon as possible is desirable, the total amount of allowances to be received over time by any given entity—and whether that amount will be used for appropriate purposes—is perhaps the most important consideration.

The Lieberman Warner 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.

Although NRDC appreciates the substantial changes that have been made to ACSA since the bill outline was released in August, 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.

Thus, faster phase out of the free allowances that would reduce the overall number of allowances that emitters receive is desirable. A faster phase out of free allowances also recognizes that while companies may need time to transition to lower and zero carbon energy solutions, they should do so as quickly as possible. Continued allocation of free allowances based on historical emissions discourages innovation and adoption of new technologies.

In addition to a faster phase out of free allowances to emitters, the initial number of free allowances to emitters should be reduced as well, to eliminate the possibility of windfall profits. By taking both of the steps above, the pool of allowances that can be either given for free or auctioned for public purposes can be substantially increased.

In particular, more revenue can be made available in the auction pool for low income energy consumers and in the free allowance pool for electricity consumers,

worker training and other public purposes. As you indicate, redirecting these revenues can have a substantial impact in terms of mitigating economic impacts and economic dislocation for those that can least afford such costs. Instead of providing windfall profits for a select group of shareholders, these funds can aid consumers and workers in adjusting to increased costs associated with the need to reduce emissions. This result should be the preferred policy outcome and under the current structure of the bill it can be achieved by a combination of a faster free allowance phaseout, and a substantial reduction in the overall amount of allowances that are allocated for free to emitters.

Senator LIEBERMAN [Presiding]. Thanks very much, Mr. Hawkins. We appreciate the testimony.

Dr. David Greene is the next witness. Dr. Greene is a corporate fellow, Geography and Environmental Engineering, at the Oak Ridge National Laboratory. Thanks very much for coming, and we look forward to your testimony now.

STATEMENT OF DAVID L. GREENE, CORPORATE FELLOW, ENGINEERING SCIENCE AND TECHNOLOGY DIVISION, OAK RIDGE NATIONAL LABORATORY

Mr. GREENE. Thank you, Senator Lieberman.

Thank you for inviting me to discuss this very important legislation and its relation to the mitigation of greenhouse gas emissions from transportation. Our transportation system produces more climate-changing carbon dioxide than any other nation's entire economy except for China. The transportation sector was responsible for 28 percent of total U.S. greenhouse gas emissions from our economy in 2005. Climate policy must effectively address the mitigation of emissions from transportation.

A policy that sends an economy-wide price signal to reduce greenhouse gas emissions as the greenhouse gas cap and trade system of the America's Climate Security Act of 2007 will do is the essential cornerstone of a meaningful climate change strategy. But analyses such as by the Energy Information Administration have shown that carbon prices that are capable of cutting electric utilities, greenhouse gas emissions in half by 2030 would have a far smaller impact on the transportation sector. There are two principal reasons for this.

One is the insensitivity of fuel economy to the price of fuel, and the second is the inter-dependencies among land use, transportation infrastructure investments and vehicle travel and the central role of governments in those processes. Fuel economy is relatively insensitive to the price of fuel, because the market for fuel economy is not efficient.

A national survey of 1,000 U.S. households this last May found that 39 percent never considered fuel economy at all in their vehicle purchase decisions. And of those who did, only 14 percent mentioned taking economic factors, like annual fuel cost or the price of fuel into consideration. In-depth interviews of the car-buying histories of 57 California households by the University of California at Davis turned up none that had ever considered the value of fuel savings over the life of a vehicle or that use concepts like pay-back periods when considering fuel economy.

But consumers are not irrational. The economic value of increased fuel economy to a car buyer is the difference between the present value of future fuel savings and the price that must be

paid for it at time of purchase. But the value of future fuel savings is uncertain. The future price of fuel, the fuel economy that will be achieved in real world driving, annual miles of travel, the life of the vehicle, all of these factors and more are uncertain. From this perspective, increased fuel economy looks like a risky bet to a car buyer.

And for the typical loss averse consumer, there is little reason to calculate the value of increased fuel economy, and as a consequence, no responsible automobile manufacturer would spend billions of dollars to retool and redesign its product lines, to provide fuel economy for which consumers are not willing to pay. This is why the world's major economies, the United States, the European Union, Japan, China, Canada, Korea, all have adopted fuel economy standards for light duty vehicles.

Fortunately, fuel economy standards work. Past fuel economy standards raised the miles per gallon of U.S. light duty vehicles by 50 percent and are saving U.S. motorists approximately 60 billion gallons of fuel each year. Medium and heavy trucks and buses account for 20 percent of transportation greenhouse gas emissions. In the past, we have assumed that these markets function efficiently and there is no need for fuel economy standards. The Japanese government has directly challenged that assumption in setting weight-based standards for fuel economy of heavy trucks in March 2006. We should investigate that option as well.

Creating an economy-wide price signal to reduce greenhouse gas emissions, as a cap and trade system will do, is the cornerstone of a comprehensive climate change strategy. However, an efficient response from transportation will be hindered by deficiencies in the market for fuel economy, together with the central role of land development policies and transportation infrastructure investments in driving demand for vehicle travel. Fuel economy policy is essential. Intelligent land use and infrastructure policies that enhance the attractiveness of walking, biking and public transit can also make an important and potentially critical difference by 2050.

At present, it is not known how effective a cap and trade system can be in reducing the carbon content of transportation fuels. Especially in the early years, a low-carbon fuel standard may also be needed. Ultimately, significant technological advances will be required if transportation's greenhouse gas emissions are to be reduced by 50 to 80 percent over current levels by 2050.

Thank you for the opportunity to present my views on this enormously important legislation.

[The prepared statement of Mr. Greene follows:]

STATEMENT OF DAVID L. GREENE, CORPORATE FELLOW, ENGINEERING SCIENCE AND TECHNOLOGY DIVISION, OAK RIDGE NATIONAL LABORATORY

Good afternoon. Thank you for inviting me to discuss the adequacy of greenhouse gas (GHG) cap-and-trade as a policy for mitigating GHG emissions from the transportation sector, and the need for additional policy measure for the transportation sector. The views I express today will be entirely my own and do not necessarily reflect the views of Oak Ridge National Laboratory or the Department of Energy.

Our transportation system is the largest in the world. Each second, it burns 6,300 gallons of oil, producing more climate changing carbon dioxide emissions than any other nation's entire economy, except China (EIA, 2007, table H.1CO₂). The transportation sector was responsible for 28% of total U.S. greenhouse gas emissions in 2005 (USEPA, 2007a, table 2-16). Climate policy must effectively address the miti-

gation of emissions from transportation. Other policies will be needed in addition to a cap-and-trade system in order to make the reductions in GHG emissions that are likely to be necessary.

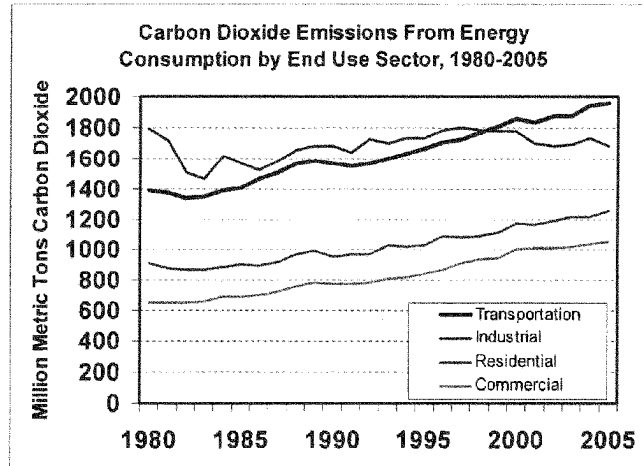


Figure 1. U.S. Carbon Dioxide Emissions by Energy End Use Sector, 1980-2005
Source: US EPA, 2007a.

A policy that sends an economy-wide price signal to reduce greenhouse gas emissions, as the GHG cap-and-trade system of the America’s Climate Security Act of 2007 will do, is the essential cornerstone of a meaningful climate change strategy. Analyses by the Department of Energy’s Energy Information Administration (EIA, 2006), for example, estimate that such policies will bring about major reductions in GHG emissions from electric power generation (figure 2). Unfortunately, the same level of economic incentives that could cut electric utility GHG emissions in half by 2030 would have a much smaller impact on transportation’s GHG emissions.

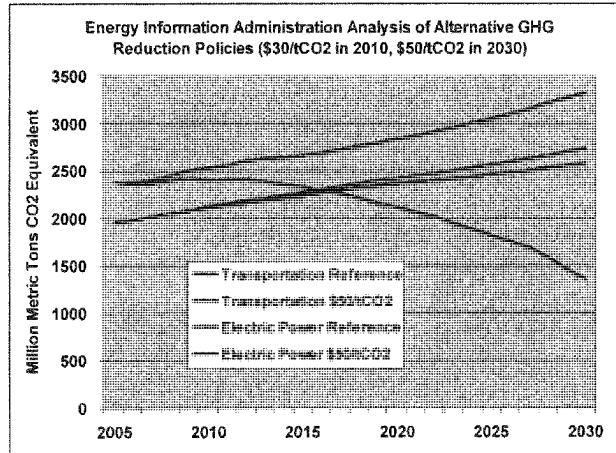


Figure 2. Energy Information Analysis of the Impacts of Carbon Prices on Greenhouse Gas Emissions from the Electric Power and Transportation Sectors through 2030.
Source: EIA, 2006.

A carbon price of \$30 to \$50 per ton of CO₂ equivalent greenhouse gas emissions, such as analyzed in the EIA study, translates into roughly \$0.25 to \$0.50 per gallon of gasoline. This is not a trivial price signal and it will help reduce demand for fossil

carbon fuels and encourage energy efficiency.¹ However, recent statistical analyses (e.g., Small and Van Dender, 2007; Hughes et al., 2007) have shown that price signals of this magnitude will have constructive but insufficient impacts on vehicle travel and fuel consumption. It is important to understand why this is so, and to implement additional policies for transportation that can cost-effectively achieve the magnitude of reductions in transportation greenhouse gas emissions that are needed.

Fuel economy is relatively insensitive to the price of fuel because the market for fuel economy is not efficient. A recent national random sample survey of 1,000 U.S. households found that 39% did not consider fuel economy at all in their last vehicle purchase (Opinion Research, 2007). Of those who did, only 14% mentioned taking economic factors, like annual fuel costs or gasoline prices into consideration. In depth interviews of the car buying histories of 57 California households (Turrentine and Kurani, 2005) turned up none that had ever considered the value of fuel savings over the life of a vehicle, or that used concepts like a payback period when considering fuel economy. When I served on the National Academy of Sciences Committee on the Effectiveness and Impact of Corporate Average Fuel Economy Standards (NAS, 2002), manufacturers told us they believed consumers would pay for only 2–4 years of fuel savings. Survey evidence backs them up (Opinion Research, 2004). In a 2004 survey, half the respondents were asked how much they would be willing to pay for a more fuel efficient new vehicle that would save them \$400 per year in fuel. The other half were asked how much a vehicle would have to save them in fuel each year to justify paying \$1,200 more for it. The payback periods implied by the answers from the two groups were strikingly similar. Consumers wanted to be paid back in 1.5 to 2.5 years (figure 3). The expected lifetime of a U.S. passenger car or light truck is 15 years, or more (Davis and Diegel, 2007, tables 3.8 and 3.9).

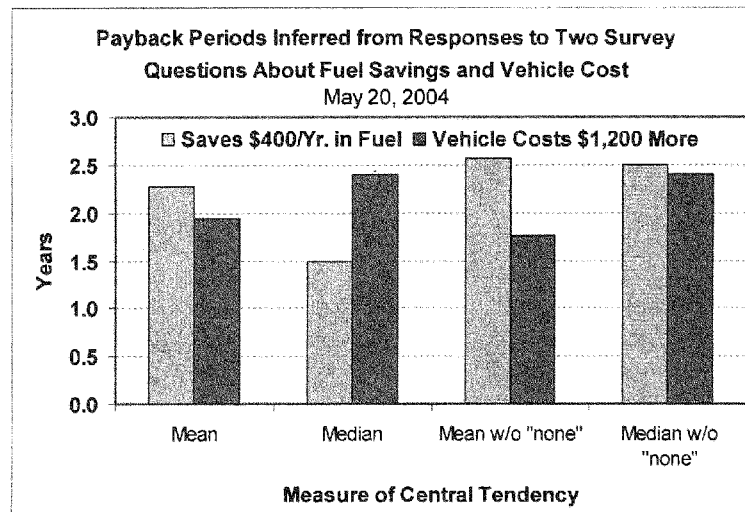


Figure 3. Consumers stated payback periods for increased automobile fuel economy. Source: Opinion Research Corporation, 2004.

Consumers are not irrational. The value of future fuel savings is highly uncertain, and consumers are in general loss-averse (Tversky and Kahneman, 1992). The economic value of increased fuel economy to a car buyer is the difference between the present value of future fuel savings and the price that must be paid for it at time of purchase. Using fuel economy cost data from the 2002 NAS study, figure 4 shows the expected fuel savings, increased vehicle cost and net present value for increasing the fuel economy of an average U.S. passenger car from 28 to 46 miles per gallon. While the value of fuel savings increases to more than \$2,000, the expected net value is much smaller, varying between \$500 and –\$500. Between 32 mpg and 38 mpg, there is no more than a \$100 difference in expected net value. But the value of future fuel savings is uncertain. The price of fuel, the fuel economy that will be

¹The America's Climate Security Act of 2007 appropriately recognizes that steps must be taken to offset the regressive impact of carbon prices on lower income households.

achieved in real world driving, annual usage, the life of the vehicle, all of these factors and more are uncertain. From this perspective increased fuel economy looks like a risky bet to a car buyer. From the perspective of a typically loss-averse consumer, the expected \$400 net benefit of increasing fuel economy from 28 to 35 mpg, because of uncertainty and loss aversion, turns out to have a value of $-\$30$ (Greene, German and Delucchi, 2007). To the typical consumer, there is little reason to calculate the value of increased fuel economy, and no responsible automobile manufacturer would spend billions of dollars to retool and redesign its product lines to provide fuel economy for which consumers are not willing to pay.

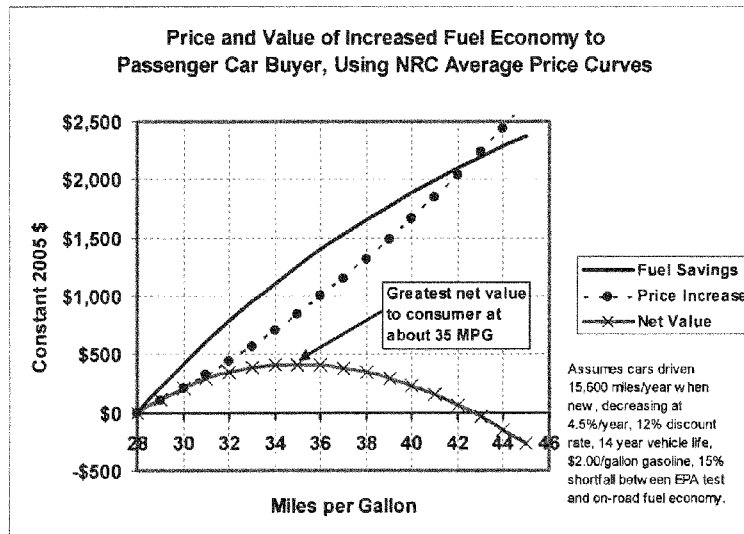


Figure 4. Price, Present Value of Fuel Savings and Net Value of Fuel Economy.
Source: authors calculations based on NRC, 2002.

This is why the world's major economies, the European Union, Japan, China, Canada and the United States, even those with fuel prices substantially higher than the U.S., have all implemented fuel economy standards for light-duty vehicles (An et al., 2007). Like the markets for energy efficiency in other durable consumer goods such as refrigerators or air conditioners, the market for automotive fuel economy is not efficient. As in these other markets, consumers do not fully value the savings fuel economy improvements provide over the lifetime of a vehicle. Because car buyers are generally not willing to pay the full value of fuel economy improvements, manufacturers do not provide them.

Fortunately, fuel economy standards work (Greene, 1998). Past fuel economy standards raised the fuel economy of U.S. light-duty vehicles by 50% (figure 4.) saving U.S. motorists approximately 60 billion gallons of fuel in 2005 (figure 5). Fuel economy standards are not the only policy that can correct the fuel economy market failure. A market-based policy, called "feebates" also has great promise (Greene, et al., 2006). A feebate system would reward vehicles with greenhouse gas emissions below a target fuel consumption (gallons per mile) value and charge a fee to vehicles above it. The amount of the rebate or fee would depend on the amount by which the vehicle's fuel consumption deviated from the target level. The target itself can be a function of vehicle attributes, such as the NHTSA's footprint metric. A significant advantage of feebates over fuel economy standards is that they provide a continuing incentive to develop and implement advanced fuel economy technology.

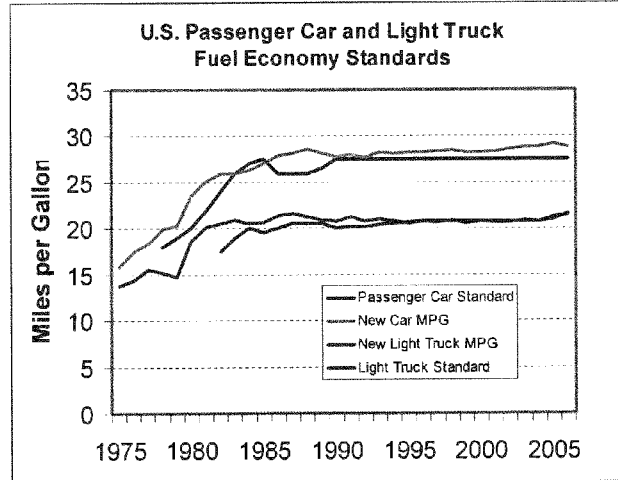


Figure 5. U.S. Passenger Car and Light Truck Fuel Economy and Standards. Source: Davis and Diegel, 2007; US EPA, 2007b.

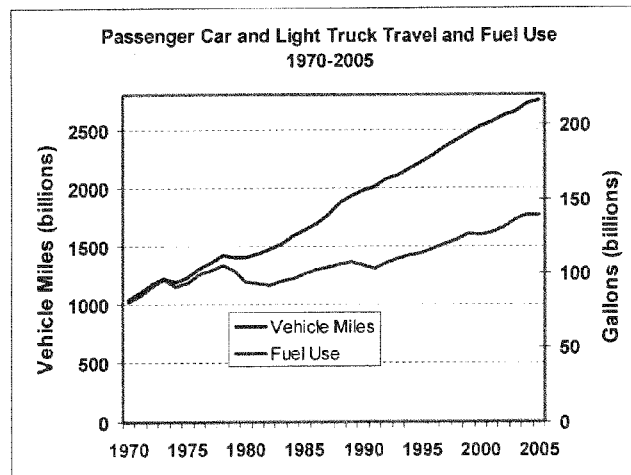


Figure 6. U.S. Passenger Car and Light Truck Travel and Fuel Use, 1970-2005. Source: FHWA, 2005; Davis and Diegel, 2007.

Medium and heavy trucks and buses account for 20% of transportation's greenhouse gas emissions (EPA, 2007, table 2-17). In the past, we have assumed that these markets do function efficiently and that there is no need for heavy vehicle fuel economy standards. The Japanese government, directly challenging that assumption, set weight-based fuel economy standards for heavy trucks in March 2006 (Goto, 2007). The standards call for an average 12% increase in new heavy truck fuel economy over the 2002 level by 2015. In my opinion, we should investigate this option, as well. Significant energy efficiency improvements are also possible in air travel, rail and shipping. According to the International Air Transport Association aircraft CO₂ emissions could be reduced by 12% through improved air traffic management, and by 6% through operational improvements that could be made by airlines and airports (JITI, 2007). The Advisory Council for Aeronautics Research in Europe has set a goal of reducing the fuel consumption of new commercial aircraft by 50% by 2020 (JITI, 2007).

LAND USE AND TRANSPORTATION INFRASTRUCTURE

Another important reason we should not expect a cap-and-trade policy alone to bring about an efficient reduction in transportation GHG emissions is the central role that local, state and national governments play in providing and operating transportation infrastructure and influencing development. The geographic distribution of people and places, especially the density of development, strongly influences the demand for transportation. The way settlements are designed—whether neighborhoods have sidewalks and bikepaths, whether homes are within walking distance of shops or public transportation—influences both the amount of travel and the modes chosen. To have the greatest beneficial impact on travel in metropolitan areas, development policies should be coordinated with investments in public transportation. Changes in the spatial structure of the built environment take time but can pay large dividends. Based on a review of the literature, it appears that vehicle travel could be reduced by about 5% in 10 years and by 10% in 25 years, versus what it would otherwise have been (Greene and Schafer, 2003). Given more time, even greater impacts should be achievable.

LOW CARBON FUELS

How strongly the cap-and-trade policy will affect the carbon content of transportation fuels is not yet clear. Without a doubt, the GHG permit price will provide an economic incentive to reduce the carbon content of transportation fuels. However, especially in the early years, permit prices may not be sufficient to cause significant reductions, nor will they reflect the need of the nation to reduce its dependence on petroleum.

In 2006, the U.S. used 5.5 billion gallons of fuel ethanol, more than a three-fold increase over the year 2001. Still, ethanol supplied only 2.5% as much energy for transportation as gasoline. The Renewable Fuels Standard calls for a further increase in renewable fuel use to 7.5 billion gallons by 2012, although the EPA projects that renewable fuel use will exceed 11 billion gallons in that year (EPA, 2007c). But the greenhouse gas impacts of renewable fuels vary greatly depending on precisely how they are produced and the feedstocks used (Farrell et al., 2006). Biofuels unquestionably have a role to play in reducing GHG emissions, as well as U.S. oil dependence. However, the best strategy for using biomass to power transportation vehicles is not yet clear. In view of that, a low carbon fuels standard appears to be a better option than a renewable fuels mandate. The advantage of a low carbon fuels standard is that it does not dictate to fuel suppliers how they should reduce the fossil carbon content of their fuels. Instead, it allows them to use their ingenuity to find the most economically efficient solution.

RESEARCH AND DEVELOPMENT

In the future, much greater reductions in emissions could be achieved with advanced technologies. Researchers at the Massachusetts Institute of Technology's Sloan Automotive Laboratory have estimated that by 2030 advanced internal combustion engine vehicles with the same size and performance as model year 2005 vehicles could achieve 80% better fuel economy (Kasseris and Heywood, 2007). MIT researchers also estimate that advanced hybrids could achieve three times the miles per gallon of today's internal combustion engine vehicles (Kromer and Heywood, 2007) (Figure 7). Beyond 2030, when our electricity sector is substantially de-carbonized, plug in hybrid vehicles could further reduce GHG emissions from motor vehicles. If carbon capture and storage is successful, hydrogen fuel cell vehicles may someday drive motor vehicle GHG emissions to zero. None of these technologies is ready for commercialization today. Substantial investments in research and development are necessary for reductions in transportation's GHG emissions of 50% to 80% over current levels to be achievable by 2050.

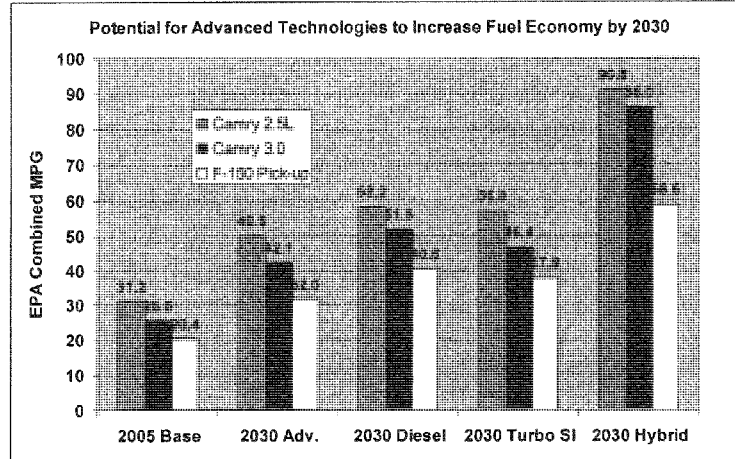


Figure 7. Potential for Advanced Technologies to Increase Automotive Fuel Economy by 2030 Based on MIT Analyses.

Sources: Kasseris and Heywood, 2007; Kromer and Heywood, 2007.

CONCLUDING OBSERVATIONS

Creating an economy-wide price signal to reduce greenhouse gas emissions, as a cap-and-trade system will do, is the cornerstone of a comprehensive climate change strategy. However, cap-and-trade is not a sufficient policy for the transportation sector. An efficient response from transportation will be hindered by deficiencies in the market for fuel economy, together with the central role of land development policies and transportation infrastructure investments in driving demand for transportation. Fuel economy policy is essential. Intelligent land use and infrastructure policies that enhance the attractiveness of walking, biking, and public transport can also make an important and potentially critical difference by 2050. At present, it is not known how effective a cap-and-trade system can be in reducing the carbon content of transportation fuels. Especially in the early years, a low carbon fuel standard may be needed. Ultimately, significant technological advances will be required if transportation's GHG emissions are to be reduced by 50% to 80% over current levels by 2050.

Thank you for the opportunity to present my views on this enormously important legislation.

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RESPONSES BY DAVID GREEN TO ADDITIONAL QUESTIONS FROM SENATOR INHOFE

Question 1. You touched on this in your written testimony, but can you elaborate on why a low carbon fuels standard is a better option than a renewable fuels mandate. Isn't it true that a low carbon fuels standard allows fuel suppliers to find the most economically efficient solution rather than mandating that they use biofuels?

Response. A low carbon fuels standard allows fuel suppliers to find the most economically efficient solution and also creates an incentive for innovation. The term "carbon" in "low carbon fuels standard" (LCFS) is shorthand for lifecycle global warming impact. Thus, the first advantage of the LCFS for addressing global climate change is that it directly targets the environmental impact of greenhouse gas emissions. Compliance with a renewable fuels mandate is not measured by the reduction in global warming impact but rather by the quantity of biofuel sold. Its greenhouse gas mitigation benefits therefore depend on the tendency of biofuels to have lower lifecycle, or well-to-wheel, greenhouse gas emissions than the petroleum fuels they replace. As the answer to question 2 clearly shows, the greenhouse gas impacts of biofuels depend strongly on the feedstocks from which, and production processes by which they are produced. As a result, the greenhouse gas mitigation benefits of a renewable fuels standard can range from a little to a lot.

The second advantage of a LCFS is that it is a performance standard and does not mandate a particular technological solution. It requires only that lifecycle global warming impact be reduced; it does not specify how that must be accomplished. A renewable fuels standard limits the range of options available to fuel suppliers to renewable fuels. Renewable fuels could turn out to be the best option, but if this were the case then the result of the LCFS would be no different from the renewable fuels standard. However, the LCFS allows fuel suppliers the opportunity to invent or discover a lower cost alternative that accomplishes the same result. In terms of economic efficiency, the LCFS will achieve a given reduction in greenhouse gas emissions as efficiently, or more efficiently than the renewable fuels standard. By allowing the widest possible range of responses, the LCFS also creates a greater incentive to find innovative solutions.

Question 2. Do renewable fuels have greenhouse gas emissions? Does this vary based on how they are produced and the feedstocks used? How so?

Response. Renewable fuels can produce net lifecycle greenhouse gas emissions depending on the feedstock from which they are produced and the process used to convert the feedstock into liquid fuel. Different methods of cultivating biomass generate different amounts of greenhouse gases. Use of nitrogen fertilizer and tilling, harvesting and transporting biomass with machinery powered by petroleum fuel are significant sources of lifecycle greenhouse gas emissions in feedstock production. Use of fossil energy in conversion processes can also be a significant source of greenhouse gas emissions. The table shown below is taken from the technical analysis supporting California's low carbon fuels standard (Farrell & Sperling, 2007) and is based on what I believe to be the two most authoritative lifecycle greenhouse gas models for the United States. The estimates based on Argonne National Laboratories' GREET model indicate that ethanol produced from corn using the corn stover as a source of fuel in a dry milling process produces only a little more than half the lifecycle greenhouse gas emissions of California reformulated gasoline. On the other hand, if ethanol is produced from corn using coal for energy, the lifecycle emissions are more than 20% higher than California reformulated gasoline. The same model indicates negative greenhouse gas emissions for diesel produced via gasification of poplar trees produced in California and fuel synthesis via the Fischer-Tropsch process. There are sometimes important differences between the estimates produced by the two models. For example, the GREET model estimates a two thirds reduction in lifecycle greenhouse gas emissions from the production of biodiesel from soybeans, while the LEM model estimates more than a doubling of lifecycle greenhouse gas emissions. Such differences are attributable to differing assumptions, especially with respect to indirect impacts on land uses. There is still a great deal to be learned about the full lifecycle impacts of biofuel production, yet there is no doubt that renewable fuels can produce very significant greenhouse gas emissions and that the quantities produced are very sensitive to feedstocks and production methods.

Table ES-3: Global Warming Impacts Estimated by Two LCA Models, Adjusted for Energy at the Wheel (g CO₂ eq / MJ) (Farrell & Sperling, 2007)

Fuel	Fuel production pathway	GREET	LEM (CEF)
CA RFG	Marginal gallon produced in CA	92	85
Diesel	Ultra-low-sulfur diesel produced in CA	71	73
Propane	From petroleum	77	67
CNG	From North American natural gas (in spark ignition engines)	79	81
BTL	Fischer-Tropsch diesel from California biomass (poplar trees)	-3	-
CTL	Fischer-Tropsch diesel from coal	167	-
Biodiesel	FAME biodiesel from Midwest soybeans	30	224
Ethanol	Midwest corn ethanol from a coal-fired dry-mill	114	-
	Midwest corn ethanol from a natural gas-fired dry-mill	70	97
	Midwest corn ethanol using stover as fuel in a dry-mill	47	-
	California corn from a gas-fired dry-mill, wetcake coproduct	52	-
	Cellulosic ethanol from California poplar trees	-12	-
	Cellulosic ethanol from Midwest prairie grass	7	-
Electricity	Cellulosic ethanol from municipal solid waste	5	-
	CA average electricity	27	-
Hydrogen	Natural gas combined cycle and renewable generation	21	34
	Hydrogen from biomass, delivered by pipeline	22	-
	Hydrogen from steam-reformation of onsite natural gas	48	26

Question 3. Studies have shown that modest improvements to traffic flow would reduce carbon dioxide emissions by as much as 77 percent and conserve more than 40 billion tons of fuel over a 20-year period (stats from letter from transportation construction coalition). What does, or should this bill do to alleviate congestion on the highways?

Response. I have not read the study on which these estimates are based but I am extremely skeptical that a modest improvement in traffic flow could reduce carbon emissions by anything close to 77%. On the other hand, 40 billion gallons of fuel over a 20-year period is an average of 2 billion gallons per year, on the order of 1% of total motor fuel use on U.S. highways (USDOT, FHWA, table VM-1, 2005). An impact on the order of 1% seems far more plausible to me as an assessment of the potential for congestion mitigation to reduce fuel use and thereby reduce greenhouse gas emissions. In my opinion, this bill should not concern itself with traffic congestion mitigation. Traffic congestion is a very significant problem for transportation and has serious economic impacts. However, in my opinion, it should be addressed directly via other policies such as improving traffic management, congestion pricing, investing in capacity expansion and alternative transport modes, land use planning and urban design.

I hope that my responses have adequately and appropriately addressed your questions. Please accept my thanks for the important work you are doing and my very best wishes for a successful result.

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Senator BOXER. Thanks very much, Dr. Greene, for that thoughtful testimony. I appreciate it.

Now we go to Robert Baugh, who is the executive director of the Industrial Union Council of the AFL-CIO. We are very grateful that you are here and welcome your testimony now.

**STATEMENT OF ROBERT C. BAUGH, EXECUTIVE DIRECTOR,
AFL-CIO INDUSTRIAL UNION COUNCIL AND CHAIR, AFL-CIO
ENERGY TASK FORCE**

Mr. BAUGH. Thank you, Senator, we appreciate the opportunity to testify before the Committee today.

The AFL-CIO believes that taking action to address global warming and to achieve energy independence are mutually reinforcing goals for the Nation, and they are in the best interests of our economic, environmental and national security. We have participated actively in stakeholder discussions all the way through this process, and it led many of us to endorse another piece of legislation. When Senator Boxer empowered you and Senator Warner to move ahead, we actively and openly participated in the stakeholder process again around the creation of America's Climate Security Act. We share the belief in the Act that the legislation should achieve its purpose while preserving robust growth in the United States economy and avoiding the imposition of hardship on the United States citizens.

I am here this morning to address five areas of the bill that we think could be improved to achieve that goal. First, the investment portfolio. We commend you, Senator Lieberman and Senator Warner, for the original draft of this legislation, which made the critical long-term commitments to technology development and deployment that are part of the key to solving our carbon footprint.

Unfortunately, two pieces of the investment portfolio were severely undermined by the automobile and coal-related amendments adopted during the subcommittee markup. The AFL-CIO believes these amendments are counterproductive and actually undermine the technological transition this legislation is attempting to achieve. We encourage the Committee to return to the original language.

Secondly, on the time lines and targets, we support realistic time lines and goals for the emissions reductions, but we are concerned that there continues to be a disconnect between the reduction targets and the actual development and deployment of new technology. This bill sets a 15 percent reduction of greenhouse gas emissions below 2005 levels by 2020. This is prior to the anticipated commercial availability of a carbon capture and storage technologies. Similar deployment and developmental issues remain in the renewable side of the equation, too, to achieve these goals in such a short time period.

And finally, this sets a standard 70 percent below the 2005 levels by 2050. Previously, we had supported a 60 percent reduction, but tied to presidential reviews and the participation of the developing world in this process to solve this problem.

On job creation, we believe that this legislation can serve a dual purpose: environmental protection and economic development. The legislation, though, needs to make this implicit idea in the bill very explicit. We urge the Committee to adopt language to direct the Climate Change Credit Corporation that the financial resources of the corporation shall be dedicated to domestic investments. We think the findings section of the bill and the purpose section of the bill should strengthen that and reflect the same idea that we are

reinvesting these monies to recycle these dollars in the American economy.

The cost control and market system. The AFL–CIO supports a limited market approach to cap and trade with price control mechanisms that prevent serious long-term damage to the economy. The Carbon Market Efficiency Board has a cost control mechanism, but frankly, we believe this works at cross purposes with the way the market system is actually being set up. The legislation’s open and unlimited trading of allowances and the ability to bank them in perpetuity leaves the system open to predatory and speculative trading practices. The hoarding of allowances will fuel volatile pricing and a market will result in damaging increases in prices to consumers, industry and utilities.

The cost control mechanism in S. 2191 may be triggered after 180 days. By that point, when people have to purchase allowances annually, the damage will have been done, it is too late. We think that the mechanism of borrowing against the future is not necessarily effective and we believe we should explore other tools to do that. We should not allow the banking of allowances in perpetuity. We should prohibit a wide open market system that allows speculators to play.

We support the international provisions. We have been very clear on that. We think they can be strengthened. The 2020 date was arbitrary. And it can be moved back. Upon enactment of this bill, the President should engage in negotiations with the developing world about participation in this process. As we employ the regulations and open the market system, you can then actually take action and it should be triggered at that point.

Finally, the offsets in international allowances portion, up to 30 percent of the allowances that a firm is supposed to be using can come from international allowances and offsets. We think this number is too high, and in fact, may act as a disincentive for making the investments in the transition and transformational technologies that need to be made. We suggest that the Committee look at this. These figures should be lower.

And we have a second concern with offsets. It is very easy to pay, allow for offsets for a business activity that would occur as a natural course of doing business. In my longer testimony, I have used the forest products industry as an example. But we are very concerned about the legitimacy of offsets that actually do reduce greenhouse gases and not pay for activity that would happen as a normal course of business or as covered by law.

We look forward to working with the Congress and with this Committee to achieve legislation that will result in a cleaner planet, greater energy efficiency and the revitalization of our manufacturing base. Thank you.

[The prepared statement of Mr. Baugh follows:]

STATEMENT OF ROBERT C. BAUGH, EXECUTIVE DIRECTOR AFL–CIO INDUSTRIAL UNION COUNCIL AND CHAIR AFL–CIO ENERGY TASK FORCE

Chairman Boxer, on behalf of the 9 million members of the AFL–CIO, I want to thank you and the members of the Environment and Public Works Committee for the opportunity to testify this afternoon on America’s Climate Security Act (S. 2191).

America needs an energy policy for the twenty first century that will result in a cleaner planet, greater energy efficiency and the revitalization of our manufacturing base. It is an opportunity for our nation to prove that economic development and environmental progress can and should go hand-in-hand. We believe that taking action to address global warming and energy independence are mutually reinforcing goals that are in the best interest of the nation's economic, environmental and national security.

The AFL-CIO has actively participated in various stakeholder meetings with members of both the House of Representatives and the Senate that have led to legislative proposals that the AFL-CIO and many of our affiliates have supported. We have also participated openly and honestly in the stakeholder meetings that resulted in S. 2191, America's Climate Security Act. It is our intention to continue working with the members of this committee to develop "cap-and-trade" legislation that addresses the environmental health of the planet while assuring that good paying jobs are not sacrificed to overseas competition.

The AFL-CIO takes to heart the statement in S. 2191 that this legislation should achieve its purpose "while preserving robust growth in the United States economy and avoiding the imposition of hardship on United States citizens." Today we wish to recognize the aspects of S. 2191 that the AFL-CIO supports and to offer our thoughts on how to strengthen the legislation.

INVESTMENT PORTFOLIO

We appreciate the fact that the original draft of S. 2191 incorporated many of our investment recommendations such as the inclusion of bonus allowances to promote early technology deployment and the early auction of allowances for quick investment into research and development. We commend Senator Lieberman and Senator Warner for their original draft of S. 2191 which made critical long term commitments to technology development and deployment with an investment portfolio that includes renewable energy supplies, appliance efficiency, biomass, advanced coal and sequestration program, and the advanced technology vehicles manufacturing incentive program.

Unfortunately, the latter two pieces of the investment portfolio were severely undermined by automobile and coal-related amendments adopted during the subcommittee markup. The AFL-CIO believes these amendments are counterproductive and actually undermine the technological transition this legislation is attempting to achieve. We encourage the committee to return to the original language

TIMELINES AND TARGETS

The AFL-CIO supports realistic timelines and goals for emission reduction. We are concerned that there is a disconnect between the reduction targets and the actual development and deployment of new technology. S2191 set a 15 percent reduction of greenhouse gas emissions below 2005 levels by 2020. This is prior to the anticipated commercial availability of carbon capture and storage technologies. Similarly, renewable technologies have their own set of technology development and deployment issues that seriously call into question the ability to meet the reduction levels without drastic economic harm.

S. 2191 also requires a 70 percent national emission reduction below 2005 levels by 2050. The AFL-CIO has supported a 60 percent or greater reduction by 2050 that was tied to a Presidential review of the participation of the developing nations like China, India, Brazil, etc in a global climate protection framework. We urge the Committee to also make this linkage and include five-year review requirement.

JOB CREATION

We believe that S. 2191 can serve a dual purpose: environmental protection and economic development. The legislation needs to make explicit the implicit economic development goals embodied in the bill's investment strategy and its stated purpose of "preserving robust growth." It is in the national interest to assure that the investment dollars generated by this legislation are reinvested in our domestic economy.

We urge the Committee to adopt language to direct the Climate Change Credit Corporation that "the financial resources of the corporation shall be dedicated to domestic investments. In addition, we suggest that "domestic economic development" be identified as a finding of Congress and that domestic investments in technology development, production and construction" be identified as a purpose of the legislation.

COST CONTROL AND THE MARKET SYSTEM

The AFL-CIO supports a limited market approach to cap and trade, with regulatory mechanisms that act as a price control to prevent any serious long-term damage to the economy. The Carbon Market Efficiency Board (CMEB) has a cost control mechanism, but we believe its market intervention tool and its open market system work at cross-purposes.

The CMEB is empowered to take action after prolonged allowance price hikes of 180 or more days but that may be too late because firms are required to obtain and use allowances annually. In 180 days the irreparable economic damage will already have been done. Additionally, the intervention tool allowing the issuance of “future” allowances to drop prices seems to be of limited value given how this market seems to be structured.

S. 2191’s open and “unlimited trading” of allowances and the ability to bank them in perpetuity leaves the system open to predatory and speculative trading practices and the hoarding of allowances that will fuel volatile pricing in the market. This will have a detrimental pricing impact on the public, utilities sector, and energy-intensive industries.

To address these concerns, the AFL-CIO recommends that the trading of allowances be regulated and restricted. Market participation should be limited to firms that intend to use the allowances. The banking of allowances be limited by setting a “time certain” by which they must be used or expire. These steps will help create a more certain less speculative trading environment. In addition, the CMEB market intervention timeline should be shortened and additional intervention tools considered.

INTERNATIONAL PROVISIONS

The AFL-CIO endorses S. 2191’s inclusion of international language which will help preserve American jobs while taking an important step forward to engaging the developing world in seeking a solution to global warming. However, modest modifications to the international timeline and implementation process would strengthen this section.

Implementation can and should take place far sooner than 2020. The bill should require the President to open negotiations immediately upon enactment. Once the regulations are in place and the cap and trade program is in operation for two to three years, then the international action can be implemented. This last step should be an administrative action, not something subject to presidential waiver.

OFFSETS AND INTERNATIONAL ALLOWANCES

We are concerned about the use of offsets and international allowances; the ability to monitor their legitimacy; and ways in which they could undermine domestic investment in industry. Under S. 2191, for up to 30 percent of the annual allowances a firm must submit be comprised of offsets (15 percent) and internationally purchased allowances (15 percent). This could prove to be a disincentive to firm investments in transformational technology.

The AFL-CIO believes that the S. 2191 should either limit the use of offsets and international allowances in combination, or simply to lower the amount available. We also have a related concern over the possibility of double dipping, whereby allowances are granted for offset activity that would have been done anyway as a course of law, tax policy and/or business practice. This does not add to greenhouse gas reduction and should be prohibited.

We look forward to working with Congress to achieve an energy policy for the twenty-first century that will result in a cleaner planet, greater energy efficiency, and the revitalization of our manufacturing base.

An appendix accompanies this testimony that provides additional information about our testimony.

APPENDIX: AFL-CIO RECOMMENDATIONS FOR AMERICA’S CLIMATE SECURITY ACT

THE INVESTMENT PORTFOLIO

Advanced Technology Vehicles Manufacturing Incentive Program

As previously indicated, the AFL-CIO strongly supports the thrust of the Advanced Technology Vehicles Manufacturing Incentive Program created under S. 2191. This program can help to accelerate the introduction of advanced technology vehicles, and thus to help our country make major strides in reducing greenhouse gas emissions and our dependence on foreign oil. At the same time, it can ensure

that the vehicles of the future are built in this country, thereby creating tens of thousands of jobs for American workers.

However, we believe the language in these provisions needs to be improved in several respects. First, the language in Section 4405(b)(1) should be modified to clarify that awards under the program can only be made to manufacturers and components suppliers for re-equipping or expanding a manufacturing facility “*in the United States*” to produce qualifying advanced technology vehicles and components. Obviously, we should not be providing funds to subsidize investment in manufacturing facilities in other countries.

Second, during the Subcommittee markup, an amendment by Sen. Sanders was adopted by voice vote that requires all qualifying advanced technology vehicles to meet a 35 miles per gallon standard to be eligible for assistance under this program. Unfortunately, this amendment totally eviscerates the program. In order to make meaningful progress in reducing our dependence on foreign oil and greenhouse gas emissions, the auto industry needs to improve fuel economy across the entire spectrum of vehicles. It needs to put hybrid and advanced diesel technology into pickups, sports utility vehicles (SUVs), minivans, and larger passenger cars, as well as smaller vehicles like the Prius.

Indeed, some of the greatest gains in reduced oil consumption and greenhouse gas emissions can come from improving the fuel economy of these bigger vehicles. However, because many of these vehicles would still be below the 35 miles per gallon level, even with the hybrid or diesel advanced technology, the Sanders amendment would effectively exclude them from being able to get any assistance under the manufacturing program. As a result, this would greatly reduce the effectiveness of the program in achieving the environmental goals, as well as its ability to generate jobs for American workers.

It is also important to note that the Sanders amendment directly conflicts with the CAFE provisions that were approved earlier this year by the Senate in the energy legislation, and that were supported by environmental groups. Those CAFE provisions specified that the fleet of vehicles for the entire industry must meet a 35 miles per gallon standard, not that each and every vehicle must meet this standard. Indeed, under the reformed, attribute-based CAFE system approved by the Senate, it was expressly recognized that different sizes and types of vehicles would have to achieve different fuel economy levels, depending on their particular attributes. Unfortunately, the Sanders amendment departs from this approach, and instead imposes a rigid, one-size-fits-all mandate on all vehicles.

Finally, Section 4405(c)(1) specifies that the manufacturing incentive program only applies to facilities and equipment placed in service before January 1, 2016. In our judgment, this time period is far too restrictive, especially since the CAFE provisions previously approved by the Senate have a far longer time period, stretching to 2020 and beyond.

Subcommittee Amendment: Coal Preference

We are concerned about the amendment approved by the Subcommittee concerning preferences for “low rank” coals with a heat content less than 10,000 BTU/pound. There should be no distinction among coal types in allowance allocations to electric generating units, or the distribution of auction revenues as incentives to promote clean coal technologies. This sets up a regional preference for coal.

This was a major flaw in the EPA’s Clean Air Mercury Rule, which awarded extra allowances to low-rank western lignite and sub-bituminous coals, despite a growing body of evidence that controlling mercury from these coals costs substantially less than from eastern bituminous coals. While there are minor differences in the CO₂ emissions of coals of different rank, CO₂ emissions can be captured by a variety of emerging control technologies potentially applicable to all coal types at both new and existing units.

We believe that all coals should compete for incentives on a level playing field without regional preferences or exemptions. The bill should remain as originally drafted.

TIMELINES AND TARGETS

Our most serious concern is the magnitude and timing of 2020 reductions (15 percent below 2005) compared to Bingaman-Specter (2006 levels). Reductions on the coal fired power generation will come from investments in increased efficiency in existing facilities, new IGCC (combined cycle technology that is only in the early developmental phase with a demonstration plant scheduled to be built in Ohio), and the development of carbon sequestration technology. Full development of these latter technologies will take a decade, and deployment to scale will take decades more.

There is insufficient time to develop and demonstrate CCS technology at commercial scale. 2020 is effectively 5 years from now in terms of corporate planning for investments. Meeting 2006 levels by 2020 is a major reduction given 1 percent population growth and 2–3 percent GDP growth. The bill suggests that the annual reviews will allow adjustments of the targets, but experience with the Clean Air Act does not support this view.

JOB CREATION

Economic Development and Domestic Investment

This legislation does have a dual purpose: environmental protection and economic development. The legislation needs to make explicit the implicit economic development goals embodied in the bill's investment strategy and its stated purpose of "preserving robust growth." We believe that this is in the national interest, and it is the intent of Congress to assure that investment dollars generated by this legislation recirculate in our domestic economy. The legislation needs to say so.

To fulfill its dual purpose, this legislation needs to promote domestic investment as an economic development strategy that runs from R&D to production and construction. The findings, purpose, and Climate Change Corp. sections need to be explicit about this intent. For example:

- Finding: "The Congress finds prompt and decisive domestic climate change investments are an unprecedented economic development opportunity for the nation.
- Purpose: "to accomplish that purpose by making climate change investments in domestic technology development, production, and construction."
- Climate Change Credit Corporation: "the financial resources of the corporation shall be dedicated to domestic investments so as to assure that the nation derives the maximum economic development return from those investments;
 - Climate Change Credit Corporation domestic investment program will be designed to capture intellectual property, encourage industry development, and to retain and create new jobs in production, construction and conservation of energy.
 - Existing facilities and populated areas shall be considered a strategic priority for manufacturing-related investments.
 - Energy incentives and investments by the federal government must not encourage off-shoring of manufacturing or the sale of assets.
 - The Climate Change Credit Corporation will report to Congress on an annual basis about the domestic economic and environmental impact of its investments."

COST CONTROL AND MARKET SYSTEMS

Safety Valves and Market Intervention

The AFL-CIO supported the cost control mechanism (the Technology Accelerator Payment) in the Bingaman-Specter bill because it provides pricing certainty for long-term investment decisions, assures a modest effect on fuel and electricity prices, and avoids short-term price spikes that can lead to fuel-switching. In this case, the legislation also sets a beginning price of \$12 per ton that rises 5 percent a year above inflation. *We are open to discussing alternative levels of a safety valve price.*

The proposed Carbon Market Efficiency Board (CMEB) also attempts to act as a cost control mechanism, but its open market system undermines this approach and its intervention tool is at best slow and of questionable value. The CMEB is empowered to act in cases where there are prolonged price hikes in allowances (180 or more days) that threaten economic damage to the nation. The CMEB will also have to determine what that "sweet spot" (price) is. With limited allowances that firms need to use annually, in 180 days the damage will already have been done. The issuance of "future" allowances to drop prices seems to be of dubious value and of real concern given how this market is structured.

Allowance borrowing from the future is not likely to work due to uncertainty about future allowance prices. With a \$10 current price, utilities would not borrow 10 years ahead unless there were certainties that prices would not be above \$25 at that time (using a typical utility weighted average cost of capital of 9.5 per cent).

Cap and Trade and the Open Market

We remain deeply troubled with a simple market-only approach. Today the so-called market has left the nation in a housing crisis and the world capital markets in turmoil. The nation is still dealing with the fallout of Enron and the deregulation of the utility industry, which will make any carbon emission legislation even more

difficult to administer. We support a limited market approach, with regulatory mechanisms that act as a safety valve to prevent any serious long-term damage to the economy. If the point of a cap and trade system is to move firms and utilities to change domestic behavior, then we need to be sure this market mechanism does that.

The open and “unlimited trading” of allowances means that anyone, not just firms that need to use them, can buy allowances from a limited and declining pool. In addition, purchasers are allowed to bank these allowances in perpetuity. This is not the stock market or a commodities market, nor should it be treated as such. The open access to allowances, and the banking of allowances, lend themselves to the kind of predatory and speculative behavior that leads to hoarding and to the creation of carbon billionaires. This would have a detrimental pricing impact on the public and the utilities and energy-intensive industries.

Imagine a scenario in which a major nation with over a trillion dollars in accumulated trade surpluses decides to create a carbon allowance shortage on the U.S. market to make our domestic firms less competitive and push them out of business. Or imagine a major hedge fund trying to corner the carbon market and to extract royalties from domestic industry. With limited allowances, one would only have to capture a limited portion to have control. That is not the intent of this legislation. This needs to be regulated:

- The trading of allowances should be regulated and should be done in such a way that it assures that allowances that are sold are used. In other words, market participants should be limited to firms that intend to use the allowances. With a declining pool of allowances, available prices will rise but not be artificially inflated by speculators.
- The banking of allowance for an unlimited time raises the same concerns about hoarding and predatory behavior that leads to price spikes and artificially elevated prices. If the point is to use a diminishing allowance system to effect real behavior change and to have a functioning market that fairly sets prices, then allowances need to have a deadline by which they must be used or expire.

INTERNATIONAL PROVISIONS

The AFL–CIO welcomes the inclusion of the Bingaman-Specter provisions on international trade within ACSA, providing a means to impose emission offset requirements on imported goods from major international trading partners that have not taken comparable action to protect the global climate. However, the language needs refinement. Implementation can and should take place far sooner than 2020.

The bill should require the President to open negotiations immediately upon passage. Once the regulations are in place and the cap and trade is in operation for two to three years, the international action can be implemented. This last step should be an administrative action, not something subject to presidential waiver.

In addition, the timetable and goals should be tied to the international language in S. 2191. It is now even more apparent than it was when the Kyoto Accord was negotiated that taking unilateral steps is not enough to engage the developing world. The Committee should include the five-year review provision included in Section 501 of S. 1766, with its requirement for presidential reviews and recommendations related to progress in international negotiations seeking commitments from major trading partners:

Presidential Recommendations to Congress.—Subsection (b) provides that, during a period between April 15, 2017 and May 31, 2017, and every 5 years thereafter, the President shall submit to the House of Representatives and the Senate a report describing any recommendation of the President with respect to changes in the Act. The President shall make recommendations with respect to—

Whether the U.S. should change the allowance amounts for future allocation periods as necessary to ensure that the United States is undertaking its equitable share of the responsibility for reducing greenhouse gas emissions, and in any case will reasonably lead the United States to reduce its annual emissions to levels at least 60 percent below current emission levels by 2050.

OFFSETS AND INTERNATIONAL ALLOWANCES

We are concerned about the legitimate use of offsets and international allowances; the ability to monitor their legitimacy, especially in the international market; and ways in which they could undermine domestic investment in industry. This proposal allows for up to 30 percent of the annual allowances that a covered entity must submit to be comprised of offsets (15 percent) and internationally purchased allowances (15 percent).

If the goal of this legislation is to change the behavior of domestic power producers and industry and to encourage the domestic investment needed to introduce new technology, this could prove to be a roadblock. One option is to limit their use in combination, or simply to lower the amount.

The expanded forestry/agriculture allowances under S. 2191 raise a broader question over potential double dipping with later offset provisions in the bill. For example, Oregon and other states already provide tax incentives for tree planting. In addition, the wood products industry is under legal and business obligations to plant trees year round. Will the offset provisions doubly reward already-existing behavior that has been backed by tax incentives or existing business imperatives? If a utility company helps underwrite a timber firm's required replanting of a logged area, could they then claim offset credits?

This simple example shows how existing tax incentives and business requirements could be used to create offsets that do not provide real value added to the environment. Offsets should be the result of creating something new or in addition to what normally would have been done as a course of business. The ability to double dip should be prohibited.

RESPONSES BY ROBERT C. BAUGH TO ADDITION QUESTIONS FROM SENATOR INHOFE

Question 1. Do you think the Carbon Market Efficiency Board can operate as a "safety valve" or cost control mechanism to protect the U.S. economy in time in the event of shocks to that economy created by the very system we have put in place?

Response. As in prior legislation, the AFL-CIO strongly supports effective cost control mechanisms as a tool for avoiding shocks to the economy and providing pricing certainty for critical long-term private sector investment decisions. The cost control effectiveness of any oversight organization will be determined by its structure, governance and the tools it has to work with.

The Carbon Market Efficiency Board (CMEB) is responsible for overseeing the market system and has been given limited market intervention tools. We believe the "system" and tools rather than reinforcing one another, actually work at cross-purposes. The legislation designs a trading system that provides open access to anyone and allows those buyers to bank their allowances in perpetuity. This is an open invitation to predatory behavior by speculators and hoarding of allowances that will drive price volatility.

To combat the volatility, the CMEB is empowered to take action after prolonged allowance price hikes of 180 or more days, but that may be too late because firms are required to obtain and use allowances annually. In 180 days the irreparable economic damage will already have been done. Additionally, the intervention tool allowing the issuance of "future" allowances to drop prices seems to be of limited value given how this market seems to be structured.

To address these concerns, the AFL-CIO recommends that the trading of allowances be regulated and restricted. Market participation should be limited to firms that intend to use (not just buy and sell) the allowances. The banking of allowances should be limited by setting a "time certain" by which they must be used or expire. These steps will help create a more certain less speculative trading environment. The CMEB market intervention timeline should be shortened and Congress should consider additional/stronger intervention tools.

We are open to the consideration of any effective cost control mechanisms that will avoid serious shocks to the American economy. At the same time, we remain committed to an investment strategy in the transformational technologies needed to change our carbon footprint.

Question 2. What are American workers and employers to do under this legislation when the technology that everyone is hoping for turns out not to be widely available on schedule but the stringent reduction requirements kick in.

Response. The AFL-CIO supports realistic timelines and goals for emission reduction. As we testified before the committee, we are concerned that there is a disconnect between the reduction targets and the actual development and deployment of new technology. S. 2191 sets a 15 percent reduction of greenhouse gas emissions below 2005 levels by 2020. This is prior to the anticipated commercial availability of carbon capture and storage technologies. Similarly, renewable technologies have their own set of technology development and deployment issues that seriously call into question the ability to meet the reduction levels without drastic economic harm.

The legislation does call for annual reviews of the standards that have been adopted, the status of efforts to meet the standards and the status of technology development and deployment needed to meet the timelines and empowers the EPA to change the standards. Unfortunately, that has not been our experience with the

Clean Air Act. The reviews are important but not sufficient. We believe Congress should play a role in any review and/or revision process.

In addition, American workers and employers must be engaged in this process. They should be represented on all the related agencies and organizations responsible for carrying out this legislation including the CMEB, Climate Change Corp., and EPA advisory bodies responsible for the reviews.

In addition, S. 2191 also requires a 70 percent national emission reduction below 2005 levels by 2050. The AFL-CIO has supported a 60 percent or greater reduction by 2050 that was tied to a Presidential review of the participation of the developing nations like China, India, Brazil, etc., in a global climate protection framework. We urge the Committee to also make this linkage and include five-year review requirement.

Question 3. What do these same American workers do/what happens to them when China and India continue to do nothing to address their rapidly widening carbon footprints.

Response. To put it bluntly, it is not in our national interest to see our efforts to reduce carbon emissions become yet another advantage that a developing nation uses to attract business. However, it is in our interest and the world's interest to have developing nations become part of the solution because the problem cannot be solved without them. Thus, the U.S. needs an approach that provides incentives for participation like the transfer of clean coal technology and penalties for non-participation such as a border adjust cost.

The AFL-CIO endorses S. 2191's inclusion of international language, which will help preserve American jobs while taking an important step forward to engaging the developing world in seeking a solution to global warming. However, the international timeline and implementation process needs to be strengthened.

Implementation can and should take place far sooner than 2020. The bill should require the President to open negotiations immediately upon enactment. Once the regulations are in place and the cap and trade program is in operation for two to three years, then the international action can be implemented. This last step should be an administrative action, not something subject to presidential waiver.

S. 2191 also touches on the international impacts of climate change by providing some resources to help nations suffering the affects of global warming. These resources should also be made available to help transfer newer cleaner energy technology to the developing world.

The AFL-CIO and Congress also have the opportunity to address this issue in international forums. In December, the AFL-CIO and a number of our affiliates will be participating in the UN sponsored meetings in Bali to discuss the post Kyoto protocols. The AFL-CIO has been working with the International Trade Union Confederation (ITUC) to adopt language that makes it clear that a unilateral approach is no longer viable and developing nations must become part of the solution. As part of the ITUC delegation we will also be supporting incentives for the adoption of clean coal and other technologies by developing nations.

Senator BOXER. Thanks, Mr. Baugh. Thanks for your participation in the stakeholder process up until now. Obviously we welcome you as this goes forward. You got a lot into five minutes there. Thank you.

Next we have Andrew Sharkey, president and CEO of the American Iron and Steel Institute. We welcome you and your testimony.

**STATEMENT OF ANDREW G. SHARKEY III, PRESIDENT AND
CEO, AMERICAN IRON AND STEEL INSTITUTE**

Mr. SHARKEY. Thank you, Senator Lieberman. On behalf of the American Iron and Steel Institute, I express my gratitude to the members of the Committee for the opportunity to testify today.

The American steel industry is part of the solution in this debate, not the problem. We are the most energy-efficient steel industry in the world and we have the data to prove it. We not only beat the Kyoto targets 11 years early, we are already doing on our own what S. 2191 seeks to do for the entire economy. Largely through recycling and investments in new technology, we have reduced energy use per ton of steel shipped by over 40 percent over the past

25 years. Reduction in carbon emissions per ton of steel shipped between 1990 and 2006 exceeded 29 percent.

If you will, this industry is laying golden eggs. Steel is the most recycled material. The entire domestic industry is using more scrap metal. The use of recyclable materials as a raw material feedstock in manufacturing processes can significantly reduce and even avoid, in some cases, greenhouse gas emissions. While our present processes are optimized, we are not standing still. The steel industry has embarked on an aggressive research and development program to advance the next generation of iron and steel making technologies that will dramatically reduce or eliminate CO₂ emissions.

Regarding steel in material, our products lead the way in reducing the greenhouse gas emissions of our customers. For example, through the design of automobiles using advanced high-strength steels, which permit much lower vehicle weights and require much less fuel, all the while retaining vehicle safety. If you take only one thing away from this hearing, it should be the impact of climate change legislation on U.S. workers and manufacturers. I want to be as clear as possible on this point. If climate legislation fails to address the competitiveness vis-à-vis foreign products, it will have devastating consequences not only for the U.S. economy but also for the environment. Not only will we export American jobs but greenhouse gas emissions will rise. The carbon footprint of our major foreign competitors selling in the U.S. market is substantially higher than the domestics as a whole.

It goes without saying that in a market open to imports such as ours, any legislation that undermines the competitiveness of U.S. mills will encourage steel production to leave this market in favor of markets with low environmental standards. Such an outcome will necessarily result in higher volumes of greenhouse gas emissions worldwide.

To put it bluntly, the big winner in such a scenario will be countries like China and India and the big losers will be U.S. workers and the global environment. Some examples, our energy costs will rise under the bill beginning in 2012, costs that our foreign competitors do not face. Our allowance obligations commence in 2012, further driving our costs up. The bill does not impose allowance obligations on foreign manufacturers if at all until 2020, 8 years later. For a cyclical industry like steel, 8 years is an eternity.

The bill's baselines for our foreign competitors invite gaming. The purchase of international allowances invites subsidies by foreign governments. And I would add under the international allowance mechanism in Title VI, any allowances that you give for free to American carbon-intensive industries must be subtracted from the allowance obligations of foreign manufacturers. That is true, apparently, even if you are trying to offset higher energy costs from cap and trade that the foreign manufacturers do not have.

We are also very concerned that S. 2191 will encourage fuel switching from coal to natural gas, further escalating natural gas prices. Electricity price hikes will unquestionably follow, not just for us, but for the entire economy. Unfortunately, energy supply is woefully neglected in this bill and in the pending energy legislation.

We believe that any competitiveness provision should one, apply simultaneously to domestic and foreign firms selling in the U.S. market; two, use the same baseline periods; three, not invite subsidies by foreign governments; and four, not enable the Administration to waive the requirements on foreign manufacturers.

In short, the best way to deal with an industry facing foreign competitors would be to adopt an approach that requires everyone selling in this market, whether domestic or foreign, to live up to the best practices and highest standards in terms of carbon performance of their manufacturing operations, based on the particular manufacturing process that is employed. Such mandatory performance standards would be fair, equitable and have the immediate effect of actually lowering global emissions without creating market distortions. Such a policy would ensure that manufacturers in the United States and elsewhere would compete on even terms, because all producers active in this market, including us, would be subject to the same rules. This approach would give your bill a true global reach and not put the domestic steel industry at a competitive disadvantage.

As our trade deficit shows, everyone wants to be in this market. Why not use that fact to encourage greener production abroad? Instead of a race to the bottom, in which manufacturers have the incentive to make the product in countries with the least restrictive standards, why not encourage a race to the top where manufacturers world-wide compete to meet our standards?

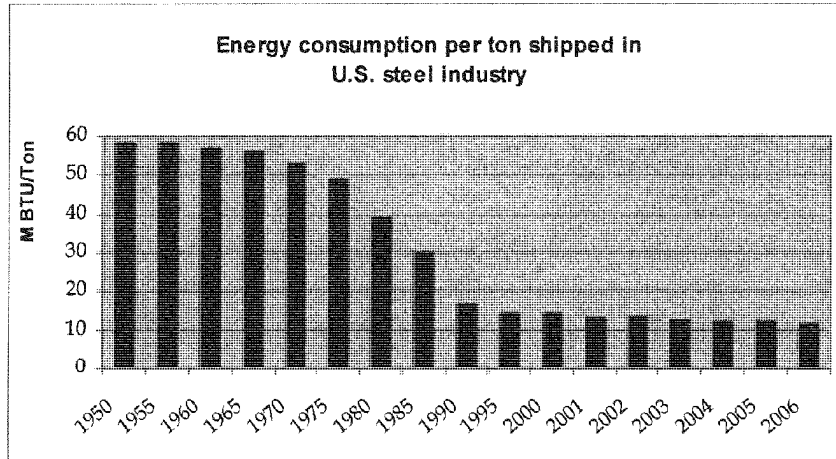
Senator Lieberman, we certainly agree on one thing. We must find prudent means of addressing climate change. But we disagree on much of what is contained in S. 2191, we want to work with you and other members of this Committee to find reasonable and effective policies. We are not just saying no, we hope that you will regard our suggestions as constructive. Thank you.

[The prepared statement of Mr. Sharkey follows:]

STATEMENT OF ANDREW G. SHARKEY III, AMERICAN IRON AND STEEL INSTITUTE

On behalf of the American Iron and Steel Institute, I express my gratitude to Chairwoman Boxer, Ranking Member Inhofe and the Members of the Committee for the opportunity to testify today.

The American steel industry is part of the solution in this debate, not the problem. We are the most energy efficient steel industry in the world and we have the data to prove it. We not only beat the Kyoto targets 11 years early, we are already doing on our own what S. 2129 seeks to do for the entire economy. The domestic industry, largely through recycling and investments in new technology, has reduced energy use per ton of steel shipped by over 40% over the past 25 years. Reductions in carbon emissions per ton of steel shipped between 1990 and 2006 exceeded 29% (a detailed chart appears below). If you will, relative to the rest of the economy, this industry is laying golden eggs.



Steel is the most recycled material. The entire domestic industry is using more scrap metal, both mini-mills and integrated mills. I understand that Senator Carper may offer a recycling amendment to the bill. The use of recyclable materials as raw material feedstock in manufacturing processes can significantly reduce, and even avoid in some cases, greenhouse gas emissions. The proposed amendment, which is purely voluntary and market based, allows manufacturers eligibility for offsets when implementing a variety of activities including increasing the use of recycled materials, manufacturing of products that can be increasingly recycled, eliminate or reduce substances that impede recycling, employ other recycling practices that increase recycling or any combination of these activities. Our industry commends Senator Carper for recognizing the important positive contributions that recycling provides for the environment. The recycling issue must be part of any approach to the reduction of GHG.

While our present processes are optimized, we are not standing still—the U.S. steel industry, in collaboration with the rest of the global steel industry, has embarked on aggressive research and development programs to develop the next generation of iron and steelmaking technologies that will drastically reduce or eliminate CO₂ emissions.

We continue to work to make strides but one reality needs to be taken into account—steel is an alloy of iron and carbon. That is, carbon is necessary in the current steelmaking process technologies and unless we undo the laws of physics, it is a reality that must be taken into account.

The steel industry has and is developing new types of steel products that lead the way in reducing the greenhouse gas emissions of our customers, for example, through the design of automobiles using advanced high strength steels which permit much lower vehicle weights and require much less fuel, all while maintaining vehicle safety. Use of some steel products results in more efficient buildings and infrastructure and is integral in pressure vessels for electrical power generation and energy transportation. Fighting global warming will require significant amounts of new steel products.

If you take only one thing away from this hearing, it should be the impact of climate change legislation on U.S. workers and manufacturers. I want to be as clear as possible on this point: if climate legislation fails to address the competitiveness issues vis-à-vis foreign products, it will have devastating consequences not only for the U.S. economy, but also for the environment. Not only will we export American jobs, *greenhouse gas emissions will rise*. The carbon footprint of our major foreign competitors selling in the U.S. market is substantially higher than that of the domestics as a whole.

It goes without saying that in a market open to imports (such as ours) any legislation that undermines the competitiveness of U.S. mills will encourage steel production to leave this market in favor of markets with lower environmental standards. Such an outcome will necessarily result in higher volumes of greenhouse gas emissions worldwide. In other words, any climate change legislation that does not adequately account for competitiveness issues will have precisely the opposite effect from that intended by its supporters. To put it bluntly, the big winner in such a

scenario would be countries like China and India—and the big losers would be U.S. workers and the global environment.

Looking specifically at S. 2129, energy costs will rise under the bill beginning in 2012, costs that our foreign competitors do not face. Our allowance obligations commence in 2012 further driving our costs up. The bill does not impose allowance obligations on foreign manufacturers, if at all, until 2020, eight years later. For a cyclical industry like steel, eight years is an eternity. The bill's baselines for our foreign competitors invite gaming. The purchase of international allowances invites subsidies by foreign governments. And I would add, under the international allowance mechanism in Title VI, any allowances that you give for free to American carbon intensive industries must be subtracted from the allowance obligations of foreign manufacturers. That is true, apparently even if you are trying to offset higher energy costs from cap and trade that the foreign manufacturers do not have.

We believe that any competitiveness provision should (1) apply simultaneously to domestic and foreign firms selling in the U.S. market; (2) use the same baseline periods; (3) not invite subsidies by foreign governments; and (4) not enable the Administration to waive the requirements on foreign manufacturers.

In short, the best way to deal with an industry facing foreign competitors would be to adopt an approach that requires everyone selling in this market—whether domestic or foreign—to live up to the best practices and highest standards in terms of the carbon performance of their manufacturing operations, based on the particular manufacturing process that is employed. Such mandatory performance standards would be fair, equitable, and would have the immediate effect of actually lowering global emissions without creating market distortions. Such a policy would ensure that manufacturers in the United States and elsewhere would compete on even terms, because all producers active in this market, including us, would be subject to the same rules. This approach would give your bill a true global reach and not put the domestic steel industry at a competitive disadvantage. And as our trade deficit shows, everyone wants to be in this market. Why not use that fact to encourage greener production abroad? Instead of a “race to the bottom” in which manufacturers have an incentive to make the product in countries with the least restrictive standards, why not encourage a “race to the top” where manufacturers worldwide compete to meet our standards?

We still have grave doubts generally about how well cap and trade can address climate change. Cap and trade worked reasonably well on the acid rain problem. The climate change issue is quite different. With climate change we have major technological gaps, the need for global reach, the presence of foreign competitors, and no guaranteed ability for regulatory cost pass-through.

More specifically, S. 2129 rewards states with extra allowances if they impose more stringent cap and trade requirements than the federal scheme. I shudder to think how American industry can cope with a federal cap and trade program and a multitude of conflicting, more stringent state programs. Recall that the states, under the U.S. Constitution and our trade laws, have no mechanism to achieve global reach, to avoid giving foreign manufacturers who sell in our markets a competitive advantage over domestic firms.

Finally, we are very concerned that S. 2191 will encourage fuel switching from coal to natural gas, further escalating natural gas prices. This scenario is already occurring, just in anticipation of legislation. Electricity price hikes will unquestionably follow, not just for us, but for the entire economy. The technologies we need are not in place, and won't be for many years. Unfortunately, energy supply is woefully neglected in this bill, and in the pending energy legislation. Obviously, if U.S. energy costs continue upwards unabated, this will only increase the likelihood that foreign manufacturers, who have access to affordable energy, will capture U.S. jobs and domestic market share, and consequently increase greenhouse gas emissions.

Madam Chairman, we certainly agree on one thing. We must find prudent means of addressing climate change. While we disagree on much of what is contained in S. 2192, we want to work with you and the other members of this committee to find reasonable and effective policies. We are not just saying “no.” We hope you will regard our suggestions as constructive.

RESPONSE OF ANDREW SHARKEY TO AN ADDITIONAL QUESTION FROM
SENATOR INHOFE

Question. Is there anything else that you would like to add into the record?

Response. We in the steel industry recognize that recycling is an important aspect of reducing carbon emissions, reducing energy consumption, and preserving natural resources. Every steel producer uses scrap material (recycling) as a vital feedstock

to lower the cost of producing steel. 2006 figures from the Steel Recycling Institute indicate that U.S. steel producers consumed approximately 70 million tons of scrap to produce just over 100 million tons of steel. Seventy percent of steel produced in the United States is eventually recycled. On average, a ton of steel will be recycled eight times in the course of fifty years. Our recyclability, coupled with our durability, is a key reason our GHG profile, on a life cycle basis, is low.

We support actions that increase recycling, and appreciate the efforts of the Recycling Roundtable to develop language that will induce additional recycling in our economy. We applaud you for recognizing the positive contributions that recycling provides for the environment. The recycling issue must be part of any approach to the reduction of GHG.

At the same time we want to ensure that the Congress, through this legislation, recognizes that steel is the most recycled commodity in the world today, and that the domestic steel industry, through the use of recycling, has already reduced its carbon footprint and continues to supply a basic building block of the economy with the minimum amount of energy consumption and carbon emissions possible.

We also believe the maturity of steel recycling demonstrates the drawbacks of imposing emissions caps on an industry which is leading the world in global steel emissions reductions.

We want to work with you, the Committee and the Congress to ensure that the domestic steel industry is not disadvantaged, and in fact is enhanced as the most carbon conservative steel industry in the global economy, through this amendment and by exploring other possibilities.

Senator LIEBERMAN. Thank you, Mr. Sharkey. That is exactly the way I heard your testimony. I appreciate it very much. We do look forward to engaging with you in more detail.

I do want to say, going back to the first part of your testimony, that the iron and steel industry really has done exactly what you said it has done. It is a great and I hope encouraging model of the way the market drives, in necessity, in a way, drives innovation to the point where you have done exactly some of the things that we are hoping and intending that this Climate Security Act do for a lot of the rest of America's economy. So we have a lot of work to do together.

Our final witness on the panel is Donald R. Rowlett, Director of Regulatory Policy and Compliance for the OG&E Energy Corporation. Good afternoon, and thank you for being here.

STATEMENT OF DONALD R. ROWLETT, DIRECTOR OF REGULATORY POLICY AND COMPLIANCE, OG&E ENERGY CORPORATION

Mr. ROWLETT. Thank you, Senator Lieberman, members of the Committee. My name is Donald Rowlett, I am Director of Regulatory Policy and Compliance for OG&E Energy Corporation, which is an electric utility and natural gas pipeline headquartered in Oklahoma City.

Senator Inhofe, I would like to offer the appreciate of OG&E and particularly everybody in Oklahoma for the bipartisan leadership that you and Chairman Boxer showed in moving the long-overdue and very important Water Resource Development bill into enactment last week.

OG&E is a medium-sized utility serving approximately 780,000 customers in Oklahoma and western Arkansas. Our fossil fuel generation mix is about 60 percent natural gas-fired and about 40 percent coal. We currently have wind power capacity of 170 megawatts, or roughly 3 percent of our total generation. Recently we announced a major initiative to quadruple the wind generation capacity to around 800 megawatts.

I would like to say that all utilities are not alike. They vary in terms of size, weather demands, financial resources, generation mix, renewable resources and of course, their State and regulatory and political environments in which they operate. These differences explain why utilities, especially those with nuclear generation, may have substantially different perspectives to S. 2191 than we have.

We can not yet sufficiently determine the economic impact of S. 2191 on our customers or on our operations. With the stakes so high, a credible economic assessment is needed at this time and certainly before enactment. We were pleased to hear from Senator Warner that this is being undertaken as we speak.

While still tentative, our best analysis thus far produces a sobering picture of the challenges presented by the bill for both OG&E and its customers. The distribution of free allowances under Section 3901 is crucially important to our ability to transition during the early years of the legislation's cap and trade program. S. 2191 does not appear to provide enough allowances to mitigate what we believe will be the economic cost of this program and the compulsion to engage in significant fuel switching to natural gas.

Conservatively, we estimate OG&E's share of the free allowance pool will only be about 36 percent of the allowances needed by OG&E in 2012. Whatever the market cost will be for additional allowances that OG&E will need to buy, this cost will be significant. If the additional allowances are priced at \$30 when OG&E needs to purchase them in 2012, it will cost us nearly \$500 million. This is almost a third of our 2006 gross revenues of approximately \$1.6 billion. It is unclear how OG&E will recover these costs, since assumptions about retail rates and the customer's ability to pay them are all uncertain at this time.

But the bill will require OG&E to do more than simply buy allowances. Our options are limited but do not likely include building new nuclear generation or even coal generation of any kind, including clean coal plants. Wind is not a suitable replacement for baseload generation needs. Perhaps domestic agricultural offsets might be available.

For sure, though, we will be faced with a compelling incentive to switch a significant amount of our coal-based generation to natural gas. If we took the drastic step of replacing all of our current generation with natural gas, it would raise the average bill for a typical retail customer over 40 percent. We believe that the incentive to switch fuels from coal to natural gas would be equally compelling to most other coal-burning utilities, because it is a strategy that utilities can rely on, they can quantify and it offers them the greatest level of control.

Switching to natural gas raises the prospect of stranding our investment in our coal plants, thus creating stranded costs. We think the bill could provide accommodations through allowances or other compensations for that outcome. S. 2191 unfairly discriminates against cooperatively-owned utilities, against investor-owned utilities. Under Section 3903, co-ops get all allowances necessary to cover their 2006 CO₂ equivalent emissions, whereas what remains in the free pool after the co-ops are fully satisfied gets distributed pro rata to everyone else.

This political accommodation is unfair. Finally, we cannot bear the cost of compliance any more than cooperatives. Co-ops burn coal, just like we do. Our need for allowance relief is no different than theirs. All utilities should be treated the same with regard to distribution of free allowances.

S. 2191 overly restricts the use of domestic offsets to 15 percent of the utilities' annual obligation and too severely limits allowances for carbon capture and sequestration development to prevent fuel switching. Allowances for CCS should not decline over the time frame after 2017, since we don't expect CCS to be available until 2020. Nor should allowances for CCS projects be limited to 10 years or be subject to pro-rata among worthy projects.

In our judgment, the Carbon Market Efficiency Board is less desirable than a safety valve to protect the economy from extreme adverse impacts. We also suggest that the Committee evaluate whether it might be more effective and efficient to impose carbon tax initially and delay implementation of a cap and trade regime.

I would like to thank you for the opportunity to present our comments today.

[The prepared statement of Mr. Rowlett follows:]

STATEMENT OF DONALD R. ROWLETT, DIRECTOR OF REGULATORY POLICY AND COMPLIANCE OGE ENERGY CORP.

My name is Donald R. Rowlett. I am the Director of Regulatory Policy and Compliance for OGE Energy Corp., which is an electric utility and natural gas pipeline company headquartered in Oklahoma City. Our electric utility, which is called OG&E, serves approximately 780,000 customers in Oklahoma and western Arkansas. Our fossil fuel generation mix is approximately 60% natural gas-fired, 40% coal-fired, and we currently have wind power capacity of 170 megawatts or roughly 3% of our total generation.

My company and I appreciate the opportunity to come before you today to provide our perspective and recommendations regarding what perhaps may be the most important environmental and economic legislation the Congress has ever considered—America's Climate Security Act of 2007 (S. 2191). I characterize S. 2191 in that historic manner because, consistent with its stated purpose in attempting to avoid catastrophic global environmental disaster, the bill's implications may very well result in the most far-reaching re-engineering of modern society ever attempted by Congress. The sheer complexity and enormity of that undertaking underscores the need to take special care to avoid approaches that would wreak serious and broad damage to the nation's economy, a goal which we believe everyone shares.

I. OG&E'S EXPERIENCE PROVIDING LOW COST, RELIABLE AND ENVIRONMENTALLY RESPONSIBLE ELECTRICITY INFORMS OUR PERSPECTIVE ON S. 2191

All utilities are not alike. They vary in many important ways: in terms of size, weather demands, financial resources, generation mix, renewable resources, and of course their state regulatory and political environment in which they operate. OG&E is a medium sized investor owned utility and lacks the resources that many of the much larger utilities that have appeared before this Committee possess. These differences can explain why larger utilities, especially those with nuclear generation, may have a substantially different perspective on S. 2192 than OG&E does. To understand our specific views on S. 2191 more fully, it may be helpful to the Committee to first have a sense of OG&E's individual persona as a utility and our particular experience and perspective in providing low cost, reliable and environmentally responsible electric service to our customer.

As a regulated utility, OG&E bears the responsibility of its "obligation to serve" all electricity customers in its service area and we take this obligation extremely seriously. This obligation to serve carries with it the requirement to provide reliable electric power at the lowest reasonable cost to our customers. But beyond that obligation to serve, OGE strongly believes that it is incumbent on us as a good corporate citizen to produce reliable and low cost power for our customers in an environmentally responsible manner. Our company's response in adopting cleaner

sources of power generation is therefore motivated not necessarily by a legal compulsion but by a belief that it is simply the right thing to do. Producing electricity with fewer emissions is a prudent, rational and worthy objective unto itself, independent of global climate change concerns. Our customers want their electricity to be inexpensive and reliable, but also as cleanly generated as we can make it. It makes good business sense to respond to our customers in that regard. It also makes good business sense in our line of work to diversify our generation mix to reduce dependency on any one fuel choice option.

OG&E and Wind Power

I can report firsthand to you from Oklahoma that the interest in environmentally friendly energy and energy related consumer behavior certainly exists in our state. In the western part of our state wind farms seem to be popping up everywhere. Oklahoma has gone from virtually no wind power just a few years ago to being ranked 6th nationally in existing installed wind power generation capacity today. And, more is on the way. On October 30, 2007, OGE Energy announced that, in response to market demand, OG&E plans to quadruple its wind power generation capacity. We also announced plans to build new transmission lines running between western and central Oklahoma to allow renewable power being developed in sparsely populated western Oklahoma to reach customers where it can be used. Under this expanded renewable energy initiative, OG&E could increase its wind power capacity from its current 170 megawatts to about 770 megawatts, and move Oklahoma up the ranking of states in terms of wind generation from its current sixth ranking to as high as third. And I might emphasize that all of this is happening without state or federal mandates.

As proud as we are of this wind initiative, we certainly recognize that it is very aggressive for a utility our size. Building this wind generation capacity and the transmission lines needed to make it useful is very expensive and creates difficult operational issues involving dispatch and reliability which increase in scale to the extent even more wind capacity might be added to address obligations created by S. 2191.

OG&E and Efficiency

In addition to wind power, we are renewing our interest and focus on demand side management (“DSM”) programs aimed at reducing energy use. Through programs like time of use rates, weatherization programs, highly efficient lighting and appliance incentive programs, commercial and industrial load curtailment programs and consumer education we are already reducing our system’s demand for power by approximately 200 megawatts. With additional customer education, better technology such as smart meters, and other programs, we believe that there is another 100 or so megawatts of additional energy savings to be obtained.

OG&E is envied in the industry as a low cost utility and we have some of the lowest electricity rates in the nation. What is important for the Committee to understand though is that as a very low cost electricity provider, it is far more difficult for OG&E to use efficiency to shift demand for power—meaning, for us to lower the volume of electricity our customers use—than it is for high cost utilities.

OG&E and Clean Coal

OG&E’s low electricity rates are primarily attributable to the favorable cost implications of our coal burning generation. Often 70% of our baseload generation will be from our coal generation, with natural gas largely used for the balance of baseload generation and for peaking demand. We use low sulfur Powder River Basin coal which has kept both our emissions and our electricity rates to our customers low, which in turn has contributed very significantly to Oklahoma’s economic viability and competitiveness, as well as our enviable standard of living enjoyed by our citizens.

Obviously, a primary purpose of S. 2191 is to make coal a significantly more expensive fuel to mitigate its traditional use and thereby mitigate its uncontrolled greenhouse gas emissions. We note that S. 2191 also has provisions to spur development of clean coal technologies, including carbon capture and sequestration (CCS) technology, that will allow the nation to continue to use “clean” coal for electric generation. OG&E strongly supports the development of such clean coal initiatives. But our very recent experience in responsibly trying to get state regulatory approval for the cleanest of existing state of the art clean coal technologies—an ultra-super critical coal plant—provides a very cautionary tale that makes us question the ability to construct any new coal plant in Oklahoma for the foreseeable future even if it is the cleanest available coal technology. I believe the Committee would benefit from an understanding of our recent experience in that regard.

Along with our sister utilities in the state, Public Service Company of Oklahoma and the Oklahoma Municipal Power Authority, we are experiencing the need for more baseload generating capacity in the 2012 timeframe. We partnered with those two utilities to propose building one 950 megawatt ultra-super critical coal-fired power plant together rather than each of us individually building, smaller, less efficient plants scattered across the state. An ultra-super critical plant represents the very latest in proven state-of-the-art technology and offers major efficiency and environmental performance advantages over older technology and even compared to modern super critical coal plants. With the addition of this plant, we projected OG&E's carbon footprint could be as much as 3% lower than today. This would be accomplished by being able to reduce the use of our less efficient coal plants and through increased use of wind power.

In reaching the decision of what type of plant to build, we quickly discounted wind power because it is not suitable for base load generation. We also discounted nuclear because our need for power is in 2012 which would be impossible to meet with the timeframes associated with nuclear plant construction. In addition the financial costs and regulatory risks associated with building new nuclear plants exceed the resource profile that OG&E can afford. We have no appreciable untapped hydro power to speak of in Oklahoma and it was apparent we could not conserve our way out of the need for base load power. So that left gas and coal as our effective options.

Both those fossil fuel options come with pros and cons. Natural gas is certainly a cleaner burning fuel, but comes with higher prices and enormous price volatility. We have low electric rates in Oklahoma but because the summers are so hot and so long, electric bills can be quite high since our customers tend to use a lot of electricity for air conditioning. By the same token, just 2 winters ago we were in emergency meetings trying to determine how we could supplement the funding of public and private low income assistance programs that were not going to be able to meet the projected heating needs of those customers that winter due to gas prices that had spiked over \$10. During this time I appeared before the Oklahoma Corporation Commission in a hearing it convened to understand the reasons for these high prices and to find out what utility companies were doing to mitigate these costs. Consequently, summer or winter, we very much understand from our customers and our state regulator how much importance they attach to the price of their power.

In recent years, we in Oklahoma, like many other states, have had our share of manufacturing plant closings. Just in the Oklahoma City area alone we have had a large tire plant and an automobile plant close, taking with them in excess of 4,000 jobs. In each case, we were called upon by many, including the Governor of our state, to see if there was anything we could do to lower the energy costs of these plants. We did as much as we could at the time, but were unable to do enough on our own to convince the manufacturers to preserve the local plants and the associated jobs. In every one of our state regulatory proceedings our industrial customers constantly remind the regulators that they compete in a global marketplace and any cost disadvantage may be the difference between staying in Oklahoma or not. So given the high price and high volatility of generating electricity by natural gas, you can understand why that is a significantly disfavored option from the perspective of its impact on customers.

Coal on the other hand is both abundant domestically and significantly cheaper than natural gas—even with the uncertainties of future environmental regulation factored in—and it still handily beats the price of natural gas by many multiples. Clearly, however, the downside to coal is the environmental cost concern. Consequently, in proposing to build an ultra-super critical coal plant, we believed we had combined a very significant emission reduction strategy with \$5.5 billion in demonstrable cost savings for consumers—a tremendous value proposition for both Oklahoma's environment and economy.

After an extensive and thorough public review and comment process at the Oklahoma Corporation Commission, last August an administrative law judge issued a lengthy and detailed recommendation strongly in favor of approval of our proposed ultra super critical plant, citing the \$5.5 billion in customer savings compared to deployment of a gas-fired base load alternative. Nonetheless, in September our application was denied in a 2-1 vote by the Oklahoma Corporation Commissioners. The Commission's majority cited concerns about process, the evidence of the need for the power, and cost recovery. Of special interest to this Committee, environmental concerns per se were not identified as reasons for denial of the application.

II. OGE'S VIEWS AND RECOMMENDATIONS ON S. 2191

A. *We cannot yet sufficiently determine the economic impact of S. 2191 on our customers or our operations*

In our view, as serious as this legislation is for the entire nation, we would assume that before the Committee would turn to marking up S. 2191 it would be able to articulate in a reasonably confident way the macro-economic impact of the bill and understand how the constituencies in each Senator's state would be affected by the bill. But we understand that such economic analysis has yet to be done. The many witnesses at prior hearings, both supporting and criticizing the legislation, have made a compelling case that the costs of a cap and trade regime such as that contained in S. 2191 will be enormous. We would observe that Section 2605 of the bill requires the Congressional Budget Office to estimate the price range at which emission allowances will trade during the two year period of the initial greenhouse gas emission market and the impact of allowance trading on the U.S. economy no later than July 14, 2014, which is two years after the implementation of the bill's allowance regime in 2012. It appears to us that this kind of analysis is needed now even more than in 2014. Given the unprecedented stakes for this legislation in terms of environmental and economic impacts, we urge the Committee to demand a credible "macro-economic" assessment at the earliest moment and certainly before enactment.

But we are also in need of more information to perform a detailed assessment of the bill's "micro-economic" impact on our own OG&E operations, our credible range of compliance options, and the consequent impact on our customers. We would draw the Committee's attention to Section 3901 et seq., which provides for distribution of "free" allowances to "incumbent utilities". Section 3903 uses several variables including an upfront reservation of a portion of the "free" pool for "new entrants" and rural cooperatively-owned utilities that reduces the overall number of such allowances available to the balance of the utility sector, which includes us, on a pro-rated basis. We cannot estimate the number of allowances that will be reserved for new entrants and the co-ops, and therefore cannot determine what is left to be prorated among the rest of the power sector. But even then we cannot determine how much of that residuum of the "free" allowances that we might receive on a pro-rated basis since to do so requires that we know the ratio of our CO₂ equivalents emissions during the 3 years prior to the bill's enactment to the annual average of the aggregate quantity of CO₂ equivalents from all of the nation's covered power plants during those same three years. While we can estimate our OG&E CO₂ equivalents over any three years from our recent actual experience, it is necessary to know what the national emissions denominator is in that ratio, and different data bases can give different answers that can materially change the result. Without knowing what are the values that the Committee is using for those variables no utility can determine with even reasonable accuracy the number of allowances that it may actually stand to receive under that section. And therefore we cannot confidently deduce the number of allowances that we will need to secure through the auction process or by purchase from groups favored with allowances that they receive from other provisions under the bill or through offsets. We would note that, as recommended in Subsection J below, a carbon tax provides far greater certainty as to the carbon price signal and allows for more reliable estimations of costs and compliance options.

We presume that the Committee is working with a set of assumed values for those variables and for the purpose of being able to work along with the Committee on an equal factual footing, regardless of whether there is consensus on the particular values the Committee might be assuming, we would urge that the Committee publish its assumptions in that regard so that estimates and comparisons can all be made by all interested parties on an "apples to apples" basis. In similar vein, we do not know what dollar value the Committee is assuming for allowances in the auction market in any particular year or even in the first year (2012), or the estimated value that allowances will demand when sold by sponsors of offsets. In our view, no Senator on the Committee can expect to understand the actual impact of the bill on their respective state's constituents without such information. By the same token, no utility can fairly evaluate compliance options and the cost thereof without such information. Certainly, the residential, commercial and industrial electric customers, and the public utility commissions in each state will want to know such information. So, we would recommend that such information be made available immediately and that the Committee allow the affected public a suitable period of time to reflect on that and similar information before a full Committee markup so that any further legislative action is properly informed.

Notwithstanding the limitation on our ability to estimate with the desired degree of accuracy the cost and compliance implications of S. 2191, our best analysis thus

far produces a sobering conceptualization of the challenge presented by the bill for both OG&E and our customers. We estimate that OG&E's CO₂ emissions represent approximately 0.9 percent of the total annual average CO₂ emissions of the electric power industry in the United States. Thus, under Section 3903's allocation methodology for "incumbent" utilities such as us, OG&E would receive approximately 9.5 million allowances in 2012. These credits are only about thirty-six (36) percent of the allowances needed by OG&E in 2012. OG&E would still need approximately 16.5 million additional allowances in 2012. This is a conservative estimate, as it is unclear how many allowances will be available to investor-owned utilities when all other allocations are made for "new entrants", "cooperatively owned utilities" and others before investor-owned utilities (IOUs) such as us receive their shares of the "free" allowance pool in 2012.

While it not clear what the market costs will be for the allowances that OG&E will need (i.e., possibly 16.5 million allowances in 2012), OG&E believes that these costs will be significant. For example, if allowances are priced at \$30 when OG&E needs to purchase them in 2012 and we opt to buy them, OG&E will have to spend nearly \$500 million that year. (This illustration's cost is scalable in accord with one's assumption of the allowance price.) It is unclear how OG&E will recover these costs since assumptions about retail rates and customers' ability to pay are all unknowns at this time.

Since the purpose of S. 2191 is to provide incentives for companies to change their operations to reduce greenhouse gas emissions rather than simply buy allowances to cover an unchanged emission rate, OG&E would likely have to do more to comply than simply buy allowances. For example, OG&E could retire all of its coal-fired generating units and switch to 100 percent natural gas generation. If OG&E pursued this option, OG&E would face the following costs:

- \$2 billion in capital cost to construct the gas-fired generation. Note: This option is not possible for 2012.
- An increase of over \$1.1 billion in fuel costs per year. This is more than double OG&E's current annual fuel costs.
- Even if OG&E eliminated coal from its generation portfolio, OG&E would still need to buy 7.8 million allowances which could cost \$234 million in 2012 (if allowances are priced at \$30 per allowance).
- OG&E could mitigate part of the increase in fuel costs and the cost of purchasing allowances if it installed significant amounts of additional wind generation. However, OG&E believes that 1000 MW of wind generation would only reduce the increased fuel costs and allowance costs by forty to fifty percent. The capital cost associated with 1000 MW of additional wind generation would be approximately \$2 billion.
- It is unclear who would pay for the very significant stranded costs associated with the retired coal-fired generating units.

Employing this full switch from coal to natural gas would increase the average monthly bill for a 1000 kWh OG&E customer by approximately forty percent—representing an increase of \$40 over the current \$100 per month bill. And as noted above, even after this fuel cost impact, OG&E would still need to spend perhaps hundreds of millions of dollars on allowances in order to comply. The costs of these allowances would also presumably be passed on to OG&E's customers, if permitted by our state regulator, thus making the estimated \$40 per month price increase to customers from full fuel switching very conservative and not all-inclusive.

B. S. 2191 fails to provide coal-based generation with sufficient transition support needed to protect customers from adverse cost and reliability impacts:

We understand the bill's objective of injecting a so-called "price signal" into the utility market to induce changes for cleaner electricity generation. However, OG&E is the type of utility that will be seriously challenged in the early years of S. 2191's regime because we do not sense that it provides adequate transitional support for us to protect our customers from adverse cost and reliability impacts.

The objective of reducing national CO₂ emissions by 15% compared to 2005 levels by 2020 will be very aggressive for us primarily due to two factors: first, our high use of coal-based generation and second, the few lower-emission alternatives available to us in what we view as the initial, transitional term of the bill, i.e. 2012 through 2020.¹

¹While we appreciate that S. 2191 projects a 65% emissions reduction from 1990 levels by 2050, we view whatever may occur beyond the general 2020 timeframe to be sufficiently uncertain and speculative that it is unrealistic to predict with much confidence what our situation

Nuclear generation opportunities have much longer lead times than S. 2191's implementation date of 2012 would allow. As suggested in the narrative in Section I above, based on the Oklahoma Corporation Commission's decision not to allow construction of an ultra-super critical coal plant that would have saved Oklahoma rate payers \$5.5 billion compared to a gas plant, we have serious doubts about the ability to build any new coal plant in Oklahoma in the near future. Beyond Oklahoma, we observe that other clean coal plants are also encountering significant difficulty in being approved by state regulators, with their difficulties often largely attributable to the opposition of environmentalists and the advocacy by natural gas sellers who see economic opportunity for themselves in the demise of any new coal plant. We also note efforts to push EPA to prevent by regulation the construction of any new coal plants that are not equipped with CCS technology. The needed CCS technology that will allow the cleaner, continued use of coal is a decade or more away, and perhaps will not be commercially available until 2025. Renewable resources such as wind, solar and geothermal are not reliable for base load purposes.

We therefore view the distribution of what are referred to colloquially as "free" allowances under Section 3901 et seq. to be critically important to our ability to transition during the early years of the legislation's cap and trade regime. If anything, we view the current provisions of Section 3903 as likely not providing enough allowances to mitigate what we believe will be the economic cost of this program and to relieve the compulsion to engage in significant fuel switching to natural gas.

In addition, while there are certainly advocates of auctioning all the allowances who will criticize the number of allowances distributed through Section 3903 as excessive or as a "windfall", we strongly disagree. We envision no realistic scenario where we do not need to continue to rely substantially on our coal generation fleet during the transition period to meet base load demand, notwithstanding the pressure for increased use of wind and natural gas generation. Any "free" allowances will mitigate the suite of new increased cost factors we will encounter from (i) our continued use of coal and increased use of more wind and natural gas generation and (ii) the expense of buying needed additional allowances through auction or off-set projects.

C. S. 2191 unfairly discriminates between co-operatively owned utilities and investor-owned utilities

Section 3903 differentiates in its distribution of "free" allowances between co-operatively owned utilities and the balance of the electric power sector. Under Section 3903, co-ops get a distribution of allowances to cover all of their 2006 CO₂ equivalent emissions, whereas what remains in the "free" pool after the co-ops are fully satisfied gets distributed pro-rata to the rest of the utility sector based on their ratio of emissions to the total national emissions of the utility sector. To us this appears to be a political accommodation that is unjustified and unfair. If there truly is an impending environmental catastrophe the ownership structure of the source of the green house gases does not change the impact on the environment. From a financial perspective, we are not necessarily better situated to absorb the cost of compliance any more than a co-operative is. Moreover, most of the co-operative utilities have a generation mix that tilts heavily toward coal-burning just like ours does. Our need for allowance relief is no different than theirs. S. 2191 should treat all utilities the same with regard to the distribution of Section 3903 allowances.

D. S. 2191 overly restricts the use of domestic offsets:

Section 2402 generally restricts the amount of allowances that a utility can use from domestic offsets to 15% of its annual obligation. A utility of OG&E's size and resource capability likely will not be engaging in international offset activity, ergo what is available from domestic offsets is of far more interest and potential usefulness. While it remains to be seen how expensive and available such offset projects may be, it is not lost on us that Oklahoma is an agricultural state where presumably agricultural offset opportunities as envisioned by the bill may exist for us. We believe that a ton of CO₂ equivalent offset is the same as a ton of CO₂ reduction at our own plants. While we cannot realistically determine so now, potentially offsets could provide a cost-effective tool for us, especially in the transition period before clean coal technology is both commercially available and politically acceptable to state regulators. We would recommend significantly increasing the percentage of offset-based allowances that a utility could use during the period prior to 2020, or, even better, completely eliminating any limit on the use of verifiable domestic offsets.

will be then, especially if we cannot successfully navigate the early transition years leading up to 2020.

E. In the absence of available alternatives in the immediate future, S. 2191 will compel massive fuel switching from coal to natural gas by utilities:

Even without being able to quantify the cost of possibly alternative compliance strategies, it is evident beyond any doubt that S. 2191 will compel coal-burning utilities to engage in massive fuel switching to natural gas. The dramatic mismatch between the allowances that will be distributed to utilities under Section 3901 et seq. compared to their historic emission profiles, and the absence of new alternative technology such as clean coal/CCS to accomplish compliance while still using coal, will drive utilities into the allowance auction market and to the offset allowance market, the cost of neither of which can be reliably estimated initially or controlled over time. In the absence of new coal plants and other good, reliable technological choices for the indefinite future, and given the onset of the cap and trade regime in 2012—just four short years from now—no serious coal-burning utility company's board of directors, knowing that state utility regulators are watching and need to approve every significant resource supply decision, will passively leave their company's or their customers' fate to the unknown and uncontrollable allowance auction market. Instead they will be compelled to adopt a compliance policy that has elements over which they exercise the maximum amount of control. We assume this is exactly the behavior the bill is intended to motivate. And for OG&E and other utilities that meet our profile, by far the most accessible and dependable such policy option is to switch from burning coal to burning natural gas. The Committee must recognize in its legislative deliberations this stark and unavoidable reality; to do otherwise is not to anchor the legislation in reality.

Not surprisingly, the EU's recent experience shows that such fuel switching apparently accounts for the bulk of emission reductions in the EU cap and trade regime. Too many credible and expert witnesses before this Committee have warned about the similar overwhelming and compelling incentive our U.S. coal burning utilities will experience to switch from coal to natural gas. They have warned that utilities, with their laudable obligation to serve their customers, will do all that is necessary to serve their customers reliably, economically and with environmental responsibility. Even if the utilities themselves did not feel compelled to do so, their state regulatory commissions would certainly insist on it. Moreover, assuming the usual ability to pass-through the cost of fuel used to generate electricity, utilities will have the economic incentive to do what will be universally viewed as the "right thing" for their customers. And no one should expect otherwise. Nor should anyone expect that increasing utilities' incentive to switch to natural gas will have anything other than a dramatic upward pressure on the price of natural gas, the supply of which is not increasing sufficiently to meet this demand.

While an increased price for natural gas is most certainly good news for many in Oklahoma's robust natural gas production industry, it imposes predictable and unavoidable adverse consequences on everyone else who either uses electricity or natural gas. Numerous experts have already testified that, with the supply of natural gas effectively not increasing, the massive increase in demand for natural gas represented in coal burning utilities switching away from coal-burning will significantly increase the price of natural gas all across this country. The adverse impact of the increased costs of natural gas to residential, commercial and industrial customers will be enormous. This will result in major economic challenges for residential, commercial and industrial users of natural gas in every state in the Union. For example, hospitals and other health care facilities are large energy consumers. These significant increases will place even greater cost burdens on an already overwhelming health care dilemma. But the bottom line is that utilities will get the natural gas they need to generate cleaner electricity for their customers and in so doing other gas users will either have to pay the higher price or do without natural gas, which raises a host of issues about demand destruction, job loss and other adverse economic consequences that have already been well established in prior testimony before the Committee by a spectrum of witnesses extending from the AFL-CIO to the Industrial Energy Consumers of America.

F. S. 2191 does not address the issue of stranded costs that may be caused by compliance with the bill's cap and trade obligations

If we are correct that significant fuel switching to natural gas will occur, leaving coal-burning facilities idled, we have a very big question as to who will deal with the stranded costs associated with those idled coal plants. The bill is silent in that regard, but we are confident that state utility commissions and electric customers will be very concerned with those stranded costs. This issue is an enormous concern. It would appear to us that in the event of such stranded costs the bill should accommodate the impact it causes by providing allowances or other compensation to the adversely affected utilities.

G. Load Serving Entities should be permitted to apply Section 3501 allowances against their cap and trade obligation

OG&E qualifies as a “load serving entity” under Section 4(18). Section 3501 distributes allowances to load serving entities, including utilities like OG&E, for the purpose of defraying the cost impact of the cap and trade regime on low and middle income electricity customers. The provision appears to require the load serving entity (perhaps envisioning entities having no electric generation-related emission obligations) to sell these distributed allowances for cash, and then use that revenue to reduce the rates that their low- and middle-income customers pay. In our view, while the distribution of allowances to load serving entities is justified in recognition of their obligation to serve customers, requiring utilities that both generate electricity and qualify as load serving entities such as OG&E to sell those allowances for cash rather than simply to apply them directly to meet their basic allowance obligation is inefficient. Load serving/generating utilities are going to need every allowance they can acquire to meet those basic obligations and in so applying their share of the load serving entity allowance distribution in that manner they will directly benefit all their customers, including their low and middle income customers.

H. S. 2191 too severely limits allowances for carbon capture and sequestration development

If one is concerned about the impacts of fuel switching in the transition period before 2020 as we are, you can understand why we prioritize the expeditious development of clean coal technologies including carbon capture and sequestration that will facilitate the continued use of coal or the resumption of the use of coal if there is switching to natural gas. The entire cap and trade regime envisioned by S. 2191 benefits by the most rapid implementation of clean coal technologies and CCS by reducing pressure to switch fuels to natural gas.

However, Section 3601 only allocates 4% of the allowances to CCS development projects. In our view this is well below the value of CCS development to the goal of cutting CO₂ emissions and well below the amount of interest coal burning utilities and their customers have in expeditiously incorporating CCS into their existing and possibly future coal-generation fleets.

It is also counter-productive that the allowances for CCS decline over time after 2017 (see Section 3603) when in our view they should increase since we do not expect CCS to be available until well beyond the 2020–2025 timeframe. Nor is it good policy to limit the allowances for CCS projects to 10 years (see Section 3604) or limit and prorate the pool of CCS allowances (see Section 3605). In addition, Section 3602(2) seems to limit allowances to geological sequestration, thus excluding other types of sequestration opportunities which can offer similarly favorable and beneficial results. If CCS is so critical to allowing an emission free use of coal, which will provide low cost electricity and mitigate fuel switching, we view allocating more allowances to incentivize that objective to be a far greater national priority than S. 2191 currently does.

I. The Carbon Market Efficiency Board is less desirable than a “Safety Valve” to protect the economy from extreme adverse economic impact

We are aware of the vibrant difference of opinion between advocates of the safety valve limit on the price of an allowance and the advocates of the Carbon Market Efficiency Board approach. Between those two options, OG&E supports the notion of the safety valve as a more effective and efficient means of preventing undesirable economic adversity. The safety valve provides far more predictability and legal certainty to affected parties. The powers of the Carbon Board are inherently restricted—ultimately the Board cannot increase the number of allowances—and any relief it grants in terms of increasing allowances in a year must be effectively “made up” by similar reductions in available allowances in future years. The Board is placed in a very rigid constraint and we simply do not agree that that level of inflexibility is either wise or needed.

J. A Carbon Tax may well be more efficient and effective in the early years of any global climate control regime:

While we cannot sufficiently quantify the compliance options and their costs as we need to do, we are impressed that the cap and trade regime in S. 2191 imposes substantial energy cost, but also significant transactional costs in the early years. The bill appears intended to drive utilities and industrial entities into a frenzy of activity including but not limited to amassing information, recordkeeping, reporting, negotiating for fuels and technologies, finding available and affordable allowances—all requiring lawyers and accountants, reminiscent of the overhead impressed on American business in Sarbanes-Oxley. We have observed that most economists who

have opined on the matter emphasize that imposition of a carbon tax has far greater transactional efficiencies and operational attributes than any cap and trade regime. A carbon tax needs no bureaucracy to monitor and administer it in the way a cap and trade regime does; plus a carbon tax can be readily adjusted up or down to ease economic adversity or provide enhanced incentive to reduce emissions. In addition, a carbon tax permits more confidence and predictability in making the significant investment decisions that utilities like OG&E are going to be faced with.

For all these reasons, it may be more efficient and effective in sending a price signal to change behavior that will produce environmental/climate benefits to impose a carbon tax than a cap and trade regime with its transactional costs and economic dislocations. We would suggest that the Committee evaluate whether it would be more effective and efficient to amend S. 2191 to initially impose a carbon tax and delay implementation of any cap and trade regime to a date when the technologies such as clean coal and CCS are actually politically and commercially available so that coal remains a vibrant contributor to the solution and not a reason to drive natural gas markets out of control.

CONCLUSION

OGE Energy Corp. wants to thank the Committee for allowing us to present our views. We respect the earnest desire of the Committee members to wrestle with the global climate issue in a responsible manner and would hope that the Committee members understand that OGE Energy has a tradition and overriding sense of obligation to do the right thing for our customers.

RESPONSE BY DONALD R. ROWLETT TO AN ADDITIONAL QUESTION FROM SENATOR CARDIN

Question. What guideline should govern the Carbon Market Efficiency Board's intervention in the allowance market to mitigate price volatility?

Response. Assuming Congress adopts the Carbon Market Efficiency Board approach in a global climate regime,¹ it is imperative that the Board have wide discretion to intervene in the allowance market to mitigate undue price volatility. As currently drafted, S. 2191 inadequately arms the Board with tools to limit destructive economic impacts in a timely manner. That said, we view this question as assuming the existing provisions of S. 2191 are enacted and that the question is asking for insights into appropriate guidelines that should govern the Board's intervention in the allowance market in order to mitigate price volatility.

As an initial comment, volatility is not in itself something that the Board should manage with the idea of completely eliminating volatility. Generally, volatility is the reflection of an imbalance in the supply and demand situation for a commodity—including GHG emission allowances—and expecting the Board to over manage the market to eliminate volatility and enforce equilibrium is unrealistic, and potentially is destructive in itself in that it can introduce artificial constraints on the market which only further enhance volatility or produce a wide array of undesirable behaviors and unintended consequences. The Board must be able to analytically segregate volatility that is acceptable from volatility that is not, which means it must develop a valid model of the parameters of making such threshold distinctions.

There are ranges of volatility that, as is the case in all commodities, are controllable through various normal business tools such as hedging on commodity futures markets, and the informed use of derivatives or insurance products. So volatility per se is not necessarily a concern that will always rise to a need for Board action. What is of concern is undue volatility that has destructive impacts that cannot be mitigated by reasonable business practices or are the result of manipulations of the market. Thus, the Board's guidelines must reflect an understanding of what levels of carbon allowance price volatility businesses should reasonably be expected to handle through available financial market risk control mechanisms (such as the use of futures, derivatives etc.) in order to be able to assess when the Board itself has an obligation to step in to take action.

¹ OGE Energy believes that the Carbon Board is not the preferred technique to prevent adverse economic impact from the cap and trade regime in S. 2191. As we testified on November 13, a carbon tax that establishes a pre-determined price for carbon, which can be both adjusted and designed to alleviate the cost impact on low and middle income taxpayers, is a better approach. Even without a carbon tax though, a safety valve price for allowances in a cap and trade regime will provide more predictability in the market for affected entities which is critical to making the investments and establishing compliance strategies needed to achieve the emission reduction goals of S. 2191.

From our perspective as a regulated utility that will likely rely heavily on the purchase of allowances in the market due primarily to our continued use of coal and natural gas based generation, a major concern we see with volatility involves the inability to reasonably predict allowance prices so that investment and compliance decisions can be made reliably. If the price of an allowance proves unpredictable, it will induce risk that, if not reasonably hedged, will definitely deter the kind of economic decision making by utilities and other affected industries that S. 2191 seeks. Another aspect of concern of volatility though involves the spiking of the cost of allowances, especially if such high prices are sustained over a period of time or are caused by manipulation. Note that high prices of allowances can cause tremendous adverse economic impact on us, our customers and everyone in the economy regardless of whether such prices are caused by manipulation or simply by too small a supply of allowances in the market in the face of a given level of demand, or even the combination of general economic factors independent from the cap and trade regime which create the environment in which the cap and trade regime is operating. The fact is the Board needs to have the tools to respond to sustained, high prices as well as to respond to undue volatility in prices since the ruinous impact of each can be the same. We suggest the Board should consider the following as guidelines governing its intervention in the allowance market:

A. The Board should be actively monitoring on a daily basis within each region of the country:

- The amount of fuel switching actually being undertaken by utilities moving from coal-based generation toward natural-gas based generation, and the consequent price supply/demand impact of such fuel-switching on utilities, the industrial and commercial sector, and residential sector.
- The actual (vs. predicted) commercial availability of advanced technologies to coal-based utilities to mitigate switching to natural gas-based generation.
- Unemployment levels and other indicators of regional economic dislocation to workers and employers attributable both to the domestic cap and trade regime and to other factors that materially contribute to the overall economic environment within which the cap and trade regime operates.
- The impact of the global climate regime as a demonstrated reason for U.S. manufacturers to shift operations and/or employment overseas to reduce cost.
- A reduction in U.S. GDP of .25% (one-quarter of a percent) in any fiscal quarter or over two successive fiscal quarters attributable to implications of the global climate regime compared to a reasonable baseline.
- Evidence that the allowance market is being manipulated or that attempts are being made to manipulate the allowance market.

B. The Board should establish as part of its intervention guidelines a set of “volatility ranges” for daily, weekly and monthly allowance trading where any exceeding of the upper level of the respective range will trigger the Board’s immediate analysis and consideration of causative factors, and where the Board concludes responsive action is necessary, an analysis of appropriate actions to mitigate the volatility. The Board should establish this “volatility range” analytical tool in advance and should establish a guideline of being able to respond with appropriate action within 48 hours of a determination that such action is warranted. The objective must be to act expeditiously to mitigate, or perhaps even to prevent, adverse impacts in the economy from volatility.

C. The Board’s intervention guidelines should be premised on establishing a close and ongoing working relationship with the Commodity Futures Trading Commission which has the expertise among federal agencies in monitoring, policing and overseeing commodity futures markets in this country. We expect carbon allowances to trade on futures exchanges and the CFTC already has the regulatory regime to collect trading information on a very timely and useful basis from market participants and to monitor for manipulations of the markets. The Board should not try to replicate that expertise of the CFTC, but rather should use that agency’s expertise efficiently and effectively. Of note, the CFTC has emergency authority to deal expeditiously with excessive speculation in the markets and to take emergency action to prevent serious economic harm and threats implicating systemic risk to the economy. CFTC can also issue cease and desist orders to prevent activity that is in violation of its statutory mandates or to prevent harm to the economy within the ambit of its jurisdictional mission. The CFTC should be viewed as a valuable asset at the disposal of the Board. The Board should enter into a Memorandum of Understanding with the CFTC to cover its cooperative activity and to be able to make referrals to the CFTC for detailed investigation in cases where the Board has evidence of or merely suspects manipulation in the allowance trading market.

D. Speed: The Board cannot analyze the situation to the point where action that is needed to mitigate—or perhaps even prevent—adverse economic impacts is de-

layed. The Board must be in position to assess market conditions and act if necessary within 48 hours, allowing itself time thereafter to take further action that modifies the initial action (i.e. more or additional intervention or reversing the initial action).

E. Bias toward increasing allowances: Where the concern is the spiking of allowances that threatens increased costs and related adverse economic impact, the Board's bias of action should be toward first increasing the availability of allowances in the market, not such alternatives as adjusting the ability to bank allowances or the interest rate on borrowed allowances etc. This broad based action parallels the value that the Federal Reserve's interest rate adjustment activity achieves. Just as the Fed's interest rates affect the whole financial market, adjustment of the number of allowances in the trading market will impact the entire allowance market—not just some identifiable subset of the allowance market. There intentionally will be only one, national allowance market, not a set of regional allowance markets. So broad, national action of the nature of the Fed's interest rate adjustment are what will be needed and should be developed as the primary tool used by the Board.

Senator LIEBERMAN. Thank you, Mr. Rowlett, very helpful testimony.

We are going to do a five minute round of questions for each of the Senators. In Chairman Boxer's absence, I will begin.

Mr. Hawkins, I would like to start with you. The National Resources Defense Council is a member of the U.S. Climate Action Partnership, correct?

Mr. HAWKINS. That is correct.

Senator LIEBERMAN. The Climate Action Partnership was announced earlier this year, was it January?

Mr. HAWKINS. It was early February.

Senator LIEBERMAN. Early February. I think that when we look back, we are going to see that announcement as a tipping point toward actually getting something done on climate change by the U.S. Because it was quite a remarkable coalition of environmental groups, such as your own, and significant representation from American business, particularly industries that are emitters of greenhouse gases, who are essentially saying, okay, we feel a responsibility to be part of a solution. And they set out a series of standards, if you will, for what Climate Action Partnership would find to be an acceptable climate change bill. That is specifically in reduction of emissions by different dates, 2012, 2022, et cetera, there were ranges.

This morning, in your testimony, you have presented your own estimates of what America's Climate Security Act would achieve by the various dates. I must say, I am pleased as I hear them and read them, because your numbers certainly indicate that in the first two periods, which are critically important, 2012 and 2022, this legislation would actually achieve more emissions reductions than the U.S. CAP recommends for those years and that the emissions reductions achieved by our bill in 2027 and 2050 fall within the range recommended by U.S. CAP.

So let me ask you first the bottom line question, can you say that on behalf of NRDC that at least when it comes to emissions reductions this bill passes the test? And if that is the standard that a Senator applies, then one should vote aye on December 5th.

Mr. HAWKINS. Thank you, Senator Lieberman. First, let me correct what I told you about the announcement date. It was the last week of January of this year, the date before the State of the Union, as I recall.

With respect to your question on emission targets, I will speak for NRDC. NRDC is a member of U.S. CAP, but I am not here today representing U.S. CAP. NRDC views the emission pathway in this bill as a very good start on what we need to do. The emission reductions in the early years are strong. It is not possible to say they are stronger than what we need. We have waited far too long to get started.

Toward the end of the period, we think the emission reductions will need to be stronger than they are in the bill, which is one of the reasons that we support the scientific review process to allow that to be adjusted. But from the standpoint of emission reductions, we think this bill merits support and merits an affirmative vote in this Committee.

Senator BOXER. Thanks so much, Mr. Hawkins.

Mr. BAUGH, let me ask you this question. As I heard your testimony, I was interested that you said that some of the things we did as part of the process on the subcommittee to come to a meeting of minds and also to get the four votes to get it out of the subcommittee you felt took it too far in one or another direction. In particular, I was interested in your comment on timeliness and targets and the qualifying criteria for the technology, for some of the technology subsidies.

As you know, there are members of this Committee who would like the bill to move further in that direction before it is reported out of this Committee. Are there any areas in which you believe that further movement of that sort would be particularly unwise from the AFL-CIO point of view?

Mr. BAUGH. We have concerns about the phase-out, but I think moving it even faster creates greater problems. I think it comes from both the investment side of moving to transformational technology—

Senator LIEBERMAN. Just clarify what you mean by the phase-out.

Mr. BAUGH. One of the points that I understand has been made is that there is the phase-out period for the free allocations that go to industry.

Senator LIEBERMAN. Correct.

Mr. BAUGH. I think we need to understand that some would like to have a system that is purely auctioned and no free allocations, which in essence would say to all of manufacturing, you are going to have to go buy allowances and you are going to have to invest in these transformational technologies. I think the idea here is that those allowances are let to businesses, and as the gentleman at the end said, they don't cover the full spectrum. It is a limited pool that declines over time.

But I think it is important to do that, so that these allowances are available for doing business. They are going to have to purchase more allowances and make investments in transformational technologies. And they are rewarded to some degree when in fact they do this and cut their carbon emissions.

So I think this is an extremely important point that this phase-out is a tough thing to stand against. We certainly wouldn't want to see it further tightened. We had concerns about it to begin with. I would share with the Committee, we actually have four studies

coming back in the next month that we worked with the National Commission on Energy Policy to take a look at what is the impact of cap and trade on energy-intensive industries. We looked at four sectors, and we will share that with the Committee as soon as we have it.

Senator LIEBERMAN. We would appreciate that.

My time is up, but I think what you said is significant. This is a balance, so this law would make some very serious demands on businesses, and they would have to spend a lot of money to comply with it, and of course, we are worried about the employment. One of the ways you cut back costs is by cutting back employees. And it was with that in mind that we created the allowances, the so-called free allowances. But we phased them out over time.

I think it is significant that AFL-CIO is saying today through you that any shortening of that phase-out period you think would be unwise.

Mr. BAUGH. We think it is damaging.

Senator LIEBERMAN. Thank you.

Senator Inhofe.

Senator INHOFE. Thank you, Mr. Chairman.

First of all, let me thank Senator Boxer, who was kind enough to extend the opening of this to 11 o'clock to accommodate my schedule, then Northwest was an hour late due to mechanical problems. So I would like to ask that my opening statement be made a part of the record.

Senator LIEBERMAN. Without objection.

Senator INHOFE. Mr. Hawkins, last week when we had Mr. Pershing here from the World Resources Institute, I asked him whether or not his organization would support nuclear power and he equivocated. I would like to ask you the same question, since it is going to be necessary in order to level off and then bring them down, in my opinion. Do you support nuclear power without a caveat, without equivocation?

Mr. HAWKINS. I would like to break the answer into two parts.

Senator INHOFE. I am sorry, for the record, then, why don't you answer in two parts. But right now, do you have a yes or no answer?

Mr. HAWKINS. We don't support diversion of additional subsidies to nuclear power. We have no objection to nuclear power being an active participant in a greenhouse gas protection program.

Senator INHOFE. Mr. Baugh, I have been troubled a little bit, I have talked to a lot of union members from various unions about the loss of jobs. Just a short answer, what is the impact of having requirements apply to plants that employ Americans starting in 2012 if China and India continue to do nothing to address their rapidly increasing carbon footprints? First of all, you are not naive enough to think that they are going to reduce theirs, are you?

Mr. BAUGH. No, Senator, I am not. And that is why we have supported the international language in this legislation. We would like to see the time lines moved up for its implementation.

The second half of that is, we think the investment side of this portfolio, that it is invested domestically in American firms so that we capture the technology, that we make it here, that we deploy it here and have it available for export, is part of the balancing at

of how we address the jobs issue that is contained in this legislation. There is a huge opportunity for the Nation to do that.

Senator INHOFE. Okay, I do appreciate your comment that you don't believe that China and India and the developing nations are going to be doing this.

Mr. Sharkey, if we adopted unilateral mandates, is there anything we can do in legislation to ensure that steel imports incur the same climate control costs as U.S.-manufactured steel products and exports?

Mr. SHARKEY. I would just come back to reiterate our testimony, there are four things that would need to be done at a minimum. One is to make sure that we have simultaneous start dates, not 2012 and then eight years later for foreign manufacturers. Have the same baseline period, make sure that we don't have government-subsidized allowances. And frankly, when you are dealing with China, of the largest 20 steel producers in China, 91 percent are government-owned or government-controlled. The subsidy issue is huge.

Then the fourth thing is obviously we can't have it be discretionary, they would have to be binding.

Senator INHOFE. All right, thank you.

Mr. Rowlett, I appreciate your being here today. I am sorry I was late, but I did hear your testimony. If this bill increases the demand for natural gas used for electric generation, what effect would this have? You talked about it, you gave a percentage of increase. I want to make sure that people paid attention to you. Why don't you repeat that part of your testimony. As I came in, I heard you say something reflecting the increase in the prices on residential natural gas heating bills.

Mr. ROWLETT. We looked at one of the more credible alternatives for us to meet the requirements of the cap and trade program, to be switching from coal generation to natural gas. That would have an impact of increasing a typical customer's bill by 40 percent if we switched all the coal to natural gas. That typical customer would use about 1,100 megawatts, which is a very small family user. It is not a large home.

Senator INHOFE. How would that disproportionately affect the poorer people, as opposed to the middle income people?

Mr. ROWLETT. Because their energy use is a much higher percentage of their costs—

Senator INHOFE. Of their expendable income, yes.

All right. The bill currently contains aggressive initial emissions reductions from targets in 2012 and 2020. Now, wouldn't it be true that if you had a less aggressive reduction requirement in the early years it would give time for technology to catch up a little bit and perhaps be able to make this workable, or more workable than I think it will be?

Mr. ROWLETT. That is one of our concerns, is that in the initial years, there is no commercially available or credible technology that is available to offset these costs, which pushes us more toward the side of fuel switching.

Senator INHOFE. Let me give you the auction question here. Can you elaborate on why being regulated can cause you to face significant problems if you are forced to operate under an auction ap-

proach for allocating emissions allowances, particularly given that State utility regulators need to approve every significant resource decision?

Mr. ROWLETT. Before we choose any kind of resource, we have to go before our State regulators. Any kind of cost we incur, we have to get past the muster of the State regulators. So nothing is automatic. Everything has to go through our State regulatory commissions to determine how cost recovery will occur.

Senator INHOFE. All right. Thank you. My time expired, Mr. Chairman. Thank you very much.

Senator LIEBERMAN. Thank you very much, Senator Inhofe. The collegial courtesy continues unabated here today and threatens to go out of control.

[Laughter.]

Senator LIEBERMAN. Senator Carper is yielding his seniority in the direction of Senator Klobuchar to ask the next round of questions.

Senator KLOBUCHAR. Thank you very much, Senators, for doing that.

I had some questions, first of all, for Dr. Greene regarding the CAFE standards and what you think the effect would be on meeting the goals of the Climate Security Act if the Senate failed to or the Congress failed to pass an increase to the gas mileage standards.

Mr. GREENE. I think increasing the fuel economy standards is the single most important policy for the transportation sector. And I think not just for light duty vehicles, but we should look strongly at whether we want to have fuel economy standards for heavy duty vehicles, as the Japanese do. Fuel economy standards have proven to be very effective at increasing the fuel economy of new cars and as the fleet turns over, increasing the fuel economy of vehicles in the fleet and reducing our energy use and petroleum use by vehicles.

I think that one of the things we have not touched on really today is the importance of that in terms of our oil dependence and in terms of its positive impacts on the world oil market in reducing oil prices. If we can have an impact on world oil prices, reducing the cost of a barrel of oil by \$10, that is equivalent to 25 cents a gallon, just as a \$25 ton of carbon price would be.

Senator KLOBUCHAR. You also talked about how aircraft CO₂ emissions could be reduced by 12 percent through improved aircraft management and by 6 percent through operational improvements that could be made by airlines and airports. Could you elaborate on that?

Mr. GREENE. These are estimates made by the airline organizations, ICAO and others, as to what could be achieved in terms of better flight planning. It requires things like reducing air traffic congestion, which we would all love to do for other reasons and greenhouse gas emissions as well. So there are a variety of steps in terms of the way flights are planned, flown and managed once they are in the air that can reduce the circuitry of the travel and reduce the fuel burn rates of the aircraft while they are in travel.

Senator KLOBUCHAR. Then I have some questions just to follow up on what Mr. Baugh was saying. I guess I would start with you,

Mr. Hawkins, about the effect that this could have, which of course we are all concerned about, on the economy and workers. We want to make sure that we have done this in a way that doesn't hurt our economy and some of the predictions that have been made, that I don't agree with. But I would like to know what Europe, having done cap and trade, what effect the cap and trade they have in place has had on their economy. And I would ask the same thing of you. I will start with Mr. Hawkins.

Mr. HAWKINS. First, I would say that the European trading system is very much an initial trial run. It has had some bumpy spots with respect to price fluctuations. The Europeans recognized that. Fortunately, we recognize it, too, and the authors of this bill recognize it and have lots of provisions to prevent those kinds of things from happening.

But we have not seen harm to the European economy as a result of this initial run. We think that given the provisions in S. 2191, we will not see harm to the U.S. economy. To the contrary, we will see economic opportunity created by the technologies that are stimulated under this bill. That will create jobs, it will not threaten jobs.

Senator KLOBUCHAR. Mr. Baugh.

Mr. BAUGH. We have seen, the European system has created a lot of carbon billionaires. They made some big mistakes in the way they structured their system to begin with.

Senator KLOBUCHAR. Correct.

Mr. BAUGH. It is having an impact. We are going to be participating in the Bali meetings with trade unions from around the world, and we will be discussing this.

But I think that we do have concerns about the impact on jobs in this Country. We have a particular sensitivity toward energy-intensive industries. We need to look hard at how the cap and trade works. That's why we help commission these studies. And we want to share them with the Committee. We have to look hard about how that impacts those industries.

Secondarily is the investment side of the portfolio and how is that used to generate the jobs in this Country. You should be assured in the State of Minnesota that if Minnesota is going to make the choice and invest in renewable technologies that they are made here, they are made in your State, they are made in the region, they are made in the Country and we capture that ability. That is why I keep coming back to our point in the legislation. Make it a provision of legislation. These are domestic investments. We are trying to generate new industry and economic opportunity for our people as we make a transition.

Senator KLOBUCHAR. Then just one last question. Mr. Sharkey, I share Senator Lieberman's views of the good work that you have done. Coming from an iron ore State, I appreciate what you have been doing. You talked about that the steel industry is developing new types of steel products that can lead the way to reducing greenhouse gas emissions. Can you talk a little bit about that and elaborate on that, what the products are, what the time line is?

Mr. SHARKEY. They are both products and processes. In terms of products, I think the critical one I would cite would be the new generation of advanced high strength steels, which is the fastest-

growing automotive material. We are working very closely with our car company partners to get this in the next generation of vehicles, because it really helps them meet their fuel efficiency goals, basically affordability goals, and also their safety goals.

In terms of processes, the projects that we have underway are not only here in North America, but they are underway globally. We call them CO₂ breakthrough projects. Basically, these are longer term research projects, I don't want to hold out the prospect that we are going to have the results of these in the next 3 to 5 years. These are 15 to 20-year time lines. But basically, these would be processes that would fundamentally look to eliminate CO₂ from the production process. That is the challenge we have made for ourselves.

I think we can get there. But again, it is going to take capital to get there. And I would only stress that probably the single most important thing in terms of deploying these new technologies, we need a steel sector that has strong financial performance, that generates the capital to put into the new technology.

Senator KLOBUCHAR. Thank you.

Senator LIEBERMAN. Thanks very much, Senator Klobuchar.

Senator Voinovich, you are next.

Senator VOINOVICH. Thank you.

Mr. Sharkey, I have been in this business a long time. I remember the voluntary restraint agreements that we tried to get through to protect our steel industry. Then when I came to the Senate, the 201 investigation so we could protect our steel industry, I think back to my days as a State legislator, when we pushed the steel industry to clean up the air and water. I woke up one day and found out that the rest of the steel industry around the world was modernizing and we needed the money to modernize. Finally we got Japanese investment in here so we could modernize.

So I am really concerned about the steel jobs that we have here in this Country and I am sure that Mr. Baugh is concerned about the same thing. I am concerned about the issue of fuel switching. I believe in my State of Ohio, our recession started in 2001 when gas prices spiked and we saw a dramatic impact on manufacturing jobs in our State and around the Country. If you believe fuel switching is going to occur, and Anne Smith testified that she thought as much as 65 percent higher by 2015, 125 percent by 2050, that was a witness we had last week, would there be any domestic industry remaining, and what would it mean to American consumers?

Mr. SHARKEY OR MR. Baugh. The point is that there is a substantial testimony and evidence that some very smart people believe that as a result of this legislation, we are going to genuinely have fuel switching in this Country. The question is, if that does occur, what is going to happen to our jobs and to our steel industry?

Mr. SHARKEY. Just very briefly, energy represents 20 percent of our production costs. So you think about that, you understand the magnitude of how important it is. Anything that raises our cost of energy makes us less competitive. Fundamentally, what will happen is that companies will make decisions about where their investment goes based on their competitiveness. We are already basi-

cally seeing that in the EU. I think it is very unlikely you will see a new steel plant in the EU. They are going to put them in Brazil, they are going to put them everywhere because of the burden that we see in the EU right now.

So it is a very important issue for the steel industry. We think that fundamentally, wholesale fuel switching to get more gas-fired, natural gas power plants is a big problem for the industry. This legislation unfortunately doesn't address that.

Senator VOINOVICH. Mr. Baugh, do you think that the Carbon Market Efficiency Board can readily operate as a safety valve or cost control mechanism to protect the U.S. economy in the event of shocks to that economy created by the system that we would be putting in place with this legislation?

Mr. BAUGH. Senator, as currently structured, I do not believe so. My testimony was directed toward that. It is a system that has weak tools. It takes too long to implement them when there are prolonged price hikes, 180 days. It has an open market system. Anybody can compete.

Let me give you an example of the volatility. The State of Illinois is actually doing carbon market trading. I just talked to the Electrical Workers from there two weeks ago at an energy conference. The number one bidder for allowances was a utility, the number two bidder was a utility. The number three bidder was Goldman Sachs.

If you want speculative behavior, speculation, if you want predatory behavior, we are going to create it. I think that is why we would argue for a much more restricted market system that would operate to avoid hoarding, to avoid predatory action and to say that you can bank allowances, but in perpetuity, that again can lead to other forms of bad behavior. I think we have questions about the effectiveness of that.

Senator VOINOVICH. Thank you.

Senator LIEBERMAN. Thank you. It is my pleasure now to call on the Chairwoman herself, Senator Barbara Boxer.

Senator BOXER. Thanks so much. I am sorry I had to run out for a couple of minutes.

The gloom and doom presented to try and stop this bill for members is simply belied by the facts. Mr. Hawkins pointed out he didn't see any harm. But I want to tell you about a meeting I had with David Miliband, Britain's Foreign Secretary. He is the former Environment Minister. He told us that since 1990, Great Britain has reduced its greenhouse gas emissions by 15 percent and its economy has grown by over 40 percent. So people can lob grenades on this point and try to scare folks, but it is just not true.

All you have to do is look at my State, which is now starting down the path, it is the most exciting place in America to be. I would urge my colleagues who are so nervous about this, I don't blame you, change is hard, we all know that. But if we do nothing, it is very dangerous. Come to my State, just see what is happening in the venture capital community. There is a coming together of folks from the business community, there is a coming together with the environment community, with Republicans, with Democrats, with Independents, with students, everybody focused on this.

The investments, I say to my friends Senator Lieberman and Senator Warner, who I know is listening to every word, the excitement because of your work and the signal it sends, the optimistic signal it sends. So I would argue every step of the way, those who are predicting gloom and doom. You sound just like the folks who predicted gloom and doom when we passed the Clean Air Act, the Safe Drinking Water Act, all the landmark laws. I am going to go back and actually get some of the nay-sayers' comments. And you will find you fight right, oh, we are rushing this, we haven't really looked at this. The fact is, when you do the right thing for the American people, by stepping up to the plate and addressing a threat like this, it has its rewards. And not to do it is, in my view, very, very dangerous.

Now, I wanted to ask Mr. Rowlett about his support of the carbon tax instead of the cap and trade. Is that correct? Is that what your position is?

MR. ROWLETT. We have asked the Committee to consider a carbon tax in lieu of a cap and trade program, particularly during the transition period. It gives a better opportunity for the technologies to develop that would be necessary to operate under the cap and trade.

Senator BOXER. Well, I think a carbon tax is what would hit lower income people the hardest. Right now, the way the Lieberman-Warner bill is written, it provides that low-income consumers will receive assistance from auction revenue in order to offset the costs. So I would posit that a carbon tax is the worst thing you can do. First of all, it is dead on arrival. I don't know too many colleagues that want new taxes. And secondly, I think it would be much more harmful to low-income people than what we have here.

And then I would say, Mr. Sharkey, I understand your concerns about foreign competition for the steel industry. You look at my record, I have stood there and said, I want to do what is right for the American economy and I am sure you would see that in my voting record.

Now, this bill addresses international competition by providing special allowances and resources to U.S. energy-intensive industries like steel. Are you recommending we delete these provisions?

MR. SHARKEY. We are simply indicating that we don't think they go far enough. We recognize the effort to address this particular problem, but we think the language that is currently in the bill is flawed and will not provide the necessary protection from competitors bringing product into this particular marketplace that is produced with a lower environmental standard.

Senator BOXER. And so you have looked at the language that the Senators have really taken from the Jeff Bingaman approach?

MR. SHARKEY. Yes.

Senator BOXER. And you don't think it goes far enough?

MR. SHARKEY. That is correct, ma'am.

Senator BOXER. Well, let me say, this last summer, I went to meet with people who run the markets, the new carbon markets. I met with a lot of industry people. One of the amazing giants of industry there who is involved with steel and concrete and all this, they are really embracing this. They had concern at first. But they are embracing this. Because you know, if you look ahead, again,

the cost of doing nothing. Now, I know industry in America and I used to be a stockbroker, so I watched very carefully what industry does to make sure profits are up and the rest.

One of the major criticisms we have always seen is that there is not enough long-term thinking. I would just suggest to you that there is this train coming down the road called unfettered global warming. If we don't step up to the plate and address it, and I think what our colleagues have done here is to really take an approach that considers everyone. I think, when you hear some of the criticism of the bill, some say, give too much to steel, give too much to coal. Others say, don't give enough to steel, don't give enough to coal. Something, you have hit that balance, it seems to me, when you get that.

From my view, I would do 100 percent auction first thing out of the box. And I will support those amendments when they come on the Floor of the Senate. Everyone knows where I am at on this. But to do nothing, again to make the perfect the enemy of the good I think is a big mistake. I would just urge you to stay at the table with us. I would hate to see you away from the table, because this is going to happen eventually, because it has to happen.

And I want to thank you, Senator Lieberman. That would be all I have to say.

Senator LIEBERMAN. Thank you very much for what you did say. Senator Barrasso.

Senator BARRASSO. Thank you, Mr. Chairman.

Mr. Baugh, in your testimony on page 6, you said you were concerned about an amendment that I did in conjunction with Senator Baucus. It is an amendment that defined the terms low-rank coal in the bill. In your testimony you state you believe the amendment would undermine the technology transition that this legislation is attempting to achieve.

In expressing concerns about my amendment, you stated in your amendment that there should be no distinction among coal types, such as higher rank or lower rank. I just wanted to know if you realize that in the underlying bill, it already made that distinction among coal types by setting aside allowances and that the amendment merely put a definition on what was called low-rank coal?

Mr. BAUGH. I would have to go back and look. I was responding to our colleagues from the United Mine Workers and others who raised that issue with us. They believed that it created a preference for western coal. We just said we didn't believe there should be preferences.

Senator BARRASSO. Well, there has been a lot of praise for the Lieberman-Warner bill. Are you saying that the Lieberman-Warner bill was not correct initially in ensuring utilization of lower-ranked coal by promoting a small fraction of assistance to projects that used that coal? Because that is in the original bill.

Mr. BAUGH. Senator, I will have to go back and look. Honestly, I can't answer that question because I don't know for sure.

May I clarify something, though? The bigger issue that was in there that I was implying that the transformation need for investments is in particular directed at the auto provision that was put into the bill that said you can't invest in anything other than an automobile that goes more than 35 miles per gallon. Frankly, when

you talk about making research and development investments, whether it is hydrogen or hybrids or other things, you are investing in raising the energy efficiency of the fleet.

You can't sort these things out this way. That is not how the industry works. We just think that that was a mistake, that it really should go back to the original language. We really do want to raise the level of the entire fleet. To do that, we have to make investments into these transformational technologies.

Senator BARRASSO. Mr. Hawkins, the target date on the bill is 2050. How much cooler do you think the planet will be if we pass this legislation but yet China and India don't follow suit with a similar cap and trade approach?

Mr. HAWKINS. Senator, if the United States passes this legislation, I am confident that China and India and other countries will engage much faster. And the contrary position, if the United States hesitates and does not pass legislation like this, we can be assured that China and India will not engage, and we will indeed be in a heap of trouble.

Senator BARRASSO. That sounds rather speculative. It is just a confidence you have in India and China's commitment to make that change in spite of what impact it may have on their own economies?

Mr. HAWKINS. It is a confidence that I have in the respect that the United States has in the world community and countries pay attention to what the United States does and they pay attention to what the United States does not do. For the last 10 years, I have been going to China a couple of times a year and meeting with business leaders and political leaders as well. Every time we bring up advanced technology and ask the Chinese what they are doing about it, the first question they ask is, what is the United States doing about it.

So the more that we can say that the United States is doing the more opportunities we have to engage them. This is not speculation. This is a method that works. We cleaned up cars in the 1970s. The Chinese then acted to clean up their cars. We took lead out of gasoline in the 1970s and 1980s. The Chinese have taken lead out of gasoline. They are now putting scrubbers on power plants, after we put scrubbers on power plants.

Senator BARRASSO. Mr. Hawkins, I have limited time to ask questions.

So the answer is, you don't know if the planet will be cooler or not cooler if we do all this and China and India do not follow suit, which was the initial question?

Mr. HAWKINS. I am confident that if we take this action, the planet will be much cooler and the climate will be protected to a degree that we cannot count on if we fail to act.

Senator BARRASSO. Could you talk a little bit about jobs? I am very concerned about the Wyoming economy. How many jobs do you predict would be lost in our State if this does take place? Because you had talked about jobs increasing rather than decreasing.

Mr. HAWKINS. Yes. We think, jobs are created when goods and services that people value are created. The world is going to value clean energy solutions. Renewable energies from your State are going to enjoy a thriving business. With coal technologies that cap-

ture carbon, which are going to be incented by this bill, again you will have a market for technologies. There will be industries as companies like Rio Tinto have observed. They will get paid for taking carbon out of the ground and they will get paid for putting carbon back into the ground. This is a job creation program.

Senator BARRASSO. And of course, that company has just announced it is going to sell all its North American assets.

Thank you, Mr. Chairman.

Senator LIEBERMAN. But before they did, they announced that they were going to be members of the U.S. Climate Action Partnership.

[Laughter.]

Senator LIEBERMAN. Senator Carper.

Senator CARPER. Thanks, Mr. Chairman. Again, to our witnesses, thanks so much for your testimony and your responses here today.

I have a couple of questions for Mr. Sharkey and one for Mr. Hawkins. Let me just start with Mr. Sharkey. In an earlier version of your testimony, you talked a little bit about the very fine job that the industry you represent has done with respect to recycling. We applaud you for that and want to make sure that it continues. You mentioned in your testimony, your earlier testimony, you said, I understand that Senator Carper may offer a recycling amendment to the bill. That is correct. Then you go on to say the use of recycling materials as raw materials, feedstock, in the manufacturing process can significantly reduce and even avoid in some cases greenhouse gas emissions. I would say amen.

In crafting an amendment that we are probably going to offer on recycling, and my colleagues that I will be asking to support, give us some idea what you think might be constructive.

Mr. SHARKEY. We will need to take that under advisement and we will be back to you very shortly.

Senator CARPER. If you could respond for the record, I would appreciate that.

A second one, if you would, I think in your testimony you discussed the reductions in CO₂ emissions per ton of steel that your industry has achieved I think since 1990. In your opinions, are there some policies that we could include in this legislation that are discussing today that would reward the progress that your industry has already achieved?

Mr. SHARKEY. Obviously we would pay very close attention to credit for early action and whatever timeframe might be set for that. I think that would be an important issue.

I think support for new technology deployment is very important. We currently have a public-private partnership with the Department of Energy, working on many of these technologies. But frankly, the United States is way behind what is occurring in Japan, Korea, the EU, where there are very aggressive support programs to develop this new technology.

Senator CARPER. All right, thank you.

And one for Mr. Hawkins, if I could. Mr. Sharkey expressed earlier some concerns over I think the allowance obligations that the industrial sector will face in, I believe it is 2012. I would just ask, and this may not be a fair question, but I will ask it anyway, and if you can answer it, fine. If not, just come back to me on the

record. But what will those obligations be? And what are the 2005 industrial emissions compared to the amount of allowances that will be given for free? Just think about that. What allowances are going to be given for free and what actually do they emit for CO₂ in 2005?

Mr. HAWKINS. The bill provides that 20 percent of the total allowance pool is available for free initially to the industrial sector. Another 20 percent is available to the electric power production sector. I can get you the figures on what the industrial emissions were in 2005. I don't have those figures broken out separately for the industrial and the power production sector. The total covered emissions in 2005 for all covered sources are on the order of 6 billion tons of carbon dioxide per year.

Senator CARPER. Somehow, I am thinking in the back of my mind that the allowances may actually be greater, the ones that are for free, might actually be greater than the level of emissions in 2005. I don't know if it is just with respect to one sector of the industrial economy or more. But if that is the case, that is an interesting point. We will get to the bottom of that, if you can answer for the record, I would appreciate it.

Mr. HAWKINS. I would be happy to do that. If they aren't greater, they are certainly a very high fraction of their total obligation. And when combined with offset provisions and others, we think that the argument that the industrial sector will have difficulty in meeting these targets is not well-founded.

Senator CARPER. Does anybody else have a thought on this point before we move on? No?

Okay, Mr. Chairman, thanks so much.

Senator LIEBERMAN. Senator Carper, thank you very much.

Senator Alexander.

Senator ALEXANDER. Thank you, Mr. Chairman.

Dr. Greene, I want to make sure I understood your comments correctly. The Senate in its Energy Bill passed higher CAFE standards, 35 miles per hour average, by 2020. Did I understand you to say that would be the single most important policy that the Congress could take in the transportation sector for reducing our dependence on oil?

Mr. GREENE. That and reducing greenhouse gas emissions.

Senator ALEXANDER. So in both cases, that would be the single most important policy within the transportation sector?

Mr. GREENE. In my opinion, yes.

Senator ALEXANDER. In order to reduce greenhouse gases and reduce our dependence on oil. You also mentioned some figures, and I was trying to follow them. Did you say that the change in a \$10 price in the barrel of oil was equal to about 25 cents in a gallon of gas?

Mr. GREENE. Yes.

Senator ALEXANDER. So if the price of oil went from \$90 to \$100 in the last couple of weeks, that basically will eventually raise the price at the pump a quarter? Is that right?

Mr. GREENE. Yes.

Senator ALEXANDER. What did you say, you said something about \$25 a ton. Does the cost of \$25 a ton of carbon cost about a quarter on a gallon of gas, or did I misunderstand you there?

Mr. GREENE. No, that is correct.

Senator ALEXANDER. I would like to ask you about the idea of a low-carbon fuel standard. How would you define what we mean by a low-carbon fuel standard?

Mr. GREENE. Well, one sets a limit for the quantity of carbon that can be emitted from burning, say, all of transportation fuels in the United States.

Senator ALEXANDER. So you would basically say to the oil companies or to the seller of gasoline that in the blend that you mix you have to have a steadily decreasing amount of carbon?

Mr. GREENE. Probably to the refiners, yes.

Senator ALEXANDER. You would say it to the refiners?

Mr. GREENE. Probably. You could do it in different ways.

Senator ALEXANDER. But probably to the refiners.

Mr. GREENE. Yes.

Senator ALEXANDER. Now, compared to a so-called upstream tax on the economy, which includes fuel, it seems to me that the possibility that we put an upstream tax on fuel, economy-wide tax that also includes fuel, that we might raise the cost, that the companies or refiners might just simply pass that tax along to the customer at the pump, and it wouldn't have the effect of changing behavior, while a low-carbon fuel standard should have the effect of actually reducing the amount of carbon in the air. Is that a valid comment?

Mr. GREENE. I don't know of a study that looks at the effect of the carbon tax on eventual carbon content of fuels. So how sensitive is the transportation fuel industry to a tax on carbon I don't think we really understand yet. But clearly, the low-carbon fuel standard sets a performance standard. I think the reason California has gone ahead with a low-carbon fuel standard is their belief that it is a method of pulling technology along.

Senator ALEXANDER. If I may ask, I have one other question I want to ask Mr. Rowlett, if you had an effective low-carbon fuel standard, a steadily-decreasing requirement in the transportation sector for fuels, why would you also need a so-called upstream tax on fuels? Why wouldn't the low-carbon fuel standard, properly administered, be sufficient?

Mr. GREENE. I think this is the same question as, should there be a tax on carbon or should there be a carbon cap and trade system, on the sense that the low-carbon fuel standard essentially sets a performance goal and says, this is how much carbon you can emit and what that costs remains to be seen.

Then the carbon cap and trade system in this case would put a price on the carbon and how much reduction in carbon that price would achieve remains to be seen.

Senator ALEXANDER. Thank you, Dr. Greene.

Mr. Rowlett, I understood you to say that while you are quadrupling your investment in wind that it is not an alternative to your baseload requirements.

Mr. ROWLETT. Exactly.

Senator ALEXANDER. Do you then use it as a reliable alternative during peak periods?

Mr. ROWLETT. It is not dependable at all during peak periods.

Senator ALEXANDER. Well, if you don't use it for baseload or peak periods, why are you investing in it?

Mr. ROWLETT. We are investing in it to lower our carbon footprint.

Senator ALEXANDER. So you mean you can't use it, but regulations are requiring you to build wind turbines?

Mr. ROWLETT. We can use it when the wind is available. And it offsets—

Senator ALEXANDER. But it is not a baseload and it is not peaking?

Mr. ROWLETT. Absolutely.

Senator ALEXANDER. What other use do you have for electricity, if it's not baseload or peaking?

Mr. ROWLETT. Well, to provide for needs when it is not baseload and it is not peaking.

Senator ALEXANDER. When would that be?

Mr. ROWLETT. It is whenever the wind is available. When the wind is blowing and it is generating electricity, it offsets coal or—

Senator ALEXANDER. But your testimony is you don't use it in your utility for baseload and you can't use it for peaking?

Mr. ROWLETT. Right.

Senator ALEXANDER. But you do it because you are required to lower your carbon footprint?

Mr. ROWLETT. Well, in our case we don't have an RPS standard. We are doing it, we are trying to take some proactive actions to reduce our carbon footprint without it ever being a mandate. That is sort of the bargain that we have reached with our local and State legislators.

Senator ALEXANDER. Thank you very much, Mr. Chairman.

Senator LIEBERMAN. Thank you, Senator Alexander.

And now for the climax of the hearing, Senator Whitehouse. You don't have to mention Long Island Sound.

Senator WHITEHOUSE. Can I mention Narragansett Bay?

Senator LIEBERMAN. Yes, you can.

[Laughter.]

Senator WHITEHOUSE. Mr. Baugh, I wanted to follow up with you because your testimony addresses most directly the concern about integrity of the allowance marketplace. First of all, you have the concern about offsets and about monitoring their legitimacy, particularly when it gets to overseas, potentially duplicative credits. Beyond that concern, do you have any recommendations on what we should set up institutionally to protect against that concern? How would you see us evaluating the legitimacy of offsets and claims and protect against the counterfeit carbon savings problem?

Mr. BAUGH. In all honesty, Senator, we haven't thought this through, to give you a straight-up answer on that. We think it needs to be done. We recognize it is a problem. We are more than willing to sit down with everyone and work through this, so that the legitimacy of the overseas issues are addressed and taken care of. We think the 33 percent total ability to offset from domestic and international is a lot. And we worry that, is that a disincentive to manufacturers and those to make the transitional investments we need to have made in the domestic economy.

The other piece of that is this issue of the offsets that are here domestically, there have been some things that were put into the

bill to address this. But I am concerned about paying for behavior that is going to happen anyway. We don't want to do that.

Senator WHITEHOUSE. Well, I look forward to working with you as well. I feel about it the same way you do, we have a big problem, and I am looking around for people who have thought ahead through the switches a couple of steps. I am not finding much there.

The other is the question of how you regulate the allowance trading itself. We have seen in American history numerous examples of markets gone bad, silver markets, stock market scams, all sorts of things. Here there is going to be an awful lot of money flowing. In my view, the regulation of it is very minimal.

You have proposed restrictions on the timing, of how long allowances can be held, and the access, who can trade in those.

Mr. BAUGH. I think very simply, I think this can act as sort of a natural regulatory mechanism, in a sense, that if the access to the market is limited to the people who have to use allowances to begin with, and remember, it is a declining pool, it is a diminishing pool to begin with, they have to buy them anyway, but limit it to the people who actually have to use them. Goldman Sachs should not be buying allowances. That leads to all kinds of bad outcomes for people. Artificially high prices, which people are worried about on this Committee, and the banking issue I think is problematic from that point of view. There may be legitimate reasons to allow certain forms of banking. But again, when does banking become hoarding and lead to behavior you really don't want to use?

I think the idea of the carbon market board and the trading system is, people have to buy these because they have to use them. It should be done in such a way that it is also encouraging the investment of their resources into the transitional technology at the same time. That is why we oppose this idea of just this wide open market system. We think it is very problematic and will have huge price outcomes, bad ones, for the American public and American industry.

Senator WHITEHOUSE. Do you think someone needs to oversee the board?

Mr. BAUGH. Oh, absolutely. I know the suggestion is that it is like a Federal reserve. That may be. I think Congress has a role here.

Senator WHITEHOUSE. Maybe more like the stock market, which has a pretty active SEC requirement.

Mr. BAUGH. Well, I don't know if we need to go the SEC and our criticisms of that. But it is a problem, that is like the foxes guarding the henhouse there. I don't think we want that, either.

Senator WHITEHOUSE. You do think there needs to be some entity of some kind?

Mr. BAUGH. I think there needs to be some entity of some kind. Senator, we share your concerns that you raised in your opening statement.

Senator WHITEHOUSE. Are you convinced that the governance of this board is adequate?

Mr. BAUGH. I think it is a start. I think it should be broadly based. We think labor should be represented on it. We said as much in our earlier testimony.

Senator WHITEHOUSE. And I wonder about the accountability of it and the openness of it, the transparency of it, just in terms of things like open meetings requirements, open records requirements, Administrative Procedures Act requirements.

Mr. BAUGH. As a public body, that should be a given. I think this issue of transparency, that the public sees, that industry sees the people that are participating, everybody understands what is happening here.

My last comment would be, people don't want to talk about taxes, but in fact, the cap and trade program is in effect a tax.

Senator WHITEHOUSE. It sure is.

Mr. BAUGH. It will raise revenue just like you could raise tax revenue. You can choose to use some of that revenue to offset the impacts on the low-income people, just like the cap and trade proposal does. Nobody is fooling each other: this will raise the cost of energy. The question is, how do we do it in a way that does not have negative impacts on our industrial base of this Country, that is done in such a way that the consumers don't get hit very hard about this, and that we make this transition, and that the investments that we are going to put out there should be made.

There are allowances allowed for the line agencies, right, for the transmission agencies. Well, make it clear on the record that if they are going to get allowances, they don't generate or produce carbon. If they are going to do that, then they have to make that, take that money, that resources and invest in high-efficiency energy with technologies that are there. It can make a big step toward some of the energy efficiency needs we have.

I guess I am saying, there are a number of ways we need to be more direct in the legislation to look out for the interests of the Nation, to assure that these jobs are created here, that we keep the jobs we have, and that we get the rest of the world to play.

Senator WHITEHOUSE. Thank you very much.

My time has expired. I thank the Chair.

Senator LIEBERMAN. Thanks, Senator Whitehouse. Those were very interesting questions and answers. I will just say real briefly that Senator Warner and I, Senator Warner was particularly focused, in the construction of the bill, on maintaining the integrity of the systems. I will say to you that the Carbon Market Efficiency Board, as we have conceived it thus far in the bill, plays a role much more akin to the Federal Reserve Board than to the SEC. It could be that, well, you probably know, check me, on the acid rain system, they are subject to regulation by the CFTC, or the SEC?

Mr. HAWKINS. Actually, the acid rain, sulfur dioxide trading program has many of the features that concern Senator Whitehouse but don't have the problems that he is worried about. There is free and open trading. There is unlimited banking. Anyone can hold allowances. We have not seen the problems develop that Mr. Baugh and Senator Whitehouse have indicated.

Senator LIEBERMAN. But remind me, is that trading system subject to oversight by the Commodities Futures Trading Corporation?

Mr. HAWKINS. Individual trading firms like the Chicago Board of Trade are subject to the standard, whatever they are subject to with respect to any other commodities. But the acid rain permit system itself is operated by EPA. EPA issues the permits, the cer-

tificates. They are traded. They have to be turned into EPA every year. And as I say, the problem with hoarding, the problem of stock speculation, simply hasn't occurred.

Senator LIEBERMAN. This is something we want to continue to work on, because it may be that we want to give some enumerated oversight to some existing regulatory entity like the SEC or CFTC. But as you said, these markets presumably will occur on one of the existing exchanges. And those exchanges are subject to review by existing regulatory groups.

But this is an open question. I would love to continue working on it with you.

The second is that you are right, that this business of the allowances and the auctions, the auctions are going to raise a very significant amount of money. To me, that says two things. One, we want to make sure that to the best of our ability, we create a system in which the Climate Change Credit Corporation, which will collect and distribute this considerable amount of money, sets up systems to make sure that, to the best of anybody's ability, that it is spent well. Our intention here is to both reduce some of the price impacts of our system, but also, and this is most significant, to reinvest the money collected as a result of the auctions in technologies that will drive exactly what happened in the iron and steel sector of our economy, hopefully creating more jobs, certainly protecting jobs.

I will tell you that we have phrased the allocation of the auction proceeds in terms of percentages. But there are groups outside who have now tried to convert that, in a reasonable basis, to actual dollars. It is an enormous amount of money. And I want to say in a positive sense, if we do everything we can to guarantee the integrity of it, and it is intended to achieve public purpose, in fashioning a system to deal with the global challenge of global warming, we have within our grasp the opportunity to create what a lot of people have been saying we needed to do for a long time, whatever your metaphor is, whether it is a Manhattan Project or a moon shoot, to make America energy independent. And incidentally, to also help to clean up other forms of air pollution that affect people's health.

So there is a real opportunity here, and as others have said, a lot of money will be on the table. But we have to be, Senator Warner and I want to make very sure that we do everything we can to not only ensure the integrity of the system when that money is on the table, but that it is used as a kind of vast venture capital pool to really unleash the most aggressive entrepreneurial, innovative talents that history shows us are there in the American economy.

You have given us a lot of time and I thank the witnesses. This has been a very interesting hearing, as the last one was. I think in both the question and the comments of the members of the Committee and the exchanges with the witnesses, we are going to a level of practical detail about the bill, which is very encouraging. It is not that everybody agrees, and not that everybody says yes, I support the bill. But I don't hear anybody much any more saying this is not a problem. I think everybody is pretty much saying we have a problem here, now what is the most sensible, effective way

to solve it. These hearings and your testimony today has really helped us to do that.

So I appreciate it very much. The hearing record will stay open for an additional week for statements that other Committee members may want to ask the witnesses, or if you or others want to file additional statements for the record.

With that, I thank you again and adjourn the hearing.

[Whereupon, at 1:30 p.m., the committee was adjourned.]

[Additional statements submitted for the record follow.]

United States Government Accountability Office

GAO

Report to the Committee on Homeland
Security and Governmental Affairs,
U.S. Senate

March 2007

CLIMATE CHANGE

Financial Risks to Federal and Private Insurers in Coming Decades Are Potentially Significant



GAO-07-285

March 2007

CLIMATE CHANGE

Financial Risks to Federal and Private Insurers in Coming Decades Are Potentially Significant



Highlights of GAO-07-285, a report to the Committee on Homeland Security and Governmental Affairs, U.S. Senate

Why GAO Did This Study

Weather-related events have cost the nation billions of dollars in damages over the past decade. Many of these losses are borne by private insurers and by two federal insurance programs—the National Flood Insurance Program (NFIP), which insures properties against flooding, and the Federal Crop Insurance Corporation (FCIC), which insures crops against drought or other weather disasters.

GAO was asked to (1) describe how climate change may affect future weather-related losses, (2) determine past insured weather-related losses, and (3) determine what major private insurers and federal insurers are doing to prepare for potential increases in such losses. In response, among other things, GAO reviewed key scientific assessments; analyzed insured loss data; and contacted private insurers, NFIP, and FCIC.

What GAO Recommends

GAO is recommending that the Secretaries of Agriculture and Homeland Security analyze the potential long-term fiscal implications of climate change for the FCIC and the NFIP, respectively, and report their findings to the Congress. In commenting on a draft of this report, the two agencies agreed with the recommendation. The Departments of Agriculture and Commerce made comments and suggestions on the presentation of several findings. The Department of Energy elected not to comment.

www.gao.gov/cgi-bin/getpl?GAO-07-285.

To view the full product, including the scope and methodology, click on the link above. For more information, contact John Stephenson at (202) 512-3841 or stephensonj@gao.gov.

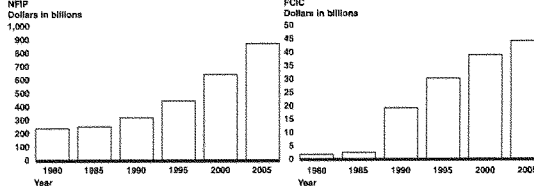
What GAO Found

Key scientific assessments report that the effects of climate change on weather-related events and, subsequently, insured and uninsured losses, could be significant. The global average surface temperature has increased by 0.74 degrees Celsius over the past 100 years and climate models predict additional, perhaps accelerating, increases in temperature. The key assessments GAO reviewed generally found that rising temperatures are expected to increase the frequency and severity of damaging weather-related events, such as flooding or drought, although the timing and magnitude are as yet undetermined. Additional research on the effect of increasing temperatures on weather events is expected in the near future, including a highly anticipated assessment of the state of climate science this year.

Taken together, private and federal insurers paid more than \$320 billion in claims on weather-related losses from 1980 to 2005. Claims varied significantly from year to year—largely due to the effects of catastrophic weather events such as hurricanes and droughts—but have generally increased during this period. The growth in population in hazard-prone areas and resulting real estate development have generally increased liabilities for insurers, and have helped to explain the increase in losses. Due to these and other factors, federal insurers' exposure has grown substantially. Since 1980, NFIP's exposure quadrupled, nearing \$1 trillion in 2005, and program expansion increased FCIC's exposure 26-fold to \$44 billion.

Major private and federal insurers are both exposed to the effects of climate change over coming decades, but are responding differently. Many large private insurers are incorporating climate change into their annual risk management practices, and some are addressing it strategically by assessing its potential long-term industry-wide impacts. The two major federal insurance programs, however, have done little to develop comparable information. GAO acknowledges that the federal insurance programs are not profit-oriented, like private insurers. Nonetheless, a strategic analysis of the potential implications of climate change for the major federal insurance programs would help the Congress manage an emerging high-risk area with significant implications for the nation's growing fiscal imbalance.

Growth in Exposure of Federal Insurance Programs (\$2005)



Source: GAO.

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Abbreviations

AAA	American Academy of Actuaries
AMO	Atlantic Multidecadal Oscillation
CCSP	Climate Change Science Program
FAIR	Fair Access to Insurance Requirements
FEMA	Federal Emergency Management Agency
FCIC	Federal Crop Insurance Corporation
HUD	Department of Housing and Urban Development
IPCC	Intergovernmental Panel on Climate Change
NAIC	National Association of Insurance Commissioners
NAS	National Academy of Sciences
NFIP	National Flood Insurance Program
NHC	National Hurricane Center
NOAA	National Oceanic and Atmospheric Administration
PCS	Property Claim Services
RMA	risk Management Agency
SAP	synthesis and assessment product
SFIP	standard flood insurance policy
USDA	U.S. Department of Agriculture

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United States Government Accountability Office
Washington, DC 20548

March 16, 2007

The Honorable Joseph I. Lieberman
Chairman
The Honorable Susan M. Collins
Ranking Member
Committee on Homeland Security and Governmental Affairs
United States Senate

As the 2004 and 2005 hurricane seasons demonstrated, weather-related events can devastate affected communities and individuals, and are costly to the insurance industry, government disaster assistance programs, and other relief organizations. Apart from the record-setting losses experienced in 2005, weather-related events over the past decade have cost the country tens of billions of dollars each year.

The property and casualty segment of the insurance industry, spanning both the private and public sector, bears a large portion of weather-related losses.¹ The private sector includes primary insurers that insure individuals and businesses directly, and reinsurers that provide insurance to the primary insurers. The public sector includes federal programs—in particular, the National Flood Insurance Program (NFTP), which insures properties at risk of damage from flooding, and the Federal Crop Insurance Corporation (FCIC), which insures crops that are vulnerable to drought, floods, or other natural disasters. Many states also administer insurance pools that provide coverage for losses caused by weather-related events.

The uncertain and potentially large losses associated with weather-related events are among the biggest risks that property insurers face. Virtually anything that is insured—property, crops and livestock, business operations, or human life and health—is vulnerable to weather-related events. To remain financially solvent, the insurance industry must estimate and prepare for the potential impact of weather-related events. As such, any unanticipated changes in the frequency or severity of weather-related

¹Insurers use the term “loss” to refer to the dollar value of approved or settled claims arising from damages incurred by a policyholder. For the purposes of this report, weather-related loss refers to the dollar value of claims made on damage attributable to weather-related events. “Loss” does not account for premium or other income, deductibles, co-payments, or damages in excess of coverage.

events can have financial consequences at the company level and industry-wide.

The earth's climate and weather patterns are dynamic, varying on seasonal, decadal, and longer time scales. The global average surface temperature has increased by 0.74 degrees Celsius over the past 100 years and climate models predict additional, perhaps accelerating, increases in temperature. While the temperature increases to date may appear small, climate models project that additional changes in temperature may alter social and economic activities in potentially profound ways. Much research and policy debate has centered on the extent to which human activities have contributed to the warming and how much is due to natural variability. For the purposes of this report, *climate change* refers to any change in the climate over time, whether due to natural variability or as a result of human activity.² Regardless of the cause, some contend that increasing temperatures—accompanied by changes in other aspects of the climate—may have adverse financial consequences for property insurers, which might slow the growth of the industry and shift more of the burden to governments and individuals.

Concerned about the implications of climate change for weather-related losses incurred by federal agencies and private insurers, you asked us to (1) describe what is known about how climate change might affect insured and uninsured losses, (2) determine insured losses incurred by major federal agencies and private insurers and reinsurers resulting from weather-related events, and (3) determine what major federal agencies and private insurers and reinsurers are doing to prepare for the potential risk of increased losses due to more frequent or more severe weather-related events associated with climate change.

To describe how climate change might affect insured and uninsured losses, we reviewed and summarized key scientific assessments by reputable international and national research organizations, including the Intergovernmental Panel on Climate Change *Third Assessment Report*, National Academy of Sciences reports, and the multifederal agency

²More specifically, we used the Intergovernmental Panel on Climate Change definition, which refers to climate change as a statistically significant variation in either the mean state of the climate or in its variability, persisting for an extended period (typically decades or longer). Climate change may be due to natural factors (e.g., internal processes or external forcings such as solar variations or heavy volcanic activity), or to persistent human-induced changes in the composition of the atmosphere or land use patterns.

Climate Change Science Program. To determine insured losses attributable to weather-related events, we analyzed data from 1980 through 2005 from the Department of Homeland Security's Federal Emergency Management Agency (FEMA) for the NFIP; from the Department of Agriculture's Risk Management Agency (RMA) for FCIC; and from the Property Claims Service, a leading source of insurance data. We analyzed changes in weather-related losses since 1980 and supplemented this analysis with a review of existing literature and the views of subject area experts on the key drivers of changes in losses.

To determine what key federal agencies and private insurers are doing to assess and manage the potential for increased losses, we conducted semistructured interviews with officials from the NFIP, RMA, and a sample of the largest private primary insurers and reinsurers in the United States, Europe, and Bermuda. The companies we interviewed represent about 45 percent of the total domestic insurance market but should not be generalized to represent all insurance companies. We also interviewed officials from catastrophe modeling firms, insurance industry associations, the National Association of Insurance Commissioners (NAIC),³ and universities to provide additional context for respondents' statements. To supplement these interviews, we reviewed documentation of federal agencies' risk management practices, studies by subject area experts, industry reports, insurance company documents, and previous GAO reports. We performed our work between February 2006 and January 2007 in accordance with generally accepted government auditing standards. A more extensive discussion of our scope and methodology appears in appendix I.

Results in Brief

Assessments by the National Academy of Sciences (NAS) and the Intergovernmental Panel on Climate Change (IPCC), a leading source for international climate expertise, report that the effects of climate change on weather-related events and—by extension—weather-related losses could be substantial. IPCC reports that global mean temperatures increased by 0.74 degrees Celsius over the last 100 years and are projected to continue to rise over the next century. Although temperatures have varied throughout history due to natural processes, such as changes in the Earth's orbit and volcanic eruptions, the IPCC and NAS report that the

³The National Association of Insurance Commissioners is an organization of insurance regulators from the 50 states, the District of Columbia, and the five U.S. territories.

observed temperature increase during the twentieth century cannot be explained by natural variability alone but is largely attributable to human activities. Warmer surface temperatures are linked to global-scale oceanographic, meteorological, and biological changes. For example, as the earth warms, more water evaporates from oceans and other sources, eventually falling as rain or snow. Key assessments that rely on both observational data and computer models have reported that warmer temperatures are expected to increase the frequency and severity of damaging extreme weather-related events (such as flooding or drought), although the timing, magnitude, and duration of these changes are as yet undetermined. Further research on the effect of increasing temperature on weather events is ongoing. Of particular note, the IPCC is expected to release its fourth assessment of the state of climate science throughout 2007, and the Climate Change Science Program is currently assessing potential changes in the frequency or intensity of weather-related events specific to North America in a report scheduled for release in 2008.

Taken together, private and federal insurers paid more than \$320 billion in claims on weather-related losses from 1980 through 2005. In constant dollars, private insurers paid the largest part of the claims during this period, \$243.5 billion (about 76 percent); followed by federal crop insurance, \$43.6 billion (about 14 percent); and federal flood insurance, \$34.1 billion (about 11 percent). Claims varied significantly from year to year—largely due to the incidence and effects of catastrophic weather events such as hurricanes and droughts—but generally increased during this period. In particular, the years with the largest insured losses were generally associated with major hurricanes, which comprised well over one-third of all weather-related losses since 1980. The growth in population in hazard-prone areas, and resulting real estate development and increasing real estate values, have increased federal and private insurers' exposure, and have helped to explain the increase in losses. In particular, heavily-populated areas along the Northeast, Southeast, and Texas coasts have among the highest value of insured properties in the United States and face the highest likelihood of major hurricanes. Due to these and other factors, federal insurers' exposures have grown substantially. Since 1980, NFIP's exposure has quadrupled, nearing \$1 trillion, and program expansion has increased FCIC's exposure nearly 26-fold to \$44 billion. These escalating exposures to catastrophic weather events are leaving the federal government at increased financial risk. FCIC officials told us, for example, that if the widespread Midwest floods of 1993 were to occur today, losses would be five times greater.

While both major private and federal insurers are exposed to increases in the frequency or severity of weather-related events associated with climate change, the two sectors are responding in different ways. Using computer-based catastrophe models, many major private insurers are incorporating some near-term elements of climate change into their risk management practices. One consequence is that, as these insurers seek to limit their own catastrophic risk exposure, they are transferring some of it to policyholders and to the public sector. In addition, some private insurers are approaching climate change at a strategic level by publishing reports outlining the potential industry-wide impacts and strategies to proactively address the issue. Federal insurance programs, on the other hand, have done little to develop the kind of information needed to understand the programs' long-term exposure to climate change for a variety of reasons. The federal insurance programs are not oriented toward earning profits like private insurers but rather toward increasing participation among eligible parties. Consequently, neither program has had reason to develop information on their long-term exposure to the fiscal risks associated with climate change.

We acknowledge the different mandate and operating environment in which the major federal insurance programs operate, but we believe that better information about the federal government's exposure to potential changes in weather-related risk would help the Congress identify and manage this emerging high-risk area—one which may not constitute an immediate crisis, but which does have significant implications for the nation's growing fiscal imbalance. Accordingly, GAO is recommending that the Secretary of Agriculture and the Secretary of Homeland Security direct the Under Secretary for Farm and Foreign Agricultural Services and the Under Secretary of Homeland Security for Emergency Preparedness to analyze the potential long-term fiscal implications of climate change for the FCIC and the NFIP, respectively, and report their findings to the Congress.

In commenting on a draft of this report, both the Departments of Agriculture (USDA) and Homeland Security (DHS) agreed with our recommendation, and USDA commented on the presentation of several findings in the draft. The Department of Commerce neither agreed nor disagreed with the report's findings, but instead commented on the presentation of several issues in the draft and offered technical comments which we incorporated into this report as appropriate. The Department of Energy elected not to provide comments on the draft.

Background

Insurance is a mechanism for spreading risk over time, across large geographical areas, and among industries and individuals. While insurers assume some financial risk when they write policies, they employ various strategies to manage risk so that they earn profits, limit potential financial exposures, and build capital needed to pay claims.⁴ For example, they charge premiums for coverage and establish underwriting standards, such as refusing to insure customers who pose unacceptable levels of risk, or limiting coverage in particular geographic areas. Insurance companies may also purchase reinsurance to cover specific portions of their financial risk. Reinsurers use similar strategies to limit their risks, including charging premiums, establishing underwriting standards, and maintaining close, long-term business relationships with certain insurers.

Both insurers and reinsurers must also predict the frequency and severity of insured losses with some reliability to best manage financial risk.⁵ In some cases, these losses may be fairly predictable. For example, the incidence of most automobile insurance claims is predictable, and losses generally do not occur to large numbers of policyholders at the same time. However, some infrequent weather-related events—hurricanes, for example—are so severe that they pose unique challenges for insurers and reinsurers. Commonly referred to as catastrophic or extreme events, the unpredictability and sheer size of these events—both in terms of geography and number of insured parties affected—have the potential to overwhelm insurers' and reinsurers' capacity to pay claims. Catastrophic events may affect many households, businesses, and public infrastructure across large areas, resulting in substantial losses that deplete insurers' and reinsurers' capital.

Given the higher levels of capital that reinsurers must hold to address catastrophic events, reinsurers generally charge higher premiums and restrict coverage for such events. Further, in the wake of catastrophic events, reinsurers and insurers may sharply increase premiums to rebuild capital reserves and may significantly restrict insurance and reinsurance coverage to limit exposure to similar events in the future.

⁴Federal insurance programs are not designed to earn financial profits.

⁵To insure a risk, private insurers must be able to both estimate an event's occurrence and its associated damages and be able to set premiums sufficient to cover their risk and earn a profit. In some cases, insurers may be prevented from charging sufficient premiums due to state regulatory actions.

Under certain circumstances, the private sector may determine that a risk is uninsurable. For example, while homeowner insurance policies typically cover damage and losses from fire and other perils, they usually do not cover flood damage because private insurance companies are largely unwilling to bear the financial risks associated with its potentially catastrophic impact. In other instances, the private sector may be willing to insure a risk, but at rates that are not affordable to many property owners. Without insurance, affected property owners must rely on their own resources or seek out disaster assistance from local, state, and federal sources.

In situations where the private sector will not insure a particular type of risk, the public sector may create markets to ensure the availability of insurance. For example, several states have established Fair Access to Insurance Requirements (FAIR) plans, which pool resources from insurers doing business in the state to make property insurance available to property owners who cannot obtain coverage in the private insurance market, or cannot do so at an affordable rate. In addition, six southern states have established windstorm insurance pools that pool resources from private insurers to make insurance available to property owners who cannot obtain it in the private insurance market.

Similarly, at the federal level, the Congress established the NFIP and the FCIC to provide coverage where voluntary markets do not exist.⁶ The Congress established the NFIP in 1968, partly to provide an alternative to disaster assistance for flood damage. Participating communities are required to adopt and enforce floodplain management regulations, thereby reducing the risks of flooding and the costs of repairing flood damage. FEMA, within the Department of Homeland Security, is responsible for, among other things, oversight and management of the NFIP. Under the program, the federal government assumes the liability for covered losses and sets rates and coverage limitations.

The Congress established the FCIC in 1938 to temper the economic impact of the Great Depression and the weather effects of the dust bowl. In 1980, the Congress expanded the program to provide an alternative to disaster assistance for farmers that suffer financial losses when crops are damaged by droughts, floods, or other natural disasters. Farmers' participation is

⁶See appendixes II and III for additional information on how these programs operate, how they assess risk, and how they are funded.

voluntary, but the federal government encourages it by subsidizing their insurance premiums. USDA's RMA is responsible for administering the crop insurance program, including issuing new insurance products and expanding existing insurance products to new geographic regions. RMA administers the program in partnership with private insurance companies, which share a percentage of the risk of loss or the opportunity for gain associated with each insurance policy written.

Climate Change May Increase Losses by Altering the Frequency or Severity of Weather-Related Events

Global temperatures have increased in the last 100 years and are projected to continue to rise over the next century. Using observational data and computer modeling, climatologists and other scientists are assessing the likely effects of temperature rise associated with climate change on precipitation patterns and on the frequency and severity of weather-related events. The key scientific assessments we reviewed generally found that warmer temperatures are expected to alter the frequency or severity of damaging weather-related events, such as flooding or drought, although the timing, magnitude, and duration of these changes are as yet undetermined. Additional research on the effect of increasing temperature on weather events is expected in the near future. Nevertheless, research suggests that the potential effects of climate change on damaging weather-related events could be significant.

Warming Temperatures Are Expected to Alter the Frequency and Severity of Damaging Extreme Weather-Related Events

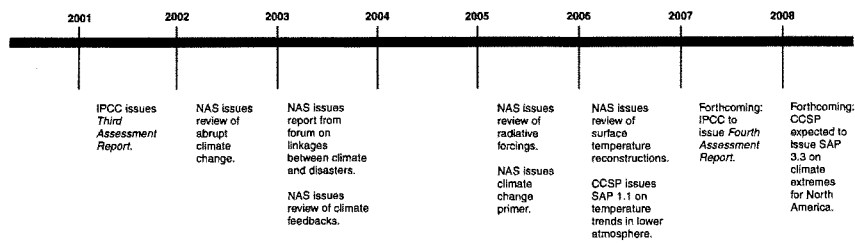
We reviewed the reports released by IPCC, NAS, and the federal Climate Change Science Program (CCSP) that are shown in figure 1.⁷ These leading scientific bodies report that the Earth warmed during the twentieth century—0.74 degrees Celsius from 1906 to 2005 according to a recent IPCC report—and is projected to continue to warm for the foreseeable future.⁸ IPCC, NAS, CCSP, and other scientific bodies report that this increase in temperature cannot be explained by natural variation alone. IPCC's 2001 assessment of the impact of increasing temperatures on extreme weather events found that it was likely the frequency and severity

⁷Appendix I contains additional information on the specific assessments we reviewed. CCSP is a multiagency effort to coordinate federal climate change science that is responsible for preparing a series of 21 climate science synthesis and assessment products (SAP) for the United States by 2008.

⁸This estimate comes from a recently released summary of a key component of IPCC's *Fourth Assessment Report* of the state of climate science, which reported an updated 100-year linear trend (1906-2005) of 0.74 degrees Celsius—larger than the corresponding 0.6 degrees Celsius reported in the 2001 *Third Assessment Report*.

of several types of events will increase as greenhouse gas emissions continue.⁹

Figure 1: Time Line of Key Scientific Assessments



Source: GAO.

Average Global Temperatures Have Increased and Are Expected to Continue to Rise

The earth's climate system is driven by energy from the sun and is maintained by complex interactions between the atmosphere, the oceans, and the reflectivity of the earth's surface, among other factors. Upon reaching the earth, the sun's energy is either reflected back into space, or is absorbed by the earth and is subsequently reemitted. However, certain gases in the earth's atmosphere—such as carbon dioxide and methane—act like the glass in a greenhouse to trap some of the sun's energy and prevent it from returning to space. While these gases play an important part in maintaining life on earth, their accumulation in the atmosphere can significantly increase global temperatures.

The earth warmed by roughly 0.74 degrees Celsius over the past 100 years, and is projected to continue warming for the foreseeable future. While temperatures have varied throughout history, triggered by natural factors such as volcanic eruptions or changes in the earth's orbit, the key scientific assessments we reviewed have generally concluded that the observed increase in temperature in the past 100 years cannot be explained by natural variability alone. In recent years, major scientific

⁹For the purposes of this report, extreme weather-related events are those with a low frequency of occurrence, but that cause severe damage, such as hurricanes, drought, winter storms, tornadoes, wildfires, and floods, among others.

bodies such as the IPCC, NAS, and the Royal Academy (the United Kingdom's national academy of science) have concluded that human activities, including the combustion of fossil fuels, industrial and agriculture processes, landfills, and some land use changes, are significantly increasing the concentrations of greenhouse gases and, in turn, global temperatures.

Although climate models produce varying estimates of the extent of future changes in temperature, NAS and other scientific organizations have concluded that available evidence points toward continued global temperature rise. Assuming continued growth in atmospheric concentration of greenhouse gases, the latest assessment of computer climate models projects that average global temperatures will warm by an additional 1.8 to 4.0 degrees Celsius during the next century.¹⁰

Some scientists have questioned the significance of the earth's present temperature rise relative to past fluctuations. To address this issue, the NAS recently assessed the scientific community's efforts to reconstruct temperatures of the past 2,000 years and place the earth's current warming in an historical context.¹¹ Based on its review, the NAS concluded with a high level of confidence that global mean surface temperature was warmer during the last few decades of the twentieth century than during any comparable period during the preceding 400 years. Moreover, NAS cited evidence that temperatures at many, but not all, individual locations were higher during the past 25 years than any period of comparable length over the past 1,100 years.

¹⁰IPCC narrowed its range of projected warming in its recently released summary from the corresponding range of 1.4 to 5.8 degrees Celsius reported in the 2001 *Third Assessment Report*. Although these two sets of projections are broadly consistent, they are not directly comparable. IPCC notes in the summary that the new range is more advanced in that it provides best estimates and an assessed likelihood range. It also relies on a larger number of climate models of increasing complexity and realism, as well as new information regarding the nature of feedbacks from the carbon cycle and constraints on climate response from observations.

¹¹National Research Council, *Surface Temperature Reconstructions for the Last 2,000 Years* (Washington, D.C.: 2006).

IPCC Expects Continued Warming to Alter Frequency and Severity of Damaging Extreme Weather-Related Events

Determining the precise nature and extent of the relationship between average global temperatures and weather-related events is an exceedingly challenging task. Several key assessments of the state of this science have addressed the large body of work on this topic. Using observational data and computer models, scientists are examining the effects of rising temperatures on precipitation patterns and the frequency and severity of extreme weather-related events. The complexity of weather systems, together with the limited statistical precision of projections of the extent of future temperature change, often produces different model results, and the results themselves represent a range of potential future conditions.

Nonetheless, a key assessment of climate model projections indicates that an increase is likely in the frequency or severity of damaging extreme weather-related events. In 2001, the IPCC, a leading scientific authority on climate science, released its *Third Assessment Report*, which assessed the state of knowledge of, among other things, the potential for global changes in extreme weather-related events. The IPCC described the relationship between temperatures, precipitation, and weather-related events. Increased global mean surface temperatures are linked to global-scale oceanographic, meteorological, and biological changes. For example, as the earth warms, more water evaporates from oceans or lakes, eventually falling as rain or snow. IPCC reported that permafrost is thawing, and the extent of sea ice, snow cover, and mountain glaciers are generally shrinking. The IPCC also noted that global sea level rose between 0.1 and 0.2 meters during the twentieth century through thermal expansion of seawater and widespread loss of land ice, and that this sea level rise could increase the magnitude of hurricane storm surge in some areas. Warming is expected to change rainfall patterns, partly because warmer air holds more moisture.

Based on model projections and expert judgment,¹² the IPCC reported that future increases in the earth's temperature are likely to increase the frequency and severity of many damaging extreme weather-related events (summarized in table 1). For instance, IPCC reported that increased drought is likely across many regions of the globe, including the U.S. Great

¹²Likelihoods for projected changes are defined by the following conditions set by the IPCC: "very likely" indicates that a number of models have been analyzed for such a change, all those analyzed show it in most regions, and it is physically plausible; and "likely" indicates that theoretical studies and those models analyzed show such a change, but only a few models are configured in such a way as to reasonably represent such changes.

Plains. Also, IPCC concluded that the intensity of precipitation events is very likely to increase across almost all regions of the globe and that heavy precipitation events are expected to become more frequent. Compared with projected temperature increases, changes in the frequency and severity of extreme events can occur relatively rapidly, according to the IPCC.

Table 1: Selected IPCC Estimates of Confidence in Projected Changes in Weather-Related Events

Weather-related event	Confidence in projected future changes
Higher maximum temperatures and more hot days over nearly all land areas	Very likely
Higher minimum temperatures and fewer cold and frost days over nearly all land areas	Very likely
More intense precipitation events	Very likely
Increased summer drying and associated risks of drought	Likely ^a
Increase in hurricane peak wind intensities	Likely ^b
Increase in hurricane average and peak precipitation intensities	Likely

Source: IPCC, *Climate Change 2001: The Scientific Basis*, 2001.

^aProjections for most midlatitude continental interiors. IPCC found a lack of consistent projections in other regions.

^bIPCC reported that changes in the regional distribution of hurricanes are possible but have not been established.

Much research has been done since the IPCC's *Third Assessment Report*, but there has not been a similarly rigorous assessment of what is known with regard to temperature increase, precipitation, and weather-related events for the United States.¹³ However, significant assessments will be completed in the near future. In particular, the IPCC is expected to release its *Fourth Assessment Report* throughout 2007.

¹³The most recent national assessment for the United States, entitled *Climate Change Impacts on the United States*, was forwarded by a federal advisory committee to the Congress and the President in 2000 as required by the Global Change Research Act of 1990. We reported in 2005 that the subsequent assessment was not submitted in November 2004 as required by the act. Instead, according to the Department of Commerce, CCSP has committed to issuing 21 shorter reports by 2008. See GAO, *Climate Change Assessment: Administration Did Not Meet Reporting Deadline*, GAO-05-338R (Washington, D.C.: Apr. 14, 2005).

While we were completing our review, the IPCC released a summary of the first of three components of its *Fourth Assessment Report*, which builds upon past IPCC assessments and incorporates new findings from the physical science research since the *Third Assessment Report*. The summary reports higher confidence in projected patterns of warming and other regional-scale features, including changes in wind patterns, precipitation, and some aspects of extreme events. In particular, the summary reports that it is very likely that hot extremes, heat waves, and heavy precipitation events will continue to become more frequent. Moreover, based on a range of models, IPCC's summary states that it is likely that future tropical cyclones (typhoons and hurricanes) will become more intense, with larger peak wind speeds and more heavy precipitation associated with ongoing increases in tropical sea surface temperatures. IPCC reports less confidence in projections of a global decrease in the number of tropical cyclones, and that the apparent increase in the proportion of very intense storms since 1970 in some regions is much larger than simulated by current models for that period. The full first component report was not publicly released prior to the issuance of our report and is expected some time after May 2007.

The other two components of the *Fourth Assessment Report* will cover impacts, adaptation, and vulnerability, and mitigation. These reports are expected to assess, among other things, key vulnerabilities and risks from climate change, including changes in extreme events. Additionally, the IPCC has committed to producing a capping report that is intended to synthesize and integrate material contained in the forthcoming reports, as well as other IPCC products.

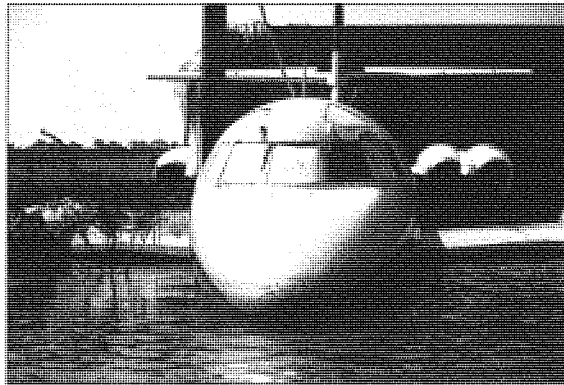
In addition to the IPCC's work, CCSP is assessing potential changes in the frequency or intensity of weather-related events specific to North America in a report scheduled for release in 2008. According to a National Oceanic and Atmospheric Administration (NOAA) official and agency documents, the report will focus on weather extremes that have a significant societal impact, such as extreme cold or heat spells, tropical and extra-tropical storms, and droughts. Importantly, officials have said the report will provide an assessment of the observed changes in weather and climate extremes, as well as future projections.

More Frequent or More Severe Extreme Weather-Related Events Could Significantly Increase Insured Losses

Extreme weather-related events impact communities and economic activity by damaging homes and vehicles (e.g., see fig. 2), interrupting electrical service and business operations, or destroying crops. IPCC reported that the insurance industry—especially the property and casualty segment—are sensitive to the effects of weather-related events. This was highlighted in the Department of Commerce’s comments on a draft of this report, which observed that altering either the frequency or severity of high impact extreme weather-related events could result in a significant increase in the risk posed to an insurer. For example, the agency said that what had been considered a 500-year event (i.e., its probability of occurring in a given year is 1 in 500) could shift under climate change to become a 100-year event (i.e., its probability of occurring in a given year is 1 in 100). Consequently, more frequent or more severe events have a greater potential for damage and, in turn, insured losses. As an official from Aon Re Australia, a large global reinsurer, reported, “The most obvious impact of climate change on the insurance sector will be the increase in insured property losses from extreme weather events.”¹⁴

¹⁴Andrew Dlugolecki, *The Changing Risk Landscape: Implications for Insurance Risk Management* (1999) http://www.aon.com.au/pdf/reinsurance/Aon_Climate_Change.pdf (downloaded Jan. 8, 2007).

Figure 2: July 1993 Flood Damage at Chesterfield Airport in St. Louis, Missouri



Source: FEMA.

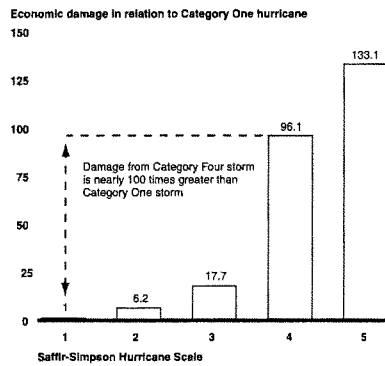
Note: According to FEMA, the depth of the floodwaters underscores the extent of the damage caused by the 1993 Midwest flood. A total of 534 counties in nine states were declared for federal disaster aid.

Notably, the economic damages associated with some extreme weather-related events could increase at a greater rate in comparison with changes in the events themselves. Seemingly small changes in the characteristics of certain weather-related events can lead to substantial increases in damage. For example, recent work on hurricanes by researchers at the University of Colorado, the National Weather Service, and other institutions examined losses associated with hurricanes that made landfall in the United States since 1900.¹⁵ Holding constant the increased population and development in coastal counties during this period, the study compared the economic damage of stronger storms with weaker storms, based on

¹⁵See Roger Pielke, Jr., et al., *Normalized Hurricane Damages in the United States: 1900-2005* (2007), accessed via http://sciencepolicy.colorado.edu/publications/special/normalized_hurricane_damages.html (downloaded Jan. 8, 2007).

the Saffir-Simpson Hurricane Scale.¹⁶ The researchers found that stronger storms have caused many times more economic damages than weaker storms, as shown in figure 3. These findings are consistent with other independent analyses conducted by insurers and catastrophe modelers.

Figure 3: Economic Damages by Hurricane Category for U.S. Hurricanes Making Landfall, 1900-2005



Source: GAO adaptation of Pielke et al. data.

Note: Value of each bar compares the median economic damage associated with hurricanes of that Saffir-Simpson category with the median economic damage of Category One storms. Of the 158 hurricanes reviewed, only three were Category Five.

Moreover, public reports from several of the world's largest reinsurance companies and brokers underscore the potential for substantially increased losses. These reports note that, in addition to greater losses in

¹⁶The Saffir-Simpson hurricane intensity category system was developed in the 1970s to calculate the destructive force of hurricanes. The scale ranges from Category One to Category Five, with Category Five being the most severe. For example, Category Three hurricanes have winds of 111 to 130 mph, whereas Category Five hurricanes have winds greater than 155 mph.

absolute terms, the potential for greater variability in weather-related events could significantly enhance the volatility of losses.

Insured Weather-Related Losses Have Been Sizeable, and Federal Insurers' Exposure Has Grown Significantly

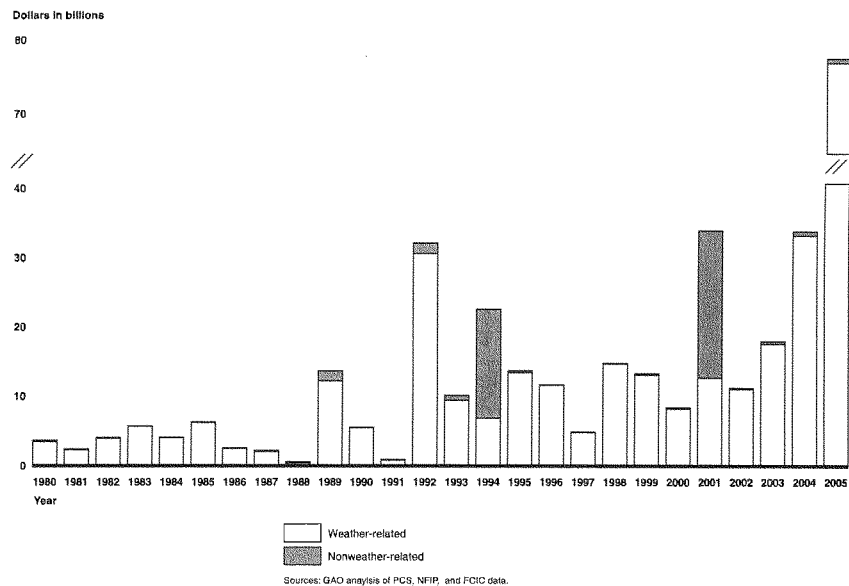
Taken together, insurers paid more than \$320 billion in claims for weather-related losses between 1980 and 2005.¹⁷ Claims varied significantly from year to year—largely due to the effects of catastrophic weather events such as hurricanes and droughts—but generally increased during this period. The growth in population in hazard-prone areas, and consequent real estate development and increasing real estate values, have generally increased insurers' exposure to weather-related events and help to explain their increased losses. Due to these and other factors, the federal insurance programs' liabilities have grown significantly, leaving the federal government increasingly vulnerable to the financial impacts of extreme events.

Claims Paid on Weather-Related Losses Totaled More Than \$320 Billion between 1980 and 2005

Based on an examination of loss data from several different sources, insurers incurred more than \$320 billion in weather-related losses from 1980 through 2005 (see fig. 4). Weather-related losses accounted for 88 percent of *all* property losses paid by insurers during this period. All other property losses, including those associated with earthquakes and terrorist events, accounted for the remainder. Weather-related losses varied significantly from year to year, ranging from just over \$2 billion in 1987 to more than \$75 billion in 2005.

¹⁷Data throughout this section are presented in constant 2005 dollars to allow for a comparison of the dollar value of losses over time and are not otherwise adjusted. See appendix I for more information on data used in this report.

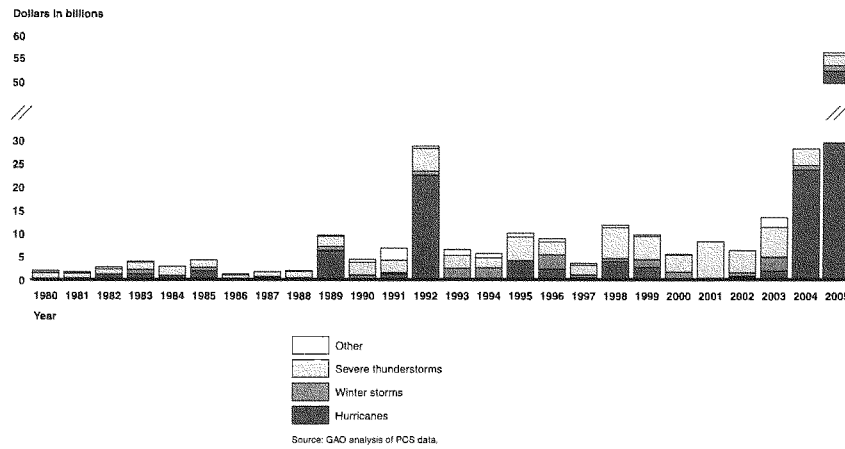
Figure 4: Annual Weather- and Nonweather-Related Insured Losses



Privately-Insured Losses

Of the \$321.2 billion in weather-related loss payments we reviewed, private insurers paid \$243.5 billion—over three-quarters of the total.¹⁸ Figure 5 depicts the breakdown of these payments among key weather-related events. Of the \$243.5 billion paid by private insurers, hurricanes accounted for \$124.6 billion, or slightly more than half. Wind, tornados, and hail associated with severe thunderstorms accounted for \$77 billion, or nearly one-third of the private total. Winter storms were associated with \$25.1 billion, or about 10 percent.

Figure 5: Weather-Related Losses Paid by Private Insurers



¹⁸Property Claim Services (PCS), an authority on insured property losses, maintains a database of estimated losses determined to be "catastrophes"—that is, loss events larger than \$25 million that affect a significant number of policyholders. PCS estimates include losses under personal and commercial property insurance policies and typically include payments made on behalf of state-administered risk pools. PCS data are described in greater detail in appendix I.

Federally-Insured Losses

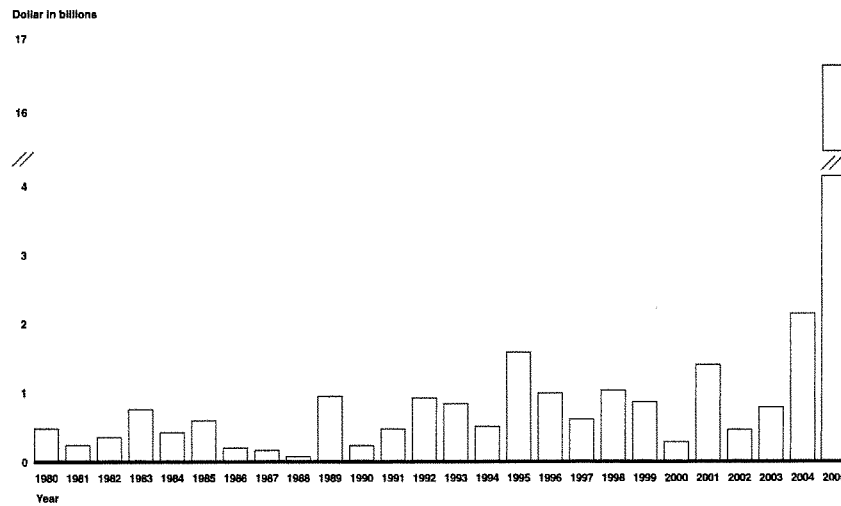
The two major federal insurance programs—NFIP and FCIC—paid the remaining \$77.7 billion of the \$321.2 billion in weather-related loss payments we reviewed.¹⁹ Although the performance of both NFIP and FCIC is sensitive to weather, the two programs insure fundamentally different risks and operate in very different ways.

NFIP provides insurance for flood damage to homeowners and commercial property owners in more than 20,000 communities. Homeowners with mortgages from federally regulated lenders on property in communities identified as being in high flood risk areas are required to purchase flood insurance on their dwellings. Optional, lower cost flood insurance is also available under the NFIP for properties in areas of lower flood risk. NFIP offers coverage for both the property and its contents, which may be purchased separately.

NFIP claims totaled about \$34.1 billion, or about 11 percent of all weather-related insurance claims during this period. As shown in figure 6, NFIP covers only one cause of loss—flooding. Claims averaged about \$1.3 billion per year, but ranged from \$75.7 million in 1988 to \$16.7 billion in 2005.

¹⁹Appendixes II and III provide additional information about the structure and operation of FCIC and NFIP. Importantly, totals only reflect what was paid during this time—some losses incurred in 2005 may be omitted from this data set.

Figure 6: Weather-Related Losses Paid by NFIP

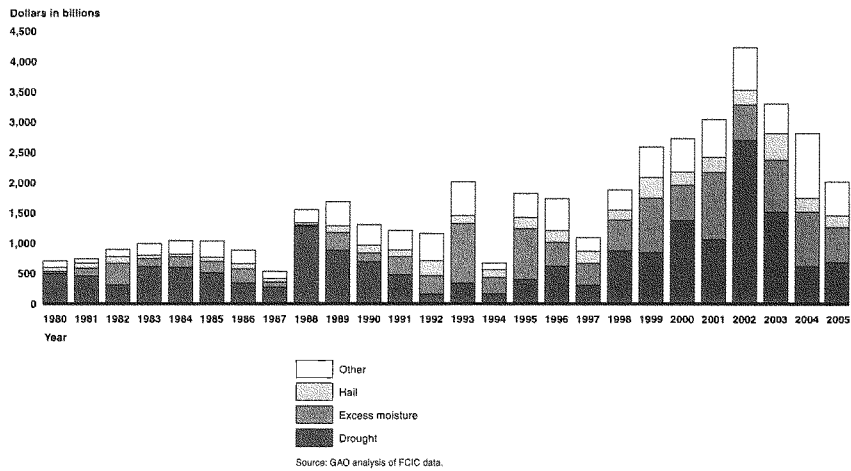


Source: GAO analysis of NFIP data.

FCIC insures commodities on a crop-by-crop and county-by-county basis based on farmer demand for coverage and the level of risk associated with the crop in a given region. Over 100 crops are covered by the program. Major crops, such as grains, are covered in almost every county where they are grown, and specialty crops, such as fruit, are covered only in some areas. Participating farmers can purchase different types of crop insurance, including yield and revenue insurance, and at different levels. For yield insurance, participating farmers select the percentage of yield of a covered crop to be insured and the percentage of the commodity price received as payment if the producer's losses exceed the selected threshold. Revenue insurance pays if actual revenue falls short of an assigned target level regardless of whether the shortfall was due to low yield or low commodity market prices.

Since 1980, FCIC claims totaled \$43.6 billion, or about 14 percent of all weather-related claims during this period. FCIC losses averaged about \$1.7 billion per year, ranging from \$531.8 million in 1987 to \$4.2 billion in 2002. Figure 7 shows the three causes of loss—drought, excess moisture, and hail—that accounted for more than three-quarters of crop insurance claims. In particular, drought accounted for \$18.6 billion in losses, or more than 40 percent of all insured crop losses. Excess moisture totaled \$11.2 billion, followed by hail with total claims of \$4.2 billion. The remaining \$9.6 billion in claims was spread among 27 different causes of loss, including frost and tornados.

Figure 7: Weather-Related Losses Paid by FCIC



**Insured Losses Understate
Total Economic Damage**

Importantly, the insured loss totals used in our analysis do not account for all economic damage associated with weather-related events.²⁰ Specifically, data are not available for several categories of economic losses, including uninsured, underinsured, and self-insured losses. As we reported in 2005, FEMA estimates that one-half to two-thirds of structures in floodplains do not have flood insurance because the uninsured owners either are unaware that homeowners insurance does not cover flood damage, or they do not perceive a serious flood risk.²¹ Furthermore, industry analysts estimate that 58 percent of homeowners in the United States are underinsured—that is, they carry a policy below the replacement value of their property—by an average of 21 percent.²² Finally, some individuals and businesses have the means to “self-insure” their assets by assuming the full risk of any damage.

Various public and private disaster relief organizations provide assistance to communities and individuals who suffer noninsured economic losses, although it was beyond the scope of this report to collect data on these losses. In particular, since 1989, \$78.6 billion in federal disaster assistance funds have been obligated through the Disaster Relief Fund administered by FEMA, the largest—but not only—conduit for federal disaster assistance money provided in the wake of presidentially declared disasters and emergencies.

Overall, according to data obtained from Munich Re, one of the world’s largest reinsurers, the type of insured losses we reviewed account for no more than about 40 percent of the total losses attributable to weather-related events.²³ NOAA’s National Hurricane Center (NHC) uses a similar proportion to produce the agency’s estimates of total economic damage

²⁰Weather-related damages are also responsible for many indirect and non-market impacts that are not entirely accounted for, if at all, in economic terms, such as environmental damage. See NAS, *The Impacts of Natural Disasters: A Framework for Loss Estimation* (Washington, D.C.: 1999), 55-64.

²¹GAO, *Catastrophe Risk: U.S. and European Approaches to Insure Natural Catastrophe and Terrorism Risks*, GAO-05-199 (Washington, D.C.: Feb. 28, 2005), 61.

²²Estimate was produced by Marshall & Swift/Boeckh, a leading supplier of local building cost information, residential and commercial property valuation services for the property and casualty insurance sector in the United States. GAO did not independently evaluate the reliability of this estimate.

²³Munich Re, *Topics 2000: Natural Catastrophes—the Current Position*. Geoscience Research Group (Munich, Germany: 1999).

attributable to hurricanes.²⁴ Although we did not independently evaluate the reliability of these estimates, subject area experts we spoke with confirmed that it was the best such estimate available and is widely used as an approximation of the relative distribution of losses.

The difficulties we and others faced in accounting for weather-related losses were the subject of the National Academies' *The Impacts of Natural Disasters: A Framework for Loss Estimation*.²⁵ Reporting how best to account for the costs of natural disasters, including weather-related events, NAS found that there was no system in place in either the public or the private sectors to consistently capture information about the economic impact. Specifically, the NAS report found no widely accepted framework, formula, or method for estimating these losses. Moreover, NAS found no comprehensive clearinghouse for the disaster loss information that is currently collected. To that end, NAS recommended that the Office of Management and Budget, in consultation with FEMA and other federal agencies, develop annual, comprehensive estimates of the payouts for disaster losses made by federal agencies. Reviewing the status of this recommendation was beyond the scope of this report. Nevertheless, our experience with trying to obtain comprehensive information on disaster costs and losses underscores the NAS findings.

Catastrophic Weather-Related Events Help Explain the Significant Year-to-Year Variance in Losses

The largest insured losses in the data we reviewed were associated with catastrophic weather events. These events have a low probability of occurrence, but their consequences are severe. Notably, both crop insurers and other property insurers face the catastrophic risks posed by extreme events, although the nature of the events for each is very different. In the case of crop insurance, drought accounted for more than 40 percent of all insured losses from 1980 to 2005, and the years with the largest losses were associated with drought. Taken together, though, hurricanes were the most damaging event experienced by insurers in the data we reviewed. Although the United States experienced an average of only two hurricanes per year from 1980 through 2005, weather-related claims attributable to hurricanes totaled more than 45 percent of *all* weather-related insured losses—more than \$146 billion. Moreover, these losses appear to be increasing.

²⁴NHC estimates total losses by extrapolating from insured losses by assuming they account for approximately 50 percent of total losses.

²⁵NAS (1999), 1.

In the data we reviewed, the years with the largest insured losses were generally associated with major hurricanes, defined as Category Three, Four, or Five on the Saffir-Simpson Hurricane Scale. Table 2 shows that, while 29 Category One and Two storms account for nearly \$18 billion in losses, the 21 major storms account for over \$126 billion in losses. In fact, claims associated with major hurricanes comprised 40 percent of all weather-related insured losses since 1980.

Table 2: Insured Losses Associated with Hurricanes

Dollars in thousands			
	Categories One, Two	Categories Three, Four, Five	Total
1980s	\$807,422 (11)	\$9,905,042 (6)	\$10,712,464 (17)
1990s	9,038,801 (11)	29,099,303 (8)	38,138,104 (19)
2000s	8,071,619 (7)	89,210,093 (7)	97,281,712 (14)
Total	\$17,917,842 (29)	\$128,214,438 (21)	\$146,132,280 (50)

Source: GAO analysis of PCS and NFIP data; NOAA (hurricane intensity classification).

Note: Totals do not include crop losses associated with hurricanes. Number of hurricanes associated with losses is included in parentheses. Hurricane classification was based on peak intensity at landfall.

Importantly, hurricane severity is only one factor in determining the size of a particular loss—the location affected by the hurricane is also important. Generally, the more densely populated an area, the greater the extent of economic activity and accumulated value of the building stock. For instance, several studies have reviewed the economic impact of Hurricane Andrew, which tracked over Florida in 1992, in light of the dramatic real estate development that has occurred in the meantime. Researchers have normalized losses associated with the storm to account for societal changes by holding constant the value of building materials, real estate, and other factors so that the storm's impact could be adjusted to reflect contemporary conditions.²⁶ Hurricane Andrew, which resulted in roughly \$25 billion in total economic losses in 1992, would have resulted in more than twice that amount—\$55 billion—were it to have occurred in 2005, given current asset values.

²⁶A normalization provides an estimate of the damage that would occur if storms from the past affected the same location under the societal conditions of another year.

Several recent studies have commented on the apparent increases in hurricane losses during this time period, and weather-related disaster losses generally, with markedly different interpretations. Some argue that loss trends are largely explained by changes in societal and economic factors, such as population density, cost of building materials, and the structure of insurance policies.²⁷ Others argue that increases in losses have been driven by changes in climate.²⁸

To address this issue, Munich Re and the University of Colorado's Center for Science and Technology Policy Research jointly convened a workshop in Germany in May 2006 to assess factors leading to increasing weather-related loss trends.²⁹ The workshop brought together a diverse group of international experts in the fields of climatology and disaster research. Among other things, the workshop sought to determine whether the costs of weather-related events were increasing and what factors account for increasing costs in recent decades.

Workshop participants reached consensus on several points, including that analyses of long-term records of disaster losses indicate that societal change and economic development are the principal factors explaining observed increases in weather-related losses.³⁰ However, participants also agreed that changing patterns of extreme events are drivers for recent increases in losses and that additional increases in losses are likely given IPCC's projected increase in the frequency or severity of weather-related events.

²⁷See, for example, Roger A. Pielke, Jr., "Disasters, Death, and Destruction: Making Sense of Recent Calamities," *Oceanography*, vol. 19, no. 2 (2006); Stanley A. Changnon et al., "Human Factors Explain the Increased Losses from Weather and Climate Extremes," *Bulletin of the American Meteorological Society*, vol. 81, no. 3 (2000); and Roger A. Pielke, Jr., and Christopher W. Landsea, "Normalized Hurricane Damages in the United States: 1925-95," *Weather and Forecasting*, vol. 13 (1998).

²⁸See, for example, Evan Mills, Richard J. Roth, Jr., and Eugene Lecomte, *Availability and Affordability of Insurance Under Climate Change: A Growing Challenge for the U.S.* (Boston, Mass.: December 2005); Paul Epstein and Evan Mills, eds., *Climate Change Futures: Health, Ecological, and Economic Dimensions* (Boston, Mass.: November 2005); and Cynthia Rosenzweig et al., "Increased Crop Damage in the U.S. from Excess Precipitation Under Climate Change," *Global Environmental Change*, vol. 12 (2002).

²⁹Peter Höpfe and Roger Pielke, Jr., eds., *Report of the Workshop on Climate Change and Disaster Losses: Understanding and Attributing Trends and Projections*, Hohenkammer, Germany, May 25-26, 2006 (Munich, Germany: October 2006).

³⁰Consensus statements agreed to at the workshop are listed in their entirety in appendix IV.

Value at Risk in Federal Insurers' Portfolios Increased Significantly between 1980 and 2005

The growth in population in hazard-prone areas, and consequent real estate development and increasing real estate values, are leaving the nation increasingly exposed to higher insured losses. The close relationship between the value of the resource exposed to weather-related losses and the amount of damage incurred may have ominous implications for a nation experiencing rapid growth in some of its most disaster-prone areas. We reported in 2002 that the insurance industry faces potentially significant financial exposure due to natural catastrophes.³¹ Heavily populated areas along the Northeast, Southeast, and Texas coasts have among the highest value of insured properties in the United States and face the highest likelihood of major hurricanes. According to insurance industry estimates, a large hurricane in Miami could cause up to \$110 billion in insured losses with total losses as high as \$225 billion. Several states—including Florida, California, and Texas—have established programs to help ensure that coverage is available in areas particularly prone to these events.³²

AIR Worldwide, a leading catastrophe modeling firm, recently reported that insured losses should be expected to double roughly every 10 years because of increases in construction costs, increases in the number of structures, and changes in their characteristics. AIR's research estimates that, because of exposure growth, probable maximum catastrophe loss grew in constant dollars from \$60 billion in 1995 to \$110 billion in 2005, and it will likely grow to over \$200 billion during the next 10 years.

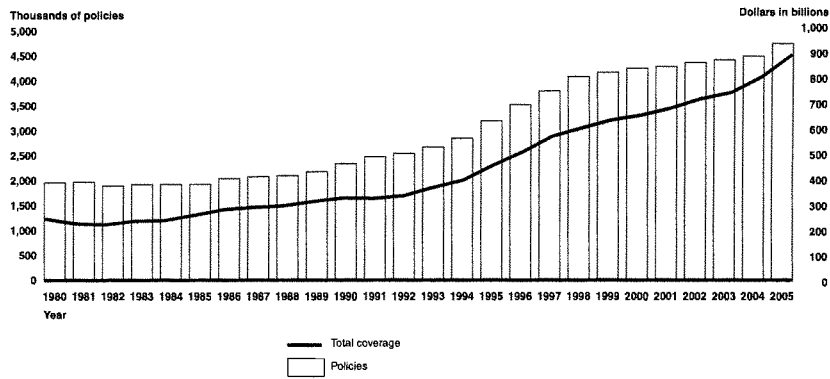
Data obtained from both the NFIP and FCIC programs indicate the federal government has grown markedly more exposed to weather-related losses regardless of the cause. For example, NFIP data show that the number of policyholders and the value of the properties insured have both increased since 1980. Figure 8 shows the growth of NFIP's exposure in terms of both number of policies and the total coverage. The number of policies has more than doubled in this time period, from 1.9 million policies to more than 4.6 million. Moreover, although NFIP limits coverage to \$250,000 for a personal structure and \$100,000 for its contents, and \$500,000 of coverage

³¹GAO, *Catastrophe Insurance Risks: The Role of Risk-Linked Securities and Factors Affecting Their Use*, GAO-02-941 (Washington, D.C.: Sept. 24, 2002), 3.

³²Past GAO work provided information on the Florida Hurricane Catastrophe Fund, California Earthquake Authority, and the Texas Windstorm Insurance Association. See GAO-02-941 and GAO, *Catastrophe Insurance Risks: Status of Efforts to Securitize Natural Catastrophe and Terrorism Risk*, GAO-03-1033 (Washington, D.C.: Sept. 24, 2003).

for a business structure and \$500,000 on its contents, more policyholders' homes are approaching (or exceeding) these coverage limits. Accordingly, the total value covered by the program increased fourfold in constant dollars during this time from about \$207 billion to \$875 billion in 2005.

Figure 8: NFIP Policies and Total Coverage

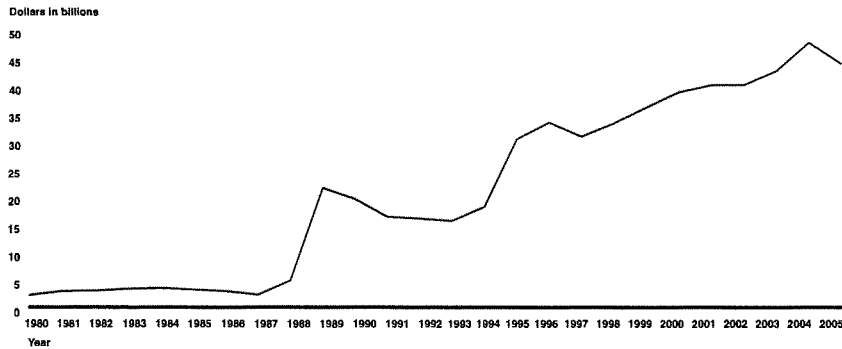


Source: GAO analysis of NFIP data.

Similarly, RMA data show that FCIC has effectively increased its exposure base 26-fold during this period (in constant dollars). In particular, the program has significantly expanded the scope of crops covered and increased participation. Figure 9 shows the growth in FCIC exposure since 1980.³⁵

³⁵To maintain comparability with other data, GAO did not adjust these data for changes in agricultural prices.

Figure 9: FCIC Total Coverage



Source: GAO analysis of FCIC data.

A senior RMA official told us that the main implication of FCIC's growth is that the magnitude of potential claims, in absolute terms, is much greater today than in the past. For example, if the Midwest floods of 1993 were to occur today, losses would be five times greater than the \$2 billion paid in 1993, according to RMA officials.

Major Private and Public Insurers Differ in How They Manage Catastrophic Risks Associated with Climate Change

Although the relative contribution of event intensity versus societal factors in explaining the rising losses associated with weather-related events is still under investigation, both major private and federal insurers are exposed to increases in the frequency or severity of weather-related events associated with climate change. Nonetheless, major private and federal insurers are responding to this prospect differently. Many large private insurers are incorporating some elements of near-term climate change into their risk management practices. Furthermore, some of the world's largest insurers have also taken a long-term strategic approach toward changes in climate. On the other hand, for a variety of reasons, the federal insurance programs have done little to develop the kind of information needed to understand the programs' long-term exposure to climate change. We acknowledge the different mandate and operating environment in which the major federal insurance programs operate but believe that better information about the federal government's exposure to potential changes

in weather-related risk would help the Congress identify and manage this emerging high-risk area, one which may not constitute an immediate crisis but which may pose an important longer term threat to the nation's welfare.

Major Private Insurers Prospectively Manage Potential Increases in Catastrophic Risk Associated with Climate Change

Extreme weather events pose a unique financial threat to private insurers' financial success because a single event can cause insolvency or a precipitous drop in earnings, liquidation of assets to meet cash needs, or a downgrade in the market ratings used to evaluate the soundness of companies in the industry. To prevent these disruptions, the American Academy of Actuaries (AAA)—the professional society that establishes, maintains, and enforces standards of qualification, practice, and conduct for actuaries in the United States—has outlined a five-step process for private insurers to follow to manage their catastrophic risk. These steps include the following:

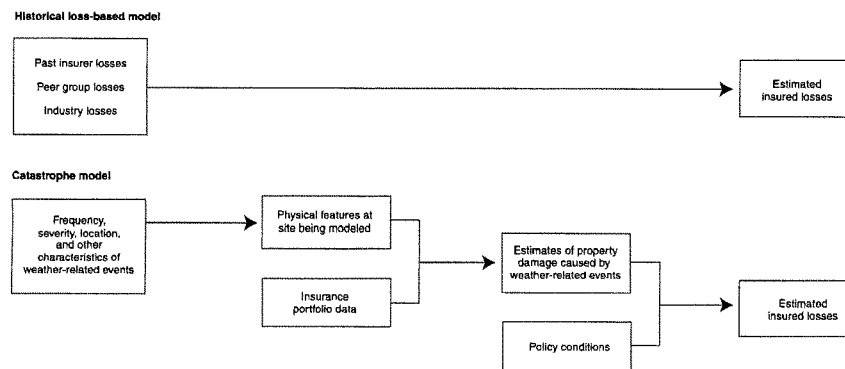
- identifying catastrophic risk appetite by determining the maximum potential loss they are willing to accept;
- measuring catastrophic exposure by determining how vulnerable their total portfolio is to loss, both in absolute terms and relative to the company's risk management goals;
- pricing for catastrophic exposure by setting rates to collect sufficient premiums to cover their expected catastrophic loss and other expenses;
- controlling catastrophic exposure by reducing their policies in areas where they have too much exposure, or transferring risk using reinsurance or other mechanisms; and
- evaluating their ability to pay claims by determining the sufficiency of their financial resources to cover claims in the event of a catastrophe.

Additionally, insurers monitor their exposure to catastrophic weather-related risk using sophisticated computer models called "catastrophe models."³⁴ AAA emphasizes the shortcomings of estimating future catastrophic risk by extrapolating solely from historical losses and

³⁴There are three main catastrophe modeling firms: AIR Worldwide, Risk Management Solutions, and EQECAT. Although many of the insurers we interviewed use models from these firms, two of the eleven insurers have developed their own catastrophe models.

endorses catastrophe models as a more rigorous approach.³⁵ Catastrophe models incorporate the underlying trends and factors in weather phenomena and current demographic, financial, and scientific data to estimate losses associated with various weather-related events. According to an industry representative, catastrophe models assess a wider range of possible events than the historical loss record alone. These models simulate losses from thousands of potential catastrophic weather-related events that insurers use to better assess and control their exposure and inform pricing and capital management decisions. Figure 10 illustrates the difference between estimating future catastrophic losses using historical data versus catastrophe models.

Figure 10: Modeling Potential Catastrophe Losses



Sources: Adapted from the American Academy of Actuaries and Towers Perrin.

³⁵American Academy of Actuaries, *Catastrophe Exposures and Insurance Industry Catastrophe Management Practices* (Washington, D.C.: American Academy of Actuaries, June 10, 2001), http://www.actuary.org/pdf/casualty/catastrophe_061001.pdf (downloaded Jan. 3, 2007), 10-12.

To determine what major private insurers are doing to estimate and prepare for risks associated with potential changes in climate arising from natural or human factors, we contacted 11 of the largest private insurers operating in the U.S. property casualty insurance market. Representatives from each of the 11 major insurers we interviewed told us they use catastrophe models that incorporate a near-term higher frequency and intensity of hurricanes. Of the 11 private insurers, 6 specifically attributed the higher frequency and intensity of hurricanes to the Atlantic Multidecadal Oscillation, which—according to NOAA—is a 20- to 40-year climatic cycle of fluctuating temperatures in the north Atlantic Ocean. The remaining 5 insurers did not elaborate on the elements of climate change driving the differences in hurricane characteristics.

Industry reports indicate that insurance companies' perception of increased risk from hurricanes has prompted them to reduce their near-term catastrophic exposure, in both reinsurance and primary insurance coverage along the Gulf Coast and eastern seaboard. For example, a recent industry analysis from a leading insurance broker reported that reinsurance coverage is substantially limited in the southeastern United States and that reinsurance prices have more than doubled from 2005 to 2006, following a record-setting hurricane season.³⁶ According to the Insurance Information Institute, a leading source of information about the insurance industry, primary insurance companies have also raised prices in coastal states to cover rising reinsurance costs.³⁷ Additionally, a recent report co-authored by a major international insurance company cites several examples of large primary insurers either limiting coverage or

³⁶Guy Carpenter, *The World Catastrophe Reinsurance Market: Sleep Peaks Overshadow Plateaus* (New York, N.Y.: Guy Carpenter, September 2006), <http://www.guycarp.com/portal/extranet/insights/reports.html?vid=30> (downloaded Jan. 3, 2007).

³⁷Insurance Information Institute, *Catastrophes: Insurance Issues* (New York, N.Y.: Insurance Information Institute, November 2006), <http://www.iii.org/media/hottopics/insurance/xxx/> (downloaded Jan. 3, 2007).

withdrawing from vulnerable areas such as Florida,³⁸ the Gulf Coast, and Long Island.³⁹

As private insurers limit their exposure, catastrophic risk is transferred to policyholders and the public sector. Insurance companies transfer risk to policyholders by increasing premiums and deductibles, or by setting lower coverage limits for policies. Insurers can also transfer risk to policyholders by passing along the mandatory participation costs of state-sponsored insurance plans.⁴⁰ For example, after the 2004 hurricane season, insurers assessed a surcharge of about 7 percent to every policyholder in Florida to recoup the cost of insurers' participation in the state-sponsored wind insurance plan. The public sector assumes management of weather-related risk at the local, state, and national level by providing disaster relief and recovery, developing mitigation projects, appropriating funds and, ultimately, providing insurance programs when private insurance markets are not sufficient or do not exist.

In addition to managing their aggregate exposure on a near-term basis, some of the world's largest insurers have also taken a long-term strategic approach to changes in catastrophic risk. For example, major insurance and reinsurance companies, such as Allianz, Swiss Re, Munich Re, and Lloyds of London, have published reports that advocate increased industry awareness of the potential risks of climate change and outline strategies to address the issue proactively. Moreover, 6 of the 11 private insurers we interviewed provided one or more additional activities they have undertaken when asked if their company addresses changes in climate through their weather-related risk management processes. These activities include monitoring scientific research (4 insurers), simulating the impact of a large loss event on their portfolios (3 insurers), and educating others

³⁸Allianz Group and World Wildlife Fund, *Climate Change and Insurance: An Agenda for Action in the United States* (New York, N.Y.: Allianz Group and World Wildlife Fund, October 2006), http://www.allianz.com/en/allianz_group/sustainability/insight/studies_and_reports/page1.html?hits=reports (downloaded Jan. 4, 2007).

³⁹The report notes that these decisions were due, in part, to state restrictions on rate increases that are designed to maintain insurance prices that are affordable, but may not accurately reflect the true potential for loss faced by the insured.

⁴⁰Thirty-one states have FAIR plans, and six southern states have state-sponsored wind insurance plans that pool resources from insurers to cover the cost of coverage for their participants.

in the industry about the risks of climate change (3 insurers), among others.

Furthermore, recent research on insurers' activities to address climate change outlines several other actions that private sector companies are taking, such as developing specialized policies and new products, evaluating risks to company stock investments, and disclosing to shareholders information about company-specific risks due to climate change.⁴¹ Additionally, concern over the potential impacts of climate change on the availability and affordability of private insurance has led state insurance regulators to establish a task force to formally address the issue. The report, issued by the NAIC, is expected to be published in the summer of 2007.

**Major Federal Insurers
Have Taken Little Action
to Prospectively Assess
Potential Increases in
Catastrophic Risk
Associated with Climate
Change**

The goals of the major federal insurance programs are fundamentally different from those of private insurers. Specifically, whereas private insurers stress the financial success of their business operations, the statutes governing the NFIP and FCIC promote affordable coverage and broad participation by individuals at risk. Although both programs manage risk within their statutory guidelines, unlike the private sector, neither program is required to limit its catastrophic risk strictly within the programs' ability to pay claims on an annual basis. One important implication of the federal insurers' risk management approach is that they each have little reason to develop information on their long-term exposure to the potential risk of increased low-frequency, high-severity weather events associated with climate change.

The statutes governing the NFIP and FCIC promote broad participation over financial self-sufficiency in two ways: (1) by offering discounted or subsidized premiums to encourage participation and (2) by making additional funds available during high-loss years.⁴² For example, discounted insurance premiums are available under the NFIP for some older homes situated within high flood risk areas where insurance would

⁴¹Evan Mills and Eugene Leconte, *From Risk to Opportunity: How Insurers Can Proactively and Profitably Manage Climate Change* (Boston, MA: Ceres, August 2006), http://www.ceres.org/pub/docs/Ceres_Insurance_Climate_%20Report_082206.pdf (downloaded Jan. 3, 2007), 34.

⁴²Note that the federal government covers most, but not all, payments in the event of loss under the FCIC—insurance providers also share in the risk, as described in detail in appendix III.

otherwise have been prohibitively expensive. FEMA is also authorized to borrow additional federal funds for the NFIP on an as-needed basis, subject to statutory limits, to cope with catastrophes.⁴³ One effect has been that the NFIP's exposure has expanded well beyond the ability to pay claims in high-loss years.

Similar to the discounted premiums offered by the NFIP, the FCIC's subsidized premiums are designed to make crop insurance available and affordable to as many participants as possible. For example, the FCIC is mandated to provide fully subsidized catastrophic coverage for producers in exchange for a minimal administrative fee, as well as partial subsidies for additional levels of coverage. Also like the NFIP, the FCIC is authorized to use additional federal funds on an as-needed basis during high-loss years—although, unlike the NFIP, the FCIC is not required to reimburse those additional funds.

Unlike the private sector, the NFIP and the FCIC can use additional federal funds, and so neither program is required to assess and limit its catastrophic risk strictly within its ability to pay claims on an annual basis. Instead, each program manages its risk to the extent possible, within the context of its broader purposes, in accordance with its authorizing statutes and implementing regulations.⁴⁴ For example, the FCIC uses coverage limits, exclusions, and premium rates to meet their statutory goal of a long-term loss ratio no greater than 1.075—including premium subsidies.⁴⁵ Although the program has experienced high-loss years that required additional federal funds, over time, these high-loss years have been offset by low-loss years, which have allowed the program to meet its goal and build reserves.⁴⁶

⁴³The Congress increased the NFIP's borrowing authority from \$1.5 billion to approximately \$20.8 billion in the wake of unprecedented losses associated with the 2005 hurricane season.

⁴⁴A detailed description of each program's risk management practices can be found in appendixes II and III for the NFIP and FCIC, respectively.

⁴⁵Loss ratio, an indicator used to evaluate program performance, is calculated by dividing claims paid by total premiums collected. A loss ratio greater than 1.00 indicates that the program paid more in claims than was collected in premiums.

⁴⁶The FCIC's average loss ratio from 1995 through 2005 was 0.91. From 1981 through 1994, it was 1.47. See appendix III for more information on the FCIC's performance.

By developing a goal to generate sufficient revenue to pay for an average loss year, the NFIP has also been able to generate a surplus in low-loss years despite borrowing funds in high-loss years. In the past, the program has been able to repay borrowed funds with interest to the Department of the Treasury, however, it is unlikely FEMA will be able to repay the nearly \$21 billion borrowed following the 2005 hurricane season based on the program's current premium income.

Although neither program faces the potential of financial ruin like the private sector, both programs have occasionally attempted to estimate their aggregate losses from potential catastrophic events. For example, FCIC officials stated that they had modeled past events, such as the 1993 Midwest floods, using current participation levels to inform negotiations with private crop insurers over reinsurance terms. NFIP and FCIC officials explained that these efforts were informal exercises and were not performed on a regular basis. FCIC officials also said they use a hurricane model developed by NOAA to inform pricing decisions for some commodities such as citrus crops, according to FCIC officials. However, unlike the catastrophic risk faced by private insurers, hurricane damages have not been a primary source of crop insurance claims.

According to NFIP and FCIC officials, their risk management processes adapt to near-term changes in weather as they affect existing data. As one NFIP official explained, NFIP is designed to assess and insure against current—not future—risks. Over time, agency officials stated, this process has allowed their programs to operate as intended. However, unlike the private sector, neither program has conducted an analysis to assess the potential impacts of an increase in the frequency or severity of weather-related events on their program operations over the near- or long-term.

Information on Federal Agencies' Long-term Exposure to Catastrophic Risk Could Better Inform Congressional Decision Making

While comprehensive information on federal insurers' long-term exposure to catastrophic risk associated with climate change may not inform the NFIP's or FCIC's annual operations, it could nonetheless provide valuable information for the Congress and other policymakers who need to understand and prepare for fiscal challenges that extend well beyond the two programs' near-term operational horizons. We have highlighted the need for this kind of strategic information in recent reports that have expressed concern about the looming fiscal imbalances facing the nation. In one report, for example, we observed that, "Our policy process will be

challenged to act with more foresight to take early action on problems that may not constitute an urgent crisis but pose important long-term threats to the nation's fiscal, economic, security, and societal future."⁴⁷ The prospect of increasing program exposure, coupled with expected increases in frequency and severity of weather events associated with climate change, would appear to pose such a problem.

Agency officials identified several challenges that could complicate their efforts to assess these impacts at the program level. Both NFIP and FCIC officials stated there was insufficient scientific information on projected impacts at the regional and local levels to accurately assess their impact on the flood and crop insurance programs. However, members of the insurance industry have analyzed and identified the potential risks climate change poses, despite similar challenges. Moreover, as previously discussed, both the IPCC and CCSP are expected to release significant assessments of the likely effect of increasing temperatures on weather events in coming months.

The experience of many private insurers, who must proactively respond to long-term changes in weather-related risk to remain solvent, suggests the kind of information that might be developed to help congressional and other policymakers in assessing current and alternative strategies. Specifically, to help ensure their future viability, a growing number of private insurers are actively incorporating the potential for climate change into their strategic level analyses. In particular, some private insurers have run a variety of simulation exercises to determine the potential business impact of an increase in the frequency and severity of weather events. For example, one insurer simulated the impact of large weather events occurring simultaneously. A similar analysis could provide the Congress with valuable information about the potential scale of losses facing the NFIP and FCIC in coming decades, particularly in light of the programs' expansion since 1980.

Conclusions

Recent assessments by leading scientific bodies provide sufficient cause for concern that climate change may have a broad range of long-term consequences for the United States and its citizens. While a number of key uncertainties regarding the timing, location, and magnitude of impacts

⁴⁷GAO, *21st Century Challenges: Reexamining the Base of the Federal Government*, GAO-05-325SP (Washington, D.C.: February 2005), 77.

remain, climate change has implications for the fiscal health of the federal government, which already faces other significant challenges in meeting its long-term fiscal obligations. NFIP and FCIC are two major federal programs which, as a consequence of both future climate change and substantial growth in exposure, may see their losses grow by many billions of dollars in coming decades.

We acknowledge that to carry out their primary missions, these public insurance programs must focus on the near-term goals of ensuring affordable coverage for individuals in hazard-prone areas. Nonetheless, we believe the two programs are uniquely positioned to provide strategic information on the potential impacts of climate change—information that would be of value to key decision makers charged with such a long-term focus. Most notably, in exercising its oversight responsibilities, the Congress could use such information to examine whether the current structure and incentives of the federal insurance programs adequately address the challenges posed by potential increases in the frequency and severity of catastrophic weather events. While the precise content of these analyses can be debated, the activities of many private insurers already suggest a number of strong possibilities that may be applicable to assessing the potential implications of climate change on the federal insurance programs.

Recommendation for Executive Action

We recommend that the Secretary of Agriculture and the Secretary of Homeland Security direct the Administrator of the Risk Management Agency and the Under Secretary of Homeland Security for Emergency Preparedness to analyze the potential long-term implications of climate change for the Federal Crop Insurance Corporation and the National Flood Insurance Program, respectively, and report their findings to the Congress. This analysis should use forthcoming assessments from the Climate Change Science Program and the Intergovernmental Panel on Climate Change to establish sound estimates of expected future conditions. Key components of this analysis may include: (1) realistic scenarios of future losses under anticipated climatic conditions and expected exposure levels, including both potential budgetary implications and consequences for continued program operation and (2) potential mitigation options that each program might use to reduce their exposure to loss.

**Agency Comments
and Our Evaluation**

We provided a draft of this report to the Departments of Agriculture (USDA), Commerce, Energy, and Homeland Security (DHS) for their review. DHS agreed via email with the report's recommendation, noting that conducting an assessment of the impact of climate change beyond FEMA's current statistical modeling (which is based on historical loss experience) could be helpful if resources were available to pursue such an analysis.

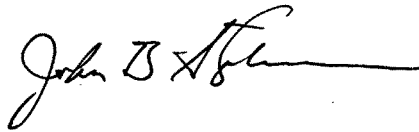
USDA also agreed with the report's recommendation, and commented on the presentation of several findings. (See app. V for the letter from the Under Secretary for Farm and Foreign Agricultural Services and GAO's point-by-point response.) In particular, USDA disagreed that it had thus far taken little action to prospectively assess potential increases in catastrophic risk associated with climate change. USDA explained that RMA does assess both the current and long-term exposure of the crop insurance program to catastrophic weather events, noting specifically that RMA (1) updates and publishes total program liability on a weekly basis and (2) estimates expected changes in liability up to 10 years ahead through its baseline projections. We acknowledge these activities, but believe it is important to note that they are limited in scope, focusing almost exclusively on retrospective measures of performance and not on the potential for increasingly frequent and intense weather-related events. These events, including drought and heavy precipitation events, are the key events acknowledged by USDA as posing catastrophic risk to the crop insurance program. Moreover, other RMA efforts to capture changes in weather-related risk rely on data reflecting what has been experienced in the past, not on what could be experienced in the future.

The Department of Commerce neither agreed nor disagreed with the report's findings, but instead offered several comments on the presentation of several issues in the draft (particularly the depth in which several issues are discussed) as well as technical comments. We have incorporated these comments as appropriate and address them in detail in appendix VI. Notably, the Department of Commerce underscored the vulnerability of high-risk coastal development, stating that such vulnerabilities will only be amplified by climate change-related increases in the frequency or severity of weather-related events.

Finally, the Department of Energy elected not to provide comments on the draft.

As agreed with your offices, unless you publicly announce the contents of this report earlier, we plan no further distribution until 30 days from the report date. At that time, we will send copies of this report to the Secretaries of Agriculture, Commerce, Energy, and Homeland Security, as well as other interested parties. We also will make copies available to others upon request. In addition, the report will be available at no charge on the GAO Web site at <http://www.gao.gov>.

If you or your staff has any questions regarding this report, please contact me at (202) 512-3841 or stephensonj@gao.gov. Contact points for our Offices of Congressional Relations and Public Affairs may be found on the last page of this report. Key contributors are listed in appendix VII.



John B. Stephenson
Director, Natural Resources and Environment

Appendix I: Scope and Methodology

We were asked us to (1) describe what is known about how climate change might affect insured and uninsured losses, (2) determine insured losses incurred by major federal agencies and private insurers and reinsurers resulting from weather-related events, and (3) determine what major federal agencies and private insurers and reinsurers are doing to assess and manage the potential risk of increased losses due to changes in the frequency and severity of weather-related events associated with climate change.

Scientific Literature

To address the first objective, we reviewed and summarized existing literature from significant policy-oriented scientific assessments from reputable international and national research organizations including the Intergovernmental Panel on Climate Change, National Academy of Sciences, and the multifederal agency U.S. Climate Change Science Program, as specified in table 3. It was beyond the scope of this report to independently evaluate the results of these studies.

Table 3: Key Policy-Oriented Scientific Assessments Reviewed by GAO

Organization	Publication
Intergovernmental Panel on Climate Change (IPCC)	<ul style="list-style-type: none"> • <i>Climate Change 2007: The Physical Science Basis, Summary for Policymakers</i> (2007) • <i>Climate Change 2001: Synthesis Report</i> (2001) • <i>Climate Change 2001: The Scientific Basis</i> (2001) • <i>Climate Change 2001: Impacts, Adaptation & Vulnerability</i> (2001)
Climate Change Science Program (CCSP)	<ul style="list-style-type: none"> • <i>Temperature Trends in the Lower Atmosphere: Steps for Understanding and Reconciling Differences, Synthesis and Assessment Product 1.1</i> (2006)
National Academy of Sciences (NAS)	<ul style="list-style-type: none"> • <i>Surface Temperature Reconstructions for the Last 2,000 Years</i> (2006) • <i>Understanding and Responding to Climate Change: Highlights of National Academies Reports</i> (2006) • <i>Radiative Forcing of Climate Change: Expanding the Concept and Addressing Uncertainties</i> (2005) • <i>From Climate to Weather: Impacts on Society and Economy—Summary of a Forum, June 28, 2002, Washington, D.C.</i> (2003) • <i>Understanding Climate Change Feedbacks</i> (2003) • <i>Abrupt Climate Change: Inevitable Surprises</i> (2002) • <i>Climate Change Science: An Analysis of Some Key Questions</i> (2001)

Source: GAO.

Note: Publication year follows publication title in parentheses.

Insured Loss Data

To address the second objective, we analyzed insured loss data from January 1, 1980, through December 31, 2005, from the Federal Emergency Management Agency (FEMA) for the National Flood Insurance Program (NFIP); the Department of Agriculture's Risk Management Agency (RMA) for the Federal Crop Insurance Corporation (FCIC); and the Property Claim Services (PCS) for private property insurance. Through electronic testing and other means, we assessed the reliability of each of the data sets to determine whether the data were sufficiently reliable for our purposes. Specifically, we interviewed the sources for each of the data sets to gather information on how records were collected, processed, and maintained. Because not all catastrophes are weather-related, we excluded all events attributable to terrorist acts, tsunamis, earthquakes, and other nonweather-related losses, based on discussions with the data provider. To adjust for the general effects of inflation over time we used the chain-weighted gross domestic product price index to express dollar amounts in inflation-adjusted 2005 dollars. We reviewed any changes in data collection methodologies that have occurred over time, and evaluated the effect of any changes on our ability to report losses. We believe that these data are sufficiently reliable for the purpose of describing insured losses. We note, however, that these data likely understate the actual insured losses.

PCS

PCS data are estimates of insured losses, or claims paid by private insurance companies, for catastrophe loss events for the 50 states, as well as the District of Columbia, Puerto Rico, and the U.S. Virgin Islands. PCS defines "catastrophes" as events that, in their estimation, affect a significant number of policyholders and that cause more than \$25 million in damages. To identify catastrophes, PCS reviews daily weather reports and wire service news stories to determine if potentially damaging weather has occurred anywhere in the nation. PCS contacts adjusters, insurance claims departments, or public officials to gather additional information about the scope of damage and potential insured losses for events. Damages associated with a single storm event are grouped together as a single catastrophe, even if they are separated by distance. PCS obtains its insured loss data from information reported by insurers. PCS estimates include losses under personal and commercial property insurance policies covering real property, contents, business interruption, vehicles, and boats. PCS estimates also typically include amounts paid by state wind pools, joint underwriting associations, and certain other residual market mechanisms, such as Fair Access to Insurance Requirements (FAIR) plans. However, PCS estimates do not include damage to uninsured or self-insured property including uninsured publicly

Appendix I: Scope and Methodology

owned property and utilities; losses involving agriculture, aircraft and property insured under NFIP or certain specialty lines (such as ocean marine), or loss adjustment expenses. Generally, PCS finalizes its estimates within 6 months of the occurrence of a PCS-identified catastrophe, according to company documents. PCS does not independently verify or audit the accuracy of the reported losses. Thus, loss totals are the best estimates of primary insurers compiled by PCS professionals, and may or may not accurately and completely reflect actual industry-insured losses. Nevertheless, PCS has determined their data to be very close to other independent estimates. PCS officials said that, when compared with state insurance commissioners' estimates based on all loss data from insurance companies following particularly large catastrophes, PCS data are within 3 to 5 percent of actual amounts. For the data used in our review, company officials told us that most estimates included in the data provided to us are final, except the 2005 hurricanes.

NFIP

NFIP data are actual claim payment totals, not estimated amounts. NFIP data represent the budget outlays that satisfy claims submitted by NFIP policyholders to their participating program companies. The companies report these data to the NFIP on a monthly basis. According to a senior program official, the Department of Homeland Security performs periodic audits of company records reported to NFIP. Although nearly all claims in the NFIP data we reviewed are considered closed by the agency (and, therefore, final), a small portion of claims associated with 2004 and 2005 hurricane season are not reflected in data we reviewed, according to the agency's database manager.

FCIC

The loss data provided by FCIC represent the actual amount paid to policyholders, not estimates. FCIC data represent the budget outlays that satisfy claims submitted by policyholders to their participating insurance companies. Participating insurance companies submit claims information for processing through a computerized validation system. Automated processing of claims information occurs annually for a period going back 5 years, but agency officials said that indemnities may have changed after automated processing closed in very specific cases, such as settlement of litigation or arbitration cases.

Identifying Insured Losses Associated with Hurricanes	To determine the insured losses associated with major and nonmajor hurricanes, we identified losses associated with hurricanes in both the PCS and NFIP data sets. We used the name and year of each hurricane to link loss records to information from the National Oceanic and Atmospheric Administration (NOAA) on the peak intensity of each hurricane at or near landfall.
Independent Studies	We supplemented our descriptive analysis with a review of existing literature and the views of subject area experts on the primary drivers of changes in the weather-related loss record in general. Given the data challenges faced by natural hazard researchers, the data sets used in these studies are generally different.
Interviews with Major Insurers	To address the third objective, we conducted semistructured interviews with officials from the NFIP, RMA, and a nonprobability sample of the largest private property/casualty primary insurance and reinsurance companies as defined by national market share. In the private sector, 11 out of 14 potential respondents elected to participate, drawing from companies in the United States, Europe, and Bermuda. Although the results from this sample should not be generalized to represent all insurance companies, the companies we interviewed represent about 45 percent of the total domestic insurance market. In developing our semistructured questionnaire, we reviewed existing literature on risk assessment and management practices, GAO guidance on risk management, and interviewed subject area experts knowledgeable about the insurance industry and federal insurance programs. Insurance industry experts included representatives from insurance brokers, catastrophe modeling firms, industry associations, the Insurance Information Institute, and academics. To reduce response error, we pretested our questions for clarity, relevancy, and sensitivity with representatives from several insurance industry associations, including the American Insurance Association, the National Association of Mutual Insurance Companies, the Property Casualty Insurance Association of America, and the Reinsurance Association of America. On the basis of feedback from the pretests, we modified the questions as appropriate. We distinguished proactive risk management responses to climate change from other responses according to whether insurers indicated that they were adjusting their activities based on projected changes in underlying weather trends rather than adapting only as changes in weather conditions reveal themselves in historical data. During our interviews, some private insurers attributed their actions to changes in the Atlantic Multidecadal Oscillation (AMO).

Because NOAA considers the AMO to be a climatic cycle, we categorized the actions of these insurers as responding to climate change.

We asked the participating federal agencies and private insurance and reinsurance companies to identify individuals knowledgeable about their weather-related risk management practices for our interviews. Based on these criteria, we spoke with a range of senior officials and representatives that included actuaries, underwriters, catastrophe specialists, regulatory affairs and counsel. During the interviews, we asked a series of questions about risk assessment and management practices for weather-related risk, significant drivers of changes to past and future weather-related risk, respondents' perception of and actions to address climate change in their risk management processes, and risk management best practices that might be transferable to federal insurers.

We also interviewed officials from rating agencies, catastrophe modeling firms, insurance industry associations, the National Association of Insurance Commissioners, and universities to provide additional context for respondents' statements. To supplement our interviews, we reviewed documentary evidence of risk management practices from federal agencies, studies from subject area experts, industry reports, publicly available insurance company documents, and previous work from GAO to provide context and support for respondents' statements.

We performed our work between February 2006 and January 2007 in accordance with generally accepted government auditing standards.

Appendix II: National Flood Insurance Program

Floods are the most common and destructive natural disaster in the United States. According to NFIP statistics, 90 percent of all natural disasters in the United States involve flooding. Because of the catastrophic nature of flooding and the inability to adequately predict flood risks, private insurance companies largely have been unwilling to underwrite and bear the risk of flood insurance. As a result, flooding is generally excluded from homeowner policies that cover damages from other types of losses, such as wind, fire, and theft.

The NFIP was established in 1968 to address uninsured losses due to floods. Prior to the establishment of the NFIP, structural flood controls on rivers and shorelines (e.g., dams and levees) and disaster assistance for flood victims were the federal government's primary tools for addressing floods. The Mississippi River Commission, created in 1879 to oversee the development of a levee system to control the river's flow, was the first of these federal efforts to address flooding. Due to the limited effectiveness of structural flood controls, continued development in flood-prone areas, and a desire to reduce postdisaster assistance payments, the Congress began examining the feasibility of prefunding flood disaster costs via federal insurance in the 1950s. Although the first federal flood insurance program authorized by the Congress in 1956 failed due to lack of funding, a series of powerful hurricanes and heavy flooding on the Mississippi River in the early 1960s prompted the Congress to revisit the issue and direct the Department of Housing and Urban Development (HUD) to conduct a feasibility study of a federal flood insurance program. The 1966 HUD feasibility study helped lead to the passage of the National Flood Insurance Act of 1968,¹ which authorized the creation of the NFIP.²

Since its inception, the NFIP has undergone several major changes in response to significant flood events. Hurricane Agnes in 1972 led to the mandatory flood insurance requirements on certain persons in flood-prone areas included in the Flood Disaster Protection Act of 1973, which also significantly increased coverage limits in a further effort to increase participation.³ Following the Midwest floods of 1993, the Congress enacted the National Flood Insurance Reform Act of 1994, which strengthened

¹Pub. L. No. 90-448, 82 Stat. 573.

²Senate Committee on Banking and Currency, *Insurance and Other Programs for Financial Assistance to Flood Victims*, 89th Cong., 2d Sess., 1966, Committee Print.

³Pub. L. No. 93-234, 87 Stat. 975 (1973).

lender compliance requirements with mandatory purchase provisions requiring mortgage-holders in flood-prone areas to purchase flood insurance and prohibited flood disaster assistance for properties that had not maintained their mandatory coverage.⁴ In 2004, recognizing that losses from repetitive flooding on some insured properties was straining the financial condition of the NFIP, the Congress passed the Flood Insurance Reform Act of 2004, which provided NFIP with additional tools to reduce the number and financial impact of these properties.⁵ These tools include: increased authorization of funding for mitigation of repetitive loss properties and statutory authority to penalize policyholders who refuse government assistance to mitigate certain structures that have been substantially or repetitively damaged by flooding, among others. Recently, the Congress has begun exploring additional changes to the NFIP to address the financial and operational challenges presented by the 2005 hurricane season.

How the Program Works

FEMA, within the Department of Homeland Security (DHS), is responsible for the oversight and management of the NFIP.⁶ Under this program, the federal government assumes the liability for covered losses and sets rates and coverage limitations, among other responsibilities.

The NFIP combines three elements: (1) property insurance for potential flood victims, (2) mapping to identify the boundaries of the areas at highest risk of flooding, and (3) incentives for communities to adopt and enforce floodplain management regulations and building standards (such as elevating structures) to reduce future flood damage. The effective integration of all three of these elements is needed for the NFIP to achieve its goals of

⁴Pub. L. No. 103-325, 108 Stat. 2255 (1994).

⁵The Bunning-Bereuter-Blumenauer Flood Insurance Reform Act of 2004, Pub. L. No. 108-264, 118 Stat. 712.

⁶In March 2003, FEMA and its approximately 2,500 staff became part of the Department of Homeland Security (DHS). Most of FEMA—including its Mitigation Division, which is responsible for administering the NFIP—is now part of the department's Emergency Preparedness and Response Directorate. However, FEMA retained its name and individual identity within the department. Under a reorganization plan proposed by the current Secretary of DHS, the Emergency Preparedness and Response Directorate would be abolished, and FEMA would report directly to the Undersecretary and Secretary of DHS.

Appendix II: National Flood Insurance Program

- providing property flood insurance coverage for a high proportion of property owners who would benefit from such coverage,
- reducing taxpayer-funded disaster assistance when flooding strikes, and
- reducing flood damage through floodplain management and the enforcement of building standards.

Over 20,000 communities across the United States and its territories participate in the NFIP by adopting and agreeing to enforce state and community floodplain management regulations to reduce future flood damage. In exchange, the NFIP makes federally backed flood insurance available to homeowners and other property owners in these communities. As of 2005, the program had over 4.9 million policyholders, representing about \$875 billion in assets. Homeowners with mortgages from federally regulated lenders on property in communities identified to be in high flood risk areas are required to purchase flood insurance on their dwellings. Optional, lower cost coverage is also available under the NFIP to protect homes in areas of low to moderate risk. The mandated coverage protects homeowners' dwellings only; to insure furniture and other personal property items against flood damage, homeowners must purchase separate NFIP personal property coverage.

Prior to the 2005 hurricanes, NFIP had paid about \$14.6 billion in flood insurance claims, primarily from policyholder premiums that otherwise would have been paid through taxpayer-funded disaster relief or borne by home and business owners themselves. According to FEMA, every \$3 in flood insurance claims payments saves about \$1 in disaster assistance payments, and the combination of floodplain management and mitigation efforts save about \$1 billion in flood damage each year.

To make flood insurance available on "reasonable terms and conditions to persons who have need for such protection,"⁴² the NFIP strikes a balance between the scope of the coverage provided and the premium amounts required to provide that coverage. Policy coverage limits arise from statute and regulation, including FEMA's standard flood insurance policy (SFIP), which is incorporated in regulation and issued to policyholders when they purchase flood insurance. As of 2006, FEMA estimated 26 percent of its policies were subsidized, and 74 percent were charged "full-risk premium"

⁴²U.S.C. § 4001(a)(4).

rates. In 1981, FEMA set the operating goal of generating premiums at least sufficient to cover losses and expenses relative to the "historical average loss year." However, the heavy losses from the 2005 hurricane season may increase the historical average loss year to a level beyond the expected long-term average. In light of this, FEMA is currently revisiting the use of the historical average loss year as a premium income target.

Risk Assessment Practices

The NFIP uses hydrologic models to estimate loss exposure in flood-prone areas, based on the method outlined in the 1966 HUD report, *Insurance and Other Programs for Financial Assistance to Flood Victims*.⁸ These techniques of analysis were first developed by hydrologists and hydraulic engineers to determine the feasibility of flood protection.

The hydrologic method uses available data on the occurrence of floods and flood damages to establish both the frequency of flood recurrence and the damage associated with a flood of a given height. The NFIP augments available flood data with detailed engineering studies, simulations, and professional judgment to establish the scientific and actuarial basis for its risk assessment process and rates.

Flood-elevation frequency data for specific communities is published in Flood Rate Insurance Maps, which differentiate areas based on their flood risk. These maps are the basis for setting insurance rates, establishing floodplain management ordinances, and identifying properties where flood insurance is mandatory.

To estimate expected annual losses and determine the basis for rate setting, NFIP combines flood-elevation frequency data with depth-damage calculations to estimate a range of flood probabilities and associated damages. Each possible flood is multiplied by the expected damage should such a flood occur, and then each of these is added together. The total of each possible flood's damage provides an expected per annum percentage of the value of property damage due to flooding. This expected damage can then be converted to an expected loss per \$100 of property value covered by insurance. This per annum expected loss provides the fundamental component of rate setting. Rates are also adjusted to

⁸Senate Committee on Banking and Currency, *Insurance and Other Programs for Financial Assistance to Flood Victims*.

Appendix II: National Flood Insurance Program

incorporate additional expense factors, such as adjustment costs and deductibles.

Program Funding

To the extent possible within the context of its broader purposes, the NFIP is expected to pay operating expenses and flood insurance claims with premiums collected on flood insurance policies rather than with tax dollars. However, as we have reported, the program is not actuarially sound by design because the Congress authorized subsidized insurance rates to be made available for policies covering certain structures to encourage communities to join the program. As a result, the program does not collect sufficient premium income to build reserves to meet the long-term future expected flood losses.⁹ FEMA has statutory authority to borrow funds from the Department of the Treasury to keep the NFIP solvent.¹⁰ Prior to the 2005 hurricane season, FEMA had exercised its borrowing authority four times, when losses exceeded available fund balances. For example, FEMA borrowed \$300 million to pay an estimated \$1.8 billion on flood insurance claims resulting from the 2004 hurricane season. Following hurricanes Katrina, Rita, and Wilma, FEMA estimates it will need to borrow nearly \$21 billion dollars to cover outstanding claims. Although FEMA has repaid borrowed funds with interest in the past, FEMA does not expect to be able to meet the \$1 billion in annual interest payments for these borrowed funds.

⁹GAO, *Flood Insurance: Information on the Financial Condition of the National Flood Insurance Program*, GAO-01-992T (Washington, D.C.: July 19, 2001).

¹⁰See 42 U.S.C. § 4016.

Appendix III: Federal Crop Insurance Corporation

In general, farm income is determined on the basis of farm production and prices, both of which are subject to wide fluctuations due to external factors. Because a substantial part of farming depends on weather, farm production levels can vary substantially on an annual basis. Commodity prices are also subject to significant swings due to supply and demand on the domestic and international markets. The Congress created FCIC in 1938 to administer a federal crop insurance program on an experimental basis to temper the weather effects of the dust bowl and the economic effects of the Great Depression.¹

The federal crop insurance program protects participating farmers against financial losses caused by droughts, floods, or other natural disasters. Until 1980, the federal crop insurance program was limited to major crops in the nation's primary production areas. The Federal Crop Insurance Act of 1980 expanded crop insurance both in terms of crops and geographic areas covered.² The expansion was designed to allow the disaster assistance payment program provided by the government under previous farm bills to be phased out. To encourage participation, the 1980 act required a 30 percent premium subsidy for producers who purchased coverage up to the 65 percent yield level. Despite the subsidies, program participation remained low, and the Congress authorized several ad hoc disaster payments between 1988 and 1993. Congressional dissatisfaction with the size and frequency of these payments prompted the Congress to pass the Federal Crop Insurance Reform Act of 1994, which mandated participation in the crop insurance program as a prerequisite for other benefits, including agriculture price support payments.³ The 1994 act also introduced catastrophic risk protection coverage, which compensated farmers for losses exceeding 50 percent of their average yield at 60 percent of the commodity price. Premiums for catastrophic risk protection coverage were completely subsidized, and subsidies for other coverage levels were also increased.

As part of the 1996 Farm Bill, the Congress created the Office of Risk Management under the U.S. Department of Agriculture (USDA), and USDA established RMA to administer the FCIC insurance programs, among other

¹Federal Crop Insurance Act, tit. V, 52 Stat. 72 (1938) (codified as amended at 7 U.S.C. §§ 1501-1524).

²Pub. L. No. 96-365, 94 Stat. 1312 (1980).

³Pub. L. No. 103-354, 108 Stat. 3178 (1994).

things.⁴ The Congress also required the creation of a revenue insurance pilot project and repealed the mandatory participation provision of the 1994 Act. However, participation in the crop insurance program has not necessarily precluded the need for further disaster assistance. For example, due to low commodity prices in 1997 and multiple years of natural disasters, the Congress enacted an emergency farm financial assistance package totaling almost \$6 billion in 1998, which included over \$2 billion in crop disaster payments, and an \$8.7 billion financial assistance package in 1999 that included \$1.2 billion in crop disaster payments.

In 2000, the Congress enacted the Agricultural Risk Protection Act, which further increased subsidies for insurance above the catastrophic risk protection coverage level, subsidized a portion of the cost of revenue insurance products, improved coverage for farmers affected by multiple years of natural disasters, required pilot insurance programs for livestock farmers, and authorized pilot programs for growers of other commodities not currently covered, gave the private sector greater representation on the FCIC Board of Directors, reduced eligibility requirements for permanent disaster payment programs for noninsured farmers, and provided new tools for monitoring and controlling program abuses, among other provisions.⁵ These changes required \$8.2 billion in additional spending from fiscal years 2001 through 2005.

How the Program Works

RMA has overall responsibility for supervising the federal crop insurance program, which it administers in partnership with private insurance companies. Insurance policies are sold and completely serviced through approved private insurance companies that have their losses reinsured by USDA. These companies share a percentage of the risk of loss or opportunity for gain associated with each insurance policy written. In addition, RMA pays companies a percentage of the premium on policies sold to cover the administrative costs of selling and servicing these policies. In turn, insurance companies use this money to pay commissions to their agents who sell the policies and fees to adjusters when claims are filed. RMA oversees the development of new insurance products and the expansion of existing insurance products to new areas to help farmers reduce the chance of financial loss.

⁴Pub. L. No. 104-127, 110 Stat. 888 (1996).

⁵Pub. L. No. 106-224, 114 Stat. 358 (2000).

The USDA determines whether the federal crop insurance program will insure a commodity on a crop-by-crop and county-by-county basis, based on farmer demand for coverage and the level of risk associated with the crop in the region, among other factors. Over 100 crops are covered; major crops such as grains are covered in almost every county where they are grown, and specialty crops such as fruit are covered in some areas. For many commodities, producers may also purchase revenue insurance. Based on commodity market prices and the producer's production history, producers are assigned a target revenue level. The producer receives a payment if their actual revenue falls short of the target level, whether the shortfall was due to low yield or low prices. Premiums for revenue insurance are subsidized at the same level as traditional crop insurance policies.

Farmers' participation in the federal crop insurance program is voluntary, but the federal government encourages it by subsidizing the insurance premiums. Participating farmers are assigned a "normal" crop yield based on their past production history and a commodity price based on estimated market conditions. The producer selects both the percentage of yield to be covered and the percentage of the commodity price received as payment if the producer's losses exceed the selected threshold. Premium prices increase as levels of yield and price coverage rise. However, all eligible producers can receive fully subsidized catastrophic risk protection coverage that pays producers for losses exceeding 50 percent of normal yield, at a level equal to 55 percent of the estimated market price, in exchange for a \$100 administrative fee. Producers who purchase this coverage can buy additional insurance at partially subsidized rates up to 85 percent of their yield and 100 percent of the estimated market price.

As an alternative, the Group Risk Plan provides coverage based on county yields rather than a producer's actual production history. If county yield falls below the producer's threshold yield (a percentage of the historical county yield), then the producer receives a payment.

Risk Assessment Practices

RMA's risk assessment/rate-setting methodology is complex because the risk of growing a particular crop varies by county, farm, and farmer. Because of all the possible combinations involved, hundreds of thousands of rates are in place. Each year, RMA follows a multistep process to establish rates for each crop included in the program. The process involves establishing base rates for each county crop combination and adjusting these basic rates for a number of factors, such as coverage and

production levels. In addition, rates are adjusted to account for the legislated limitations in price increases.

For each crop, RMA extracts data on counties' crop experience from its historical database. The data elements for each crop, crop year, and county include (1) the dollar amount of the insurance coverage sold, (2) the dollar amount of the claims paid, and (3) the average coverage level. The historical data are adjusted to the 65 percent coverage level (the most commonly purchased level of coverage) so that liability and claims data at different coverage levels can be combined to develop rates. Using the adjusted data, FCIC computes the loss-cost ratio for each crop in each county. The loss-cost ratio is calculated by dividing the total claim payments by the total insurance in force; the result is stated as a percentage.⁶ To reduce the impact a single year will have on the average loss-cost ratio of each county, RMA caps the adjusted average loss-cost ratio for any single year at 80 percent of all years.⁷ To establish the base rate for each county, the average for all the years since 1975 is calculated using the capped loss-cost ratios and a weighting process to minimize the differences in rates among counties.

Rates are further adjusted by: a disaster reserve factor, a surcharge for catastrophic coverage for each crop based on pooled losses at the state level,⁸ a prevented planting factor, farm divisions, crop type, and differences in both average yield and coverage levels.⁹

⁶For example, if the claims paid in 1 year totaled \$7.36 and the insurance in force was \$100, the loss-cost ratio is 7.36 percent. The percentage represents the rate that would need to be charged per \$100 of insurance coverage if total premiums are to equal the total claim payments for that year. In this example, the 7.36 percent indicates that a rate of \$7.36 was required per \$100 of insurance coverage sold.

⁷The excess of losses above the capped amount is pooled at the state level and reallocated to the counties. According to FCIC, this procedure is intended to reduce the variation of rates from one year to the next.

⁸The surcharge is established by pooling the amount of insurance in force and the claim payments for capped years with the highest loss-cost ratios in each county that were not factored into the county unloaded rates at the state level. These data are used to calculate a statewide surcharge for catastrophic coverage (pooled claims payments divided by pooled insurance in force). If the pooled losses at the state level exceed five points, the excess is returned to the counties and included in the county unloaded rate.

⁹Prevented planting factor adds a provision for losses due to crops that were never planted because of external factors not directly related to yield loss.

Program Funding

The crop insurance program is financed primarily through general fund appropriations and farmer-paid premiums. In addition to the premiums paid by producers, FCIC receives an annual appropriation to cover necessary costs for the program's premium subsidies, excess losses, delivery expenses, and other authorized expenses. According to USDA budget documents, for fiscal year 2005, insurance premium and administrative fee revenue from farmers was approximately \$2.1 billion, and gross claims equaled almost \$3.3 billion. Total government operating costs in fiscal year 2005 were approximately \$3 billion.

RMA is required to set crop insurance premiums at actuarially sufficient rates, defined as a long-run loss ratio target of no more than 1.075. From its initial expansion in 1981 through 1994, the crop insurance program had an average loss ratio of 1.47 and paid roughly \$3.2 billion in claims excess of subsidized premium income during that period.¹⁶ From 1995 to 2005, the program had an average loss ratio of 0.91, and collected roughly \$2.7 billion in subsidized premium excess of claims during that period. Excluding subsidies and measuring performance on the basis of a producer premium, from 1981 to 1994, the crop insurance program averaged a loss ratio of 1.93 and paid roughly \$5.2 billion in claims excess of producer premium over that period; from 1995 to 2005, the program averaged a loss ratio of 2.15 and paid roughly \$14.2 billion in claims excess of a producer premium during that period.

Generally, producers can purchase crop insurance to insure up to 85 percent of their normal harvest (yield), based on production history. In 2007, the USDA expects the FCIC to provide \$48 billion in risk protection on 287 million acres nationwide, which represents approximately 80 percent of the nation's acres planted to principal crops. The USDA estimates this level of coverage will cost the federal government \$4.2 billion in 2007.

¹⁶The Federal Crop Insurance Reform Act of 1994 mandated participation in the program to receive other commodity support payments, although this requirement was rescinded in 1996.

Appendix IV: Consensus Statement among Participants at 2006 Munich Re Workshop

Munich Re, one of the world's largest reinsurance companies, and the University of Colorado jointly convened an international workshop on climate change and disaster loss trends in May 2006 in Hohenkammer, Germany. The workshop brought together 32 experts in the fields of climatology and disaster research from 13 countries. White papers were prepared and circulated by 25 participants in advance of the workshop and formed the basis of the discussions. In the course of the event, participants developed a list of statements that each represent a consensus among participants on issues of research and policy as related to the workshop's two central organizing questions: (1) What factors account for increasing costs of weather related disasters in recent decades? and (2) What are the implications of these understandings, for both research and policy?

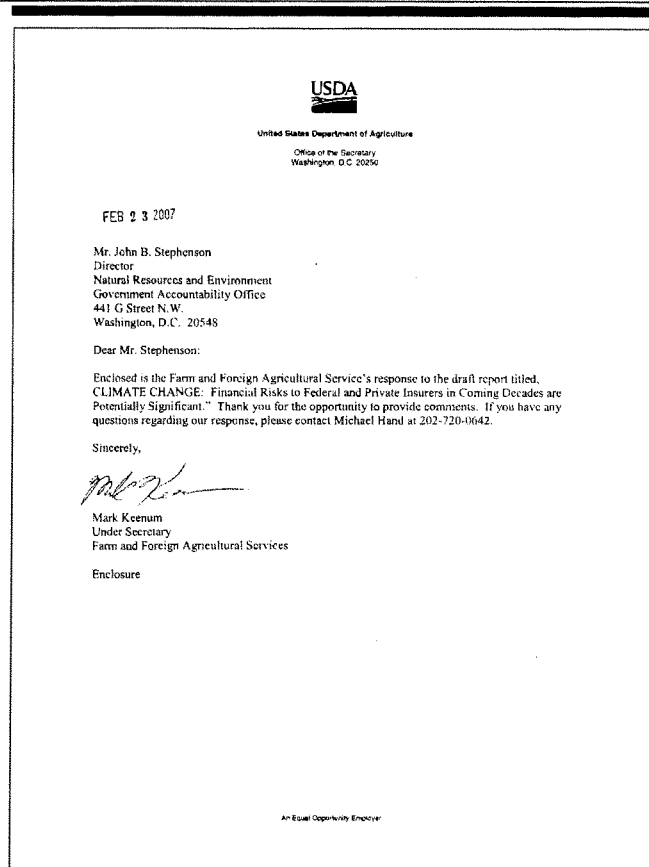
Consensus (unanimous) statements of the workshop participants:

1. Climate change is real, and has a significant human component related to greenhouse gases.
2. Direct economic losses of global disasters have increased in recent decades with particularly large increases since the 1980s.
3. The increases in disaster losses primarily result from weather related events, in particular storms and floods.
4. Climate change and variability are factors which influence trends in disasters.
5. Although there are peer reviewed papers indicating trends in storms and floods there is still scientific debate over the attribution to anthropogenic climate change or natural climate variability. There is also concern over geophysical data quality.
6. IPCC (2001) did not achieve detection and attribution of trends in extreme events at the global level.
7. High quality long-term disaster loss records exist, some of which are suitable for research purposes, such as to identify the effects of climate and/or climate change on the loss records.
8. Analyses of long-term records of disaster losses indicate that societal change and economic development are the principal factors responsible for the documented increasing losses to date.

9. The vulnerability of communities to natural disasters is determined by their economic development and other social characteristics.
10. There is evidence that changing patterns of extreme events are drivers for recent increases in global losses.
11. Because of issues related to data quality, the stochastic nature of extreme event impacts, length of time series, and various societal factors present in the disaster loss record, it is still not possible to determine the portion of the increase in damages that might be attributed to climate change due to greenhouse gas emissions.
12. For future decades the IPCC (2001) expects increases in the occurrence and/or intensity of some extreme events as a result of anthropogenic climate change. Such increases will further increase losses in the absence of disaster reduction measures.
13. In the near future the quantitative link (attribution) of trends in storm and flood losses to climate changes related to greenhouse gas emissions is unlikely to be answered unequivocally.
14. Adaptation to extreme weather events should play a central role in reducing societal vulnerabilities to climate and climate change.
15. Mitigation of greenhouse gas emissions should also play a central role in response to anthropogenic climate change, though it does not have an effect for several decades on the hazard risk.
16. We recommend further research on different combinations of adaptation and mitigation policies.
17. We recommend the creation of an open-source disaster database according to agreed upon standards.
18. In addition to fundamental research on climate, research priorities should consider needs of decision makers in areas related to both adaptation and mitigation.
19. For improved understanding of loss trends, there is a need to continue to collect and improve long-term and homogenous data sets related to both climate parameters and disaster losses.
20. The community needs to agree upon peer reviewed procedures for normalizing economic loss data.

Appendix V: Comments from the U.S. Department of Agriculture

Note: GAO comments supplementing those in the report text appear at the end of this appendix.



Appendix V: Comments from the U.S.
Department of Agriculture

U.S. Department of Agriculture
Response to the
U.S. Government Accountability Office Draft Report GAO-07-285
"CLIMATE CHANGE: Financial Risks to Federal and Private Insurers in Coming
Decades are Potentially Significant"

February 8, 2007

Weather-related events have caused billions of dollars in damage over the past decade. GAO examined actions taken by private and Federal insurers to address the potential increase in losses. As a result of the study, GAO recommends that the United States Department of Agriculture (USDA), specifically the Risk Management Agency (RMA), analyze the potential long-term implications of climate change using forthcoming assessments from the Intergovernmental Panel on Climate Change to establish sound estimates of expected future conditions.

USDA Response

USDA is in general agreement with GAO's recommendation.

Specific Comments

Although USDA agrees with GAO's recommendation, we do not agree with some of the conclusions drawn within the report.

Much of the focus of this report is with losses related to coastal weather events, especially hurricanes. However, the main cause of catastrophic losses for the crop insurance program is drought in the nation's interior. This is why the loss experience of the crop insurance program is distinct from the loss experience described in the report for the National Flood Insurance Program and property and casualty losses for private insurers.

The increase in crop insurance indemnities over time reflects the rapid growth of the crop insurance program, not an increase in either the frequency and/or severity of catastrophic weather events. In fact, the severity of loss for the crop insurance program, as measured by the loss ratio, has been generally lower in the 1990's and 2000's than in the 1980's. Thus, if anything, the frequency and severity of catastrophic loss events for the crop insurance program appears to be decreasing.

USDA does not agree that it has "taken little action to prospectively assess potential increases in catastrophic risk associated with climate change." RMA tracks total program liability – a definitive measure of the total value at risk from climatic weather events. This number is updated on a weekly basis and is available on RMA's public website.

See comment 1.

See comment 2.

See comment 3.

Appendix V: Comments from the U.S.
Department of Agriculture

See comment 4.

See comment 5.

RMA also estimates expected changes in liability up to 10 years ahead through RMA's baseline projections. Therefore, RMA does assess the long-term, as well as current, exposure of the crop insurance program to catastrophic weather events.

GAO's draft report treats the recurring 20- to 40-year Atlantic hurricane cycle as synonymous with climate change. However, other parts of the report describe climate change in terms of a long-run progression, such as global warming, that leads to an increase in frequency and severity of weather events. Referring to the normal cycle of Atlantic hurricanes as climate change appears to be inconsistent with how climate change is described in other parts of the report.

When GAO surveyed private insurers about what they are doing to estimate and prepare for the risks of climate change, they found that insurers were using catastrophe models that incorporate the hurricane cycle. RMA also incorporates hurricane risk into premium rates for several of its insured commodities. However, rather than focusing on short-term fluctuations in the hurricane cycle, RMA uses historical hurricane data that spans several cycles.

The following are GAO's comments on the U.S. Department of Agriculture's letter dated February 23, 2007.

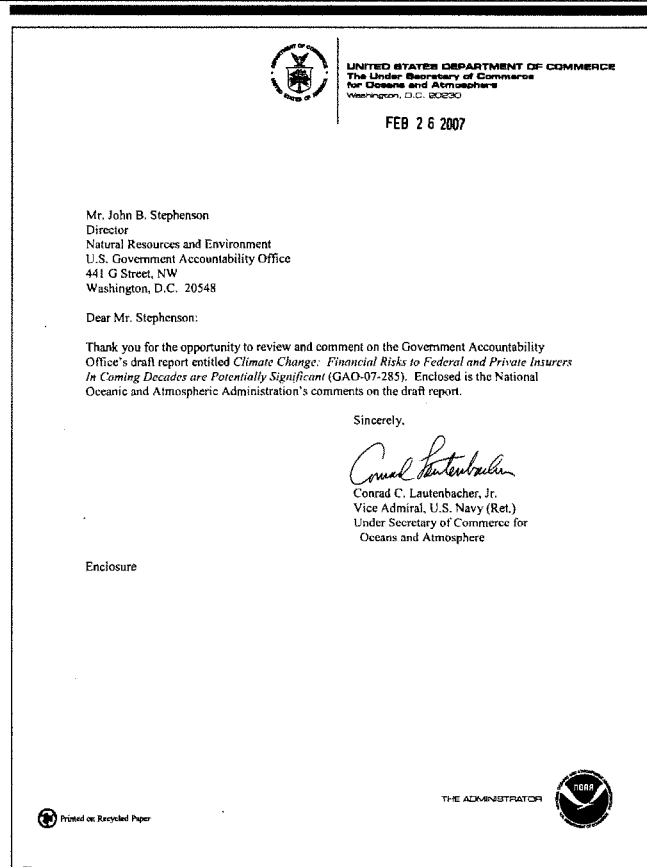
GAO Comments

1. We agree that the loss experiences of NFIP, FCIC, and private insurers are distinct and sought to reflect these distinctions in our draft report. For example, we acknowledged on page 23 of the draft the specific distinction USDA highlights—that the main cause of catastrophic losses for FCIC is drought in the nation's interior (see pages 24 and 25 of this document). Despite these and other differences, however, we believe the report's findings and underlying message are still applicable to the NFIP, the FCIC, and private insurers.
2. Our analysis of insured losses does not attempt to attribute increases in past losses to changes in the severity of weather events in the data sets we reviewed, as implied by the comment. Moreover, we acknowledge that the increase in FCIC's losses (indemnities) largely reflected the rapid growth of the crop insurance program. However, given the IPCC's projections for potential increase in the frequency and severity of weather-related events—including those that affect crops—we believe that limiting an evaluation of FCIC's *future* weather-related risk to the program's loss ratio—which only captures *historical* performance of the program based on past climatic and market conditions—to be a potentially misleading metric upon which to make a prospective assessment.
3. We acknowledged these activities in the draft report. However, we believe that USDA's actions are limited in scope, focusing almost exclusively on actuarial performance and not on the potential implications of climate change for FCIC's operations (i.e., changes in the frequency and severity of weather-related events, weather variability, growing seasons, and pest infestations). Accordingly, we believe the program should do more to prospectively assess the implications of climate change.
4. We employed the IPCC's definition of climate change, which includes statistically significant variations in climate, brought on by factors that are both internal and external to the earth's climate system, and that persist over time—typically decades or longer. Under this definition, the Atlantic hurricane cycle, as with other significant variations that are understood to be internal to the earth's climate system, can be considered climatic changes. Our use of the definition was corroborated by a senior NOAA scientist.

5. We updated our discussion of FCIC's modeling activities (see page 36) to reflect this hurricane model. However, as stated on page 22, 75 percent of FCIC's claims were associated with drought, excess moisture, and hail from 1980 to 2005, whereas hurricanes were associated with a much smaller portion of FCIC's claims during this period. Accordingly, we believe that if more sophisticated, prospective risk assessment techniques (such as those used in FCIC's hurricane model) were applied to drought, moisture, and hail events, it would allow for a far more useful assessment of the potential implications of climate change for FCIC's operations.

Appendix VI: Comments from the Department of Commerce

Note: GAO comments supplementing those in the report text appear at the end of this appendix.



Appendix VI: Comments from the Department of Commerce

Department of Commerce
National Oceanic and Atmospheric Administration
Comments on the Draft GAO Report Entitled
"Climate Change: Financial Risks to Federal and Private Insurers
In Coming Decades are Potentially Significant"
(GAO-07-285/March 2007)

General Comments

The Department of Commerce (DOC) appreciates the opportunity to review this report. The issues covered in the report are very important and reflect the real world intersection between science, policy, and economics.

See comment 1.

We have three major comments on the structure of the report. First, GAO should provide a clear definition of the phrase "climate change" at the beginning of its report. While it is addressed on page 2, DOC recommends the authors refer to the definition provided by the 2007 Intergovernmental Panel on Climate Change (IPCC) Working Group 1:

IPCC Working Group 1 Climate Change Definition

Climate change refers to a change in the state of the climate that can be identified (e.g., using statistical tests) by changes in the mean and/or the variability of its properties, and that persists for an extended period, typically decades or longer. Climate change may be due to natural internal processes or external forcings, or to persistent anthropogenic changes in the composition of the atmosphere or in land use.

See comment 2.

The second comment is directed to page 2 of the report and relates to the discussion of frequency and intensity of weather phenomenon. The authors write:

"Regardless of the cause, increasing temperatures—accompanied by changes in other aspects of the climate—may impact communities and, by extension, the insurance industry by altering the frequency or severity of weather-related events such as hurricanes, tornadoes, severe thunderstorms and hail events, and wildfires."

While DOC recognizes the IPCC's Fourth Assessment Report was not available at the time of GAO's review, the issue of frequency and intensity has been well discussed in the scientific community, and policy makers would benefit from drawing information from the IPCC's Summary for Policy Makers for Working Group 1. According to page 10 of this summary, "there is insufficient evidence to determine whether trends exist... in small scale phenomena such as tornadoes, hail, lightning, and dust storms." The authors could state the frequency of heavy precipitation events has increased over most land areas... (page 8). On hurricanes, IPCC notes an increase in "intense tropical cyclone activity," but also mentions "there is no clear trend in the annual numbers of tropical cyclones," which refers to frequency. Tropical cyclones projections are addressed on page 16 of the summary, where the IPCC projects future tropical cyclones will become more intense, but there is less confidence in projections of a global decrease in numbers of tropical cyclones.

Appendix VI: Comments from the Department of Commerce

See comment 3.

See comment 4.

Further, DOC notes the report could be strengthened by a discussion of what is meant by "altering the frequency or severity of weather-related events" and how this is linked to risk. For example, altering either the frequency or severity of high impact extreme weather-related events could result in a five fold increase in risk for what has been considered a 500-year event (i.e., probability of occurring in a given year = 1/500) shifts under climate change to be a 100-year event (i.e., probability of occurring in a given year = 1/100).

The third comment is the report should examine coastal development impacts more rigorously. The National Oceanic and Atmospheric Administration (NOAA) has done work that uses data from the Bureau of the Census to show coastal communities have seen population growth of nearly 40 million people from 1970 to 2000. The authors refer to Roger Pielke, Jr.'s work on coastal impacts, but cite it only to show that more intense hurricanes tend to have higher impacts. Pielke, Jr., and others, including Chris Landsea of NOAA and Kerry Emanuel of Massachusetts Institute of Technology, have examined hurricanes, climate change, and development, and found coastal development has increased the vulnerability to winter storm surge, wind damage, and hurricanes. These vulnerabilities, due to high risk coastal development, will only be amplified by climate change related increases in the frequency or severity of high impact extreme weather-related events.

The authors cite anecdotal evidence, such as increased development in the area hit by Hurricane Andrew, but the report lacks analysis of the long term trends and does not quantify what portion of the increase in losses is attributable to societal change and economic development as referenced on page 58 in the Munich Re consensus statement. This would be useful information for policy makers.

Appendix VI: Comments from the Department of Commerce

The following are GAO's comments on the Department of Commerce's letter dated February 26, 2007.

GAO Comments

1. We agree that a clear and accurate definition of *climate change* is a necessary prerequisite for any discussion of the issue. While a variety of definitions for the term are in use, we did not attempt to independently define the term. Rather, we relied upon the IPCC's most current publicly-available definition.
2. We revised the introductory statement referred to in Commerce's comments for editorial purposes (see page 2). To the extent practicable, we also incorporated the Working Group I Summary for Policymakers of the IPCC's *Fourth Assessment Report* into the detailed discussion of the potential changes in the frequency and severity of weather-related events identified in the 2001 *Third Assessment Report* (see pages 8 to 13).
3. We included an elaboration on page 14 of how altering the frequency and severity of weather-related events is linked to risk.
4. It was outside the scope of this report to conduct our own quantitative trend analysis of the relative roles of societal factors (such as development or agricultural prices) and climate change in shaping the increases in weather-related insured losses observed in the data. In response to the comment, however, we clarified which studies we reviewed that addressed this question, both for coastal hazards (such as hurricanes) and inland hazards (such as drought and excess moisture).

Appendix VII: GAO Contact and Staff Acknowledgments

GAO Contact

John Stephenson, (202) 512-3841, or stephensonj@gao.gov

Staff Acknowledgments

In addition to the individual named above, Steve Elstein, Assistant Director; Chase Huntley; Alison O'Neill; Michael Sagalow; and Lisa Van Arsdale made key contributions to this report. Charles Bausell, Jr.; Christine Bonham; Mark Braza; Lawrence Cluff; Arthur James, Jr.; Marisa London; Justin Monroe; and Greg Marchand also made important contributions to this report.

We also wish to give special tribute to our dear friend and colleague, Curtis Groves, who died many years too soon after a long battle with multiple myeloma near the conclusion of our work.

Related GAO Products

National Flood Insurance Program: New Processes Aided Hurricane Katrina Claims Handling, but FEMA's Oversight Should Be Improved. GAO-07-169. Washington, D.C.: December 15, 2006.

Catastrophic Disasters: Enhanced Leadership, Capabilities, and Accountability Controls Will Improve the Effectiveness of the Nation's Preparedness, Response, and Recovery System. GAO-06-618. Washington, D.C.: September 6, 2006.

Crop Insurance: More Needs To Be Done to Reduce Program's Vulnerability to Fraud, Waste, and Abuse. GAO-06-878T. Washington, D.C.: June 15, 2006.

High-Risk Program. GAO-06-497T. Washington, D.C.: March 15, 2006.

Federal Emergency Management Agency: Improvements Needed to Enhance Oversight and Management of the National Flood Insurance Program. GAO-06-119. Washington, D.C.: October 18, 2005.

Crop Insurance: Actions Needed to Reduce Program's Vulnerability to Fraud, Waste, and Abuse. GAO-05-528. Washington, D.C.: September 30, 2005.

Catastrophe Risk: U.S. and European Approaches to Insure Natural Catastrophe and Terrorism Risks. GAO-05-199. Washington, D.C.: February 28, 2005.

21st Century Challenges: Reexamining the Base of the Federal Government. GAO-05-325SP. Washington, D.C.: February 2005.

Climate Change: Information on Three Air Pollutants' Climate Effects and Emissions Trends. GAO-03-25. Washington, D.C.: April 28, 2003.

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**AMERICA'S CLIMATE SECURITY ACT OF 2007,
S. 2191**

TUESDAY, NOVEMBER 15, 2007

U.S. SENATE,
COMMITTEE ON ENVIRONMENT AND PUBLIC WORKS,
Washington, DC.

The full committee met, pursuant to notice, at 10 a.m. in room 406, Dirksen Senate Office Building, Hon. Barbara Boxer (chairman of the full committee) presiding.

Present: Senators Boxer, Inhofe, Lieberman, Carper, Klobuchar, Warner, Voinovich, Isakson, Vitter, Barrasso, Craig, Alexander, and Bond.

**STATEMENT OF HON. BARBARA BOXER, U.S. SENATOR FROM
THE STATE OF CALIFORNIA**

Senator BOXER. Good morning. The hearing will come to order.

We are very happy to be here again to talk about a very important subject that my colleagues wanted to have more hearings on. We are hoping they do come.

I note Senator Voinovich is here, and that is very good, Senator, I think that much of you.

But let me just say, instead of going through my usual opening of these hearings, which is that we have to act, we must act, and praising Senators Lieberman and Warner for all their work and all my colleagues for their help and the outside groups, what I want to do for my opening statement, which is 5 minutes, is to call our attention to an article today in the New York Times: Governors Join in Creating Regional Pacts on Climate Change. There are three really wonderful photographs of my Governor, Governor Schwarzenegger, talking about the threat of greenhouse gases. We all know that Arnold Schwarzenegger is a Republican. Utah Governor John Huntsman said western Governors are setting ambitious targets. He is in this article. And he is a Republican. And Democratic Governor Brian Schweitzer, a Democrat, of Montana, saying, do something, anything, move.

And I can't tell you how excited I am about this, because there is going to be a big advertising campaign. Now, I am not underestimating the fact that the other side will have one as well. But I want to talk about this one. Beginning Monday, three western Governors will appear in a nationwide television advertising campaign sponsored by an environmental group trying to generate public and political support for climate change legislation now before the Senate. The 30-second ad features Arnold Schwarzenegger, Republican, of California, John Huntsman, Republican, of Utah, and

Brian Schweitzer, Democrat, of Montana, standing in casual clothes in scenic spots, talking about the threat posed by greenhouse gas emissions.

The Nation's Governors are acting, but Congress is not, they say. Now it is their turn, says Arnold Schwarzenegger. And indeed, I couldn't agree more. This is the moment, and we are poised to do landmark legislation. I know that I sometimes reiterate and my kids tell me that all the time, but I think some things are worth repeating, and that is that we have a window here to act, and we need to act. I truly believe that our generation is going to be judged by whether or not we do the right thing at this moment.

Senator Warner, who I understand will be here in a little while, when he comes, if it is okay with my colleagues, we will stop what we are doing and listen to him, because he has that problem of not being able to sit for long periods of time. And Senator Lieberman, this amazing breakthrough that they achieved, the many hearings that we have held and all the groups that have come to the table, this is not an easy thing to do. But I am convinced we can and must act.

With that, here we are at another hearing. I am very happy to see three of my Republican friends here. I hope colleagues on both sides will come throughout the morning. That is about what I have to say. I have made copies of this article for Senators, if you are interested in reading the entire thing. I will place this in the record, without objection.

We are going to go in order of arrival, which I have here as Senator Barrasso.

**STATEMENT OF HON. JOHN BARRASSO, U.S. SENATOR FROM
THE STATE OF WYOMING**

Senator BARRASSO. Thank you, Madam Chairman. Thank you again for the hearing.

As I have stated throughout this debate on this legislation, we must adapt, we must make changes to address the effects of global warming. This past weekend, flying home to Wyoming as I do every weekend, there is a special energy section of the Financial Times. And in it, they said, Big Hopes Pinned on Carbon Capture. I would just like to read a couple of paragraphs from here. It says, "Coal is abundant and relatively cheap. China and India have huge coal reserves and are using it to fuel their rapid economic development." Then it says, "Asking developing countries not to exploit their coal reserves is unrealistic, say many energy analysts. The answer is finding a way to burn coal that limits its carbon emissions, hence the current interest in so-called clean coal technology. Clean coal technology includes equipment to make coal-fired power plants more efficient, such as super-critical boilers. But the most exciting prospect is so-called carbon capture and storage, which involves capturing the carbon dioxide before it is released into the atmosphere, turning it into a liquid and storing it."

Then it goes on, and I have a chart to show exactly this quote. This is from Lord Oxbow. It says, "Lord Oxbow, former chairman of Shell, said in an energy debate last month that clean coal technology was the world's best hope for tackling climate change." Clean coal technology, the world's best hope for tackling climate

change. He said coal would continued to be burned, and while renewables and nuclear could play a part in reducing emissions, carbon capture was the only technology for managing climate change that we cannot do without. The only technology for managing climate change that we cannot do without.

Madam Chairman, the World Energy Congress met this past week in Rome. There is a story out in the Associated Press today, dateline actually yesterday, it says, "China and India are under pressure to reduce their carbon emissions by energy executives and Government representatives. The energy executives and Government representatives agreed yesterday that the two blooming economies will be sticking with coal, whether the rest of the world likes it or not."

And then they quote the Secretary of the Indian Ministry of Power: "India and China need cleaner coal technology. That is the technology they are going to use for generating power, whether the rest of the world likes it or not." And we heard here in testimony the other day that, well, if we develop the technology and put on these restraints that may affect our economy negatively, that China and India would just follow suit because of our leadership in the world. I am not convinced, and this comment out of the World Energy Congress by the Indian Ministry of Power says they are continuing to use coal, whether the rest of the world likes it or not. So Madam Chairman, I think that we need to work and put the effort into the technology, which then we can get spread around the world, so we can continue to use the sources of energy which are certainly important in the west, coal, but also which are going to continue to be used for the next half century in China and India.

Thank you, Madam Chairman.

Senator BOXER. Senator Barrasso, I just think you made the case for the Lieberman-Warner bill. The Lieberman-Warner bill has many provisions designed to assure that coal will continue to play a large role in our energy portfolio, clean coal. And this bill devotes tens of billions of dollars to clean coal. It is really a Manhattan Project for coal.

So I hope that in your conversations with Senator Warner and Senator Lieberman, you will give them the opportunity to go through this and show you why what you said is thoroughly consistent with the bill that they have written.

Senator BARRASSO. As long as there are guidelines that are such that we can continue to move toward credible numbers, rather than put a number so high that people wave a surrender flag.

Senator BOXER. Well, you know, everybody wants it done exactly the way they want it done. But I just need to tell you that everything that you said about coal is reflected in this bill. In many ways, so much so that other people are critical of it, they say it is too much. But it is all right. I think what you said is key. I think again, it gives me hope that you can come on board with this bill, hopefully.

Senator Carper.

**STATEMENT OF HON. THOMAS R. CARPER, U.S. SENATOR
FROM THE STATE OF DELAWARE**

Senator CARPER. I have no comments, other than to say welcome, we are delighted to have you here. We have had a chance to say our piece for the last couple of weeks, and today we would love to hear you say yours. Thank you for joining us and to help us shape this legislation.

Senator BOXER. Thank you, Senator.
Senator Voinovich.

**STATEMENT OF HON. GEORGE VOINOVICH, U.S. SENATOR
FROM THE STATE OF OHIO**

Senator VOINOVICH. I thought this was good, what Senator Barrasso said. We want to accomplish the same thing.

Senator BOXER. Good.

Senator VOINOVICH. The question is how do we get there.

Senator BOXER. Good.

Senator VOINOVICH. On this final hearing before markup, I want to again express my concern with the lack of time to respond to the legislative text or receive an EIA or EPA analysis of what must be the most significant legislation ever to appear before this Committee, rivaling the Clean Air Act and the Clean Water Act and other environmental statutes combined. We have to understand that this is the most significant legislation that we have ever considered in this Committee probably in its history.

The bill will place a massive bureaucratic intrusion into the American lives, it will have a profound impact on businesses, communities and families. Madam Chairman, you seem ready to disregard the modeling data presented by Charles River Associates during last week's hearing, preferring analyses conducted by environmental organizations instead. But this is the only comprehensive analysis of the proposal we have. And while we may not like the story that emerges from the data, there is no credible reason to disregard its results.

The analysis presented by Anne Smith, who is a highly regarded economist, presented a devastating critique of this policy proposal, estimating that by 2020, the policy would result in the loss of as many as 3.4 million American jobs, an annual decrease in disposal income by as much as \$2,500 and annual losses in GDP of \$1 trillion. It is important to note that these projections are national averages.

In reality, the impacts will be far greater for States in the Midwest, Great Plains and Southeast who depend on coal for much of their electricity. In fact, Duke Energy, a major electricity provider in Ohio, released data indicating that customers in their service area could suffer a 53 percent increase in electricity bills when this policy becomes effective in 2012. Duke Energy, as many of you know, is a U.S. CAP company, many of whom are now coming out against this policy proposal as demonstrated by a November 14th letter from the International Climate Change Partnership.

Madam Chairman, I would ask that this letter be inserted in the hearing record.

Senator BOXER. Without objection.

Senator VOINOVICH. I see nothing that would dispute the modeling results presented by Ms. Smith. In fact, they are consistent with what many expected from this proposal. Senator Lieberman himself confirmed this policy was more aggressive and costly than S. 280, and the numbers bear this out.

I urge my colleagues to take a hard look at Ms. Smith's analysis. Indeed, we are staring down the barrel of a gun. But the gun has two barrels. One may be climate change, but the other is our competitive position in the global marketplace. While there is little question that this policy will hurt our economy, it is far from clear that the bill will do anything to avert climate change. In fact, we look to EPA's analysis of previous bills, some even more stringent than this proposal, and the evidence suggests that it will not.

I agree with the Chairman's statement of Tuesday that we shouldn't let the perfect be the enemy of the good. But this problem is not so simple. The evidence suggests that this bill is neither perfect nor good. Proponents of this legislation like to point to the economic impacts of previous environmental initiatives as evidence that compliance costs won't be as dire as predicted.

And maybe the impacts won't be as hard-hitting in States that use little or no coal for electricity or have no manufacturing base. But in States like Ohio, we are all too familiar with the results. Natural gas prices are up 300 percent since 2001. And we have seen the exodus of manufacturing jobs to overseas markets, stemming largely from poorly-calibrated environmental policies.

Moreover, solving the problem is not as simple as forcing companies to install end of pipe technologies, because the technologies don't exist. Senator Barrasso made a good point with the Financial Times. Solving this problem will require technological revolution and a wholesale transformation of our economy centered on the way we use and produce energy.

I will be the first to agree that there has been a void in the debate concerning the appropriate policy in terms of climate change. But there are alternative policies now under consideration that are less intrusive, less costly and that will achieve greater reductions in emissions faster than what we are considering today. Policy approaches that better stimulate actual innovation and transformative technologies, better avoid administrative complications, and this will be a gigantic administrative undertaking by the EPA to put this legislation into place, better address the challenge of a newly-industrialized world, and that better address avoidance behavior and that limit opportunities to game the system.

I urge my colleagues to slow this process down, so that a reasonable policy to address climate change can be developed. It makes no sense for us to empower a gigantic bureaucracy with control over nearly every aspect of the American economy and indeed, our lives, for little or no environmental benefit. There are alternatives that should be and must be considered before moving forward with this proposal.

And Madam Chairman, I hope that we consider those alternative proposals before we hit the Floor, and if we don't, then we will discuss them next year when this bill does hit the Floor of the United States Senate.

[The prepared statement of Senator Voinovich follows:]

STATEMENT OF HON. GEORGE V. VOINOVICH, U.S. SENATOR FROM THE
STATE OF OHIO

Madam Chairman,

On what is the final hearing scheduled for S. 2191 before mark-up, I again want to express my concern with the lack of time to respond to the legislative text, or receive an EIA or EPA analysis, of what may be the most significant legislation ever to appear before this committee—rivaling the Clean Air Act, Clean Water Act and other environmental statutes combined.

This bill contemplates a massive bureaucratic intrusion into Americans lives that will have a profound impact on businesses, communities and families. Madam Chairman, you seemed ready to disregard the modeling data presented by Charles River Associates during last week's hearing—preferring analyses conducted by environmental organizations instead. But this is the only comprehensive analysis of the proposal we have. And while we may not like the story that emerges from the data, there is no credible reason to disregard its results.

The analysis presented by Anne Smith, who is a highly regarded economist, presented a devastating critique of this policy proposal, estimating that by 2020 the policy would result in the loss of as many as 3.4 million American jobs; an annual decrease in disposable income by as much as \$2500; and annual losses in GDP of \$1 trillion. Naturally, the prices of electricity, natural gas, gasoline and other necessities skyrocket under this proposal.

It is important to note that these projections are national averages. In reality, the impacts will be far greater for states in the Midwest, Great Plains and Southeast who depend on coal for much of their electricity. In fact, today Duke Energy, a major electricity provider in Ohio and a U.S. Cap company I might add, released data indicating that customers in their service area could suffer a 53 percent increase in electricity bills when this policy becomes effective in 2012.

I have seen nothing that would dispute the modeling results presented by Ms. Smith. In fact, they are consistent with what many expected from this proposal. Senator Lieberman confirmed in last week's hearing that this was a more aggressive and costly policy than S280, and the numbers bear this out this prediction.

I urge my colleagues to take a hard look at Ms. Smith's analysis. Indeed we are staring down the barrel of a gun, as many of our environmental friends like to point out. But the gun has two barrels—one may be climate change, but the other is our competitive position in the world market place. And while there is little question that this policy will hurt our economy, it is far from clear that the bill will do anything to avert climate change. In fact, if we look to EPA's analyses of previous bills—some even more stringent than this proposal—the evidence suggests that it will not.

I agree with the Chairman's statement of Tuesday that we shouldn't let the perfect be the enemy of the good. But this problem is not so simple: the evidence suggests that this bill is neither perfect, nor good.

Proponents of this legislation like to point to the economic impacts of previous environmental initiatives as evidence that compliance costs won't be as dire as predicted. And maybe the impacts won't be as hard hitting in states that use little or no coal for electricity or that have no manufacturing base. But in states like Ohio, we're all too familiar with the results: natural gas prices are up 300 percent, and we've seen an exodus of manufacturing jobs to overseas markets, stemming largely from poorly calibrated environmental policies.

Moreover, Carbon dioxide is more ubiquitous and more difficult to control than the criteria air pollutants subject to caps under current Clean Air Act programs. Solving this problem is not as simple as forcing companies to install end of pipe technologies because the technologies don't exist. Solving this problem will require technological revolution and a wholesale transformation of our economy, centered on the way we use and produce energy.

I will be the first to agree that there has been a void in the debate concerning the appropriate policy address climate change, leaving many to believe that cap and trade is the only policy option to address this problem. But there are alternative policies now under consideration that are less intrusive, less costly and that will achieve greater reductions in emissions faster than what we now consider. Policy approaches that: better stimulate actual innovation in transformative technologies; better avoid administrative complications, better address the challenge of the newly industrializing world; and that better address avoidance behavior and that limit opportunities to "game the system."

I urge my colleagues to slow this process down so that a reasonable policy to address climate change can be developed. It makes no sense for us to empower a giant bureaucracy with control of nearly every aspect of the American economy, and in-

deed our lives, for little or no environmental benefit. There are alternatives that should and must be considered before moving forward with this proposal.

Thank you.

Senator BOXER. Thank you, Senator.

Senator I wanted you to know yesterday our staff walked your staff through a modeling that used the EIA data, the same computer modeling. So they have been briefed on this and I want to make sure that you get a copy of it. So the Department of Energy, we use the same computer modeling the Clean Air Task Force did, and we came up with a model here which we shared with your staff. We have also joined, Senator Lieberman has, in asking EPA to do a model. So we are very much looking forward, because this model came out really well in terms of economic growth. But I just wanted to make sure you knew your staff was briefed on this.

Senator VOINOVICH. May I point out, Madam Chairman, that the Clean Air Task Force is an environmental organization.

Senator BOXER. Yes, I know that.

Senator VOINOVICH. And I want to say this, I want to publicly thank you for the fact that you and your staff have requested an impact statement of this legislation by the EPA and by the Energy Information Agency. Thank you very much.

Senator BOXER. You are very, very welcome. This is true that the Energy Department will, however, use the same computer. So I just, hopefully that will come out the same way.

Now, we are just going to go down in order of arrival, but I have to ask if my wonderful Ranking Member will give his opening statement, and then we will go down the rest.

STATEMENT OF HON. JAMES M. INHOFE, U.S. SENATOR FROM THE STATE OF OKLAHOMA

Senator INHOFE. I will, and I thank you for that.

We have a problem that Senator Warner and I both have, and that is that we are having our U.S. Army hearing in the Senate Armed Services Committee, it is required attendance. Kind of like this is, Madam Chairman.

Senator BOXER. Yes, I know.

Senator INHOFE. I found the legislative hearings conducted over the last week to be really informative. I am sure it has been the case for other members of the Committee. As we begin the process of digesting this testimony, I would like to share what I think are common themes of all the hearings. This will be very, very costly. I think we understand that. The impacts will be severe and the bill will have significant impacts on energy markets.

There remain some fringe elements who still claim that this bill will create jobs instead of destroy them. But most of the people are acknowledging that this bill will cost a great deal of money. Indeed, I appreciate the acknowledgement by one of the sponsors of this bill, Senator Lieberman, who was quite candid that this bill would cost hundreds of billions of dollars. We have heard testimony from perhaps the premier econometric modeling firms in the Country that found the impacts of this bill would be substantial, with the national costs escalating up to between \$800 billion and \$1 trillion a year. The Midwest and South will see the most dramatic increases. If we are lucky, the Northeast and California will see dra-

matic increase in the LNG imports. If we are not, the economic consequences of the bill will be even worse.

A November 6th Washington Post article put it succinctly when it stated that the current global warming proposals will “require a wholesale transformation of our Nation’s economy and society.” The fact is that many U.S. businesses are at the margin and industries such as iron and steel, concrete, fertilizer, manufactured goods would be forced overseas. We have found several witnesses that were very emphatic as to that kind of effect it would have on America.

So what I would like to do, Madam Chairman, is I will be going back and forth between the two committees, I would like to put the rest of my statement into the record.

[The prepared statement of Senator Inhofe follows:]

STATEMENT OF HON. JAMES M. INHOFE, U.S. SENATOR FROM THE
STATE OF OKLAHOMA

Madame Chairman, I have found the legislative hearings conducted over the last week to be quite informative, as I’m sure has been the case for other Members of the Committee. As we begin the process of digesting the testimony, I would like to share what I think are the common themes of all these hearings: this will be very, very costly; the impacts will be severe; and the bill will have significant impacts on energy markets.

There remain some fringe elements who still claim that this bill will create jobs instead of destroy them. But most people are acknowledging that this bill will cost a great deal of money. Indeed, I appreciate the acknowledgment by one of the sponsors of this bill, Senator Lieberman, who was quite candid that this bill will cost hundreds of billions of dollars. We have heard testimony from perhaps the premier econometric modeling firms in the country that found the impacts of this bill would be substantial—with national costs escalating to between \$800 billion to \$1 trillion per year and costs of up to \$2700 annually or more than \$200 per month to the average family. Within just a few years, up to 2.3 million people will be put out of work by this bill and the cost of gasoline, natural gas and electricity will skyrocket, with electricity prices climbing 36–65 percent.

The Midwest and the South will see the most dramatic increases. If we’re lucky, the Northeast and California will see dramatic increases in LNG imports. If we’re not, the economic consequences of this bill would be even worse.

A November 6 *Washington Post* article put it succinctly when it stated that the current global warming proposals “will require a wholesale transformation of the nation’s economy and society.”

The fact is that many U.S. businesses are at the margin, and industries such as iron and steel, concrete, fertilizer, and manufactured goods would be forced overseas where the carbon footprint would only grow. I would also add that if the costs to provide concrete increases dramatically, it will drive up the costs of highway projects. Moreover, no one has any idea how we will make up the over 30% energy shortfall by 2020.

Much has been made about the California experience, but it is important to remember they are still in the planning phase, and not only have they not decided how to make their reductions yet, but they haven’t started reducing yet either.

The fact is that this bill is not ready for prime time. It appears structured to fail. While they have yet to oppose it officially, it is clear from the positions taken by organized labor that it has serious concerns with this bill and what that will mean to America’s workers. In closing, I would ask my colleagues who are thinking of voting for this bill one question: for all the pain and disruption this bill will cause to our nation’s families, what are we buying?

From EPA’s October 1st analysis, it is clear that our unilateral actions of this magnitude will still do nothing to avert increasing concentrations of greenhouse gases—instead of being slightly above 700 parts per million at the end of the century, we will be at slightly under 700 parts per million—300 parts per million above today’s levels. If there is to be any opportunity to reduce global concentrations, it will have to come from the emerging nations that will be responsible for increasing those concentrations. This bill fails to do that.

It was true ten years ago when we passed Byrd-Hagel, and it is true today—we should not pass a law if it harms the American economy or if developing countries

are not part of the equation. This bill fails on both those fronts and should be rejected.

Senator BOXER. Yes, sir, absolutely will do. And we will go back to our time of arrival, and that would be Senator Vitter.

STATEMENT OF HON. DAVID VITTER, U.S. SENATOR FROM THE STATE OF LOUISIANA

Senator VITTER. Thank you, Madam Chair. I continue to have very serious concerns about the bill, and I will mention just a few.

First of all, I want to agree with Senator Voinovich, associate myself with all of his comments about the absolute need for more time to understand the precise impacts of this specific bill. I don't think we have had that. Just as a for instance, every day I heard from Louisiana constituents about energy prices, about prices at the pump, about the price of natural gas, and that impact, about all energy prices. I would like to see a clear, rigorous analysis, a clear consensus opinion on what this bill does to energy prices, gasoline prices at the pump, natural gas prices. I haven't seen that clear, rigorous consensus analysis.

I think that is a pretty minimal request to consider and vote on this bill and amendments to this bill, particularly when every day, all of us are deluged with calls about energy prices, what is going to be the impact. That is just one example. We need more time for that rigorous analysis.

I know there are models out there, all sorts of other things. Most of them are based on general discussion and not the specifics of this bill, which we need to look at.

Secondly, I also want to agree with Senator Barrasso. I just have a fundamental disagreement, I guess, with some people's notions of international negotiations and negotiating strategy. Everyone agrees that no U.S. legislation will have any impact on the problem if there isn't dramatic change in countries like China and India. Everybody agrees with that. I think it is a pretty fundamental question whether the right way to achieve that is just going off on our own and causing enormous costs to our economy and giving them a huge additional competitive advantage in terms of their economy and hoping they follow when they will be doing quite well economically because of our actions, even better competitively than now, or whether in fact that would be throwing all the leverage we have in international discussion away.

Seems to me the huge leverage we have on this topic in the international arena is the ability to tie our actions with requirements of other countries and other peoples, and we would basically be throwing that out the window. I don't know what leverage we would have left. So there is just a fundamental issue and disagreement there.

With that, Madam Chairman, I will end and look forward to the testimony of all our witnesses and I thank them all for being here.

[The prepared statement of Senator Vitter follows:]

STATEMENT OF HON. DAVID VITTER, U.S. SENATOR FROM THE STATE OF LOUISIANA

Madame Chairman, thank you for agreeing to hold this hearing today on S. 2191, America's Climate Security Act.

This bill has been the focus of attention for thousands of my constituents. I've met people and industries who have come out of the woodwork to express their grave concern with this bill.

The more time I spend focusing on this bill, the more I'm concerned about two things the proponents of this legislation tout.

The Environment: supporters of this bill claim that this legislation will improve the environment and reduce greenhouse gas concentrations in the environment. Those sound like laudable goals; however, will that be the outcome? Imposing mandatory reductions in greenhouse gas emissions will increase the cost of doing business in the United States. There is no question. The bill's sponsors have admitted this fact.

Keep in mind that the United States already has some of the most stringent environmental and labor standards. The United States is already in the world one of the most expensive places to do business. So, what happens when U.S. manufacturers decide that due to this additional regulation—that the majority of other nations do not have to deal with—to move their operations to China, Mexico or India? How stringent are the environmental standards in these countries? How can our labor unions compete?

What is the net effect on the environment? I can tell you that the greenhouse gas emissions per kilo-watt hour in the United States is much lower than that of those other nations such as China and India. This bill has just increased pollution, lost American jobs and left an abandoned factory in the United States.

The Economy: How does the economy respond to this bill? Well, as all of these American manufacturers move to China, Mexico or India, our unemployment increases, our tax base decreases, our economy slumps. It is very simple, increasing the cost of doing business and regulation in an already expensive business climate, decreases employment opportunities, income and economic activity. The United States will lose its leverage and global competitiveness unless we have these other nations at the table.

The proponents of this bill will argue that this bill will benefit the economy and environment. To those claims I respond, then let the Energy Information Administration and others fully evaluate the bill. We need a clear analysis of how this bill will impact energy prices, natural gas prices, prices at the gas pump and how it will impact ratepayers and consumers. Driving blind like what is being proposed in this bill could have dire consequences. I want to thank our witnesses today and look forward to hearing from you.

Senator BOXER. Senator, thank you very much.

I am compiling the list of hearings we have had on global warming since January and the hearings we have had on this bill and the briefings we have had on this bill and the daily briefings staff has given. Look, I have been here for 25 years in the Congress. I wasn't born yesterday, that is obvious. The fact is, I know when there is a sincere call for more information and when it is just delay.

You could just see it, because every time we have a hearing, every comment from the other side, who all want, they want more time, it is the same comment all the time. It is, this is the worst thing since sliced bread, this is the worst thing, this is horrible. Now, either we are going to have a do something committee, or a do nothing committee. If I felt that we couldn't move on anything, if I felt that we couldn't do any good, I would just hand over the gavel. I would hand it back—well, no, not that direction, hand it in this direction.

[Laughter.]

Senator BOXER. I knew that would get your attention. But the bottom line is, we need to do something. The people want us to do something and they want us to do something good. And they want us to do something relevant.

When you have three Governors chastising the Congress, they all have credibility, two Republicans, one Democrat. They are saying, Congress, do something. We have the States acting. We have the

cities acting. We have the world acting. We have individuals acting. And for us to be so late to this issue is a real stain, I think, on this Congress.

So I have done everything that I can do to give you the time, give you the information. We are going to take every amendment that you may offer in the markup, we will stay here through the night, into the morning and days and we will get it done.

But I will just say now, because there is this constant ask for more time, I would be so bold as to say we could take another year and I don't think I would pick up another vote from the people who do not really want to move on this. And I think then that is a sham.

So the bottom line is, I would say to any of you who feel you need more information, I will sit with you one on one and give you every piece of information. This model that was done is an up to date model. And it is done with the Department of Energy's computer model program. We will give you everything that you need. Then if you feel that it is still not a good idea to vote for that legislation, I totally understand and respect that point of view.

But let's not make a false argument that we need more time, because we all know around here what that means. That means doing nothing. And I would rather take this as far as we can. If we don't have it at the end of the day, we don't have it at the end of the day. But I feel I need to move this now, because the window is closing. And I feel very, very strongly about that.

Senator Cardin.

**STATEMENT OF HON. BENJAMIN L. CARDIN, U.S. SENATOR
FROM THE STATE OF MARYLAND**

Senator CARDIN. Thank you, Madam Chair. I agree with your comments. I have only been a Senator since January, but I can tell you, we have been talking about this legislation and this issue since my arrival in the United States Senate. I have been in the Congress for 20 years. And we have been talking about this issue during my 20 years in the U.S. Congress. So this is not a new subject. And there has been a great deal of debate within the Congress as to what to do about the problems of global climate change.

Legislation was introduced earlier in this Congress by many members. And I applaud the efforts, as I have said before, of Senator Lieberman and Senator Warner and the Chairman of our Committee, for bringing together a bill that we can move forward. It won't be a perfect bill, but it will be a credible bill. I think that is our challenge, to be a player not only in the United States on global climate change, but to be an international leader, so that we can do what we need to do as a responsible player internationally.

So I applaud your efforts, Madam Chair, and I hope we will be able to move a bill shortly. I thank you for having another hearing with experts who I think can add to the record of our Committee, which is very, very important.

Just yesterday, the President's science advisor, Dr. John Marburger, testified before the Senate Commerce Committee on the state of climate science. In his testimony, Dr. Marburger acknowledged that climate change is occurring and that there is a level of urgency to begin reducing greenhouse gas emissions. It is

refreshing and timely to hear a representative of the Administration make these statements as we consider America's Climate Security Act of 2007.

As I have noted in the past, this legislation provides a solid framework to address the most compelling environmental energy independent and national security issues facing our Nation. I believe that there are particular ways that this legislation can be strengthened. I talked to my colleagues about that. I believe we need to tighten the emission caps and be more rapid transition to full auction of emission allowances. In addition, as I said at Tuesday's hearing, we need to be more fully engaged in providing solutions to the transportation sector.

We also need to include provisions in this legislation to enhance the scientific community's ability to monitor the evolving state of our climate system. Let me just focus on this area for one moment. The transportation sector is responsible for 28 percent of the total U.S. greenhouse gas emissions. Any effective climate policy must address the mitigation of emissions from this sector. We indirectly consider emissions from this sector in terms of fuel, but we could do more.

We will hear today from Washington State King County Executive Ron Sims. I look forward to Mr. Sims' testimony on the use of new fuel technologies, particularly biofuels, and how his county has purchased hybrid vehicles as part of their fleet. These are examples of the sort of direction we should be heading nationally to reduce our carbon emissions in the transportation sector.

Madam Chair, I want to mention one additional point that I think is important, and that is for years, we have been degrading the ability of our Nation to use scientific information to help us in these areas. There have been funding cuts to NASA and NOAA's capabilities to monitor Earth climate systems, particularly satellite platforms. This legislation that we are considering requires reviews by the National Academy of Sciences to assess the effectiveness of the law in reducing greenhouse emissions and how the climate has been impacted by these efforts. But we don't provide any resources to conduct this vital science.

I hope that we will look at strengthening the capacity to monitor the state of global climate, including atmosphere and oceans. These science observations are vital to our understanding of climate change decades out. They will also serve much shorter term needs, including daily weather predictions and the associated issuance of timely warnings to protect lives and property.

I have heard my colleagues talk that we want to make science-based judgments, so let's give capacity to our agencies to provide that information to us. Climate change will likely lead to more high-impact weather events like stronger hurricanes and heat waves. An enhanced environmental monitoring system is essential for us to provide the information necessary for emergency managers and longer term decision makers to deal with the impacts of these changes.

Madam Chair, I look forward to hearing from our witnesses today and the continuation of our efforts to try to produce the best possible bill to further the policy of our Country to deal with global climate change. Thank you, Madam Chair.

[The prepared statement of Senator Cardin follows:]

STATEMENT OF HON. BENJAMIN L. CARDIN, U.S. SENATOR FROM THE
STATE OF MARYLAND

Madame Chairman, thank you.

Just yesterday, the President's science advisor Dr. John Marburger testified before the Senate Committee on Commerce, Science, and Transportation on the state of climate science. In his testimony, Dr. Marburger acknowledged that:

- (1) climate change is occurring and
- (2) that there is a level of urgency to begin reducing greenhouse gas emissions

It is refreshing and timely to hear a representative of the Administration make these statements as we consider America's Climate Security Act of 2007.

As I have noted in the past, this legislation provides a solid framework to address the most compelling environmental, energy independence and national security issue facing our nation.

I believe that there are particular ways that this legislation could be strengthened.

Among them are: tightening of the emission caps, a more rapid transition to full auction of emission allowances, inclusion of the transportation sector more fully, and including provisions in this legislation to enhance the scientific and decision making communities' ability to monitor the evolving state of our climate system.

I'll focus on these last two areas for strengthening ACSA in my remaining time.

As we learned on Tuesday from Dr. David Greene of the Oak Ridge National Laboratory, in 2005, the transportation sector was responsible for 28% of total U.S. greenhouse gas emissions. Any effective climate policy must address the mitigation of emissions from this sector. While we indirectly consider emissions from this sector in terms of fuel, we can do more.

As Dr. Greene stated on Tuesday, we should be considering how we develop are public areas so as to make public transportation more desirable. We should be making improvements to our transportation infrastructure by encouraging the use of low-carbon fuels and moving toward greater mass transit vehicle fuel economy. We should be encouraging more people to use public transportation. The rising costs of fuel and the desire of some mass transit systems to consider upgrades of their vehicles to those that are more fuel efficient add further urgency to this issue. People want safe, reliable mass transit without burdensome costs.

We can and should be able to meet this need.

We'll hear today from Washington State's King County Executive, Mr. Ron Sims, who has taken a leadership role in promoting increased ridership of public transportation systems in King County and thereby reducing traffic congestion. I look forward to hearing more about King County's use of new fuel technologies, particularly biofuels and how his county has purchased hybrid vehicles as part of their fleet. These are examples of the sorts of directions we should be heading nationally to reduce our carbon emissions in the transportation sector.

Madame Chairman, I believe that an additional issue that ACSA could address is the degradation of our climate monitoring system. There have been funding cuts in NASA's and NOAA's capabilities to monitor the Earth's climate system—particularly satellite platforms. Given that ACSA requires a periodic review by the National Academy of Sciences of how effective ACSA has been in reducing greenhouse emissions and how the climate has been impacted by these efforts, provisions should be included in this bill to upgrade and maintain an effective system to monitor the state of the global climate including the atmosphere and oceans. Additionally, funding should be available to not only take these observations, but to ensure that the data provided from these observations is put to greatest use in operational weather and climate prediction.

A suite of observations ranging from surface-based measurements to satellites are required to assess the state of Earth's climate systems so that we can not only reduce uncertainties in our climate projections, but also enhance our abilities to better to understand what will be necessary to mitigate and adapt to changing conditions.

These observations are not only vital to our understanding of climatic changes decades out, but are also important for much shorter-term needs including daily weather prediction and the associated issuance of timely warnings to protect lives and property. Climate scientists project that climate changes will be potentially associated with increasing variability in weather, including perhaps more high-impact weather events like stronger hurricanes and heat waves. An enhanced global environmental monitoring system is essential for us to provide the information nec-

essary for emergency managers and longer-term decision makers to deal with the impacts of these phenomena.

Further strengthening this bill in the areas of climate monitoring and more fully engaging the transportation sector in emissions reductions by promoting public transportation systems are among a number of issues of considerable interest to me.

I look forward to hearing from all of today's witnesses, and working to not only strengthen this already strong bill, but also move it quickly and thoughtfully through the full Committee and on to the floor of the Senate.

Thank you to Madame Chairman.

Senator BOXER. Thank you, Senator Cardin.

Senator Isakson.

Senator ISAKSON. Madam Chair, in the interest of expediting the testimony, I will yield back my time.

Senator BOXER. That was nice.

Senator Bond.

**STATEMENT OF HON. CHRISTOPHER S. BOND, U.S. SENATOR
FROM THE STATE OF MISSOURI**

Senator BOND. Thank you very much, Madam Chair.

Senator BOXER. It is always good to see you, sir.

Senator BOND. I apologize for the delay. I had to appear on the Floor. But I didn't want to pass up the opportunity to join with you and the members of the Committee as we talk about this very, very important subject.

I do want to associate myself with the very significant remarks of my colleague from Louisiana, Senator Vitter, who I had an opportunity to hear when I arrived. But Madam Chair, I am not pushing for delay. I am not pushing for more time. I know what we have in this bill. I would agree with you, we need to do something.

But for heaven's sakes, let's not do harm. Carbon caps have not worked and they are not going to work, and they are going to impose tremendous hardships on many sectors of our economy, and probably do very little in the overall world-wide problems.

Now, I will lay out some of the things that I think we should do now, we should have done earlier and that we could agree on. But I think it is important today to describe how carbon auctions are unfairly expensive for millions of consumers. Some may wonder how this bill will cost families and workers up to \$1 trillion per year, according to one estimate, and at least hundreds of billions of dollars according to the bill's sponsors. Energy prices will rise, because families and workers will pay multiple times for what they pay once for now. Consumers will first pay higher power costs from the production costs from higher natural gas prices. Then they will pay for expensive new carbon controls or alternative energy sources, such as wind.

Then this bill will force them to pay still more for the cost of auctioned carbon allowances. Producers are forced to buy at auction the carbon allowances they need to operate. They will then pass those costs on to customers. Families and workers will end up paying \$50 billion more a year, rising to \$150 billion per year by 2030. Consumers did not suffer this auction surcharge under the successful acid rain cap and trade program, which I co-sponsored with Senator Byrd. Its SO₂ allowances were allocated to generators at no cost.

However, environmental groups concerned with how European companies earn windfall profits in its failed carbon trading scheme suggest auctions as the answer. It is a bad idea. Nevertheless, a report by a Clean Air Watch by the head of the National Wildlife Foundation claims that we must institute a multi-billion carbon auction to avoid corporate windfall profits. That report, as do those of many environmental groups, insist that no-cost allocations create windfall profits. They cite in their footnotes a CBO study from April 2007 which seems to agree, at least until one reads further, its footnote reveals that an exception to the ability to reap windfall profits is where consumer rates are set by regulators.

What is the meaning of this footnote to a footnote? It admits the reality that windfall profits are prohibited by law in the 36 States with regulated power markets. A State which regulates its power markets, caps profits that generators may collect. Additional profits must be refunded back to consumers. Windfall profits are prohibited by law. That means 36 States in the United States do not share Europe's windfall profit problem.

And yet, the nationwide carbon auction in this bill will require families and workers in the Midwest, South and Mountain West to pay billions extra for a problem they did not create. States in New England, Montana, California and others made the decision to deregulate their power markets. It was their choice to make themselves vulnerable to windfall profits. But we should not punish families and workers in the Midwest, Mountain West and South to solve the problems of 14 States.

Those 36 States together add up to over 130 million Americans who will suffer needlessly and thus unfairly under carbon auctions. Amendments to require auctions for all 100 percent of allowances would also hurt millions of Americans. I too oppose Government-sponsored windfall profits, but we should find a way to do so without punishing 130 million in 36 States and the best way to do it is to oppose carbon caps totally.

Some will say that the auctions are an effective way to collect money. That is true, if you want the highest price regardless of fairness. Others will say auctions are needed to raise funds to pay for environmental mitigation, a scheme to rob Peter to pay Paul.

We need to pour more money into clean energy technology. I support environmental mitigation, I supported it in the WRDA bill. We can cut carbon emissions by aggressive achievable CAFE standards, a clean portfolio stand for wind, solar, nuclear and hydro, biofuels and a Marshall Plan for clean energy technology. This, Madam Chair, this is the clean energy future with the widest support, and I urge you to embrace it. I thank the Chair.

[The prepared statement of Senator Bond follows:]

STATEMENT OF HON. CHRISTOPHER S. BOND, U.S. SENATOR FROM THE
STATE OF MISSOURI

Madame Chairman, thank you for holding this hearing on the carbon cap and trade bill we are considering. Today, I want to describe how its carbon auctions are unfairly expensive for millions of consumers.

Some may wonder how this bill will cost families and workers up to \$1 trillion dollars per year according to one estimate, and at least "hundreds of billions of dollars" according to the bill's sponsors.

Energy prices will rise because families and workers will pay multiple times for what they pay once for now. Consumers will first pay for higher power production

costs from higher natural gas prices. Then they will pay for expensive new carbon controls or alternative energy sources such as wind.

Then, this bill will force them to pay still more for the cost of auctioned carbon allowances. Producers are forced to buy at auction the carbon allowances they need to operate. They will then pass those costs on to consumers. Families and workers will end up paying \$50 billion more a year, rising to \$150 billion per year by 2030.

Consumers did not suffer this auction surcharge under the successful acid rain cap and trade program. Its SO₂ allowances were allocated to generators at no cost. However, environmental groups concerned with how European companies earned windfall profits in its failed carbon trading scheme suggest auctions as the answer.

A report by Clean Air Watch with a forward by the head of the National Wildlife Federation claims that we must institute a multi-billion dollar carbon auction to avoid corporate windfall profits.

That report, as do many environmental groups, insists that no-cost allocations create windfall profits. They cite in their footnotes a CBO study from April, 2007. The CBO study seems to agree—at least until one reads further. Its footnote reveals that an exception to the ability of reap windfall profits is where consumer rates are set by regulators.

What is the meaning of this footnote to a footnote? It admits the reality that windfall profits are prohibited by law in the 36 states with regulated power markets. A state that regulates its power markets caps profits that generators may collect. Additional profits must be refunded back to consumers. Windfall profits are prevented by law.

That means 36 states in the U.S. do not share Europe's windfall profit problem. And yet, the nationwide carbon auction in this bill will require families and workers in the Midwest, South, and Mountain West to pay billions extra for a problem they did not create.

States in New England, Montana, California and others made the decision to deregulate their power markets. It was their choice to make themselves vulnerable to windfall profits. But we should not punish families and workers in the Midwest, Mountain West and South to solve the problem of 14 states.

Those 36 states together add up to over 130 million Americans who would suffer needlessly, and thus unfairly, under carbon auctions. Amendments to require auctions for all 100% of allowances would also hurt millions of Americans.

I too oppose government sponsored windfall profits, but we should find a way to do so without punishing 130 million people in 36 states.

Some will still say that auctions are the most effective way to collect money. That is true if you want the highest price regardless of fairness. Others will say that auctions are needed to raise funds to pay for environmental mitigation, clean technology and low-income protection programs. That may get us closest to the real motives of this bill—a scheme to “rob Peter to pay Paul.”

I agree that we need to pour billions into clean energy technology. We need to spend more on environmental mitigation. I supported spending billions more for environmental mitigation in the WRDA bill.

We can also cut carbon emissions, but we should do it without cutting family budgets or worker payrolls. I support aggressive but achievable CAFE standards, a clean portfolio standard for wind, solar, nuclear, and hydro, biofuels and a Marshall Plan for clean energy technology. This is the clean energy future with widest support. I urge us to embrace it. Thank you.

Senator BOXER. Senator Bond, thank you. I am going to put into the record that page that deals with electricity prices. This is the modeling that was done based on the Department of Energy's computer model. And it shows, because of energy efficiency and so on, that at the end of the day, the average price, typical residential bill, will go down eventually by 2030.

I also think it would be a good time, since Senator Bond brings up a number of these issues, and he has been very sure-footed on his concern for consumers, I think it is important to know that the religious community has been very involved with us in trying to draft provisions to protect the vulnerable people that you talk about, Senator.

I would ask unanimous consent to place into the record a letter where they have discussed, and I think some of them are here now, and the groups are the National Association of Evangelicals, the

National Council of Churches, the United States Conference of Catholic Bishops and the Union for Reformed Judaism. They have gotten together and they have taken those concerns that you have eloquently stated since we have started this debate, and they have laid out some principles that they are looking for in the bill.

If I might finish, and then I will allow you to respond. I think what is important to note is that Senators Lieberman and Warner have been meeting with a lot of stakeholders. I just wanted you to know, Senator Bond, that your concern for consumers is their concern, and the vulnerable people, and that we are working with them. We have made some progress on this, but we have a way to go. I hope you will work with us as we try to strengthen these provisions in the bill.

Senator BOND. Madam Chair, I thank you. You have been most kind in hearing my concerns. We would like also to be able to put in the record some of the footnotes and questions which I mentioned. I turn to the religious community for my spiritual guidance. They know far more about theology and spiritual matters than I do. But I trust our economics better. They got into theology, not economy. We are going to continue to work with what I think are the overwhelming economic concerns of consumers.

Senator BOXER. Right. I would just point out, if I might respond, that their concerns have nothing to do with theology. Their concerns emanate from a deep feeling that they don't want people to suffer needlessly, nor do you, nor do I. I just want you to know that we welcome everybody to the table. We certainly welcome them to the table, as well as all the other voices.

Senator Inhofe, did you want to say something?

Senator INHOFE. Madam Chairman, I have a unanimous consent request to include in the record from three groups with major concerns: the American Chemistry Council, the Fertilizer Institute and the International Brotherhood of Boiler Makers.

[The referenced material follows on page 427.]

Senator INHOFE. Then I would say also, in reference to what you refer to as the religious community, if you really want to pursue this, then I would be requesting that we have a hearing. Because I can assure you that this would be a subject that would be of great interest to a lot of people.

Senator BOXER. Yes. We did have a hearing from the religious community—

Senator INHOFE. No, I am talking about just on—

Senator BOXER.—and we did have your witnesses at that hearing. We can give you the transcripts.

All right. We are going to get to the panel now. I am just very pleased that you are all here for this last hearing before the markup. Fred Krupp, President of Environmental Defense, we welcome you, sir.

STATEMENT OF FRED KRUPP, PRESIDENT, ENVIRONMENTAL DEFENSE

Mr. KRUPP. Thank you, Madam Chair. It is an honor to be here with you today as the Committee deliberates America's Climate Security Act. It is indeed a front row seat in history.

Across the globe, countries and corporations are changing, adapting to a new world of energy and innovation to meet the crisis of climate change. With America's Climate Security Act, the United States can now join this movement toward a cleaner, more stable and more prosperous future.

Discussion and debate on the issue of climate change has finally come to the halls of Congress, and the members of this Committee deserve great credit for bringing us to this point. But the scientific realities of global warming mean that only action, fast, decisive bold action will be a satisfactory outcome. If the members of this Committee remember one thing from my testimony today, it should be this: we must pass comprehensive climate change legislation now. Our economy, our environment and our national interest compel it.

Consider this. If the legislation is enacted and takes effect in 2012, the emissions cap would result in an annual reduction of emissions just under 2 percent per year for covered sources arriving at a reduction of 15 percent below current levels by 2020. But what happens if we delay the legislation by just two years? Just two years of delay, holding everything else constant, has major consequences. As you can see in the diagram behind me, in order to result in the same amount of cumulative emissions by 2020, and with the climate change, it is the cumulative emissions that matter, a two year delay will require that emissions fall by 4.3 percent every year. We would be demanding over twice the rate of reduction if we delay two years.

Instead of a reduction of 15 percent in the annual emissions for the year 2020, two years of delay means 2020 emissions have to be reduced by 23 percent just to get to the same place. The worst thing we can do for our economy and our environment is to do nothing at all. But the second worst thing we can do is delay. And as this chart shows, even by just two years.

We believe that this legislation not only provides the fastest route to reduced emissions, but has the right framework to address the challenge of climate change in a way that makes sense for the environment, entrepreneurs and the economy. The Act sets strong, early targets which would jump start the entrepreneurial energy we need to employ current technology and develop even better technology. In addition to safeguarding the environment, the Act protects our economy. First, it uses the time proven mechanism, cap and trade, that allows regulated entities access to the lowest cost emissions reductions.

Among the other important cost containment options is the ability by companies to purchase offsets from American farmers or earn credits by reducing international forest destruction. The bill's authors have wisely recognized that we cannot solve climate change alone, and the Act includes an innovative system of carrots and sticks to prompt action from major emitting developing economies.

One carrot is the opportunity to participate in the U.S. greenhouse gas emissions market. If emitters in other countries would like to sell allowances they earn in their home countries into the United States emissions market, then those countries will have to meet the practices and standards called for by this Act. A stick

would prompt action to ensure that the emissions reductions of the America's Climate Security Act are not undone by emissions associated with imported products manufactured in major emitting uncapped nations.

The bill has recognized that our domestic greenhouse gas reduction program will move forward in a world grappling with the realities of globalization and its impact on the United States. This approach makes economic and environmental sense. In order to avoid the consequences of delay I spoke of earlier, it is imperative for this legislation to reach the Floor as soon as possible. That includes preserving the delicate political balance that Chairman Boxer spoke of in a previous hearing, while adding new support in Committee and on the Floor.

There are improvements to the legislation that we would support as the bill moves through the legislative process. For instance, we have steadily supported Senator Carper's efforts to not only reduce emissions of greenhouse gases but also mercury, SOx and NOx. But I also have to say, we see time running out now on this Congress. Therefore, we strongly support moving the bill out of Committee in its current form, even if the Committee has not yet resolved some of these issues.

We will oppose amendments that would weaken the targets and time lines or any price cap, the so-called safety valve. A safety valve would mean abandoning the cap.

Thank you for the opportunity to offer our thoughts. I don't think there is a higher priority for Congress as a whole than speedy adoption of effective and efficient measures to address this crisis.

[The prepared statement of Mr. Krupp follows:]

STATEMENT BY FRED KRUPP, ENVIRONMENTAL DEFENSE

I am honored to be here with you today as this Committee deliberates America's Climate Security Act. There is no more important legislation that this Committee will ever consider than comprehensive climate change policy.

Environmental Defense is a leading national nonprofit organization representing more than 500,000 members. Since 1967, we have linked science, economics and law to create innovative, equitable and cost-effective solutions to society's most urgent environmental problems. Environmental Defense is dedicated to protecting the environmental rights of all people, including future generations. Among these rights are clean air, clean water, healthy food and flourishing ecosystems. We are guided by scientific evaluation of environmental problems, and the solutions we advocate will be based on science, even when it leads in unfamiliar directions.

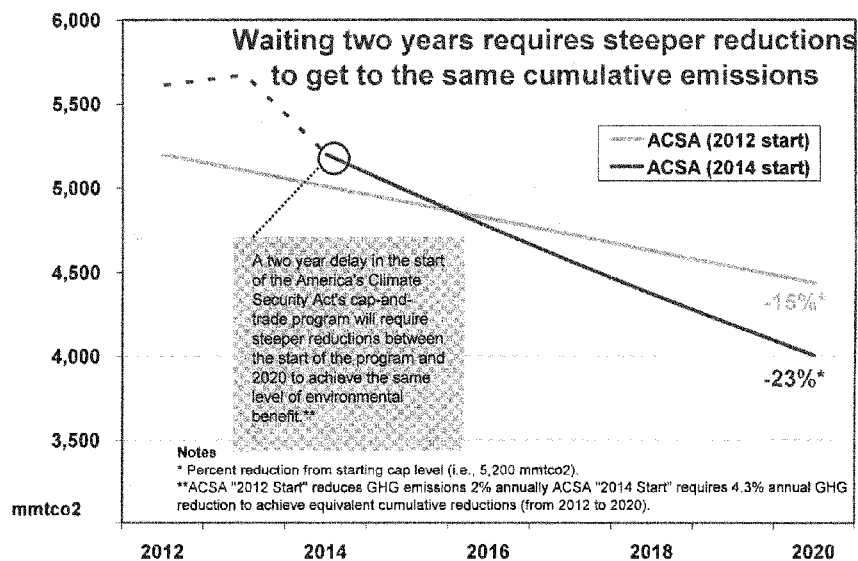
America's Climate Security Act contains all of the essential elements needed in legislation for the U.S. to begin to tackle the problem of global climate change. If the members of this committee remember one thing from my testimony today—it should be this—we must pass comprehensive climate legislation now. Our economy, our environment, and our morality compels it—and if I am back here three years from now—still calling on this Committee to pass legislation—then all who are in this room today will have failed. We would have lessened our chances of preventing the most dangerous consequences of climate change and we would have raised the costs to the economy of meeting the challenge.

In my testimony today, I want to make 5 points: (1) why time is of the essence, (2) that America's Climate Security Act has the right framework to tackle climate change, (3) that we have the technology we need to get started, (4) that the carrots and sticks in America's Climate Security Act will prompt international action, and finally, (5) I will comment on a couple of amendments that I believe are worth special notice.

1. There is no time for delay.

If the legislation is enacted and takes effect in 2012, the emissions caps would result in an annual reduction of emissions of just under 2% per year and, for covered sources, arrive at a reduction of 15% below current levels by 2020. But what

happens if we delay enacting legislation by two years? Just two years of delay—holding everything else constant—has major consequences. As you can see in the diagram behind me, in order to result in the same amount of cumulative emissions by 2020 (and with climate change, it is the cumulative emissions that matter), a two-year delay will require that emissions fall by 4.3% every year—over twice as quickly! Instead of a reduction of 15% in the annual emissions for the year 2020, two years of delay means 2020 emissions have to be reduced by 23%—just to get to the same place. The worst thing we can do for our economy and our environment is to do nothing at all, the second worst thing we can do is to delay—and as this chart shows, even by just two years.¹



2. America's Climate Security Act has the right framework to address the challenge of climate change in a way that makes sense for the environment, entrepreneurs, and the economy.

The Act sets strong early targets. As I have mentioned earlier, these targets are important to the environment and the economy. Aggressive early year targets increase our ability to avoid a greater than 2° increase in warming and the consequences that would bring. The early targets will jump start the entrepreneurial energy we need to deploy current technology and develop even better technology. The Act contains long-term targets that provide assurance to our grandchildren and our financial markets that we will stay committed to the task.

A recent report by the University of Maryland reviewed data and studies on the economic impacts of climate change and the costs of inaction. The review finds that economic impacts of climate change will "occur throughout the country, [and] economic impacts will be unevenly distributed across regions and within the economy and society." Just to highlight one finding of the report, it "found that negative climate impacts will outweigh benefits for most sectors that provide essential goods and services to society." The review finds that

New York State's agricultural yield may be reduced by as much as 40%, resulting in \$1.2 billion in annual damages. Expected water shortages in California's Central Valley are likely to affect the agricultural sector in the area. Agriculture around the San Antonio Texas Edwards Aquifer region is likely to suffer a similar fate. The regional impact may reach losses of \$3.6–6.5 billion by 2030 and \$6.75–10.13 billion by 2090. Even those farms and regions that temporarily benefit from altered environmental conditions (e.g., carbon fertilization and extended growing season) risk economic losses if temperatures exceed those pre-

¹The data used to derive this chart is the national allowance account for the years 2012–2020 from the introduced version of S. 2191. The emissions growth from 2005 to 2013 is assumed to be 1.1% (which is an average of the 2004 and 2005 rate <http://www.epa.gov/climatechange/emissions/downloads06/07ES.pdf>)

ferred by the crops they currently produce. Climate change will also trigger increases in energy demand for cooling and will outpace declines in heating requirements. For example, electricity demand in Massachusetts may increase by 40% in 2030 because of climate change alone, most of which will occur in summer months and require significant investment in peak load capacity and energy efficiency measures. Nationwide, the required investment may exceed \$300 billion by the middle of this century. Given the long lead times of capacity expansion in the energy sector, little time remains to act on anticipated warming trends.²

In addition to safeguarding the environment, the Act protects the economy in many ways. First, it uses the time-proven mechanism, cap-and-trade, that allows regulated entities access to the lowest cost emissions reductions possible. Cap-and-trade provides a whole range of cost management mechanisms that allow companies a wide choice in managing their compliance with emissions limits. Companies can

- make emissions reductions at their own facilities,
- purchase allowances from other facilities whose cost of reductions are even lower (so much so that they can “over-comply” and sell their excess allowances to others), and
- optimize plant development schedules and maintenance and can “bank” and “borrow” emissions allowances to fit into those schedules.

As experts have written “enhanced environmental performance can be attributed to the increased flexibility associated with emissions trading. Where emission reduction requirements are phased in and firms can bank emission reductions—as was the case in the Lead Trading, Acid Rain, ABT, and Northeast NOx Budget Programs—the achievement of the required emission reduction has been accelerated.”³ (See Attachment 1 for more information on cap and trade programs.)

Companies can also purchase offsets from American farmers. They can earn credits by reducing international forest destruction. The ability to sell excess allowances creates an incentive for inventors and entrepreneurs to develop and deploy new technologies. All of these processes work together to allow us to meet our challenge at the lowest possible cost.

3. Some question whether we have the technology to meet the emission requirements of the Act. It is natural to ask: How will we get there?— How can we accomplish the deep reductions in global warming pollution that science tells us we must achieve, and that this bill would require?

The good news is that we know how to cut emissions today, with proven technologies.

- *Energy efficiency.*—Based on programs already in place at the state level, the National Action Plan for Energy Efficiency has estimated that by 2025 we will be able to reduce carbon dioxide emissions by over 400 million tons a year simply by using energy more wisely. [And in many cases, conserving energy ends up saving consumers money.]⁴

- *Farms and forests.*—The U.S. EPA estimates that activities such as improved forest management, agricultural soil carbon sequestration, and methane and nitrous oxide mitigation could cut emissions by 620 million metric tons a year by 2015 at a cost of under \$15 per ton—and that figure would double at prices of \$30 a ton. (See Attachment 2 for a summary of EPA’s findings.)⁵

Just putting those numbers together yields over one billion tons of reductions a year. This is more than a third of the way (or more precisely 35%) to the abatement required in the year 2025.

And that is just the tip of the iceberg. The next generation of coal-fired power plants will have “carbon capture and sequestration” technology available to them. While that may sound far off, in fact all of the components have been tested and are in place. Gasification technology has been available for decades. And oil and gas companies are already—pumping CO₂ into geologic reservoirs as part of enhanced oil recovery. The only reason we have not deployed these technologies widely for

²M. Ruthe, D. Coehlo, D. Karetnikov, “The U.S. 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>.

³Ellerman, et al. (2003), p. 34

⁴National Action Plan for Energy Efficiency. July 2006. Chapter 1, p. 18 <http://www.epa.gov/solar/pdf/napee/napee-report.pdf>.

⁵Environmental Protection Agency, “Greenhouse Gas Mitigation Potential in U.S. Forestry and Agriculture.” November 2005,—Appendix 4.A

electric power generation is that there has been no financial incentive to do so. Placing a cap on carbon will change all that.

I could list all of technologies available today from wind power—which is exploding across the Plains and the West—to more efficient vehicles like the hybrid diesel vehicles being built in Ohio—to low carbon fuels being developed in Tennessee and other states—to the substitution of chemical processes at plants in Delaware—to methane management for farms all across America. The list goes on and on. And putting a cap on carbon will bring even more technologies to market.

4. America's Climate Security Act has a system of carrots and sticks to prompt action from major emitting developing countries.

The first carrot is the opportunity for participation in the U.S. greenhouse gas emissions market. If emitters in other countries would like to sell allowances that they earn in their home countries into the United States emissions market, then those countries will have to meet the practices and standards called for in this Act. Another important carrot is the International Forest Carbon provision. Every year, the cutting and burning of the world's tropical forests causes 20% of greenhouse gas pollution world-wide, irrevocably destroying the richest repositories of biological diversity on the planet, and impoverishing the hundreds of millions of people who depend on forests for their livelihoods—all because the forest is worth less alive than it is dead. This Congress can change all of this and, for the first time, give living forest economic value for tropical nations and forest peoples, by allowing tropical countries that make real, verifiable reductions of their national deforestation emissions to sell those reductions in our carbon market.

A stick is present in what is commonly referred to as the Bingaman-Specter provision because it mirrors what is in the Low Carbon Economy Act of 2007 (S. 1766). This provision would prompt action to ensure that the emission reductions of ACSA are not undone by emissions associated with imported products manufactured in major emitting uncapped nations. The bill's authors recognize that our domestic greenhouse gas reduction program will move forward in a world grappling with the realities of globalization and its impacts on the U.S. As the USCAP Call for Action states: "[C]are should be taken that policies do not merely push emissions from U.S. facilities to overseas plants, ultimately there must be an international program for addressing climate change and its impacts. U.S. action to implement mandatory measures and incentives for reducing emissions should not be contingent on simultaneous action by other countries. Rather, we believe that U.S. leadership is essential for establishing an equitable and effective international policy framework for robust action by all major emitting countries."

Recognizing that poorer nations might not be able to cap and cut emissions as quickly as the United States, but that we cannot address the global warming problem effectively unless all major emitting nations do cut emissions, the bill first calls for new international agreements engaging all major emitting nations in cutting their emissions. If negotiation of these new agreements proves unsuccessful, the bill would, after a certain time period, level the environmental and competitiveness playing field by requiring that imports of products produced in uncapped nations submit emissions allowances sufficient to cover the emissions incurred by the production of those products abroad.

As part of a comprehensive framework, a combination of these kinds of carrots and sticks makes sense. However, if we want nations with less capacity, fewer resources, and more problems to take serious action to cut GHG emissions, then we as a nation must act forcefully and without equivocation. Let's show them how to do it credibly and effectively and set a reasonable timeframe for their comparable action.

5. We strongly support moving the bill forward in its current form and will oppose amendments that would weaken the bill.

As the bill moves forward to Senate floor and through the legislative process, there are issues that we hope Senators will continue to work on:

(1) The best science we have today indicates that we will need to make economy-wide emissions reductions of 80% by 2050. The bill's science review (sometimes called "lookback") provisions, can be amended to ensure that new scientific information generated in the future is not only evaluated but also leads directly to action with minimal delay. The EPA should be given the authority to take additional actions if the science reviews mandated by the bill demonstrate that the bill's emissions targets will not be met.

(2) Senator Whitehouse has discussed an amendment to establish an Ocean Trust as part of the adaptation assistance provisions in the bill. Elevated CO₂ levels are projected to profoundly impact the health of the oceans, which provides about 20% of the world's protein, and the coasts, where over half the U.S. population now lives. The bill amendment will help our fisheries and oceans adapt to ocean acidification,

increasing water temperatures, and rising sea levels, by establishing a dedicated funding mechanism for on-the-ground efforts to protect and restore ocean and coastal ecosystems. Establishing such an oceans trust was a priority recommendation of the U.S. Commission on Ocean Policy created by Congress—and I thank Senator Whitehouse for his efforts here.

(3) International-adaptation provisions should not be limited solely to national-security considerations and resources provided international adaptation should be increased. Currently, ACSA would provide international adaptation funding only where such expenditures are deemed “necessary to enhance the national security of the United States,” specifically to “assist in avoiding the politically destabilizing impacts of climate change in volatile regions of the world.” While national security is one appropriate consideration in this context, it is not the only one. Many of the world’s poorest peoples will be adversely affected by climate change that is, to a significant degree, of America’s making.

We will oppose amendments that would:

- (1) Weaken the targets and timelines of the bill.
- (2) Include any price cap (or so-called “safety-valve”). A safety-valve set at any price would gut the environmental targets in the bill and would prevent investors from making the commitments needed to develop and deploy needed technology.
- (3) Further restrict the use of offsets. We believe high-quality offsets can play an important role in reducing emissions quickly, providing new revenue streams for farmers, and lowering costs for regulated entities and yield important environmental benefits.

ATTACHMENT 1: WHY CAP-AND-TRADE IS THE PREFERRED POLICY TO ADDRESS CLIMATE CHANGE

The Cap-and-Trade Experience

WHY IT IS THE PREFERRED POLICY TO ADDRESS CLIMATE CHANGE.

All serious climate change policy proposals have identified cap-and-trade as the regulatory mechanism of choice. As Congress begins to craft its climate change policy, it is imperative to revisit the reasons why cap-and-trade is the best regulatory mechanism to address the challenge of climate change.

Numerous reports (both federal and state), academic articles, and other publications analyze cap-and-trade policies – past, present and future – and articulate clearly the benefits of such policies. Relevant excerpts from five select sources have been compiled here to exemplify how a well-designed cap-and-trade policy can deliver superior environmental performance and significantly reduce economic costs when compared to conventional regulatory mechanisms. These excerpts also highlight other benefits of cap-and-trade policies, including: how they spur innovation, improve and accelerate compliance, and provide emitters with considerable flexibility.

Cap-and-trade policies differ from other regulatory systems. Cap-and-trade is not a three syllable word – it identifies two different components of a policy that, working together, achieve results. The *cap* limits emissions and *trading* lowers compliance costs.

- Cap-and-trade is recommended due to its putting "a clear and specific limit on aggregate emissions and its potential to achieve the emissions-reduction target at lower cost than would otherwise be possible." (MAC (2007), p. 5)
- Cap-and-trade "provides a framework to meet emissions reduction goals at the lowest possible cost...by giving emissions sources the flexibility to find and apply the lowest-cost methods for reducing pollution. Emission sources with low-cost compliance options have an incentive to reduce emissions more than they would under command-and-control regulation." (Ellerman, et al. (2003), p. iii, Executive Summary)

Cap-and-trade achieves results at lower costs. Experience shows that, when compared to command-and-control policies, cap-and-trade is more environmentally effective and economically efficient. Cap-and-trade also reduces the informational burden on regulators, lowering administrative costs.

- "Savings under the trading program amounted to 43-55% of expected compliance costs under an alternative regulatory program that imposed a uniform emission standard." (MAC (2007), p. 7)
- The Acid Rain Program, achieved "...savings of over 65% compared to a policy that might have forced post-combustion controls (scrubbers) to achieve the same level of emissions." (MAC (2007), p. 7)
- "In the long run, allowance trading may achieve cost savings of \$700-\$800 million per year compared to an 'enlightened' command and control program characterized by a uniform emission rate standard. The cost savings would be twice as great if the alternative to trading were forced scrubbing." (referring here to the Acid Rain Program, Carlson, et al. (2000), p. 12)
- Over the first 13 years of the Acid Rain Program, the ability to trade allowances nationwide across affected units and through time is estimated to reduce compliance costs by a total of \$20 billion, a cost reduction of about 57% from the assumed command-and-control alternative. (Ellerman, et al. (2003), p. 16)
- "Administrative costs can be lower because regulators are relieved of responsibility for establishing specific targets on a facility-by-facility basis." (MAC (2007), p. 5)

Cap-and-trade provides firms flexibility in meeting environmental goals. Cap-and-trade policies offer businesses flexibility for compliance; this is a key source of cost reductions. Firms can choose how, when, and where they meet the program's requirements. These choices are created through several policy components including trading, rewards for early action, and banking.

- "Offsets bring in less expensive emission reductions from uncapped sources and thereby allow compliance at a lower cost than could be achieved by the covered sectors acting alone." (RTI/Nicholas (2007), p. 4-5)
- "The flexibility of the trading program has encouraged utilities to capitalize on advantageous trends, such as changing fuel prices and technological innovation that might have been delayed or discouraged by traditional regulatory approaches." (Carlson, et al. (2000), p. 25-26)
- McCain-Lieberman 2003 (S.139) "provides some measures that give entities a certain amount of flexibility in complying with the emissions limits. These provisions include early action credits, allowance trading and banking, and a mechanism to allow participation from non-covered sources. These flexibility measures are expected to result in a relatively smooth transition through the first and second compliance periods. As a result, the economic burden of controlling emissions is rolled in gradually over time." (EIA (2003), p. 64)

Trading

- "By giving firms the flexibility to reallocate (trade) emissions credits or allowances among themselves, trading can reduce the compliance costs of achieving the emissions target." (Ellerman, et al. (2003), p. 1) "Differences in emission control

costs across emissions sources create the opportunity to reduce costs through trading." (Ellerman, et al. (2003), p. 5)

- "Enhanced environmental performance can be attributed to the increased flexibility associated with emissions trading. Where emission reduction requirements are phased in and firms can bank emission reductions - as was the case in the Lead Trading, Acid Rain, ABT, and Northeast NO_x Budget Programs - the achievement of the required emission reduction has been accelerated." (Ellerman, et al. (2003), p. 34)
- "Spatial trading has allowed sources with high abatement costs to reduce emissions less—and those with low abatement costs to reduce emissions more—than under a command-and-control mechanism requiring uniform emissions rates, and thus has reduced the overall cost of the mandated emissions reduction." (Ellerman, et al. (2003), p. 14)
- "The available evidence suggests that the increased compliance flexibility of emissions trading yields costs savings of as much as 50 percent." (Ellerman, et al. (2003), p. iv, Executive Summary)

Banking

- "The reason for the remarkable reduction in [SO₂] emissions in 1995...is the availability of 'inter-temporal trading' in the form of banking. The prospect of higher marginal abatement costs after 2000 made abating more than required in Phase I an appealing option for smoothing the transition to the more demanding Phase II cap. As a result, the reduction in emissions experienced in Phase I was about twice what would have been required to bring emissions below the level allowed in these years." (Ellerman, et al. (2003), p. 14)
- "Because allowance can be sold or held for future use, covered entities will have an incentive to reduce emissions under the bill even if they are allocated sufficient allowances to cover their annual emissions." (EIA (2003), p. 5)

Cap-and-trade policies encourage continuous technological innovation. Because every incremental reduction in emissions has value in a cap-and-trade market, cap-and-trade encourages continuous innovation. Money can be made and competitive advantage can be gained through innovations that reduce emissions at a lower cost.

- "The actual realized cost of the policy will depend significantly on the development and deployment of low-carbon technologies that are not widely in use today. Indeed, it may involve deployment of technologies not yet on the drawing board." (RTI/Nicholas (2007), p. 7)
- "The cap not only limits emissions, it creates a market for emissions allowances where every ton of emissions has a price. This price provides sustained incentives for developing new technologies that can reduce GHG emissions" (MAC (2007), p. 14)
- "...since allowances are valuable, cap-and-trade programs give firms continuing incentives to identify low-cost reduction opportunities: additional reductions are

attractive because they allow firms to either sell more allowances or to reduce the number of allowances they must purchase." (MAC (2007), p. 7)

- "The incentive to abate in cap-and-trade programs, where there is no specific standard for any single plant, is continuous and any improvements in abatement technology will result in allowance savings." (Ellerman, et al. (2003), p. 35)

Cap-and-trade policies have high compliance rates. This is because of two factors: 1) cap-and trade's inherent ability to avoid differing hardship for particular sectors, and 2) clear and automatic penalty provisions. Under cap-and-trade, fair treatment, clear penalties, flexibility and incentives make it cheaper for firms to comply than to seek the relaxation of the cap.

- "Four features describe the environmental performance of the Acid Rain Program. First, a large reduction of emissions was accomplished relatively quickly—in the fifth year following passage of the enabling legislation. Second, the schedule of emission reduction was accelerated significantly as a result of banking. Third, no exemptions, exceptions, or relaxations from the program's requirements were granted. Four, the 'hot spots' that were feared to result from emissions trading have not appeared." (Ellerman (2003), p. 3)
 - "...it becomes cheaper for these firms to comply than to seek some relaxation of the standard. Moreover, the existence of a market removes the primary reason for seeking relaxation: unique hardship due to the uniform application of a rule to source-specific circumstances. No one is uniquely disadvantaged in a market with many buyers and the highest cost is that of a permit. The happy result is a regulatory system in which compliance has been made cheaper than seeking some type of relaxation." (Ellerman (2003), p. 7)
 - The SO₂ "program was implemented without the granting of the exemptions, exceptions, or relaxations of the regulatory requirement that are typically issued to avoid the undue hardship that can result when a more or less uniform mandate is imposed on sources exhibiting cost heterogeneity." (Ellerman (2003), p. 4)
 - "Allowing firms that face high marginal costs of abatement, or even technical infeasibility, to comply with environmental requirements by buying allowances—effectively paying others to reduce more on their behalf—has eliminated one of the features of command-and-control programs that diminishes environmental effectiveness. In a command-and-control program, economic hardship or technical barriers can be dealt with only by relaxing the emissions standard in some way. While often justified, these exceptions reduce the regulation's environmental effectiveness because they are one-sided: standards are relaxed to avoid "hardships" for some facilities, but increased emissions cannot be offset by increasing standards at facilities for which abatement is less expensive or easier technologically." (Ellerman, et al. (2003), p. 34)
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ATTACHMENT 2: SUMMARY OF EPA'S FINDINGS OF POTENTIAL
EMISSION REDUCTIONS IN AGRICULTURE AND FORESTRY SECTORS

Table 4.A.1: Key Results at the National Level by Activity, Time Period, and Constant-Price Scenarios
Quantities are Tg CO₂ Eq. per year net emissions reduction below baseline for
representative years 2015, 2025, and 2055.

Year	Activity	GHG Price (\$/T CO ₂ Eq.)				
		\$1	\$5	\$10	\$50	\$50
2015	Afforestation	0	0	145	337	477
	Forest management	27	121	227	271	301
	Agricultural soil carbon sequestration	66	139	194	191	177
	Fossil fuel mitigation from crop production	17	33	35	46	25
	Agricultural CH ₄ and N ₂ O mitigation	11	15	28	46	59
	Biofuel offsets	0	0	0	16	17
	All activities	121	299	629	1,129	1,496
2025	Afforestation	0	12	328	696	1,298
	Forest management	22	89	168	250	309
	Agricultural soil carbon sequestration	67	140	204	197	153
	Fossil fuel mitigation from crop production	14	18	32	46	32
	Agricultural CH ₄ and N ₂ O mitigation	7	17	36	70	116
	Biofuel offsets	0	0	0	21	23
	All activities	110	266	665	1,690	2,021
2055	Afforestation	1	-7	-370	-673	-626
	Forest management	-10	49	171	322	325
	Agricultural soil carbon sequestration	1	-29	-22	-10	-30
	Fossil fuel mitigation from crop production	14	40	42	62	111
	Agricultural CH ₄ and N ₂ O mitigation	7	11	26	62	101
	Biofuel offsets	0	0	121	395	1,021
	All activities	13	74	38	572	1,101

From Greenhouse Gas Mitigation Potential in U.S. Forestry and Agriculture, November 2005, EPA 430-R-05-006,
(<http://www.epa.gov/sequestration/pdf/greenhousegas2005.pdf>).

ATTACHMENT 3: COMPENSATED REDUCTION

Compensated ReductionA POSITIVE INCENTIVE FOR TACKLING THE LARGEST SOURCE OF GREENHOUSE
GAS EMISSIONS IN THE DEVELOPING WORLD

Compensated Reduction (CR) is an innovative proposal that provides positive incentives for developing countries to reduce deforestation rates on a voluntary basis and strengthen the global effort to mitigate climate change.

- According to the Intergovernmental Panel on Climate Change (IPCC, 2001) and the 2006 Stern Review, tropical deforestation accounts for approximately 20% of annual GHG emissions and is the largest source of emissions in the developing world.
- If current rates of deforestation in Brazil and Indonesia alone remained the same through 2012, the emissions from this deforestation would offset nearly 80% of the emission reductions of the Kyoto Protocol. (Santilli et al, Climatic Change (2005) 71: 267–276).

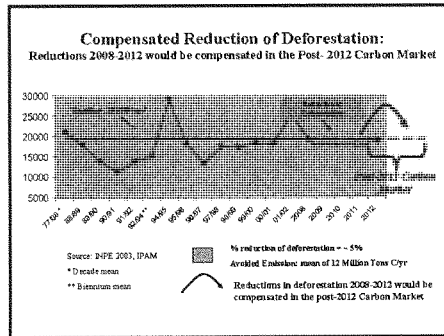
Compensated Reduction would reward countries that demonstrate a real decrease in deforestation. The concept is simple: Any nation that reduces national deforestation below a baseline (based on average historical deforestation rates) would be eligible for compensation, receiving emissions allowances tradable in the global carbon market.

- The compensation would be post facto. Successful countries would receive compensation after 2012 after real reductions were concretely measured; a portion of the tradable allowances would be held in an insurance reserve.
- To determine if real reductions occurred, a country's forests would be monitored by robust, reliable satellite imagery, supplemented by ground-truthing.
- At least one nation, Brazil, has already begun to demonstrate that it is possible, with serious and committed effort, to reduce deforestation.

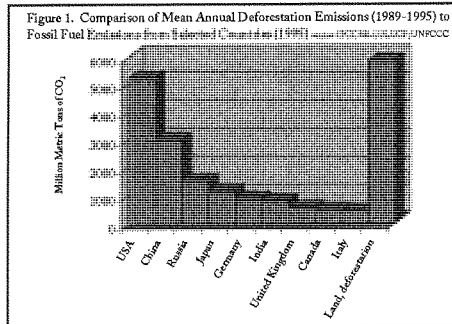
Compensated Reduction involves a nation's entire forest system, not just individual projects, thereby avoiding problems that have hindered consensus on forest issues.

- CR addresses key flaws in the Kyoto Protocol, enabling those developing nations that choose to do so to receive compensation – through the global carbon market – for reducing emissions.

- By harnessing market forces in favor of forest protection, building capacity and enhancing community involvement, and providing incentives for better monitoring, CR has the potential to engage orders of magnitude more financial support than even the most optimistic estimates of official development assistance (ODA) that could reasonably be expected from foreign aid. CR therefore supports both President Bush's Initiative Against Illegal Logging (see <http://www.whitehouse.gov/infocus/illegal-logging/piail.html>) and the U.S. Senate's 2005 Resolution stating that it is time for Congress to enact mandatory, market-based limits and incentives to slow, stop, and reverse greenhouse gas emissions growth in a manner that will not significantly harm the U.S. economy; and will encourage comparable action by other nations that are major trading partners and key contributors to global emissions.
- A coalition of developing nations has formally asked to have the issue of reducing emissions from deforestation placed on the agenda for the Twelfth Conference of the Parties the UN Framework Convention on Climate Change.



Any nation that reduces national deforestation below a baseline (based on average historical deforestation rates) would be eligible for compensation, receiving emissions allowances tradable in the global carbon market.



The largest share of developing country emissions is from the deforestation sector, an amount comparable to total US fossil fuel emissions.

RESPONSES BY FRED KRUPP TO ADDITIONAL QUESTIONS FROM SENATOR INHOFE

Question 1. I assume you are familiar with the EU cap and trade regime. While most of the EU countries will not meet their target, Great Britain made significant reductions. Isn't it true, however, that GB will only meet its target because it switched from coal to natural gas, and that over the last 9 years since that shift, its emissions have climbed again?

Response. It is important to note that the United Nations reported this week that the EU as a whole is likely to meet its -8% Kyoto commitment. (See press release here: <http://unfccc.int/files/press/news-room/press-releases-and-advisories/application/pdf/20071120-emissions-of-industrialized-countries-english.pdf>.) The time period you refer to was a pilot phase, a learning opportunity for the EU, who has not had the benefit of our acid rain program to gain experience. That phase is over, and lessons have been learned.

It is correct that the bulk of the recent emissions reductions in the United Kingdom (UK) during the initial period of the EU-ETS pilot phase are due to fuel switching. This shift in the UK seems to have slowed down. It is also correct that UK emissions have increased in recent years. Robust economic growth, combined with increasing natural gas prices and relatively low coal prices, led to an annual increase of CO₂ emissions of 3% during the current pilot phase of the EU Emissions Trading System (ETS), which runs from 2005-2007. It is important to note this current ETS pilot phase lasts only 3 years, affording little time for emitters to introduce major capital stock changes to harvest significant CO₂ emission reductions. The next EU-ETS phases of 2008-2012 (5 years) and 2013-2020 (8 years) give more time for a wide variety of CO₂ emission reduction investments to be made.

The U.S. can benefit from the UK experience. For industries with long lead times for investment and building capital stock, the sooner Congress sets the rules for 5, 10, 15 and 20 years from now, the sooner these industries can invest in the needed technology, such as carbon capture and storage. Delaying action could inadvertently lead to the level of fuel switching that Senator Inhofe so correctly wishes to avoid happening in the future.

Question 2. China is now the leading emitter of Carbon Dioxide. Many argue that the industrialized countries benefited, and their economies benefited, from their excessive emissions from many years, and they should repay those past excesses. Do you agree with that?

Response. No, Environmental Defense does not agree with that. Environmental Defense is most concerned with what our actions will be going forward—both domestically and internationally—to have the best chances of avoiding dangerous consequences of climate change. It is unreasonable to expect that all nations will achieve the same percent reduction in greenhouse gases. There are many justifications why developed and developing nations may have different rates of reductions, including:

- most of the GHG in the atmosphere today are from the developed nations,
- and the per capita emissions from the developed nations are on average about three times larger than those of the developing nations, and
- developing nations are much more dependent on increasing energy production to provide an acceptable standard of living for their peoples.

Question 3. Mr. Krupp, I, as well as many of my colleagues were concerned with the attacks directed at TXU after they announced plans to invest in coal. Those attacks, I believe, weakened the value of their stock making them a prime target for a takeover. Were you or anyone in your organization involved in any discussions with KKR during the takeover of TXU, especially regarding any advice on alternatives to the cancelled coal plants?

Response. When we were informed of the proposal by TXU to build 11 new powerplants, we began to investigate the proposal. We found that TXU was planning to build such plants without utilizing available technology to capture and store the greenhouse gas emissions from such plants. Because of that, and the impact the plants would have on air quality in the Dallas-Ft. Worth region (which has yet to achieve federal health standards for air quality), we opposed the proposal. We then initiated discussions with TXU, offering TXU ideas (including the use of cleaner coal technologies such as IGCC, ultrasupercritical, and carbon capture and storage) on how to meet electricity needs without increasing emissions. We had no contact with KKR about TXU until after they had reached an agreement on the price for the acquisition of the company in February 2007. Since February of 2007, we have had discussions with KKR and the new TXU management about power alternatives that would be more profitable in the long term for TXU and less environmentally harmful than conventional coal plants.

The best thing that we all can do to help the financial outlook of electric utilities and coal-fired generation is pass comprehensive climate change legislation. Right now, utilities and regulatory commissions are caught in a bind—they expect future regulation but the rules of the road have not been established. This uncertainty plays havoc with planning, investment and regulatory approval. This situation is one of the reasons that the National Association of Regulatory Utility Commissioners adopted a resolution this month in support of federal climate legislation. In the resolution, NARUC states: “the existence of uncertainty about the nature and extent to which [greenhouse gas] emissions will be subject to future federal regulation makes it difficult for State regulators, regulated utilities, and others to appropriately plan for needed investments in electric transmission and generation infrastructure.”

RESPONSE BY FRED KRUPP TO AN ADDITIONAL QUESTION FROM SENATOR VITTER

Question. One compliance strategy could be switching from coal to natural gas. If fuel switching occurs significantly during the initial phase of [the] program and natural gas prices increase dramatically, how would residential natural gas customers cope?

Response. One of the advantages of a cap-and-trade system to reduce greenhouse gas emissions is that it allows a wide variety of emission reduction technologies to be deployed. A catalyst to the development of those technologies is a predictable long-term emissions path. Under such a program, we would expect to see a range of market responses to a cap on carbon emissions. In the early years, energy efficiency and offsets are but two strategies that are far more cost effective than increased combustion of natural gas. Other cost management characteristics of a cap-and-trade system are the ability to bank and borrow allowances. As adopted by the subcommittee, America’s Climate Security Act also contains additional cost management provisions originated by Senators Landrieu, Graham, Lincoln and Alexander. Beyond these provisions, there are other provisions in ACSA targeted to low income home energy assistance that we support.

Senator BOXER. Thank you so much, Mr. Krupp. And thanks to your organization. I think you have been a very positive part of our discussions. Thank you.

Mr. KRUPP. Thank you, Senator.

Senator BOXER. Our next speaker is Hon. Eileen Claussen, President, Pew Center on Global Climate Change. Welcome.

STATEMENT OF HON. EILEEN CLAUSSEN, PRESIDENT, PEW CENTER ON GLOBAL CLIMATE CHANGE

Ms. CLAUSSEN. Thank you, Senator Boxer, Ranking Member Inhofe and members of the Committee. Thank you for the opportunity to testify on the most cost-effective means of reducing U.S. greenhouse gas emissions.

The Pew Center strongly supports reporting the America’s Climate Security Act of 2007 from the Committee on the schedule that you have announced, and looks forward to working with you and the rest of the Congress as the bill goes through the legislative process.

Senators, the bad news is that climate change poses real risks to our Nation’s security, economy and environment, and that these risks will grow dramatically if we do not begin to reduce our greenhouse gases now. The good news is that the market-based mechanisms found in the ASCA will allow us to address this problem cost effectively and in a way that enhances U.S. competitiveness.

Through the cap and trade program created by the bill, Congress can set the overall greenhouse gas reduction goals and let the emitters decide for themselves how to achieve the environmental goals of the program, at least cost. This does not mean that achiev-

ing our climate security goals will be cost free, just that the costs can be kept as low as possible and far lower than the costs of not acting.

We favor the economy-wide approach taken by the bill. Certainly sector by sector approaches can work, but the most cost-effective approach for the economy as a whole is to bring power plants, factories and transportation together in one market. An economy-wide trading program will draw key technologies into the marketplace when they are ready, diminish the burden on any one sector, reduce the cost to the economy as a whole and provide the broadest incentives possible for early emission reductions and technology innovation.

As a result, America's Climate Security Act will enhance U.S. competitiveness. Given what the peer-reviewed science tells us about climate change, we must move quickly to an economy in which our greenhouse gas footprint shrinks, even as our standard of living increases. This will require a profound world-wide technological revolution. The United States should be leading that revolution, but we currently are not. An appropriate price on greenhouse gas emissions, combined with incentives, will push technology into the marketplace and ensure that we meet our environmental goals at the lowest possible costs.

I would like to mention briefly three other important issues before I conclude: how to deal with transportation, the use of allowance allocation as a tool, and the need for cost certainty and reliability. First, transportation. Transportation emissions account for roughly one quarter of total U.S. emission and are growing rapidly. Reversing that trend is essential and can only be done by increasing vehicle efficiency, reducing vehicle miles traveled and reducing the carbon footprint of transportation fuels. The bill would include transportation fuels in the cap and trade program, providing a price signal that would promote all three.

Second, allowance allocation. While the use of a well-designed cap and trade program ensures the lowest overall cost, many important sectors of the economy will face real transition costs that can and should be dealt with through the allowance allocation process. Allocation has no effect on the greenhouse gas reductions mandated by the cap.

Given this, we should use the allocation process to address the legitimate transition costs some sectors will face as we move to a low greenhouse gas economy. Take coal-based electricity, for example. Coal is cheap and plentiful, and the United States is going to use it for the foreseeable future. And even if we did not, as was pointed out, China and India would. So rapid deployment of climate-friendly technologies is essential.

The best hope seems to lie with carbon capture and sequestration, which will likely take at least a decade to deploy widely. While we need not wait until then to begin cost-effective deductions, it would be appropriate to allocate initially a significant amount of allowances to this sector to help with the transition. As the need for transition assistance diminishes, the allocation of free allowances should phase out, which the bill does as well.

Finally, cost containment. Some stakeholders fear that in the early years of the program, the market price of an allowance might

be volatile, might swing too high too rapidly. Similarly, concerns have been raised about market liquidity, hoarding of allowances, manipulation of the market and exceptionally high costs. ACSA includes powerful cost containment mechanisms, including banking, borrowing and the use of offsets. In addition, the bill draws from the excellent work of Senators Warner, Landrieu, Graham and Lincoln in establishing a Carbon Market Efficiency Board which can step in should unexpected problems arise.

We look forward to working with the authors of the bill, Chairman Boxer and others as the bill moves forward to refine measures to provide additional assurances of a smoothly functioning market, so long as they do not undermine the integrity of the greenhouse gas emissions cap.

In conclusion, the America's Climate Security Act of 2007 is an excellent foundation. We applaud the Committee's work to date and urge the Committee to report the bill. Thank you.

[The prepared statement of Ms. Claussen follows:]

STATEMENT OF EILEEN CLAUSSEN, PEW CENTER ON GLOBAL CLIMATE CHANGE

Chairman Boxer, Ranking Member Inhofe, and members of the committee, thank you for the opportunity to testify on the most cost-effective means of reducing U.S. greenhouse gas emissions. My name is Eileen Claussen, and I am the President of the Pew Center on Global Climate Change.

The Pew Center on Global Climate Change is a non-profit, non-partisan and independent organization dedicated to providing credible information, straight answers and innovative solutions in the effort to address global climate change. Forty-five major companies in the Pew Center's Business Environmental Leadership Council (BELC), most included in the Fortune 500, work with the Center in these efforts.¹

The Pew Center strongly supports reporting the America's Climate Security Act of 2007 from the committee on the schedule that you have announced, and looks forward to working with you and the rest of the Congress as the bill goes through the process. I would like to discuss several reasons for recommending that you move forward with this bill.

CAP-AND-TRADE IS THE MOST COST-EFFECTIVE WAY OF REDUCING GREENHOUSE GAS EMISSIONS

Senators, the bad news is that climate change poses real risks to our nation's security, economy and environment, and that these risks will grow dramatically if we do not begin to reduce our greenhouse gas emissions now.² The good news is that the market-based mechanisms found in the America's Climate Security Act of 2007 will allow us to address this problem cost effectively and in a way that enhances U.S. competitiveness.

Unlike most emissions this committee deals with, greenhouse gas emissions are essentially fungible. Greenhouse gases mix quickly throughout the atmosphere, which means that wherever you can reduce a ton of greenhouse gas emissions—whether from a car, a factory, or a power plant; whether in Los Angeles, London, or Lagos—the benefit to the climate is the same.

In most of our other environmental laws, Congress directs EPA to dictate how much of a given pollutant a facility can emit or which pollution control technology to use. We do not have to take that approach with greenhouse gas emissions. Instead, by using a cap-and-trade program, Congress can set the overall greenhouse gas reduction goals and let the emitters decide for themselves how to achieve the environmental goals of the program at least cost. When we used a market-driven approach in the acid rain program, it provided the best environmental result at the

¹For more on the Pew Center, see www.pewclimate.org.

²For more on the science of climate change and the threat to our environment and economy, see the Pew Center's extensive body of reports available at www.pewclimate.org/global-warming-in-depth and the most recent findings of the Intergovernmental Panel on Climate Change at <http://www.ipcc.ch/>

lowest overall cost to our economy.³ This does not mean that achieving our climate security goals will be cost-free, just that the cost can be kept as low as possible—and far less than the cost of not acting.

AN ECONOMY-WIDE PROGRAM WILL BE MORE COST-EFFECTIVE THAN SECTOR-BY-SECTOR PROGRAMS

The Pew Center supports the proposal to apply the cap-and-trade program to all large sources of greenhouse gas emissions simultaneously. Congress has seen several proposals to cap and trade emissions from power plants only. Similarly, Congress has seen several proposals that address the transportation sector only, for example, by reducing the carbon footprint of transportation fuels. Certainly, such a sector-by-sector approach can work, but it will be more expensive and slower than an economy-wide approach.⁴

The most cost-effective approach is to bring power plants, factories and transportation together in one market, where all can benefit from the efficiencies and technological breakthroughs available in any sector at a given time. With an economy-wide program, we do not have to await the deployment of a single solution—such as carbon capture and sequestration, for example—to begin cost-effective reductions. The Pew Center's research with leading companies demonstrates that there are numerous cost-effective and even cost-saving reductions available now from off-the-shelf technologies and fuels.⁵ This is especially true in reducing non-CO₂ emissions from industrial processes, increasing industrial and building energy efficiency, increasing the use of low-carbon fuels, and improving vehicle efficiency.⁶ In the medium and longer term, steeper reductions will be made possible through deployment of more advanced technologies, such as highly efficient vehicles, improved nuclear power plants, renewable energy combined with enhanced electricity storage capacity, and carbon capture and storage (CCS). An economy wide trading program will draw these technologies into the marketplace when they are ready, reducing the burden on any one sector, reducing the cost to the economy as a whole, and providing the broadest incentive possible for early emission reductions and technology innovation.

The America's Climate Security Act uses other important measures to lower the cost of greenhouse gas reductions as well. The bill allows companies to offset some of their emissions with reductions from sources not covered by the program. Allowing the use of offsets motivates emission reductions throughout the economy from sources too small or dispersed to be specifically targeted by the program. Companies would also be allowed to use credits from the markets of other countries, thus making use of the global fungibility of greenhouse gases and expanding the scope of the program. Again, the larger the program, the lower the cost. We see opportunities to increase the use of these measures even beyond what is already in the bill.

A GREENHOUSE GAS CAP-AND-TRADE PROGRAM WILL ENHANCE U.S. COMPETITIVENESS

The America's Climate Security Act will enhance U.S. competitiveness. Given what the peer-reviewed science tells us about climate change, we must move quickly from our current economy to one in which our greenhouse gas footprint shrinks even as our standard of living increases. That will require a profound worldwide technological revolution. The United States can and should be leading that revolution, and positioning itself to reap the economic benefits associated with decreased depend-

³For more on our experience with emissions trading programs and on the design of a greenhouse gas reduction program, see Ellerman, Denny A., *Emissions Trading in the U.S.: Experience, Lessons, and Considerations for Greenhouse Gases*, Pew Center on Global Climate Change, May 2003, and Nordhaus, R., *Designing a Greenhouse Gas Reduction Program for the U.S.*, Pew Center on Global Climate Change, May 2003.

⁴The benefits of a wider trading program have been repeatedly demonstrated in all of the credible economic models—including the large number which participate in Stanford's Energy Modeling Forum. See www.stanford.edu/group/EMF/

⁵For more on the Pew Center's work with companies on strategies to address climate changes, see http://www.pewclimate.org/companies_leading_the_way_belc

⁶For example, 37 of the 45 companies in the Pew Center's Business Environmental Leadership Council have set voluntary targets, 22 have achieved those targets, and all have done so from a combination of efficiency improvements and process changes. DuPont, for example, has reduced its emissions 65% through a combination of energy efficiency and process change and has saved over \$2 billion. See also the proceedings from a workshop co-sponsored by the Pew Center on Global Climate Change and the National Commission on Energy Policy, *The 10-50 Solution: Technologies and Policies for a Low-Carbon Future*, found at http://www.pewclimate.org/global-warming-in-depth/workshops_and_conferences/tenfifty/proceedings.cfm and Reilly, John M., *Multi-gas Contributors to Global Climate Change: Climate Impacts and Mitigation Costs of Non-CO₂ Gases*, Pew Center on Global Climate Change, February 2003.

ence on foreign oil and increased export potential of low carbon technology. We currently are not leading, however, and federal R&D subsidies alone will not change that. An appropriate price on greenhouse gas emissions, in combination with “technology push” policies, will.

Some have asserted a false dichotomy between the need for mandatory climate policy on the one hand and support for climate-friendly technology on the other. In fact, a well-designed mandatory climate policy that leverages the power of the market is essential for driving deployment of climate-friendly technology. When combined with subsidies for specific technologies, it is the most cost-effective method of driving deployment. Government would have to spend roughly ten times the amount in incentives alone in order to achieve the same environmental result as a price signal coupled with incentives.⁷ The America’s Climate Security Act wisely combines mandatory greenhouse gas constraints and technology subsidies.

I would like to mention three other important issues before I conclude: how to deal with transportation, the use of allowance allocation as a tool, and the need for cost certainty and reliability.

REDUCING EMISSIONS FROM THE TRANSPORTATION SECTOR

Transportation emissions account for roughly one-quarter of total U.S. emissions and are growing rapidly. Reversing that trend is essential, and can only be done by (1) increasing vehicle efficiency, (2) reducing vehicle miles traveled (VMT), and (3) reducing the carbon footprint of transportation fuels. The America’s Climate Security Act would include transportation fuels in the cap-and-trade program, providing a price signal that would promote all three—especially if complemented by the other measures currently being proposed by the White House and Congress to increase vehicle efficiency and promote low carbon fuels, and with VMT-reduction measures, such as those in the Transportation Equity Act.⁸

USING THE ALLOCATION PROCESS TO AID TRANSITION

While the use of a well-designed cap-and-trade program ensures the lowest overall cost, many important sectors of the economy will face real transition costs that can and should be dealt with through the allowance allocation process. Allocation, contrary to the impression some stakeholders may be creating, has no effect on the greenhouse gas reductions mandated by the cap. Given this, we should use the allocation process, in the early years of the program, to address the legitimate transition costs some sectors will face as we move to a low-greenhouse gas economy.

Take coal-based electricity, for example. Coal is cheap and plentiful, and the United States is going to use it for the foreseeable future. Even if we did not, China and India would, so rapid development and deployment of climate-friendly technologies is essential. The best hope, at the moment, lies with carbon capture and sequestration, which most experts believe will take at least a decade to deploy throughout the power sector. While we need not wait until then to begin cost-effective reductions, it would be appropriate to allocate initially a significant amount of allowances to this sector to help with transition.⁹ The bill does this and also appropriately uses bonus allowances and a clean coal technology program funded out of auction proceeds to accelerate CCS deployment and speed and smooth the transition. There is a similar need for transition assistance in other sectors of the economy, most particularly energy-intensive industries that face significant foreign competition. As the need for transition assistance diminishes, the allocation of free allowances should phase out, which the bill does as well.

In addition, the bill includes provisions to mitigate any effect the program may have in increasing energy prices, especially for low- and middle-income Americans. A significant percentage of the proceeds from the auction have been dedicated to help these consumers and to help states assist their residents.¹⁰

⁷For more on the benefits of combining R&D and a carbon constraint, see Goulder, L., *Induced Technological Change and Climate Policy*, Pew Center on Global Climate Change, October 2004.

⁸For more on policies to reduce emissions in the transportation sector, see Green, David L., *Reducing Greenhouse Gas Emissions from U.S. Transportation*, Pew Center on Global Climate Change, May 2003.

⁹For more on the policy and technology options to deal with GHG emissions from coal see the Pew Center’s new Coal Initiative series found at <http://www.pewclimate.org/white-papers/coal-initiative>

¹⁰For more on community adjustment and worker transition to climate change policy, see Greenwald, Judith M.; Roberts, Brandon; Reamer, Andrew D.; *Community Adjustment to Climate Change Policy*, Pew Center on Global Climate Change, December 2001, and Barrett, Jim,

Continued

ADDRESSING PRICE VOLATILITY AND COST CONTAINMENT

Some stakeholders fear that, in the early years of the program, the market price of an allowance might be volatile and might swing too high too rapidly. Similarly, concerns have been raised about market liquidity, hoarding of allowances, and manipulations of the market.

In addition to the cap-and-trade itself, which provides for flexibility in meeting the environmental target, this legislation includes powerful cost containment mechanisms, including banking and borrowing. Allowing firms the ability to bank excess allowances or credits for future use helps firms manage the normal swings of the market. Allowing firms access to offset credits further lessens the danger of supply shortages, which in part create this price volatility. The bill also draws from the excellent work of Senators Warner, Landrieu, Graham and Lincoln and the Nicholas Institute at Duke University in establishing a Carbon Market Efficiency Board, which can gauge market activity and step in should unexpected problems arise. We look forward to working with the authors of this bill, Chairman Boxer, and others as the bill moves forward to refine measures to provide additional assurances of a smoothly functioning market, so long as they do not undermine the integrity of the greenhouse gas emissions cap.

CONCLUSION

In conclusion, the America's Climate Security Act of 2007 is an excellent foundation for an environmentally effective, cost-effective greenhouse gas reduction program. Continuing to move it through the legislative process will engage important stakeholders whose contributions will improve the bill. We applaud the committee's work to date, and urge the committee to report the bill.

RESPONSES BY EILEEN CLAUSSEN TO ADDITIONAL QUESTIONS FROM SENATOR INHOFE

Question 1. Do you support not allowing any more coal plants to be built until the future date when carbon capture and storage technology is available?

Response. The Pew Center supports a greenhouse gas (GHG) emissions cap-and-trade program which increases in stringency over time, as well as a large-scale carbon capture and storage (CCS) demonstration program. In the early years of the program, coal plants could be constructed, but these facilities would need to purchase GHG emission allowances or offset their emissions. These new plants could be CCS demonstration sites and would be eligible for CCS incentives such as bonus allowances.

Question 2. In your written testimony, you say that "we should use the allocation process, in the early years of the program, to address the legitimate transition costs some sectors will face as we move to a low-greenhouse gas economy." Are you saying you support reducing the number of "free" allowances further than provided in S. 2191?

Response. The Pew Center believes there are sound policy reasons for providing covered entities with a high level of free allowances initially to account for their transition costs—even at levels higher than in the current version of S. 2191—and phasing them out over a reasonable period of time.

RESPONSES BY EILEEN CLAUSSEN TO ADDITIONAL QUESTIONS FROM SENATOR VITTER

Question 1. You suggest that an economy-wide approach to emissions reductions is preferable and more efficient because it provides flexibility and diversity of reduction sources. If this is true, why stop at just domestic industries? This bill does very little in terms of reducing global emissions. Would it not be even more efficient to have emission sources from all nations on the table?

Response. The Pew Center believes that to address global climate change all major greenhouse gas (GHG) emitting nations must enter into binding agreements that require mitigation commitments of them. The Pew Center also supports, however, the statement of the U.S.-ratified U.N. Framework Convention on Climate Change (UNFCCC) that nations hold "common, but differentiated responsibilities" in addressing climate change. In other words, the commitments which we may expect of a developing country might be different from those expected of the United States or any other developed country. While we hope ultimately to see an international emissions trading system implemented under such agreements, we do not

anticipate that it would initially cover developing countries. Industrial GHG emissions in such countries could instead be addressed through sector-specific policies and measures or through international sectoral agreements.

If the U.S. is willing to make a commitment to reduce its emissions—as the leading contributor to current concentrations—it will be in a better position to work with other countries to do the same. Enactment and implementation of S. 2191, while on its own will not completely solve the global warming problem, would (a) send a price signal throughout the U.S. economy that would turn our unrivaled innovative capacity towards the problem of reducing GHG emissions while increasing standards of living, and (b) allow the United States to credibly begin negotiations with the other emitting nations in securing agreements that bind them to mitigation commitments, both of which will be essential in reducing global emissions to the necessary level. Without enactment of mandatory U.S. GHG reductions, neither of these essential steps will be possible.

Question 2. Considering that this bill will have virtually zero impact on greenhouse gas concentrations in our atmosphere, doesn't working within the UN Framework Convention on Climate Change make more sense and allow the U.S. to compete on a level playing field rather than taking unilateral action on a emissions regime that may or may not comport with future international programs?

Response. The Pew Center does not agree that the proposed 70% cut in emissions below 2005 levels will have a negligible impact on atmospheric concentrations of greenhouse gases, especially when compared to business-as-usual emissions. Further, the Center supports the rapid enactment of a U.S. domestic program to reduce GHG emissions precisely so that the United States can credibly negotiate with the other major emitting nations to secure mitigation commitments under the UNFCCC that will allow the United States to compete on a level playing field.

Question 3. This bill does not include providing any allowances to refiners for the petroleum transportation fuels that they produce. How would refiners comply with this bill in 2012 to cover the greenhouse gas emissions from petroleum transportation fuels?

Response. The Pew Center would not object to providing some free allowances to refineries for the transportation fuels they produce. That said, however, refiners could certainly comply with the current version of the bill by purchasing allowances on behalf of their customers either through the auction or from other covered entities. Economic analysis suggests that this sector can pass on the costs of purchasing allowances to their customers more readily than other sectors of the economy.

Question 4. This bill explicitly does not preclude or abrogate the right of a state to adopt or enforce a standard, cap, limitation, or prohibition relating to greenhouse gas emissions. We could end up with a national cap-and-trade program and different state controls. Shouldn't states be preempted to prevent duplicative and possibly conflicting environmental controls?

Response. In order to solve the climate change problem, action will be needed by all levels of government. For example, land use planning and building codes have an important influence on greenhouse gas emissions, and these policies are primarily the responsibility of local governments. Electric utility regulation also strongly influences greenhouse gas emissions and the costs to consumers of greenhouse gas reductions, and that is the purview of state public utility commissions. The federal government has a key role to play in ensuring that our nation overall takes the most efficient and effective approaches to reducing greenhouse gas emissions, and that the costs and benefits of the program are fairly distributed nationally. The federal government also has a key role to play in ensuring that the United States participates in global efforts to address climate change.

Senator BOXER. Thank you so much. We really appreciate that.

Ron Sims, we are very happy to have you here. You are King County Executive, State of Washington. Welcome, sir.

**STATEMENT OF RON SIMS, COUNTY EXECUTIVE OF KING
COUNTY, WASHINGTON**

Mr. SIMS. Madam Chairman, Senator Inhofe—I am nervous, and I can't believe this after being in office for 22 years.

[Laughter.]

Mr. SIMS. Members of the distinguished Committee, I want to thank you for inviting me to testify today about the importance of

investments, particularly in public transportation and other strategies to reduce driving in order to cut emissions of greenhouse gases.

I am the King County Executive and I am proud to serve as its elected leader of the 14th largest regional government in the United States. I am also Board Member of the Center for Clean Air Policy, a leading think tank crafting cost-effective climate policy solutions. King County stretches from the Puget Sound shores to the snow-capped peaks of the Cascade Mountains. It is the best place in the world to live. In between are 2,000 square miles containing vibrant urban centers, four major river systems, 760 lakes, 3,000 miles of streams and 1,000 square miles of forest. It is a wonderful community and home to 1.8 million people and businesses such as Boeing, Microsoft, Amazon.com and Starbucks.

With regard to transportation, King County also owns and operates Metro Transit, one of the ten largest bus transit systems in North America, with an annual ridership of over 100 million. Recently King County secured designation as a U.S. Department of Transportation Urban Partnership, which provides significant Federal funding to pursue a range of congestion pricing measures, reduction measures, including major new transit improvements as well as new technologies and incentives for changing commuting behaviors.

King County was also the first county and transit agency to join the Chicago Climate Exchange in part to help ensure that regional transit agencies have a voice during the creation of national cap and trade rules and legislation. Our region is growing extremely fast, both in our economy and our population. But our global warming challenges are also fast-growing. There will be two and a half million more people in the Puget Sound by 2050. So I think about how much decisions today as an elected official will shape what the region looks like then and whether those people, including my children and my grandchildren, will enjoy the well-being and prosperity that I have enjoyed.

That is why I am proud to speak before you today on the critical issues of America's response to global warming. King County appreciates the comprehensive approach of this bill. We support creating a market cap that sends a consistent economy-wide carbon price signal to all sectors. As Congress now examines how to reduce the emissions of greenhouses through national legislation, I urge you to consider that capping carbon emissions and promoting investments in clean energy and fuels alone will not solve this national and global crisis.

In King County, as in so many regions in the United States, especially the west coast, greenhouse gas emissions from the transportation sector are the single biggest source of global warming pollution. Additionally, the single largest contributor to transportation pollution are cars driving on our roads and our highways. Simply put, we cannot solve the problem of greenhouse gas emissions unless we create ways for people to drive less.

Not surprisingly, King County, as the regional transit agency, is confronted each day with the challenges of moving people out of their cars and into cleaner transportation alternatives. Therefore, a critical step in addressing the vehicle miles traveled problem lies

in assuring that the scope of this legislation fully recognizes and rewards those governments and institutions that are implementing policies right now to increase transportation choices and reduce the need for driving. Examples of such policies include smart growth planning, expanded transit, bolstering alternatives modes, such as biking, walking, tele-commuting and promoting density and transit-oriented development.

The research shows that if one solo commuter of a household switches from driving to transit for their commute to work, he or she can reduce their carbon footprint by 10 percent, the equivalent of more than 4,800 pounds of CO₂ for an average commuter each year. If that same commuter rides transit to work and their household gives up a second car, that family can reduce their carbon emission of up to 30 percent.

The comprehensive approach you are now taking also should provide incentives for those communities that are not currently engaged in those strategies. These include direct allocation of allowances to localities and regions engaged in policies to make significant investments in public transit, such as allowances or revenues, will make it easier for refiners to meet their greenhouse goals.

This can be done. In King County, we are either doing or promoting each of these policies. And we have gone one step further. We have said in response to our own environmental policy act that we are going to look at carbon emissions as one of the standards. Rewarding local governments engaged in comprehensive approaches that address all sectors of the economy and all three legs of that stool of transportation will be an essential element in the national fight against global warming.

Madam Chairman, Senator Inhofe and members of this Committee, thank you again for the opportunity to speak with you today to advocate for Federal Government action on global warming. I look forward to continuing to work with you to pass this very important and critical legislation. Thank you.

[The prepared statement of Mr. Sims follows:]

STATEMENT OF RON SIMS, COUNTY EXECUTIVE OF KING COUNTY, WASHINGTON

Madam Chairman, Senator Inhofe, and members of the Committee, thank you for inviting me to testify today about the importance of investment in public transportation and other strategies to reduce driving in order to cut the emission of greenhouse gases.

I am King County Executive Ron Sims, and I am proud to serve as the elected leader of the nation's fourteenth largest county government in the country. I am also a board member of the Center for Clean Air Policy, a leading think tank crafting cost-effective climate policy solutions. King County stretches from the Puget Sound shores to the snow-crested peaks of the Cascade Mountains. Between are 2,000 square miles with vibrant urban centers, four major river systems, 760 lakes, 3,000 miles of streams, and 1,000 square miles of forest. Our county is home to 1.8 million people.

With regard to transportation, King County also owns and operates Metro Transit, one of the ten largest bus transit systems in the nation, with an annual ridership of more than 100 million. Recently, King County was a lead in securing designation as a U.S. Department of Transportation "Urban Partnership," which provides significant federal funding to pursue a range of congestion reduction measures, including major new transit improvements, as well as technologies and incentives for changing commuting behaviors. King County was also the first county to join the Chicago Climate Exchange in part to help ensure that regional transit agencies have a voice during the creation of national cap and trade rules and legislation.

My region is growing extremely fast, both in our economy and our population. And our global warming problem also is fast-growing. I know that I will not be in the

Puget Sound region in 2050, but 2.5 million people will live there. And I think about how my decisions as an elected official today will shape what our region looks like then, and whether those people—including my children and grandchildren—will enjoy well being and prosperity. That is why I am pleased to speak before you today on the critical issue of America's response to global warming.

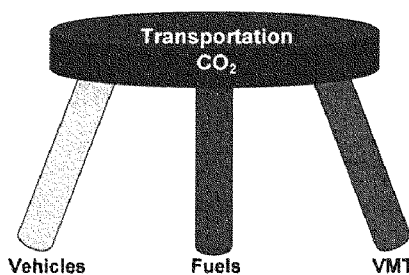
King County appreciates the comprehensive approach of S. 2191. We support creating a market cap that sends a consistent economy-wide carbon price signal to all sectors. As Congress now examines how to reduce the emission of greenhouse gases through national legislation, I urge you to consider that capping carbon emissions and promoting investment in clean energy and fuels alone will not solve this national crisis. It is my hope that you take this opportunity to build on the existing provisions in S. 2191 to prioritize and ensure investments will be made in policies designed to reduce vehicle miles traveled (VMT). That may require being more explicit about the types of VMT reduction activities eligible for funding beyond transit (which is already specifically noted in the bill), increasing available funding dedicated to those purposes, and considering funding VMT reductions from both the allowance and auction sources.

In King County and so many regions in the United States, especially on the west coast, greenhouse gas emissions from the transportation sector are the single biggest source of global warming pollution. Additionally, the single biggest factor in the amount of transportation pollution is the number of vehicle miles traveled. Not surprisingly King County, as the regional transit agency, is confronted each day with the challenge of moving people out of their cars and into cleaner transportation alternatives.

Nationally, the transportation sector is responsible for 33 percent of CO₂ emissions, and those emissions are projected to increase rapidly. Passenger vehicles (cars and light trucks) are responsible for more than three-fifths of transportation sector CO₂ emissions. With the significant reductions in CO₂ emissions needed to protect the climate (e.g., 60 to 80 percent below 1990 levels), the continuing growth of emissions from transportation will undoubtedly put more pressure on other sectors (including refining, manufacturing and electricity) to reduce their emissions.

The transportation sector's CO₂ emissions are a function of vehicle fuel efficiency, fuel carbon content, and VMT (vehicle miles traveled), factors we refer to as a "three-legged stool" (Figure 1). Energy and climate policy initiatives at the federal and state levels (including S. 2191) have focused almost exclusively on technological advances in vehicles and fuels, the first two legs. Yet, there is a growing recognition that managing VMT has to be part of the solution—this third leg is needed to support the stool and should complement vehicle technology and fuels policy.

Figure 1. Transportation CO₂ Emissions: The Three Legged Stool

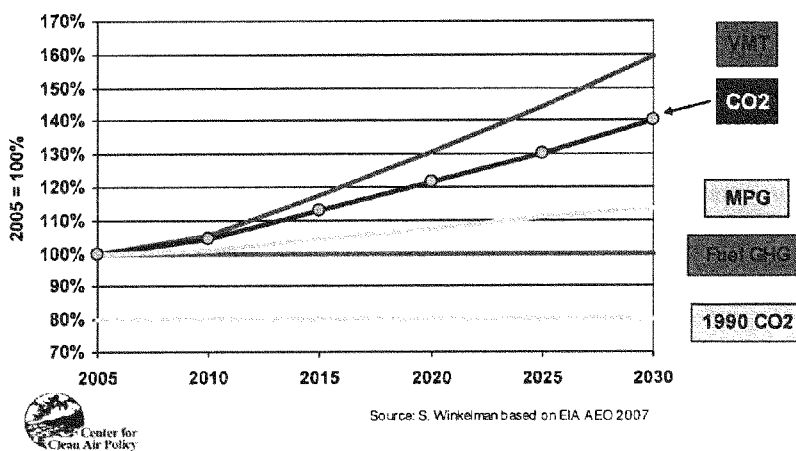


Source: Center for Clean Air Policy (2007)

In fact, expected growth in our driving habits will overwhelm planned reductions in CO₂ emissions from even the most aggressive proposed improvements in vehicle and fuel efficiency. As discussed below, an analysis by the Center for Clean Air Policy (CCAP) finds that current policy proposals on vehicle technology and fuels would leave passenger vehicle CO₂ emissions well above 1990 levels in 2030, significantly off-course for meeting the bill's 2050 target. Reduction in travel demand will be an important element of effective climate policy.

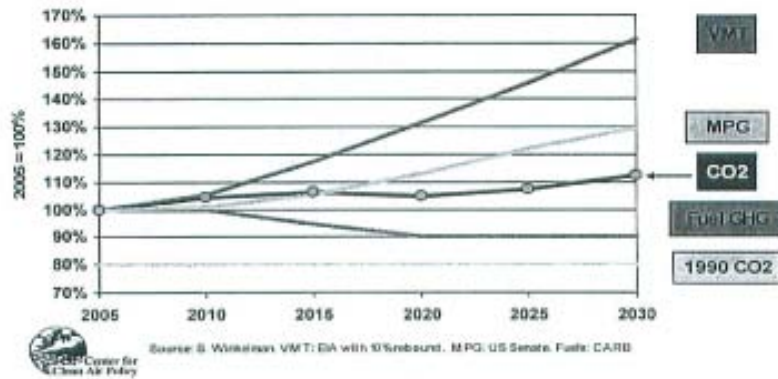
According to forecasts of the U.S. Department of Energy's Energy Information Administration (EIA) VMT already is expected to increase by 59 percent from 2005 to 2030 (the red line in Figure 2), outpacing projected population growth of 23 percent. This growth in VMT is due in large part to sprawling development patterns that require Americans to drive long distances as well as limited transportation alternatives (transit, walk, bike). Over this time period, the EIA projects fuel economy for new passenger vehicles to increase by 16 percent (from 25 to 29 mpg) and the fuel economy of the full stock of vehicles (the green line in Figure 2) to increase by 13 percent, as more efficient vehicles penetrate the fleet. CO₂ emissions would increase by 40 percent over the same time frame (the dark blue line in Figure 2). In this case, transportation CO₂ emissions in 2030 would be 75 percent above 1990 levels (the turquoise line in Figure 2).

Figure 2. Projected Growth in CO₂ Emissions from Cars and Light Trucks



The more important question is what would happen to CO₂ growth even if we implemented CAFE increases and a low carbon fuel standard. In June 2007, the U.S. Senate passed new CAFE standards that would increase new passenger vehicle fuel economy (cars and light trucks combined) to 35 mpg by 2020. California is implementing a low carbon standard for transportation fuels that calls for a 10 percent reduction in fuel carbon intensity by 2020. If California's low carbon fuel standard were applied at the national level (the purple line in Figure 3), in conjunction with the Senate's CAFE standard of 35 mpg by 2020 (the green line in Figure 3), passenger vehicle CO₂ emissions in 2030 would be 12 percent above 2005 levels, or 40 percent above 1990 levels. In other words, projected growth of VMT would still overwhelm the CO₂ savings from vehicle and fuel regulations.¹

¹In this scenario, VMT growth increases by 2 percentage points (61 percent growth by 2030) due to the "rebound effect" whereby driving increases as fuel economy increases (10 percent short-run elasticity).



Clearly, lowering transportation CO₂ emissions to 60 to 80 percent below 1990 levels by 2050 would require even greater improvements in vehicles, fuels and, almost certainly, reductions in VMT per capita.

Therefore, a critical first step in addressing the VMT problem lies in assuring that the scope of this legislation fully recognizes and rewards those governments and institutions that are implementing policies right now to increase transportation choices and reduce the need for driving. Examples of such policies include, rewarding those communities engaged in regional smart growth planning, expanding transit networks, bolstering alternative transportation modes (bike, walk), and promoting infill and transit-oriented development around compact mixed use communities.

The comprehensive approach you are taking now also should provide incentives for those communities that are not currently engaged in regional smart growth planning to adopt these strategies to slow growth in VMT. As the recent legal settlement in California surrounding the land use practices of San Bernardino County exemplifies, local land use decisions can and must be part of the solution to achieve the greenhouse gas reduction goals articulated in this legislation. Now is the time to seize upon the opportunity to craft incentives and develop resources that will enable local governments to find effective solutions to VMT growth.

There are a number of options for providing such incentives to the transportation sector beyond the price signal sent by a cap on refiners in this bill. These include direct allocation of allowances to localities and regions engaged in policies to reduce VMT such as making significant investment in public transit, or use of auction revenues through a competitive process to communities that reduce VMT. Such use of allowances or revenues to reduce VMT will also make it easier for refiners to meet their GHG target.

The research shows that if one solo commuter of a household switches from driving to transit for their commute to work, he or she can reduce their household carbon footprint by 10 percent, the equivalent of more than 4,800 pounds of CO₂ for an average commute each year. If the same commuter rides transit to work and their household can give up a second car, a family can reduce its total carbon emissions up to 30 percent.

According to a new report, compact development alone could reduce VMT by 20–40% as compared to typical suburban development.² Shifting 60 percent of new growth to compact patterns could reduce transportation CO₂ emissions by 85 MMTCO₂ in 2030. This is equivalent to the savings from a 28 percent increase in CAFE standards (to 32 mpg) or half the GHG savings from the Senate's 35 mpg CAFE bill. These savings do not include strategic investments in transit or pricing policies such as congestion pricing, pay-as-you-drive insurance, commute trip reduction and alternative work schedule programs, which could potentially double these savings.

In King County we are either doing or promoting each of those local policy options. And we have gone even one step further, requiring through our State Envi-

²R. Ewing, Keith Bartholomew, S. Winkelman, J. Walters, and D. Chen, *Growing Cooler: The Evidence on Urban Development and Climate Change*, Urban Land Institute, in press. Final draft available here: <http://www.ccap.org/transportation/smart.htm>.

ronmental Policy Act that new projects being built where the County is the local government authority account for greenhouse gas emissions prior to being approved. Rewarding local governments engaged in comprehensive approaches that address all sectors of the economy and all three legs of the transportation stool will be an essential element in the national fight against global warming.

Madam Chairman, Senator Inhofe, and members of the Committee, thank you again for the opportunity to speak with you today and play a role in advocating for meaningful federal government action on global warming. We look forward to working with you in the future on the important issue of VMT and climate change.

RESPONSES BY RON SIMS TO ADDITIONAL QUESTIONS FROM SENATOR VITTER

Question 1. You suggest that an economy-wide approach to emissions reductions is preferable and more efficient because it provides flexibility and diversity of reduction sources. If this is true, why stop at just domestic industries? This bill does very little in terms of reducing global emissions. Would it not be even more efficient to have emission sources from all nations on the table?

Response. No, this domestic economy-wide bill positions the United States to have a significant impact on greenhouse gas concentrations in our atmosphere. Furthermore, it is not dependent on but remains consistent with development of a future international treaty to reduce global greenhouse gas emissions, which I strongly support.

The United States has an unrivaled capacity to innovate and invest in new emissions reduction strategies at the local and regional level, with important co-benefits. In King County, for instance, our research has shown that compact development not only reduces our greenhouse gas emissions but also improves our air quality and public health, by making our communities more appealing for alternative transportation choices, such as walking, biking and riding public transit. Other local and regional strategies to reduce vehicle miles traveled (e.g., congestion pricing, pay-as-you-drive insurance, commute trip reduction and alternative work schedule programs) are also very important to reducing greenhouse gas emissions, increasing our workforce productivity, and improving our public health. These strategies are best recognized and rewarded by a domestic, economy-wide approach.

In turn, we leaders of large urban regions such as King County can position our business communities and regions to be important world exporters of related green expertise, in areas ranging from walkable community design and transit-oriented development to clean technologies and fuels.

Economy-wide national climate policy should recognize and reward local and regional strategies to expand policies such as these, which we already know to be effective in reducing greenhouse gas emissions.

Question 2. Considering that this bill will have virtually zero impact on greenhouse gas concentrations in our atmosphere, doesn't working within the UN Framework Convention on Climate Change make more sense and allow the U.S. to compete on a level playing field rather than taking unilateral action on a emissions regime that may or may not comport with future international programs?

Response. No, this bill positions the United States to have significant impact on greenhouse gas concentrations in our atmosphere. Please see response to Q1.

Question 3. This bill does not include providing any allowances to refiners for the petroleum transport ration fuels that they produce. How would refiners comply with this bill in 2012 to cover the greenhouse gas emissions from petroleum transportation fuels?

Response. The Executive prefers to defer to those panelists with expertise in this area.

Question 4. This bill explicitly does not preclude or abrogate the right of a state to adopt or enforce a standard, cap, limitation or prohibition relating to greenhouse gas emissions. We could end up with a national cap-and-trade program and different state controls. Shouldn't states be preempted to prevent duplicative and possibly conflicting environmental controls?

No, state and local governments should not be pre-empted on a *de facto* basis. If federal policies are more stringent than state and local requirements, a good argument could be made for preemption, as long as such a measure is consistent with science, legislative and legal history.

Senator BOXER. Thank you very much, County Executive Sims, for your statement. We thank you for coming such a big distance to help us shed some light on the bill. Thank you.

Our next speaker is Kevin Book, Senior Analyst and Vice President, Friedman Billings Ramsey and Company, Inc.

STATEMENT OF KEVIN BOOK, SENIOR ANALYST AND VICE PRESIDENT, FRIEDMAN BILLINGS RAMSEY AND COMPANY, INC.

Mr. BOOK. Thank you, Madam Chairman, Ranking Member Inhofe and distinguished members of this Committee for the opportunity to contribute to the vital work you are doing to safeguard climate security.

The views I will present today are my own and do not necessarily represent those of my employer. My name is Kevin Book, I am an energy research analyst for Investment Bank, FPR Capital Markets Corporation, which is headquartered in Arlington, Virginia. I serve the Wall Street institutional investors who manage the assets of individuals, private trusts, charitable organizations, pension funds and other capital sources very likely to play central roles in the implementation of the national policy goals that will be established by this Committee. I consider it an honor to have the privilege of service to this whole Committee, to offer my observations about this matter.

My wife this morning said, if you really want to be of service, try to translate this time from economist to English. So my best effort follows.

My overarching point is the need to balance action with caution. The world is indeed looking to this Nation and all developed economies for leadership. All year, even as oil prices have risen and the U.S. dollar has fallen, the leaders of developed economies have debated, as this Committee has, how to apportion responsibility for greenhouse gas emissions.

By contrast, the leaders of emerging economies have continued to comb the world in a no-holds barred pursuit of the cheapest fossil energy sources, primarily oil and coal. This is because billions of impoverished men and women world-wide regard hydrocarbon fuels as the shortest path to basic amenities. For fast-growing populations in China, India and in the oil-producing States of the Middle East, the freedom to make environmental responsibility a national priority remains a far-distant dream. Thus, our Nation must demonstrate not only a commitment to environmental stewardship but also that needed controls retain sound economic fundamentals before the developing world would be likely to consider enacting controls of its own. That is the core challenge, wealth, energy demand and environmental externalities all tend to rise and fall together. At the extreme, nothing cleans the air like an economic slowdown.

Inventions born of necessity may be ingenious, but it is far better to have them born of rich capital markets and a stable society. Basically, innovation and profligacy often live in the same zip code, if not under the same roof. Better technologies will require more wealth for investment, not less.

The irony here, the fossil energy linked to climate change also fuels economic growth, social freedom and the engines of Western innovation. Thus a small first step is less likely to be a mis-step.

Let me give you a couple of recent economic data points. Home loan defaults during the third quarter of 2007 rose to a decade high of approximately 0.85 percent of residential mortgage debt. This same third quarter was the epicenter of sub-prime mortgage rate increase. Further defaults may lie ahead in the not too distant future, particularly given high energy prices.

As my written testimony discusses at length, Sates with lower average incomes tend to also have coal-fired power and to drive longer distances. Nobody wants to see this happen, but consumption patterns underlying the emissions from some sectors of our economy may potentially shift during the next six months because of these economic factors.

In light of that, a sequenced approach may actually give the U.S. economy a chance to respond before introducing systemic risk. I am saying essentially, change one thing, watch the results and if it is okay, keep going. I am not saying pick one thing over any other, I am just offering that as a suggestion.

As I suggested during my February 2007 testimony, the power generation sector is already regulated under the acid rain program, which is very successful and could be a starting point. But markets, as they say, have their ups and downs. Taxation may be a more efficient and flexible way to set a carbon price. Because even though markets are efficient distribution pricing mechanisms for commerce, they can inject unanticipated volatility into regulation. Because scarcity can distort price when commercial buyers, whose businesses cannot operate without the commodity in question, are forced to bid against non-commercial traders who generate profits, as they should, through scarcity and who may be reluctant to sell. Price can move down in this context as fast as it moves up. But volatility can make it difficult for commercial buyers to efficiently deploy capital.

So to ensure stability, commercial buyers often purchase options to buy or sell in the future. But options do not reduce CO₂ levels in the atmosphere. And the costs of hedging are not available necessarily for investment in cleaner energy. Neither are the frictional transaction costs associated with markets, which includes service fees associated with brokerage and the fees of moving in and out of a proxy currency like a carbon allowance. Again, in sort of the English my wife asked for, the more complicated a system becomes, the more you are going to need skilled intermediaries to get you through it. The more you spend on commissions and payments to those intermediaries, the less you are going to have available to spend on new technologies.

One final point. However one sets price, visibility and direct accountability into how the proceeds are spent is vital. The Crude Oil Windfall Profits Tax Act and the Synthetic Fuels Corporation it was intended to finance might have survived longer had Congress stuck with President Carter's original design, which was the allocation of proceeds to a separate account devoted to energy security investments. At the end of this process, the retention of the separate accounts and the laudable reporting requirements already es-

established in the America's Climate Security Act of 2007 are likely to go further toward the program goals than putting the money into the general fund.

Madam Chairman, that concludes my prepared testimony. I look forward to answering any questions you might have.

[The prepared statement of Mr. Book follows:]

STATEMENT OF KEVIN BOOK, SENIOR VICE PRESIDENT, ENERGY POLICY, OIL &
ALTERNATIVE ENERGY FBR CAPITAL MARKETS CORPORATION

Thank you, Madam Chairman, Ranking Member Inhofe and distinguished members of this Committee, for the opportunity to contribute to the vital work you are doing to safeguard climate security. The views I will present today are my own, and do not necessarily represent those of my employer.

WALL STREET IS WATCHING

As an energy research analyst for an investment bank, I serve the Wall Street institutional investors who manage the assets of individuals, private trusts, charitable organizations, pension funds and other capital sources likely to play essential roles in the implementation of national policy goals that will be established by this Committee.

This year, from my perspective, the stewards of U.S. and international financial assets appear to be taking an unprecedented interest in how you, the stewards of U.S. environmental policy, will structure a national regulatory framework to reduce anthropogenic greenhouse gas (GHG) emissions. Given the diverse set of views expressed by the Members of this Committee, I doubt any of you will be surprised that I have encountered a broad range of investor perspectives. Some investors have shared their optimism for a cleaner, more efficient energy future and, quite frankly, their curiosity about how the America's Climate Security Act of 2007 (ACSA) and similar legislation might allow them to participate in capital formation and value creation. Others have shared their concerns that efforts to internalize the cost of GHG emissions could seriously disrupt one or several economic sectors, particularly power generation, heavy industry and fossil energy production. In essence, investors at both ideological extremes are wrestling with the policy challenge that has long confronted governments hoping to attenuate the effects of global climate change: *wealth, energy demand and externalities all tend to rise and fall together.*

Three energy crises, two recessions and one very successful Clean Air Act during the last four decades of U.S. history suggest that, while well-considered policies may motivate stakeholders to diminish the externalities associated with their energy use and increase the energy efficiency of their domestic output, nothing cleans the air better or faster than an economic slowdown. Of course, every Congress during the decade since the Byrd-Hagel Resolution has rightly rejected economic contraction as a climate policy lever, because the short-term social costs and political consequences are obvious. While slowdowns caused by natural disasters and other external events may soon be followed by recoveries, an imprecise rebalancing of the economy-energy-environment relationship could potentially deter necessary investment and lead to longer-lasting economic underperformance. Because it is not just Wall Street, but the entire world, that is watching U.S. steps towards climate change regulation, a misstep could bring undesirable global consequences.

Inventions born of necessity may be ingenious, but they are likely to be undercapitalized. By contrast, innovation and profligacy often live in the same zip code, if not necessarily under the same roof. New technologies to address global climate change are going to require more investment dollars, not less. Stable economies encourage wealthy enterprises to invest in research and development towards new transformational technologies, as well as evolutionary improvements to existing processes. This may explain past U.S. leadership in energy and environmental technologies: not just because laws established new pollution controls, but also because, once rules were in place, the nation's rare, if not unique, combination of efficient markets, open society and economic prowess enabled new pollution control technologies to emerge from corporate laboratories and basement inventors alike.

It is possible that plain old Yankee ingenuity might really be a lucky accident, but I believe it comes from a synergy among related and supporting industries that form what Harvard business scholar Michael Porter would call our "national advantage". This means that policies that raise the operating costs of industrial innovators enough to cause a recession could deprive the U.S. and the world of emis-

sions control technologies made possible, ironically, by the same wealth and stability that inure energy end-users to the price signals that encourage conservation.

THE PRICE-SENSITIVE CONSUMER AND PRICE SIGNALS

Relying solely on scientific data reported here through U.S. and international governmental channels, and having no academic background in the natural sciences that would lead me to reach any other conclusion, I am inclined to share the consensus view that U.S. policymakers should act quickly to lead the world towards an effective strategy to minimize the long-term risks associated with global climate change.

I would submit, however, that recent economic data associated with the collapse of the sub-prime mortgage sector may reasonably raise the question whether the present moment in time calls for an economy-wide system of regulation, given that the consumption patterns underlying the emissions from some sectors of our economy may potentially shift during the next 6-12 months. Home loan defaults rose during the third quarter of 2007 to a decade high of approximately 0.85% of residential mortgage debt. The third quarter also represented the epicenter of “resets” (interest rate increases) for sub-prime adjustable rate mortgages, suggesting that further defaults may lie ahead in the not-too-distant future, particularly given the lagging, but significant price increases associated with record nominal high oil prices.

If there is to be a shift in driving behavior and aggregate energy use patterns, it might be easiest to see on the road. According to a study released in October 2006 by the Institute for Transportation Studies at the University of California, Davis, short-run price elasticity of gasoline demand was an order of magnitude less during the 2001–2006 timeframe (-0.034 to -0.077) than it was during the 1975–1980 timeframe (-0.21 to -0.34). Many of my clients and colleagues have hypothesized that this difference reflects the newfound wealth many urban drivers attained by refinancing their homes, as well as a new inflexibility derived from home ownership in suburbs and rural areas. In effect, one major reason why U.S. households did not demonstrate price-responsiveness in recent years may have been that they were “driving their homes”.

The possibility that consumption behaviors could change in response to fiscal strictures underscores the precariousness of the current economic situation, particularly as consumer responsiveness to price signals occurs at the margin. That implies that any effort to trigger conservation or environmental stewardship, even if price hikes are mediated through larger enterprises before they reach consumers, will affect the poorest Americans first. The regressive effect may be enhanced by the fact that, consumers at the lowest income levels may have less working capital with which to avail themselves of conservation behaviors like efficiency improvements to their homes and purchasing higher fuel economy cars.

The distribution of income and natural resources throughout the United States has set up regional economic advantages for certain power generation fuels, a fact reinforced by the graphic in Figure 1, below, which depicts the primary power generation fuel on a statewide average basis.

Table 1: Per Capita DPI, Primary Fuel and Average Electricity Price/kWh

State	DPI/capita	Primary Electricity Generation Fuel	Average July 2007 Residential Power \$/kWh
Mississippi	\$ 24,829	Coal	\$0.0940
West Virginia	\$ 25,387	Coal	\$0.0681
Arkansas	\$ 25,643	Coal	\$0.0908
Utah	\$ 26,285	Coal	\$0.0860
South Carolina	\$ 26,517	Nuclear	\$0.0934
Idaho	\$ 26,558	Hydroelectric	\$0.0697
Kentucky	\$ 26,571	Coal	\$0.0735
New Mexico	\$ 26,845	Coal	\$0.0932
Montana	\$ 27,615	Coal	\$0.0932
Alabama	\$ 27,764	Coal	\$0.0928
Nevada	\$ 34,178	Natural Gas	\$0.1210
Colorado	\$ 34,711	Coal	\$0.0903
Alaska	\$ 35,021	Natural Gas	\$0.1570
New Hampshire	\$ 35,377	Nuclear	\$0.1500
Wyoming	\$ 35,904	Coal	\$0.0860
New York	\$ 37,039	Nuclear	\$0.1720
Maryland	\$ 37,494	Coal	\$0.1340
Massachusetts	\$ 39,317	Natural Gas	\$0.1570
New Jersey	\$ 39,857	Nuclear	\$0.1640
Connecticut	\$ 42,014	Nuclear	\$0.1830

Source: FBR Research using BEA, EIA Data

Table 2 addresses transportation fuels needs. Examining the vehicle miles traveled per disposable personal income dollar standardizes consumer wealth exposure to existing driving behaviors. Applying a standard fuel economy (mathematically, any number will do, but I used a national light-duty average of 20.5 miles per gallon for this calculation) and latest available gasoline prices creates a percentage of average disposable income allocated to driving behaviors at current gasoline prices. Last, Table 2 incorporates a *pro-rata* surcharge of \$0.34/gallon for carbon, which reflects the \$39 per metric ton carbon market premium when the European Emissions Trading Scheme peaked in April 2006, adjusted for currency effects at the time, applied to the gasoline-powered fleet on a national average basis. This presents potentially stark regional effects under an economy-wide cap-and-trade scheme.

Table 2: State Rank by VMT per Disposable Income Dollar, with Carbon Surcharge

Rank	State	Per-Capita Disposable Income Per Vehicle Mile Traveled	11/13/2007 Average Gasoline Price (Regular)	Percentage of Disposable Income at 20.5 MPG	Percentage of Disposable Income at 20.5 MPG and \$39/MtCO _{2e}
1	MS	\$ 1.95	\$ 3.00	7.50%	8.37%
2	WY	\$ 2.00	\$ 3.03	7.39%	8.23%
3	AL	\$ 2.24	\$ 3.03	6.60%	7.35%
4	OK	\$ 2.25	\$ 3.08	6.68%	7.43%
5	NM	\$ 2.27	\$ 3.13	6.73%	7.47%
6	AR	\$ 2.39	\$ 3.03	6.18%	6.89%
7	SC	\$ 2.44	\$ 2.97	5.94%	6.63%
8	WV	\$ 2.45	\$ 3.17	6.31%	7.00%
9	GA	\$ 2.40	\$ 3.05	6.20%	6.90%
10	MT	\$ 2.48	\$ 3.18	6.25%	6.94%
41	NV	\$ 4.17	\$ 3.15	3.68%	4.09%
42	MD	\$ 4.21	\$ 3.03	3.51%	3.91%
43	IL	\$ 4.29	\$ 3.19	3.63%	4.02%
44	RI	\$ 4.65	\$ 3.05	3.20%	3.56%
45	HI	\$ 4.66	\$ 3.32	3.48%	3.84%
46	AK	\$ 4.68	\$ 3.03	3.16%	3.52%
47	CT	\$ 5.30	\$ 3.21	2.95%	3.27%
48	MA	\$ 5.31	\$ 3.00	2.76%	3.07%
49	NJ	\$ 5.42	\$ 2.91	2.62%	2.93%
50	NY	\$ 5.76	\$ 3.24	2.74%	3.04%

Source: FBR Research using BEA and EIA data and price data from fuelgatereport.com

These data enhance my already profound appreciation for the enormity and complexity of the task ahead for this Committee and the whole U.S. Congress in structuring an economy-wide GHG emissions reduction strategy. These also suggest that the most prudent approach may be to outline a phased strategy to regulate emissions from the whole economy on a sector-by-sector, sequential basis.

THE UNITED STATES AS A GLOBAL LEADER

As I suggested during my February 2007 testimony before this Committee, the power generation sector could represent a natural starting point for sequenced controls as it is already regulated under the existing framework of the Acid Rain program. In light of uncertain economic conditions, a sequenced approach might also give the U.S. economy a chance to respond to changing price dynamics across regions and industrial sectors before injecting further systemic risk. This could be an alternative to the two-year economic review anticipated by ACSA. A rush out of the gate to sudden economic consequences could potentially undermine the Act's stated goal of providing leadership to the developing world.

After all, there is a natural reason why the U.S. and the developed economies of the world must lead the global climate change debate: developing economies have explicitly refused to pay. In fact, the energy use patterns of the developing world make it less likely that the Kyoto Protocol will result in much more than a wealth transfer out of OECD economies, and certainly not an abatement of global climate change. All year, even as oil prices have risen and the U.S. dollar has fallen, the leaders of developed economies have debated how to apportion responsibility for GHG emissions across industrial sectors and national boundaries. By contrast, the leaders of emerging economies have continued to comb the world in a no-holds-barred pursuit of the cheapest fossil energy sources, primarily oil and coal. Wealthy, oil-consuming nations turn to environmental stewardship to incrementally improve an already-high quality of life, while billions of impoverished men and women worldwide regard hydrocarbon fuels as the shortest path to basic amenities. For the fast-growing populations of China and India, but also the oil producing states of the

Middle East, the freedom to make environmental responsibility a national priority remains a far-distant dream.

The bottom line is that the U.S. must be able to demonstrate not only its commitment to environmental stewardship, but its ability to undertake needed controls while retaining sound economic fundamentals before the developing world will be likely to consider enacting controls of its own.

THE VICISSITUDES OF MARKETS

It is in this context that I would suggest that setting carbon price through taxation rather than market pricing may improve prospects that U.S. climate security policies will be both effective and commercially viable. While markets tend to be efficient distribution and pricing mechanisms for commerce, they also possess characteristics that can inject unanticipated volatility into regulation, particularly when the governance structure encourages noncommercial traders to enter the market to provide necessary liquidity.

The challenges arrive under conditions of scarcity, a predicament best exemplified by the current price of crude oil. No fundamental analysis or rational assessment of currency and risk effects can account for \$95 crude, and my models suggest an upper-bound risk and currency-effect-adjusted price should be no higher than \$80 per barrel, particularly with troubling economic indicators overhanging demand. But refineries are still buying oil at a premium due to market dynamics, not fundamentals. Commodity markets frequently distort price under conditions of scarcity because commercial buyers, whose businesses cannot operate without the commodity in question, are forced to bid up for it at the same time that noncommercial traders, who generate profits through scarcity, may be reluctant to sell. Ultimately these pricing dynamics normalize, sometimes with startling downward pressure on price, but the volatility can make it difficult for commercial buyers to efficiently deploy investment capital. Over the long term, all businesses can respond to price changes, but short-term price volatility ultimately forces commercial buyers to look for ways to ensure price stability, usually by purchasing the option to buy or sell at a range of prices in the future.

Commercial enterprises pay for these options as a cost of doing business, but the costs of managing potentially volatile carbon prices might well undermine the public interest goal of reducing emissions at the lowest economic cost to regulated entities and ratepayers. An emissions option is not an emissions reduction and it provides revenue to its seller whether or not the buyer exercises it; unlike an allowance or an offset, the option itself does nothing to reduce the carbon dioxide levels in the Earth's atmosphere. Nor can emitters devote the cost of hedging to needed investment in next-generation technologies. Even when emitters can achieve financial gains through hedging activities, they still bear the "frictional" costs of commissions and service fees, and businesses that can generate returns on capital through financial engineering are unlikely to undertake investments in sustainable energy production.

The challenges facing the Kyoto Protocol, where 65% of today's global GHG emissions are not governed by mandatory caps, derive in part from its market pricing architecture. The use of emissions credits as a proxy currency requires emitters who would be governed by the caps to value that currency, which is not the case for China, India, Australia or the United States. As unappealing as carbon taxation may seem from a political standpoint, one of its greatest virtues may stem from the fact that taxes can be assessed in any reference currency or exchange-adjusted foreign denomination at the moment of any intra- or international commercial transaction. Governments may also tailor tax regimes to respond to economic conditions faster than they can retire allowances, offsets or any carbon proxy currency.

SEPARATE ACCOUNTING MAY IMPROVE PROGRAM DURABILITY

This is not to say that carbon taxation does not also present risks. For example, it might be best to avoid any structure that permits climate-related taxation without accountability for financial and environmental yield, and ACSA's performance reporting structure certainly addresses part of this requirement. Accountability for the use of proceeds may also help to ensure optimal outcomes.

The history of the Crude Oil Windfall Profits Tax Act and the Synthetic Fuels Corporation it was intended to finance may have continued far longer, or been subject to early modification that could have improved the financial durability of the program, had Congress stuck with President Carter's original design: the allocation of proceeds to a separate account devoted to energy security investments. Whether the pricing mechanism for U.S. carbon standards operates through full auction, phased auction or direct taxation, it may be worthwhile to consider structuring a

set-aside account in addition to the laudable reporting requirements already established.

Madam Chairman, this concludes my prepared testimony. I will look forward to answering any questions you or other Committee members may have.

RESPONSES BY KEVIN BOOK TO ADDITIONAL QUESTIONS FROM SENATOR INHOFE

Question 1. What do you think would be the impact on the economy of the Lieberman-Warner bill after it is implemented, say in 2014, if the U.S. economy dives into a recession? Would it worsen a recession?

Response. Senator Inhofe, even since the testimony I offered before the Committee, several potential signals of economic hardship have continued to surface. The November 26, 2007 Wall Street Journal suggests that Citigroup, one of the nation's leading financial institutions, may face as much as \$41 billion in subprime mortgage exposure. Reverberations have shown up within financial sectors outside of home lending, including bond insurance and student loans.

As I stated in my testimony, economic growth is proportional to environmental consequence. Prosperous economies emit more greenhouse (and other) gases, although they tend to demonstrate diminishing marginal emissions per unit of economic growth, and OECD economies are far more energy efficient than developing nations. On the other hand, any mechanism that assigns a cost to currently costless energy-related externalities is likely to slow economic growth if the regulated economy does not have adequate time to retool. America's energy and industrial infrastructure was, in many cases, built to last: useful capital life often exceeds 30 or even 50 years. While this has proven to be a source of enduring competitive advantage, it also creates risk when the rules of the game change.

One consequence of any economy-wide greenhouse gas regulation could be factor cost inflation at every link of the U.S. industrial value chain. In general, the most GHG-emitting industries are also the most fundamental to economic recovery (because fossil fuels produce output at lowest economic cost), most notably manufacturing, homebuilding and construction. If the economy were in a sustained recession, the traditional engines of economic growth—consumer spending and business investment—could be further constrained by small, but potentially cumulative and disruptive surcharges on all economic activity. Without mechanisms to alleviate these financial risks, any mandatory limit on emissions would be likely to prolong a recession and could even discourage the necessary research and development spending that might yield new, higher-efficiency energy production technologies and innovative climate change mitigation practices.

Question 2. If we moved to full auction as a way to allocate allowances, is that approach closer to straightforward taxation than the bill as currently written?

Response. Auctioning emissions allowances on an annual basis to all industrial and non-commercial bidders would eliminate the perceptions of “unfairness” or “windfall gains” associated with government allocations to one or several industrial sectors, but the price of carbon set by an open-ended auction process in the absence of any control mechanism could easily result in prices that far exceed the targets that could be established under a well-defined system of taxation. This could have the effect of penalizing fuels and processes that are (a) the most carbon-inefficient per unit of output; (b) the least able to switch quickly or to source at effective cost the working capital necessary to effectuate change. A likely result would be a premium for more highly carbon-efficient or more readily adaptable fuels or processes, but no conventional or alternative fuels are sufficient to sustain even a portion of American primary energy demand currently satisfied by coal and oil. This raises the specter of uncontrolled fuel switching that could further provoke price inflation. A tax would designate a specific surcharge for a given fuel or process, and government-defined deductions could minimize the transitional costs to less adaptable industrial sectors or processes characterized by higher capital intensity.

Question 3. Would you contrast some of the economic impact differences between a tax-based program and S. 2191, a cap-and-trade program without a fixed safety valve mechanism?

Response. The idea of a “safety valve” price for GHG emissions offers price certainty for emitters, but EIA forecasts of likely behavior under a market-based carbon pricing with a designated maximum price suggest that most emitters will opt to pay the safety valve price in the long run. This raises a few obvious but important points.

First, to extend the metaphor, if an industrial process perpetually triggers its safety valve, it suggests that the process itself may be fundamentally unsafe. There is nothing valve-like about a valve that is always on; it is better known as a conduit.

Second, creating a safety valve at a price point that exceeds emitters' economic tolerances offers no safety, because it will be out of reach. Conversely, setting the price below likely market-clearing prices for carbon undermines the purported value of establishing a market as a price-setting mechanism. Regulatory efficiency may be improved by choosing a single, transparent pricing mechanism rather than trying to circumscribe a market or add flexibility to a tax.

Third, the idea of creating an entity charged with carbon market oversight responsibility similar to the monetary policy role played by the Federal Reserve Board of Governors creates a new source of bias, namely the risk that emitters may see through an overly-transparent carbon policy and ignore price signals in anticipation of future events or, alternatively, make inefficient economic choices as a result of misreading a more inscrutable, Greenspan-like "Carbon Fed."

In my view, the best-cost, most transparent implementation would make use of the existing taxation (and tax rebating) powers of the Federal Government.

RESPONSES BY KEVIN BOOK TO ADDITIONAL QUESTIONS FROM SENATOR VITTER

Question 1. I share your conclusion that this bill will cause a massive demand for natural gas in the United States. My state is responsible for providing over 20 percent of the natural gas we consume in America. You would think that my representation of a top natural gas producing state would be supportive of increasing demand of a "state product". In most cases I would; however, in the case of natural gas we are already in a supply crunch. Do you have an assessment of natural gas prices resulting from this bill?

Response. Senator Vitter, I do not have forward-looking gas price projections based on the specifics of S. 2191, but the experience of the sulfur dioxide credit market in the wake of Hurricane Katrina illustrates how fuel-based climate change surcharges could motivate flexible electric generators to choose natural gas as the marginal source of power until the price of natural gas rises to set a new "floor" on the cost of generation. After Katrina struck, sulfur credits rose on speculation that impaired natural gas production in the Gulf of Mexico would drive generators to coal; despite the abundance of spare import capacity for LNG and the strong price signals generated by the rise in natural gas prices, natural gas could not come to our shores or your coastline overnight, and the entire "Btu complex" faced upward pressure until gas supplies normalized.

The nation's increasing reliance on natural gas as a home heating fuel, industrial feedstock and marginal power generation source diminishes the flexibility of current energy use patterns. Ultimately, this forces tough questions regarding natural gas access and the build-out of re-gasification facilities on the U.S. coastline. Imposing any surcharge on coal at the same time as natural gas, as S. 2191 would do, would likely raise the floor price for the entire Btu complex in much the same fashion, crowding out the most price sensitive industrial and residential consumers.

Question 2. You cite the regressive nature of this bill in your testimony—the poorest Americans will be the first hit and the hardest hit with the compliance cost of the proposed bill. Have you done an analysis on environmental stewardship when families and companies are forced into tighter margins? For example, would this cause them to be better or worse stewards of the environment?

Response. The Organization for Economic Cooperation and Development (OECD) reported in September 2007 on the per capita environmental expenditures by emerging economies within the former Soviet Union and Eastern Europe as compared to their wealthier European and former Soviet neighbors. OECD's data showed that wealthier economies devoted between 1.2% and 1.6% of GDP to environmental funds, more than twice the spending exhibited by less-developed, neighboring states.

At the core of this macroeconomic phenomenon lies the same logic that defines household discretionary spending habits: mandatory outlays towards national security and economic stability are likely to take precedence over spending on environmental stewardship. Moreover, cleaner infrastructure comes at additional cost. In the consumer sector, better-performing goods often derive their efficiency from better design, longer product cycles and higher development costs that require firms to recapture greater outlays through premium pricing. An easy example is the "rich man's rebate" for well-engineered gas-electric hybrid automobiles. The cost of engineering cleaner cars requires automakers to demand higher sticker prices to justify the magnitude and risk of greater spending, but ultimately the high price sets a barrier to entry that locks out the price-sensitive consumers who would derive the

greatest proportional economic benefits from owning a hybrid, even with federal subsidies.

Senator BOXER. Thank you very much, sir. We really appreciate it.

Our last speaker is Christopher Berendt, Director, Environmental Markets and Policy, Pace Global Energy Services. Welcome, sir.

STATEMENT OF CHRISTOPHER BERENDT, DIRECTOR OF ENVIRONMENTAL MARKETS AND POLICY, PACE

Mr. BERENDT. Good morning. On behalf of Pace, a global energy and carbon management consultancy, I wish to thank Madam Chair, the Ranking Member and the Committee for this opportunity to testify.

The Nation's need for new power generation is colliding with the uncertainty created by the Supreme Court's decision in *Massachusetts v. EPA*. The need for an intelligent, comprehensive national energy policy has never been greater. Without a clear Federal response to the global climate change issue, the United States is now running headlong into decreased energy security, higher prices for the U.S. consumer and more CO₂ emissions on a global basis.

Under the Supreme Court's decision, CO₂ is now deemed a pollutant, thereby creating a regulatory void all the way down to the local level. The impact of this void was evidenced this year by the TXU agreement to cancel coal plant investment, and more recently in Kansas, where for the first time CO₂ emissions were cited as the reason for rejecting an air permit, bringing an end to the Holcomb plant expansion.

Our clients are increasingly telling us that they cannot build any coal plants, no matter how clean the technology, and that the only generation options in the near term are renewables and natural gas, forsaking our most abundant domestic energy resource. While renewables will be an important part of a diverse portfolio approach to generation, alone they will not be able to meet the 120,000 megawatts of incremental generation capacity required over the next ten years. Further, there is no clear road map for increased nuclear generation within the same time period.

Therefore, should this carbon uncertainty persist, the near-term options for electricity generation in the United States will likely remain highly reliant on natural gas. We at Pace have estimated that if natural gas-fired generation is tapped to fill the entire gap left by coal, our Nation will require substantial incremental natural gas supply, about 6 percent above current projections by 2017. Contrast that the last six years when gas demand was flat and prices nearly tripled.

Further, the United States has become a natural gas importer in recent years. While most of these imports used to come from Canada, future imports of liquified natural gas are expected to come from less stable overseas supplies. Pace expects that an increase in natural gas demand of 6 percent by 2017 could increase imports by 33 percent. That increase will come from foreign sources of LNG. This would expose our economy to greater prospects of natural gas price volatility and less certainty of supply.

With these concerns in mind, I would like to offer the following comments about carbon market mechanisms. Should this Committee choose to enact a market mechanism to clarify the carbon price signal, it is important to ensure that U.S. carbon markets will have the functionality and liquidity to establish a forward curve for carbon and encourage investments in new low-carbon technologies, especially clean coal, with carbon capture and sequestration.

Stimulating the creation of a vibrant offset market is also important. Innovation in carbon offsets may be one of the cost-effective means of making a real difference, especially if the non-covered and covered entities that deploy select low-carbon technologies are allowed to generate offsets. The creation of a consolidated national carbon market is a must to avoid State by State vagaries.

The present new build environment does not have clear carbon price signals nor the incentives required to develop high capital cost clean energy technologies. Until these issues are dealt with, new technologies will not be able to be deployed and natural gas imports will be required to meet a large share with 120,000 megawatts of new generating capacity needed over the next ten years. This could negatively impact our energy security and the economics of power generation for the U.S. consumer.

The Supreme Court in its decision has created a situation of stark uncertainty for the U.S. power generators and a likely over-reliance on natural gas. Should this Committee chose to implement market-based mechanisms, the resulting carbon price signals must be clear and provide long-term price transparency so that we can retain the U.S. tradition of advanced technology development and adoption.

Thank you.

[The prepared statement of Mr. Berendt follows:]

STATEMENT OF CHRISTOPHER BERENDT, DIRECTOR OF ENVIRONMENTAL MARKETS AND POLICY, PACE

Good morning, my name is Christopher Berendt. I am the Director of Environmental Markets & Policy for Pace, which is a global energy & carbon management consulting firm. Pace has experience in all types of energy throughout the entire energy value chain from exploration, production & generation, to the transmission and distribution to the individual U.S. energy consumer. Pace's clients include energy companies, electric utilities, financial institutions, energy project developers, and energy-intensive industrial companies.

My company and I appreciate the opportunity to come before this committee to provide our perspectives and recommendations regarding this important environmental and economic legislation—America's Climate Security Act of 2007 (S. 2191).

The Nation's need for new power generation is colliding with the uncertainty created by the Supreme Court's decision in *Mass v. EPA*. Without a clear federal response to the global climate change issue the U.S. is now running headlong into decreased energy security, higher prices for the U.S. consumer, and more carbon dioxide, CO₂, emissions on a global basis.

Under the Supreme Court's April decision, CO₂ is now deemed a "pollutant" by the highest court in the land, thereby creating a regulatory void all the way down to the local level. The impact of this void is evidenced this year by the TXU agreement to cancel coal plant investment and more recently in Kansas where for the first time CO₂ emissions were cited as the reason for rejecting an air permit bringing an end to the Holcomb plant expansion.

Our clients increasingly advise us that they cannot build any coal plants, no matter how clean the technology, and that the only generation options in the near-term are renewables and natural gas.

While renewables will be an important part of a diverse portfolio approach to generation, alone, they will not be able to meet the 120,000 MW of incremental generation capacity needed over the next 10 years, even under the most optimistic expecta-

tions. Further, there is no clear roadmap for increased nuclear generation within this same time period.

Therefore, should this carbon uncertainty persist, the near-term options for electricity generation in the U.S. will likely be highly reliant on natural gas. We at Pace have estimated that if natural gas-fired generation is tapped to fill the entire gap left by coal—our nation will require substantial incremental natural gas supply, about 6% above current projections by 2017.

The U.S. has become a natural gas importer in recent years. While most of these imports have come from Canada, growth in deliveries of liquefied natural gas, or LNG, in the past two years have become important. Pace expects that an increase in natural gas demand of 6% by 2017 could increase imports by 33% and that increase will come from foreign sources of LNG. This would expose our economy to the prospects of greater natural gas price volatility.

With that in mind, I would like to offer the following comments about carbon market mechanisms.

Should this Committee choose to enact a market mechanism to clarify the carbon price signal, it is important to ensure the U.S. carbon markets will have the functionality and liquidity to establish a forward curve for carbon and encourage the financial community to outlay capital for the development of new clean energy technologies.

Stimulating the creation of a vibrant offset market is also important. Innovation in carbon offsets may be the most cost-effective means of making a real difference, especially if both non-covered and covered entities that deploy advanced low carbon technologies are allowed to generate offsets. Further, a healthy supply side market mechanism for carbon is also one of the best ways to control price.

The creation of a consolidated national carbon market is a “must” such that generators are not forced to deal with state-by-state vagaries. A national market will provide a more efficient design versus balkanized efforts at the state and regional levels.

The present new build environment does not have clear carbon price signals nor the incentives required to develop high capital cost, clean energy technologies. Until these issues are dealt with, new technologies will not be able to be deployed and natural gas imports will be required to meet a large share of the 120,000 MW of new generating capacity needed over the next ten years—this could negatively impact our energy security and the economics of power generation for the U.S. consumer.

The Supreme Court decision has created a situation of stark uncertainty for U.S. power generators. We laud this Committee’s efforts to utilize market based mechanisms to ensure that the energy markets operate efficiently and we retain the U.S. tradition of advanced technology development & adoption.

Thank you.

Senator BOXER. Thank you very much, Mr. Berendt. And thank you to the entire panel.

What I will do, because Senators Alexander and Klobuchar weren’t here, I am going to give you instead of five minutes seven minutes, so that you can do a little bit of your opening statement. Is that all right with both of you?

Senator ALEXANDER. Thank you, Madam Chair. I really came to listen to the witnesses, but thank you very much.

Senator BOXER. OK, we are done with the witnesses and we are on to the questions.

I am going to start with you, Mr. Book, because I was an economics major and a stock broker. I think the advice of your wife vis-à-vis turning economics language into English was very good and you did very well on that point. What I wanted to say is, I took away from your testimony some great encouragement for this bill. Because you said we need to balance, I wrote down action with caution. I hope you will take a look at the parts of the Lieberman-Warner bill that really heard what you are saying.

One thing is, we have these transitional free allowances allocated to emitters. So we don’t just say, you are on your own. That is one thing.

Secondly, the availability of domestic offsets. Thirdly, a Carbon Market Efficiency Board that Senator Warner really was very involved in crafting with some Democratic colleagues who are not on this Committee, interestingly, and Senator Lieberman thought this was an excellent idea and put it in the bill. They put it in the bill. That Carbon Market Efficiency Board is the caution part of your statement. Because they will be looking every year to see if this thing is working. And they are authorized to loosen a year's cap by as much as 5 percent in the event of economic dislocation. And finally, we have constant look-backs by the National Academy of Sciences.

So I really found your testimony to be very compelling. It underscored my support for this legislation. I think that we can in fact use some more caution and I think that we are working to make these look-backs even better. So I think that the words that you said today are very, very important.

Mr. Krupp, in your testimony, you discuss how the Lieberman-Warner bill has a system of carrots and sticks to encourage international involvement on addressing this issue through the protection of tropical forests and the provisions requiring nations that wish to export goods to the United States to hold allowances for their emissions. Would you also agree that as the largest historical emitter of greenhouse gases, when the United States takes action it will help spur other nations, including China and India?

One of the things that really has surprised me coming from the opponents of this legislation and coming from the opponents of doing anything is their statement, China and India should go first. I have never seen America sit back and wait for China and India to do anything. We are the ones who set the pace.

So because Senator Warner has come, think upon your answer. I am going to turn the floor over to Senator Warner for his statement, and then I am going to turn to Senator Lieberman and then we will get back to the questions.

Senator WARNER. Madam Chairman, I am sorry to be a little late. We have another hearing of the Armed Services going on.

I would like to just sequence in, following the distinguished Ranking Member perhaps, in my regular order. Thank you very much for the courtesy, though.

Senator BOXER. Absolutely. Senator Lieberman, did you want to put an opening statement in?

Senator LIEBERMAN. I thank you, Madam Chair, and apologize also. I am just going to put a statement in the record. I am sorry to be here late. I thank those on the panel, some of whom I have seen quite a lot before in this pursuit. I just want to thank Fred Krupp and Eileen Claussen for the really pioneering work they have done, not only intellectually, but tactically and strategically, dare I elevate the term and say even politically, to get us to where we are now, which is in reach of doing something constructive about global warming together. Thank you.

[The prepared statement of Senator Lieberman follows:]

STATEMENT OF HON. JOSEPH LIEBERMAN, U.S. SENATOR FROM THE
STATE OF CONNECTICUT

Thank you, Chairman Boxer.

I thought I might describe where we now appear to be in this process from my perspective.

At the subcommittee business meeting on November 1, the second highest ranking Republican on this committee and the second highest ranking Democrat, each of whom hails from a coal-producing state, voted in favor of a mandatory, economy-wide, cap-and-trade climate bill.

On Tuesday of this week, the Natural Resources Defense Council testified that the emissions reductions mandated by that bill are stringent enough to warrant a “yes” vote from every member of this committee.

If, on December 5, at least nine of the ten majority members of this committee join Senator Warner in voting in favor of the bill, then, for the first time in U.S. history, legislation mandating reductions in U.S. greenhouse gas emissions will be reported to the full Senate.

We will have made history. We will have convinced any remaining doubters in the private sector that this legislation is coming, that it will be strong, and that they had better come to the table. We will have reassured the American public that this institution is capable of legislating on this surpassingly important topic. And we will have signaled to the rest of the world that the United States government is finally removing its head from the sand.

So I believe that if, on December 5, at least nine of the ten majority members of this committee vote in favor of America’s Climate Security Act, it will be a tremendous accomplishment and victory for all of us who want to protect our children and grandchildren from growing up in a world diminished by global warming.

I do not believe I need to describe the disappointment we will cause if we, the advocates of strong climate legislation, stumble in this committee and fail to report the bill to the floor.

Of course this bill can be improved. If, at full committee business meeting on December 5, improvements can be made that would help earn the support of additional members of this committee—without jettisoning the support of any of the four members who already voted in favor of it on November 1—then by all means those changes should be made. But I will do everything in my power to ensure that we do not forfeit any of the “yes” votes that we won on November 1.

Chairman Boxer, I know that you share my views in this regard. You have been tremendously effective in using your power as chairman to strengthen this bill even as you perform the delicate balancing function necessary to move big legislation through a committee. We would not have gotten this far without your expert, guiding hand. And I know that, with you sitting in that chair, we will succeed in this committee.

Thank you, Chairman Boxer.

Senator BOXER. Senator, thank you. So we will go back to the question, this whole notion of not doing anything until China and India act is something that I have always taken issue with as an American who has always seen America on the cutting edge of all these things, and as a Californian.

So I wonder if you could respond. Do you think that when we act, it is going to help world-wide?

Mr. KRUPP. Yes, Madam Chairman, I don’t think there is any question in my mind and from all the evidence that we have gathered, and we have been working in China now for 17 years, that our acting will inspire action by China, India and the other developing countries. This is the way it has always been on environmental policy. America has always gone first. In this case, we are behind every other developed nation with the exception of Australia. Every other developed nation has already done what you are deliberating about doing today.

As a matter of fact, I talked about this chart in my testimony, about how a two year delay, just a two year delay means to achieve the same reductions by 2020, instead of having a 2 percent average reduction per year, you would need a 4 percent. But in fact, this chart ignores the fact that the faster we act, the faster China will act. So the stakes of us acting now in this Congress are enormous. Not only will it ease the burden on the American economy if we

act sooner, but it will also in the negotiating process lead the other countries to act faster.

Senator BOXER. Mr. Krupp, just for the sake of Senator Lieberman, and I guess Senator Warner had to step out, for my last question, could you just repeat what you said, a delay in two years, what that means to trying to reach any kind of goal to avert catastrophic global warming? Repeat what you had said in your testimony.

Mr. KRUPP. Sure, and thank you, Senator Lieberman, for your kind remarks when you opened.

In my testimony, the principal point of this chart is that to achieve a cumulative emissions budget in the United States between now and 2020, if we act now, as you have proposed in your legislation, we would need to average about a 2 percent reduction per year. But if we wait two years, and try to get down to the same level of total emissions cuts by 2020, we would need to instead of having 15 percent reduction level for covered sources, we would need to have a 23 percent level. We would be starting at a higher level because emissions will go up for the next couple of years while Congress delays. And then we would have to start from a higher level, cut to a lower level just to get the same emissions reductions. That will be harder for the economy.

So I would say to all the Senators concerned about costs, there is enormous benefit in reducing the costs by acting early.

Senator BOXER. Thank you.

Senator Inhofe.

Senator INHOFE. Thank you, Madam Chairman.

Let me first of all compliment you, Mr. Berendt, in the way that you very succinctly articulated the problem in near-term when you talk about renewables and natural gas, and the fact that, I think you said by 2017, our imports could increase by 33 percent. We know what countries we would be dependent upon, and that is something that concerns every member of the United States Senate.

Mr. Krupp, let me just ask you one question that would be a yes or no. Would you support more LNG terminals in the States on the West Coast and upper East Coast, number one; and number two, new nuclear plants?

Mr. KRUPP. Under the right safeguards, we do need to increase our supply of natural gas. So I don't think it is a yes or no question, but yes, we have to do what we need to do to expand supply.

As to the nuclear question, Senator, I think we have a number of concerns with nuclear power. We would support increased funding by Congress to resolve those concerns about waste security. I don't think any option that is a low-carbon option should be taken off the table.

Senator INHOFE. All right, thank you very much.

Ms. Claussen, do you generally agree with that?

Ms. CLAUSSEN. Yes.

Senator INHOFE. Good.

Mr. Book, I have said that a tax is a more straightforward, a little more honest way to go. People realize what the cost is going to be, it can't be masqueraded as it can in a cap and trade. But you have said that taxation is more effective than a cap and trade, and

some of the other members disagree with you. Why do you believe you are right in this statement?

Mr. BOOK. Senator, I think it is more a question of first recognizing that the controls that have been erected seem to be somewhat redundant, given what we already have. There is already a Securities and Exchange Commission, there is already an IRS, there is already an EPA. Of course, if you don't let the whole world play and the market isn't a completely open market, then market dynamics don't always work the way you want them to work.

So you can use a tax, because we have a tax system, and you can use tax deductions, because we have those, too, and get a lot of the same things done.

Senator INHOFE. It has been discussed several times by other witnesses, not just in this hearing but in previous hearings, and I would ask the question, do you think that an aggressive, unilateral greenhouse gas reductions in the United States, without participation by China, India and other developing countries, would lead to lower global concentrations of greenhouse gases? In other words, as the job flight, in my opinion, goes to these countries where they have less controls, less technology, could this end up in increasing the amount of greenhouse gases?

Mr. BOOK. I think that any aggressive stance taken that does not take into account the growth rate of the developing world is probably either a wealth transfer or a loss of value. That said, there is a value in showing that it can be done economically. And if we keep our own economy running smoothly, then we have a right to hold them accountable too, through duties and some of the trade recourse.

Again, why recreate the wheel? We already have it.

Senator INHOFE. All right. Mr. Book, in your written testimony you elaborated a little bit more on how the costs associated with S. 2191 would hurt disproportionately lower income people, but you didn't have time to get to that in your opening remarks. Do you want to elaborate on that?

Mr. BOOK. It is just a consequence of America's natural resource distribution and the beautiful expanse of the Midwest, as well as the population concentrations in the coastal areas and their tendency to be innovation clusters that you have essentially the poorest people in America driving the longest distances using predominantly coal-fired power and living very frequently in the seasons that give them the greatest extreme temperature changes.

That means that on a State-wide national average basis, some folks are going to suffer more than others.

Senator INHOFE. And would you expect increased dependency on politically unstable regions to exacerbate the price volatility you highlighted in your testimony?

Mr. BOOK. The instability in the oil market is a function of the fact that the oil market is very close to full capacity in the perception of traders. Anything scares them now. The greatest thing we can show the oil market for stability is that there is more oil. Of course, that is proving harder to do, given the political change.

Senator INHOFE. It is, you are right.

I want to thank all the witnesses for their excellent testimony. Thank you, Madam Chairman.

Senator BOXER. Senator Inhofe, I know you need to go to another meeting. Before you leave, I just thought we could start a little interesting debate. Just think about what I am going to say.

When you say you think a carbon tax is more honest, I just disagree. Because a carbon tax is something we, the politicians, would set. And cap and trade is the free market that picks the price. So it is interesting, as an old stock broker, I just believe in the free market, and I think the cap and trade that Senators Lieberman and Warner have come up with is the fair way, whereas a tax is, you know, Government in a little smoke-filled room deciding what the price of carbon is. So maybe you should think about it and we could have a good debate.

Senator INHOFE. Well, let me respond to that.

Senator BOXER. Please.

Senator INHOFE. I think back during the time that we were looking at Kyoto, when the Wharton Econometrics Survey first came in with the estimates of that, it was \$300 billion a year. They translated that into what it would cost a family of four, which was \$2,700 a year. Now, CRA International, as we learned from our last witnesses in the last hearing we had, said that this number would be much greater on this bill, because it is a more aggressive reduction. That being the case, the statement I made is I think the tax approach is a more honest approach, because people would be in a position to know what they are paying and not have it masqueraded in something that is more difficult to translate into how it affects the people around the kitchen table.

Senator BOXER. All right. It will be a very interesting switch, you supporting a tax and me supporting the free market.

[Laughter.]

Senator INHOFE. Let me also say I like your idea on switching the gavel.

Senator BOXER. Oh, I know, I know.

[Laughter.]

Senator BOXER. I think I am moving it to this side right now. Thank you, Senator Inhofe.

Now, in terms of who I am calling on next, I want to lay it out and see if people think it is fair. Senator Lieberman, do you mind if the other two—

Senator LIEBERMAN. Not at all.

Senator BOXER. And on your side, could we go with Senator Warner? OK.

Senator WARNER. [Remarks made off microphone.]

Senator BOXER. Senator Carper, go ahead, please.

Senator CARPER. Thank you, Madam Chair.

My first question is of Eileen Claussen. I understand that you spoke at a forum in Washington early this week that focused on nuclear energy, is that correct?

Ms. CLAUSSEN. Yes, with you.

Senator CARPER. I had to leave before you spoke. Could you give us a takeaway or two from your comments, please?

Ms. CLAUSSEN. Yes. I believe that nuclear has to be a part of the solution to dealing with the climate issue. And I think the best thing for nuclear is for us, for the Congress to pass a cap and trade

program to put a price on carbon, because that would make nuclear more competitive.

That said, I also indicated that there are some problems that nuclear has to solve, particularly the issue of waste, and suggested that instead of the current station or possibly Yucca Mountain, there might be some interim solutions that actually could move us along the path here. I think that is something that the Congress should think about. But that is sort of the bottom line of what I said.

Senator CARPER. All right, thanks very much.

Let me ask a question of Mr. Book if I could. Again, our thanks to each of you for being here. Madam Chair, you put together just a terrific panel, and we are grateful not just for your testimony today but for the work that you have done in helping us to craft this legislation and other pieces of legislation that some of us have been involved in. We are grateful for that.

For Mr. Book, I believe one of the primary goals of climate legislation is to incentivize the deployment of new, clean forms of energy like renewables and like nuclear. Along with a couple of my colleagues, I am interested in maybe adding some provisions to this global warming bill, such as providing allocations to incentivize renewables and nuclear. My question is, put your economist hat back on again if your wife will let you and tell us what are some of your thoughts, and maybe some thoughts from the financial community on ways to incentivize renewables and new nuclear as we go through this legislative process?

Mr. BOOK. Thank you, Senator. The world needs more BTUs, the British Thermal Unit, the common denominator of all of this. Nuclear power is one of those sources that can give and keep on giving at a low marginal cost.

It has, however, a very high startup cost and it has increased as more of the world has started to want nuclear power for themselves. When I look at the incentives that this Congress has produced for nuclear power, they are considerable. There are loan guarantees, there are production tax credits, there are insurance policies. It is clear that letting the free market work isn't exactly what the policy stance has been, because these are designed to promote nuclear power.

If as this panel, the fellow to my left has pointed out, we aren't going to build any more coal plants, we are going to need more nuclear. And if we are not going to solve our power generation needs by renewables, as sort of a small but essential tail to the problem in the near years, then probably whatever you can do to get it built is in the best national interest.

Senator CARPER. Thank you.

Mr. Sims, have you ever run for State-wide office?

Mr. SIMS. Yes.

Senator CARPER. Did you ever run for the United States Senate?

Mr. SIMS. Yes, I did.

Senator CARPER. So if things had worked out a little differently, colleagues, he could be sitting over here—

[Laughter.]

Senator CARPER. And maybe we could be sitting out there. When I was Governor, I used to get to testify on behalf of the National

Governors Association, which I loved to do. You said earlier that you were nervous, but it didn't show. But I used to say to people that I would give good money just to have the chance to come down and testify about once a week. It never happened that often, but I always enjoyed doing it.

I want to ask you some questions about transportation and the role that transportation plays in what we are trying to accomplish here. I think you mentioned in your testimony that even if California's low carbon fuel standard were implemented nationwide, and if our CAFE standards were raised to 35 miles per gallon, which I think we are going to do that, emissions from the transportation sector would still be about 40 percent above 1990 levels by 2030. And I have a three part question, I probably will not have time to ask all those parts, but let me just ask one part. If you want to answer that, great, if not, I will go to part two.

Part one is, how can we ensure that investments in transit and in other policies that reduce greenhouse gas emissions from driving generate credits or funding under this bill?

Mr. SIMS. Within your bill, you have vehicle miles traveled reductions. What I am urging is that you in fact make those as bold a commitment as you have for your CAFE standards, as well as your alternative energy standards. Because if you look at all the data, if we don't reduce vehicle miles traveled and that continues to grow, our carbon emissions, we can't achieve our reductions if we still don't address the issues of vehicle miles traveled, which is what I would urge us to do and make those kinds of investments. We have done that in our county by buying hybrid buses, converting them to biofuel buses. We have had an incredible reduction, 27 percent reduction in fuels, 30 percent reduction in carbon emissions. It is our key strategy to becoming a very viable economic community in this 21st century.

But our goal is to, what I love about this bill is the market you can build. But I think having measurable, quantifiable results that we think we can achieve by vehicle miles reduced and the kinds of technologies you use in terms of public transportation are key. There need to be incentives. They just can't be left. That third leg of the stool, as we call it, just can't be ignored. Because what will happen in 10 to 15 years is we will find out that all the other things we endeavored to do, the CAFE standards, alternative energy standards, didn't allow us to achieve our reductions as to vehicle miles traveled that is the key to being able to achieve our reduction goals.

Senator CARPER. I would just say to my colleagues, Madam Chair, I think Mr. Sims has said a great truth. I am hopeful that we will pass a strong CAFE bill, I hope it will include a 35 mile per gallon standard by 2020 or thereabouts.

But unless we also incentivize people to drive less, whether it is by transit, inter-city passenger rail, making sure that we have other options that are available to them, we are not going to be as successful as we otherwise would be. So I applaud you, and I know there is an effort in the Lieberman-Warner bill that try to ensure that we do incentivize. People encourage people to get outside of our cars, trucks and vans, and have options other than those to get places we need to go. We need to make sure at the end of the day

that the bill includes those provisions and maybe improves on them.

Senator BOXER. Yes, I want to say, Senator, we look forward to having your input on this, as well as Senator Cardin is very interested in this, and working with us as well. I would say zero emission vehicles can't be forgotten, too, because that is a real possibility.

Senator Warner, you have 7 minutes.

Senator WARNER. Thank you, Madam Chairman.

I would like to follow on that important colloquy of our colleague from Delaware and Mr. Sims. You talked in your direct testimony, Mr. Sims, about the need to reduce vehicle miles traveled. This comes back to this time-honored sort of concept that we I think fortunately follow here in Congress. That is pretty much sort of a State issue, because it is the States that deal with the highway modernization and one thing and another to help work on this BMT issue.

But I have drawn the colleagues, the Chair and the Senator from Delaware talk about incentives to individuals. Maybe we ought to put in some incentives to the States to step up and address this issue as part of their overall annual highway budget and review program. Again, observing States' rights.

Mr. SIMS. I would be overjoyed to have States have to make a commitment to reducing vehicle miles traveled. I also think there is a strong Federal role for that, because the tone will be set by the Federal Government. So it is the incentives that can be provided for congestion pricing, incentives provided through tele-commuting, as we have in the Urban Partnership Grants that just came out to many of our communities. But having the States do that would be an extraordinary step as well, and a very welcome one.

Senator WARNER. I agree with that.

I also would like to, the question of nuclear power will eventually be addressed in the context of our Committee deliberations. I speak with some background in this area, having been a part of the Navy Department for many, many years. Today's domestic infrastructure to respond to what I perceive is to be the correct and laudable desire to move more and more into nuclear power, there is a choke point. And that is, the infrastructure today, the complexity of metallurgy alone, the craftsmanship, the ability to machine the extraordinarily complex components of the nuclear power systems, that infrastructure in America has simply dwindled over the years, as a consequence of our looking away from nuclear power as a resource.

It is really there now to support the continued modernization and safety requirements of existing plants and the good old United States Navy, which has continuously never lost a heartbeat going forward in devising new nuclear power systems and ships, primarily submarines, carriers coming on. Even in this provision of a bill that we are working on in another hearing room, not distant from here, is for the next class of nuclear cruisers, possibly, some units to have nuclear power.

But where is the infrastructure? What do we do to help that infrastructure recognize that they may be called upon, to use the

word, surge in their ability to help meet domestic needs? Does anyone have a background that wishes to address that issue? Or I have made it all into a speech?

[Laughter.]

Senator WARNER. Yes?

Ms. CLAUSSEN. I will try, but my background is that my very first job after graduating was working with submarines, including nuclear submarines.

Senator WARNER. But you were under the tutelage of one of the most brilliant men I ever knew, Admiral Rickover, I presume?

Ms. CLAUSSEN. Right.

Senator WARNER. That was a rare experience for both of us.

Ms. CLAUSSEN. But that was a long time ago.

Senator WARNER. Well, I date back a few years myself.

[Laughter.]

Ms. CLAUSSEN. One of the things I can say is, Senator Carper and I were both speaking at the annual meeting of the American and European Nuclear Societies on Monday of this week. We both talked about climate change and how we see nuclear as part of the solution.

There was a lot of discussion at that meeting about education and the need for increased education, the very point that you make about our infrastructure and our ability to respond. The only thing that strikes me is that if there is a demand for nuclear, we will actually figure out how to do all of that. And the best way to get that demand, I think, is to pass a bill like this that puts a price on carbon, so that we actually have nuclear playing a significant role and having that ability to move nuclear I think will mean that we start to rebuild what we once had in terms of infrastructure.

Senator WARNER. Well, it will take some time.

To Ms. Claussen, I would like to address another question here. You have addressed pretty well the positive impacts of the cap and trade legislation and the prospect for creating new green collar jobs. Do you look upon that as a positive contribution to the American economy?

Ms. CLAUSSEN. Yes, but, is the way I would like to put it. I think there is no question that as we move to a carbon-constrained world, we will create a lot of jobs. But, and I think this is quite important, we also have to have a system that minimizes any job loss in existing employment. We also need to make sure that we take care of those who might be faced with a difficult situation.

So I think that, for example, making sure that energy-intensive industries, coal-burning power plants, are afforded some ability to make that transition as inexpensively as possible through the allocation process is very important. I think in the end, that will also mean that consumers in those areas might have increased energy costs, and we should, through the allocation process, try to deal with them.

But I think on that, we will probably create more jobs than we lose. But that doesn't mean that there aren't some distributional effects that I think we need to deal with.

Senator WARNER. Well, I thank the panel. It has made a valuable contribution to this very, very important challenge to this

Committee. I once again commend our Chairman and indeed, our Ranking Member and others. Clearly, my colleague from—yes?

Senator CARPER. Would you yield to me just for a moment? I would just say, Senator Voinovich is not here, but he and I convened a week or two ago a roundtable here, with the acquiescence of our Chair, where we had folks to come in from organized labor, John Sweeney was there, a number of folks from organized labor, different building and construction trades, folks from the nuclear industry were there, and we spent about two hours just focusing on how we were going to have the human resources to build these nuclear plants, to operate these nuclear plants. I hope as we go through this process and figure out what to do with some of the money we are going to incent things for that we consider incenting the education of people to build these plants and to operate these plants. Because frankly, the folks with those skills, whether they are electricians, whether they are pipefitters, plumbers, sheet metal workers, they are not there in great abundance these days, as you know.

Senator WARNER. You are quite right. The essence of all nuclear power is absolute quality control. That takes time.

Senator BOXER. Well, Senator Warner, I just want to say how thrilled I am that you could sit for a little bit longer today as your leg heals.

Senator WARNER. I will be back with a clap of thunder after the Thanksgiving break. For the markup I will be here in full power. [Laughter.]

Senator BOXER. I cannot wait for that. Believe me, we need you here for sure. Thank you so very much.

Senator KLOBUCHAR, I am giving you 7 minutes.

Senator KLOBUCHAR. Thank you very much. Thank you, Senator Warner and Senator Lieberman, for your good work on this bill. Thank you, Chairman, for holding this hearing.

On Tuesday we talked a lot about the importance of other policies working in concert with this climate change bill, including electricity standards, which I have mentioned here many times. We have an aggressive one in Minnesota, of 25 percent by 2025 and 30 percent for Excel Energy by 2025, for renewable electricity standards. And also the gas mileage standard that we are pushing to get through and successfully pass through the Senate.

I am also glad as we continue the discussion of these compatible policies that Mr. Sims is here. We are aggressively pursuing—finally—in Minnesota some of the things you have been doing in Seattle with light rail. We have a very successful light rail line now out to the airport and the Mall of America, not to give a pitch for our mall during the holiday season.

[Laughter.]

Senator KLOBUCHAR. The Mall of America—OK.

Senator BOXER. Did you say the Hall of America?

Senator KLOBUCHAR. No, I would say the Mall—

[Laughter.]

Senator KLOBUCHAR. I guess you have never been there, Senator Boxer.

Senator BOXER. I will go with you.

Senator KLOBUCHAR. Very good.

Then we also are pursuing a rail line to St. Cloud, where we have a lot of traffic on a major interstate. So I am looking forward to hearing more on these issues.

I think one of the most important parts of this bill is as was earlier related in this discussion with Senator Inhofe and Senator Boxer, the Carbon Market Efficiency Board and the cap and trade. I believe that this provision helps prevent volatility and provides the underpinnings of a strong emissions trading market. At this moment, we have the opportunity to learn from the mistakes made in Europe. They had some, there is no doubt. We have met with some of the people involved in that and we can learn from their mistakes.

Minnesota is also the home, in addition to the Mall of America, of Tom Friedman, who as you know has been doing a lot in this area and wrote a very good piece for the New York Times Magazine about the power of green. In that, he asked, how do our kids compete in a flatter world, how do they thrive in a warmer world and how do they survive in a more dangerous world. The answer to me which would make the most sense is to try to encourage these economic and technological opportunities to reduce our dependency on fossil fuels and to encourage the next great global industry.

So I am curious, Ms. Claussen, to pursue some of the discussion, I think it was Senator Bond, before I got here, who talked about how you can't really make this comparison to the acid rain market. But we know that we had success with sulfur dioxide and the nitrogen oxide emission trading systems here in the United States. We also have the European system to look at.

As more and more countries accept the need to address climate change emission trading I believe will play an increasingly significant role. This is because it not only creates incentives for firms to cut greenhouse gas emissions, but I think we also have to remember, as Senator Boxer reminded us, that it creates incentives to spur technology innovation that further reduce emissions. I have told our Committee members that I come from a State that believes in science. We brought the world everything from the Post-It note to the pacemaker. We really see this opportunity in our State with the technological know-how we have and the great universities and a lot of the companies that we have there, that there could be some opportunities for us, as there would be for the rest of the Country.

So I guess my first questions would be of you, Ms. Claussen, along the lines of the issue raised by Senator Bond about, and the debate that we have had about whether or not the success of the past years of the acid rain program is applicable to America's Climate Security Act. Some argue it is inapplicable because that only involved one sector of our economy. The Pew Center is widely recognized as giving some unbiased advice, and I would like to hear what you say about that.

Ms. CLAUSSEN. Thank you very much, Senator. Yes, I am a big believer in Minnesota's innovation and everything else. My son went to college there, and it was a great experience for him.

But let me sort of try to answer your question this way. We learned a great deal in the course of putting the acid rain program into place about what is important in a cap and trade system. One

of the things that is most important, and I think we learned this, is that you have to make sure that a ton is a ton. In other words, that everything you do is verifiable and that you know that it is real. Because otherwise, the gold standard of the program becomes debased. And then you don't have a good program.

So I think it is very important that we make sure that what we do here has integrity. That is something we learned.

I think we also can learn from some of the mistakes that were made in Europe. Europe did not have a very good data base that would tell them where the emissions were coming from and what those amounts were. So when they decided to make their initial allocations, they made ones that were too large, given what turned out to be the actual case. I think we did learn this in the acid rain program, too, you need a really good data base. You have to make sure that you have good numbers, and then you have to make sure that what you do makes some sense.

So I actually think there are lots of lessons to be learned both from the acid rain program and from the European experience. I think Europe has learned a great deal from their phase of experimenting. And it looks like they are going to correct a lot of those mistakes. They are going to have targets that are much more stringent in the next phase, which is the real phase. Don't forget, the Kyoto targets don't actually take effect until 2008 to 2012. So what they were doing here was really going through a period of learning. From everything that we have learned from them, and you probably learned much of this when you were there, they actually have learned a great deal and I think they will have a system that works. If we also have a system that works, this will be so much better in terms of achieving environmental results and keeping the costs as low as possible.

Senator KLOBUCHAR. Have you done any research about how you would intertwine our program with these other countries' programs so we can trade internationally?

Ms. CLAUSSEN. I think if we on a national level have a cap and trade program with a real cap we will in fact be able to do that. The best way to assure that is to have a global agreement that allows for that kind of trading. Don't forget, the United States is not a party to Kyoto. So while we can do some things between States and countries, and the International Climate Action Partnership, which was just announced, is going to try to see what can be done on an interim basis until we have a national law. I think once we have a national law and an international agreement, we will in fact be able to trade.

So the job is not done when legislation is passed in the United States, because we do need a global agreement. But I don't think we will get that until we pass something here. So the urgency of actually getting a bill out of this Committee and through the Congress is, that is number one.

Senator KLOBUCHAR. So Mr. Krupp had talked about the need to move things along quickly, that we can't wait. I obviously agree with this, but I was thinking more in terms of after seeing Greenland the melting of the icebergs, what is going on in our own State. But you see it not only for getting quick action, it is also to urge other countries to act.

Ms. CLAUSSEN. Yes. I spent a number of years negotiating internationally on behalf of the United States in earlier lives of mine. Nothing works better than to actually be able to say that we are doing something, and let's figure out a way to do it together.

Now, I don't think it is all being nice. Sometimes it is important also to say, and you have to do something. But we aren't able to do that now, when we ourselves are not doing something. So the first step has to be that we do something here domestically.

Senator KLOBUCHAR. One last question. Mr. Sims, I had mentioned you were doing and how we have to view this not just as a burden on us but also an opportunity. Could you just go through quickly the economic gains from having this public transit that you have seen? I know that Senator Carper talked to you about how it fits in with the carbon system. But just the straight economic gains that you have seen from having your public transit system in Seattle.

Mr. SIMS. Senator, we have had a 14 percent increase in our ridership, 7 percent this last year. People are opting to use it because the buses are both cleaner, more efficient. We work with General Motors, we bought 274 buses. The demand is so great, we are buying 500 more. Because people are now beginning to rely on that bus system as a method of commuting. The interesting thing is Microsoft just put together its own bus system because we weren't moving fast enough, because they are growing very, very rapidly.

So we hope over the next several years to be able to catch up, so we can have Microsoft believe that they can actually move more of their people on our bus system. So we are trying to catch up with the companies that are growing very rapidly and wishing to compete. It is very clear in our environment that public transportation is an absolute key to moving people throughout our county. We can't grow without it, we know we can't grow without it.

All the data that we have available regarding our economic capacity in our region, the growth and where it should occur, is going to require us to have more substantial investments in public transportation. We are going to make them. We would again believe that we are no different than any other community, that public transportation works as it does, and we are trying to keep up with Minneapolis and St. Paul in Minnesota.

But to us, we are having sustained growth now, as you know, in our region. We believe that can be maintained. But the key is the efficiency of the dollar spent. We are a very conservative county. We are AAA rated and we tend to be very conservative, looking at return on investments. We believe that public transportation is our best return on investment for moving people in a globally warmed world, but also in an area that is growing very rapidly. We can't build out, it is too costly.

Senator KLOBUCHAR. Thank you very much.

Senator BOXER. Thank you, Senator.

Senator Lieberman, I think it is very appropriate that you be the last questioner here.

Senator LIEBERMAN. Thank you very much, Senator Boxer. Thanks to the panel. I regret that I didn't hear the opening statements, but I did get to read them last night. And they are excellent. I mentioned my thanks previously to Fred Krupp and Eileen

Claussen. Ron Sims, it is good to see you again. Thank you for your practical and productive leadership. Mr. Book, Mr. Berendt, thanks for your testimony.

I thought I would start briefly, because we have heard so much, the very good exchange at these hearings, to say probably what is obvious, but two things. We are operating now in a context, thanks to a lot of people who are in the room, and thanks to the science, most of all, where John Warner says, when you ask him quickly, why did you decide to play a leadership role in this fight to do something about global warming, he says two things: science and my grandchildren. And that is exactly, that sums it up.

The science has really put most members of Congress, it has ended a debate that went on for a long time here about global warming: is it real, is it caused by us, people. Now pretty much everybody agrees it is real. Now the question is, what to do about it. And the grandchildren part of it, of course, is another way and a most human and personal way, of saying, are we going to assume our responsibility here. I will go so far to say, because I think it is fitting, our moral responsibility. But certainly our practical responsibility to, as leaders, to avert a problem that could be disastrous for our grandchildren and those that follow them.

So in that context, the bill that Senator Warner and I have put together, with a lot of help from a lot of people and a lot of input from a lot of people, has attempted to, I would say, to phrase it simplistically, do a couple of things. The first is to really do something to reduce greenhouse gas emissions in the United States. But to do it in a way that is not disruptive of our economy. In fact, we think it will ultimately have a positive effect, in addition to the fact that it is averting this potentially disastrous situation.

So we have crafted a balance which doesn't please everybody. Or let's put it this way. It is not the idea of the perfect for everybody. Part of what we are struggling with now, Senator Warner and I, Chairman Boxer, is to keep people together for this without sort of walking away. Because that one additional thing they wanted to do to make it better is not in there. And because if I didn't feel this bill really made a difference, I couldn't make that case if it was enacted. But I think all the evidence is that it does.

This leads me to ask you, Fred Krupp, this first question. I thought that part of what you said, as I came in, in answer to Senator Boxer's question, was very powerful and not really thought about enough in this debate, which is that we are not dealing here with a static situation, an environment, using the word broadly, a reality that is constant. This problem is getting worse every day. Therefore every day and every month and every year we wait to do something about it, it is not only harder, but it is more costly.

And it is particularly harder, as you said, to do something quickly and early enough. It is very important to remember that particularly for people, I will be blunt, who will say, hey, let's wait until 2009, the political context will be different, we will have more people here, we will really want to pass a perfect bill. But who knows, really, who will be here in 2009. And if we can do it now, as best we can, of course we should do it now. Nobody thinks that we are not going to come back and look at this. In fact, our bill requires

that we come back and look at it regularly in the years, in the 45 or so years to follow.

My question to you, Fred, is this. Talk a little bit more about why the early goals for greenhouse gas reduction, the caps, for instance. In 2020, you focus a lot on that. Why is that so important as compared—I know everything is important longer term. But why is that so important? Why is the loss of two years here in terms of that 2020 goal so important?

Mr. KRUPP. First of all, Senator, the loss of two years of actions means that it is very, very hard to then recover those two years of cuts by 2020. And the atmosphere cares a lot about how soon these cuts are. If we want to avert the worst catastrophic damages, the sooner we make cuts, the better. So you would have to be living on another planet to believe that any different political situation in 2009 was going to so change the politics that we could achieve the same goal by 2020, because inevitably, it is only going to be fair to provide industry with a certain number of years before they are required to begin to make cuts. So there is a huge atmospheric benefit from acting now.

Second, the signal it sends internationally, when I go to China, the question I get asked and that our staff there every day gets asked is, America is a very smart country, America is a very wealthy country, you are so smart, you are so wealthy, you haven't taken a cap. How can you even discuss that with us? So the sooner we take a cap, the sooner we have every reason to believe in the moral standing to ask China to control its greenhouse gas emissions even more so than their attempts to date.

Finally, Senator, the last thing that is so important, I spent the last year researching all the different technologies that I could find that would reduce greenhouse gases. I have interviewed dozens of people. I have talked to an Israeli engineer named Eli Gaul who worked for GE when the sulfur law, the Clean Air Act Amendments in 1990 were put in place. At the time, scrubbers didn't work too well. But as soon as there was a profit motive, GE figured out how, instead of having to have two scrubbers on every plant, because one kept clogging up, they made the scrubbers so efficient that that redundancy was no longer necessary, it became a profit center.

As a result of this year-long survey of technologies and talking to entrepreneurs of all stripes, I can tell you there is a burst of entrepreneurial energy out there. But that doesn't really flower until we give them the certainty of a carbon cap. So doing this two years early will support a revolution in technology that John Dorr, perhaps the most famous venture capitalist in America says, could very well be way, way larger than the information technology revolution and the web.

Senator LIEBERMAN. That was a great answer. Thank you.

My time is running out, but I want to ask a somewhat related question of Mr. Berendt. In your testimony, you said that the uncertainty created by Congressional inaction on climate change is creating problems for the development of new power infrastructure in the Country. Of course, this says to me that, based on what you said, that Congress should set up a carbon price signal—of course, I favor cap and trade—as soon as possible to avoid keeping power

producers and the people they have to go to for money in limbo, and that to choose not to do so would actually expose the economy to what an economist might call inappropriate choices about power development, because they are made in the context of uncertainty, which soon may become a certain context and change the playing field.

I think you followed that long question. I am over my time, so the quickest answer you can give, the better.

[Laughter.]

Mr. BERENDT. That is correct, Senator.

[Laughter.]

Mr. BERENDT. And I would simply add that to develop a forward curve for carbon requires a market that is liquid and functional, so that derivatives can begin to operate. Therefore, while it is very important that we help to recognize and engage the stalling that we are seeing right now current in the new build environment for high fixed cost technologies, it is very important that we move forward, and if we do decide to implement a market-based mechanism, that it is functional and liquid in how it operates so that it does send a clear price signal. So that when project developers go in front of the credit committees and investment banks, those investment banks can rely on the line items and the liability side of the column for the assets and avoidance of liability as created by the market.

Senator LIEBERMAN. Those are important points, I appreciate it. So I want to say, and I know you have different points of view on some things, but Mr. Krupp and you, Mr. Berendt, are saying to us that the sooner we send a signal of some clarity to both the power producing sector of our economy and the financing sector, the better we are going to be.

Mr. BERENDT. The one thing that all low-carbon advanced technologies have in common, whether it is clean coal, carbon capture and sequestration, renewable energy, nuclear energy, advanced energy efficiency, is that they all share a high fixed capital cost. It is very difficult to outlay that capital, especially on the time frame that the energy industry operates on, which tends to be a 30 year, without that clear pricing.

Senator LIEBERMAN. Yes. That is of course why we put various other forms of assistance to the power sector into our proposal to try to ease that very costly transition to acquire the fixed cost technologies.

Thank you very much.

Senator BOXER. Thank you, Senator.

Senator VOINOVICH.

Senator VOINOVICH. This last discussion has been really interesting. I have been on this Committee, I think since my ninth year or eighth year. You have this difference of opinion, you have your environmental groups, then you have your business groups. Ms. Claussen, you were talking about the fact that you thought this would enhance America's competitiveness. We had the AFL-CIO in here and said, we have some real problems with this in terms of what impact it is going to have on jobs. We have had, I mentioned Duke Energy today coming back and saying that the electric costs would go up 53 percent for their customers. So there are a lot of

concerns about the impact this is going to have on our economy and our competitiveness.

It appears to me that the thinking is that by going through cap and trade that somehow we are going to jump start the technology that we need to deal with this. I have always said that the technology should drive the cap and trade, not the cap and trade drive the technology. I think you believe that the cap and trade will drive the technology.

I have also, Mr. Krupp, looked at and tried to make a list of all the technology available. I have had people come in and say, we have just the right thing. But you talk about being commercially viable, particularly for older power plants and putting them on, they come back and say, no, it is not commercially viable. We have some good ideas and we think we could do it, but it is going to take us, the Energy Department has this FutureGen project, and they are going to have those things built in 2012. But the whole idea of FutureGen is can we do NO_x, SO_x, mercury and take care of carbon. That is a question mark. In terms of sequestering, the Department of Energy has three outfits that are doing some experimentation and sequestering. The geology, does it migrate, getting into the questions of liability and the rest of it.

For the life of me, I can't believe that there is some other way besides this gigantic new regime that we could go to that would get us to the goal that we have sooner than what we are doing here, and that is what is the Federal Government doing in terms of tax incentive, in terms of grants, perhaps maybe we need to collect a major new tax that wouldn't be that very much, but for the American people that would be earmarked to say, we are going to put this money into making sure that we are number one in terms of the technology we need to really reduce greenhouse gases, and by the way, once we do that, we are going to be able to say to these other countries, we have it, you guys have to do it and if you don't do it, then you are going to have to pay for it.

What is your response to that? Is there some other way that we could get to the goal of reducing greenhouse gases quicker than going into this, I think, unbelievable new program that is, I mean, we talk about the acid rain provisions of the Clean Air Act, I know about them because I dealt with them when I was Governor. But I have to tell you, the acid rain provisions are like a wart on the back end of an elephant compared to this thing that we are talking about. Is there an easier way to do this?

Ms. CLAUSSEN. You are asking me?

Senator VOINOVICH. I am asking both of you.

Mr. KRUPP. Senator, I would just say a couple of things. First of all, I know that you care about this problem from our previous discussions. You were telling me how the water has warmed in the Gulf and you do have an appreciation of the problem, and I appreciate that. I want you to know that I completely share your concern about costs. I absolutely think we need to approach this in the least cost way.

Is there another way? I have looked around the world at ways that countries have gone about solving air pollution problems, which this is, in essence. We are throwing something into the air that shouldn't be there. I have yet to find a single example of an

air pollution problem being solved other than putting a mandatory limit on how much can be emitted.

I am reminded, Senator, of what Jim Imholt of General Electric has said often, that to him this is kind of a chicken and egg problem. While he makes many technologies, GE does, that are low carbon, wind turbines, nuclear, carbon capture systems that would be associated with their IGCC technology, because of the capital cost problem that has been referred to earlier, no one is going to order these machines until there is this mandatory limit. That was one of the reasons that the 27 companies that now are in U.S. CAP, including Jim Rogers in his most recent press statement, he continues to be a strong supporter of a mandatory cap, the same system. He has differences in some of the details in his proposal. But he supports the same mandatory cap system because it is the only way that gets you out of the chicken and egg problem that no one is going to order the technology and you won't go to scale and reduce the costs until there is a limit. It provides this massive influx of private capital into the technologies that need to go to scale and need to be deployed.

The last thing I would say, Senator, is that you are absolutely right in your noting that this is a much bigger thing than sulfur dioxide. That is one of the reasons I am so optimistic, because by having this wide hunt in many sectors for low-cost technologies, we open up a myriad of opportunities for ingenuity. If there is one thing that America has always led the world in, it is American ingenuity, inventiveness. This hunt, this carbon cap that will create and inspire this hunt will be a wonderful thing for anyone who believes in the entrepreneurs that this Country has always been so proud of.

Senator VOINOVICH. The reaction that you get, though, from a lot of people that you talk to, is that the fact of the matter is that we are going to see people trying, because of the status of where the technology, and it is not there yet, that they are going to move toward a lot more natural gas, which can exacerbate a problem. I have to tell you, every four months I have people come into my office and say, you have to do something about natural gas costs. And they are not kidding. One company, I will not mention it, had 22,000 employees in the United States, now they have 16. And he said, we are going to have a lot less unless you do something about your natural gas costs.

So what I am concerned about is, in spite of the fact that we believe that the caps and people are going to do certain things, the issue is, is it going to result in the behavior that you think is going to occur, or are we just going to see a tremendous increase in the costs for everybody in this Country, and then a lot of people deciding, you know what? We are in a global marketplace, we are going to get the heck out of here, we will go to China or we will go to India. And the Chinese have said, pretty authoritatively, that they are not going to sign up on any kind of Kyoto protocol. That doesn't mean down the road we can't get them to do something. But I can tell you from dealing with the Chinese that I have seen on intellectual property, even the environmental thing, if it is jobs, and the environment or jobs and intellectual property, jobs trump the environment and jobs trump intellectual property. So that is going to

be a big effort for us to get them into the net and say, you guys have to do what you are supposed to do.

Mr. KRUPP. There are many options, other than natural gas. The beauty of the way the bill was designed is it allows offsets to come from paying American farmers to sequester carbon in their soil, or even from tropical deforestation, from avoiding tropical deforestation.

Senator VOINOVICH. I know, I hear what you say. But we probably have the expert, Dr. Loo, at Ohio State University, in sequestration. There is no question that we can do a whole lot better job in that area. But in terms of what it is going to contribute to reducing greenhouse gases is somewhat speculative.

Ms. CLAUSSEN. I would like to try to answer your questions in a slightly different way. You asked whether we should do a cap or whether there isn't another way, a way with incentives. I think the issue is that you need both. I think one without the other does not work well.

You raised the issue of the status of carbon capture and sequestration, and I agree with you, we actually think you need a much larger effort than the one in FutureGen to actually look at different geologies and different kinds of combustion technologies and make sure that you have a system that works.

So then I think you asked the question about, in the early stages, before that technology is commercially available or will be deployed, what happens with the caps. And I think I would draw on the experience in the private sector already. We work with a large group, 45 companies, it includes Duke Energy and American Electric Power, but also a lot of energy-intensive manufacturers. Of these 45 companies, 37 have already set targets to reduce their emissions and 22 have already met those targets.

The obvious question is, how have they done that, what is it that made them able to do it. And actually, some of these targets are very ambitious. Almost all of them have done it through efficiency improvements, things that are actually helpful in the bottom line. So from my perspective, one of the things that is really important in this bill, because it is economy-wide, it is not only the power sector, is that you actually will get reductions taking place across the economy in places where we can do it most cheaply.

I don't think in the power sector it is necessarily going to be sort of the number one case. I think there will be some time here to actually get carbon capture and sequestration going, to get more nuclear bills, because I think we are going to need that, to get an improvement in the amount of renewables that we use. Because we need all of these technologies, it is not just one, we need all of them.

So I just think you need both the carrots and the sticks, and they ought to work together, so that we can actually meet these kinds of objectives.

Senator LIEBERMAN [Presiding]. Thanks. Thanks, Senator Voinovich, and both of you for your answers.

Senator Craig, thank you for your patience, and that is rewarded with an extra two minutes. You can have a seven minute round. You can even go over a little.

Senator CRAIG. Well, I do appreciate that. I also recognize the tolerance of the posterior of those sitting.

[Laughter.]

Senator CRAIG. I will be brief. I do want to say, the reason for my early absence and I missed your testimony, as did Joe, we were down at the White House. Joe and I were celebrating arts and humanities with some awards that were going on down there, so we don't apologize. But I will read all of your testimony. I do want the record to show, especially for the benefit of the Chairman, that my presence here represents here a perfect attendance record and a full Republican complement, understanding her earlier comments during the hearing.

Obviously, there was criticism brought by the Chairman and I don't question is, when CRA did an analysis. Now Clean Air Task Force has a modeling analysis. Because oftentimes this great debate does spiral around philosophical lines and out of those philosophies grow approaches toward policy, and that is not an unusual model, I think it is critically important for us, Senator Lieberman, and for your bill, to have an EIA, EPA, full analysis. Neutrality is critical if we are going to send this 90 percent of our economy on a journey that is without question valuable, but without question, very, very expensive.

I don't disagree that there may be great new economies generated. But I also recognize that our whole philosophical drive as a Country today is toward cleanliness. You have spoken to it, as it relates to what companies are doing today. It isn't out of a fixed cap. It is out of a very new, real philosophy in this Country that if we are going to do it, it has to be clean. And we are doing that more and more and more.

That is why nearly every economic unit of growth in our Country today is cleaner than any other country's, or nearly any other country's. And it is certainly much cleaner than it has been and much cleaner than China's and much cleaner than India's. I have always believed that technology will take us there, in a much more realistic way beyond philosophies and beyond command and controls of government. Reasonable approaches by government can in fact direct economies. We have seen that with CAFE standards. And I have broken my mold this year by asking for mandatory CAFE standards.

I want to do what is real. I want to do what creates greater independence and greater wealth in this Country: independence in energy forms and wealth in ingenuity and creativity. So I think it is important for us, if we are going to get into a command and control policy in this Country that we must, before we go, have absolute certainty for the Craigs and the Voinovichs of this world and others that it is the right one. Because when you are talking about hundreds of billions of dollars out there in play and huge investments on the part of the consumer, we had better have it as close to right to begin with, because this is really not just an effort in, well, let's try this, because we have really studied it all and it is the only thing out there that can possibly work.

Well, while you are studying, the world gets cleaner from our standpoint and technology takes us there, old and new. That is why I have always been a bit frustrated by this. I accept the

science of warming, or the studies of that. But I also know that philosophy drives science sometimes more than it should. I am trying to sort that out right now.

So I will read your testimony with due diligence, because we have a very important decision to make in this Congress, whether it be this year or next, as to where we go. I recognize our position as a world leader. I think on this issue we should lead.

But in leading, we need to offer the rest of the world a place to go. And I thank you all very much.

Thank you, Mr. Chairman.

Senator LIEBERMAN. Thank you, Senator Craig. I appreciate the statement. I think you know that Senator Warner and I have asked for an estimate by EIA and EPA of the proposal we have made. There are now, as you know, the Clean Air Task Force has taken our proposal and used the EIA model to project. So there is some basis for us going forward. But I think it is important that we have asked for that and we get it as soon as we can.

Incidentally, on the whole question of the use of natural gas, the Clean Air Task Force does actually come to the conclusion that under our bill there will be less use of natural gas than if we don't pass it and not switching to natural gas. The reason is one, that we have included natural gas in the cap, but two, I think most significantly, that the Climate Change Credit Corporation, selling these, auctioning the credits, will have an enormous amount of money, and the language of the bill commits a very substantial amount of money, in fact, over \$300 billion over the course of the life of the bill, to coal and how we can use this most abundant American natural energy resource in a way that is consistent with the purposes of the bill and a clean environment. In other words, carbon sequestration and carbon recapture and the rest. I think if you fit that in, that is a good perspective.

Senator CRAIG. Mr. Chairman?

Senator LIEBERMAN. Yes.

Senator CRAIG. My only reaction to that is that in the interim, whether it is 10 years or 20 years, as technology catches up, I think fuel switching will occur, it has to occur if we are going to meet baseloads out there, and if we are going to keep our economy vibrant. And that is gas. I don't think any of us dispute the fact that that is probably gas, and as quickly as we can bring nukes online and yes, there is without question, the Clean Air Task Force, I am pro-nuclear, so when they come out saying X number of reactors, I am saying, yes, that is good stuff.

But I also look at the downstream reality of technology and the capability of producing them, and gearing this world up for what we want to do, because we are not the ones that are going to want to build them out there, as we know that. So that is a problem.

But something rings in my ear as it relates to transportation that also puts a burden on gas in a way that we haven't anticipated until the day comes when we do high temperature gas reactors and we can start producing processed heat for the chemical industry and take gas out of the equation, and we can produce hydrogen by continuous operation of high temperature gas reactors, which we hope to do some day. That reality is the head engineer at GM says, come on, Congress, we are going to have an operating

fuel cell vehicle in the market in 2009 or 2010. And they have three models out on the street today and they already have one in the market, a modified SUV. That hydrogen for that fuel cell comes from gas.

If we head this economy toward gas and gas alone in the next decade, it is going to cost a heck of a lot more. Because nobody wants to site a terminal. We will put these huge LNG boats on the oceanfront. And those are the realities of what we are about here. We have to shape it in a way that doesn't create the crash. Because remember, \$2.50 gas versus \$3.00 gas and sustained above \$3.00 for a family of four, commuting 26 miles a day, is an \$800 hit a year after taxes. That doesn't include their gas bill, that doesn't include their electric bill. That doesn't include anything else.

What are we bumping up here? Two thousand, three thousand dollars a year for an average consumer? You and I might be able to afford that. There are a great deal many people in my State who can't. Those are the steps along the way that we must get right. And fuel switching, in the absence of new technologies, frustrates me a great deal, because I think we put a lot of burdens on it.

Senator LIEBERMAN. I appreciate the statement.

As you can see, what has happened as we have gone along here in these hearings and considerations, every member of the Committee is grappling with this, the reality of the problem. There is a lot of good faith exchanges that are going on like this. Also, the conversations are now going beyond the sort of warring camps to what is the most practical, effective way to solve this problem, and getting more into details. I think we are all coming to understand both the immensity of the challenge, the urgency of the problem and how important it is for us to meet the challenges.

These witnesses have been excellent. You have helped to educate us. You have answered the questions well. I can't thank you enough for your time and your contribution.

The record of the hearing will be held open for a week if any of you want to submit additional testimony. Others may want to submit statements for the record, or members may want to ask additional questions.

With that, the hearing is adjourned.

[Whereupon, at 12:30 p.m., the committee was adjourned.]

[Additional statements submitted for the record follow.]

STATEMENT OF HON. JOHN WARNER, U.S. SENATOR FROM THE
COMMONWEALTH OF VIRGINIA

Madam Chairman, I thank you for honoring the request from members of this committee for more time to examine the impacts of this bill. We have a great line up today, for the fourth hearing specifically on America's Climate Security Act. Overall, I must say that I have been quite pleased with the quality of the hearings we have had on this bill.

In addition, I am pleased that my colleagues on the Committee are taking advantage of the member briefings, and our staffs continue to meet as well.

I believe it is critical that we balance the sense of urgency global climate change poses with the responsibilities of this Committee to perform its legislative duties. We are doing that, Madam Chairman, and I look forward to continuing this process with a spirit of cooperation.

I thank my colleagues and welcome today's witnesses.



November 9, 2007

The Honorable Barbara Boxer, Chairman
Senate Committee on Environment and Public Works
456 Dirksen Senate Office Building
Washington, D.C. 20510

Dear Chairman Boxer:

The American Chemistry Council welcomes the committee's deliberations on climate policy. We believe that the August outline of "America's Climate Security Act of 2007" showed real promise as a framework for an effective national climate policy. However, S. 2191, as reported from the subcommittee, contains a number of provisions that we believe move the bill in the wrong direction. S. 2191 remains a work in progress, it needs sweeping changes, and we hope to continue working with the bill's authors to develop climate policy that will provide real environmental benefit while balancing economic considerations.

American chemistry brings a unique perspective to the climate debate: we use energy to save energy. More specifically, we use energy inputs to make energy-saving materials. For example, our industry makes building insulation materials that save 300 to 1000 BTUs of energy over a 30-year period for every BTU of energy consumed to make the material. Energy saved equals lower greenhouse gas emissions, as much as 3 tons of CO₂ per year per house. While providing energy efficient products, American chemistry has made unprecedented strides in reducing greenhouse gas emissions at its own operations. Since 1990, the chemical industry's greenhouse gas emissions intensity is down by 38 percent. Absolute GHG emissions, in that time period, are down by 12.5 percent, putting American chemistry ahead of the targets set in the Kyoto Protocol.

To continue to supply the nation with energy efficient materials, American chemistry must have access to an adequate and affordable supply of low-carbon natural gas. Climate policies that have the effect of increasing demand for natural gas – in the absence of new sources of supply – could have significant ramifications, not only in our sector, but throughout the economy. Over the past decade, the competition for scarce supplies of natural gas drove the price of natural gas to record levels. Those high prices imposed \$425 billion in added costs to consumers and contributed to the loss of 3 million jobs in the manufacturing economy. In our view, it is critical that climate policies address the potential impact on U.S. energy demand. The Energy Information Administration (EIA) has reported that even with increased renewable sources, our growing economy will need an estimated 28% more oil and 19% more natural gas in year

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2030 than in 2005. Any climate change policy must begin with improving our domestic sources of energy, including natural gas, which has the lowest emissions per BTU of any fossil fuel.

ACC evaluates climate legislation based on three criteria: (1) the ability of the domestic chemical industry to remain competitive in the global marketplace; (2) the commitment to research, development, and deployment of enabling technologies; and (3) the degree to which the legislation takes into account the global nature of climate change. ACC has examined the chemical industry's ability to remain economically competitive based on a number of provisions in the bill, including emissions reduction targets and timelines, allowance allocation and trading, credit for early action, offsets, the potential for fuel switching to natural gas, federal preemption, point of regulation, and the scope of coverage. The US industrial sector must be able to successfully compete in a global market under any carbon program that is implemented.

S. 2191, in its present form could inhibit industry's ability to operate and remain profitable in the US by increasing our costs of doing business in five distinct ways: (1) the price we pay for fossil fuel-based feedstocks; (2) the cost of natural gas and other fuels we use to heat and power our plants; (3) the price of electricity; (4) the cost of transportation fuels we need to ship our products; and (5) the cost of regulatory compliance. Provisions which place US industry at a competitive disadvantage to global competition without compensating features lead to an inability both to adapt and support the US economy.

Emission Reduction Targets and Timelines

America's Climate Security Act of 2007 (S. 2191) contains a number of emission reduction targets and timelines. The earliest target is to cap emissions at 2005 levels in 2012, a reduction of 10 percent from business as usual. The next target is to reduce emissions by 15% below the 2005 level by 2020, which is equal to 1990 emission levels. These two earliest targets and timelines would result in large increases in natural gas consumption (up to 3 TCF) by the power sector. In the absence of corresponding increases in access to natural gas supplies, increased demand for natural gas in the power sector will come at the expense of the industrial sector. Thus it is important that Congress ensure that action on greenhouse gases includes energy and technology policies that provide the needed energy "tools" to address the climate challenge.

One recent study by the Nicholas Institute¹ estimates that in order to return emissions to 1990 levels by 2020, the US would have to reduce coal's market share in the power sector by more than half, boost natural gas consumption by 50 % and achieve a 270 % increase in renewable energy's contribution to power supply. Nicholas assumes that advanced nuclear power systems and carbon capture and storage technologies (CCS) will not be commercially available at scale before 2020. Other studies have reached

¹ Murray, Brian; Ross, Martin; and Gumerman, Etan. "A Path to Greenhouse Gas Reductions in the United States: Economic Modeling of Interim national Targets." Prepared by the Nicholas Institute for Environmental Policy Solutions, Duke University, September 2007.

similar conclusions. If these studies are accurate, then it may be impossible to reach the specified short-term targets without disproportionately impacting US manufacturers.

A better approach is to develop targets and timelines based around the development and deployment of enabling technologies and actions to increase supplies of natural gas. This is a realistic and achievable approach for reducing greenhouse gas emissions while enabling the industrial sector to remain economically competitive.

Allowance Allocation

Section 3901 in the bill would put industry on the same allowance schedule as the utility sector by distributing 20% of allowances to industry and utilities beginning in 2012 with decreases to zero by 2036. This is in contrast to the August outline, which suggested that globally competitive industries should get a full ration of allowances for the full length of the program. Free allowances should be made available to sectors that cannot easily pass through their regulatory costs, face stiff international competition, and are energy-intensive. These characteristics describe the US industrial sector much better than the power sector. The customer base and globally competitive nature of the industrial sector is fundamentally different from the customer base for the utility sector. The utility industry does not compete globally. A utility has an established base of customers, with limited competition that allows the utilities to pass any carbon costs onto the customer. Based on this difference, industry should not be on the same allocation schedule as the utility sector. Any industrial allocation schedule should be uniquely tailored to account for industry's global competition.

In order to keep the industrial sector economically competitive in the global market, the legislation should not transition the industrial sector to an allowance auction, certainly not at the same pace as the utility sector. An auction will result in inflated allowance prices that will hit the industrial sector especially hard and result in damaging economic consequences. Companies with domestic facilities will be forced to export jobs, invest in new facilities in other countries, and eventually transfer operations to other parts of the world where carbon regulations will not affect their bottom line.

Offsets

Offsets can be a valuable tool in helping to control the costs of the program while achieving adequate reductions. The bill should greatly expand: (a) the scope of qualifying offsets; and (b) the amount of emissions that can be satisfied with offsets. Section 2402 in the bill would require that offset projects represent real, verifiable, additional, permanent and enforceable reductions in greenhouse gas emissions. This is a rigorous standard to evaluate offsets and is sufficient to ensure reductions. The bill as written needlessly restricts the use of a broad range of domestic and international offsets beyond agriculture, forestry, and other land-use related projects. The bill also needlessly restricts the use of offsets to 15% of a facility's emissions. The standard that the drafters incorporated for reviewing offsets would result in actual emissions reductions. Since the

bill's overall goal is to reduce emissions, the offset program should not limit the number of emissions that can be satisfied with offsets.

Fuel Switching

The aggressive targets and timelines required in the legislation would cause fuel switching from coal to natural gas. The EIA analysis of S. 280, the Lieberman-McCain climate bill introduced early this year discounts the coal-to-natural gas fuel switching scenario. Instead, using the National Energy Modeling System (NEMS), EIA assumes that emissions reductions will be achieved by building 145 GW of new nuclear generating capacity and 110 GW of new biomass capacity by 2030. We have reviewed a number of other economic analyses of how energy markets would respond to new constraints on GHG emissions, and no one else believes that nuclear and biomass will make such large contributions to the nation's energy portfolio over this time period. Rather, most believe that the legislation's 2012 target to cap emissions at 2005 levels is so aggressive that utilities would have no realistic choice other than to switch their generating capacity to use as much lower-carbon emitting natural gas as possible. This added demand to natural gas will result in higher prices to the industrial sector, making it more difficult to compete in a global market and American consumers will experience higher electricity and home heating costs. Higher energy and feedstock costs can be moderated. Policymakers should take measures to increase supplies of natural gas. Energy supply and climate policies must be developed in tandem.

The Role of State Programs

The legislation does not preempt states from enacting GHG reduction programs that are more stringent than this legislation's program. To the contrary, the legislation sends a strong signal to the states to quickly adopt more stringent emissions programs by giving them additional free allocations. American companies with facilities in multiple states will be faced with an administrative burden of complying with multiple programs, and possibly purchasing both state and federal allowances for the same ton of emissions. Encouraging state-by-state regulatory programs presents regulated parties with a great deal of regulatory uncertainty, making strategic planning and capital investment decisions far more difficult.

Traditionally, Congress does not preempt more stringent state environmental laws where there are local impacts. This recognizes that the citizens of one state may desire a more stringent standard than the citizens of another state, and, importantly, that they can achieve the more stringent standard by controlling actions within that state. However, unlike the pollutants presently regulated under the Clean Air Act which have local and regional impacts, greenhouse gas emissions do not respect state or national boundaries. A more effective climate policy is a national program with a single set of rules.

Allowance trading

Section 2101 would allow anyone to buy, hold, sell, trade or retire allowances. This arrangement could cause carbon dioxide allowances to quickly become the most heavily traded commodity in the world, resulting in a highly volatile market, with "considerable monetary value, perhaps \$100 billion or more annually."² The way the provision is currently structured, it creates the potential for market speculation, manipulation, volatility and high prices. These market conditions would put the industrial sector at a competitive disadvantage in the global marketplace. Commodity traders would likely be the big winners. The result of this provision is higher allowance prices, which ultimately would be passed on to the American consumer in the form of higher electricity and heating costs.

A thorough oversight program or board needs to be established to provide oversight of the market and to institute rules as may be required to maintain the integrity, openness, and effectiveness of the markets and minimize price volatility while allowing the most effective program to proceed. This is a very long term issue with major economic implications and potentially massive wealth transfers; programs managing the market need to be appropriately robust. We urge Congress to carefully consider how non-emitters would and should interact with the carbon market in general and the auction process in particular, especially during the price discovery phase of the markets development.

Point of regulation

The substitute bill, which was introduced the day of mark-up, contains a new upstream point of regulation for natural gas. In crafting this new point of regulation, the drafters have retained the downstream approach included in the bill as it was originally introduced. The effect is that the bill in its current form would regulate natural gas, both upstream at the point of sale or import, and downstream at the point of emissions. This approach is unfair to the industrial sector and must be corrected. Regulating fossil fuel emissions downstream targets carbon intensive sectors of the US economy.

A better alternative is to regulate hydrocarbons at the point of production or import. Regulating upstream would expand coverage to a greater amount of emissions and would lower the transaction costs of the program because one would reduce the number of entities having to adhere to a cap. This is how the bill regulates transportation fuels. Regulating upstream at the point of production or import would spread the carbon costs associated with natural gas to a broader portion of the US economy. This approach would assist domestic industries in their quest to compete in a global market.

Any bill that includes an upstream point of regulation must include a feedstock exemption. Industry uses fossil fuels such as natural gas as raw materials or feedstocks for its products. In fact, the chemical industry uses hydrocarbon feedstocks to make energy-saving products that reduce GHG emissions, e.g., building insulation. These

² Resources for the Future, September 2007: *Background: Allowance Allocation* [Raymond J. Kopp].
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feedstocks are not combusted and therefore do not release greenhouse gases. A feed stock exemption is needed to avoid regulating a fossil fuel that will not result in carbon emissions. In 2005, the US chemical industry spent more than \$63 billion on energy inputs – two-thirds of that total was spent on feedstock purchases. A feedstock exemption is a vital feature of any legislation that regulates natural gas at the point of production or import.

Scope of Coverage

The bill would cover "any facility that in any year produces, or any entity that in any year produces, non-fuel chemicals that will emit more than 10,000 CO₂ equivalents of GHG, assuming no capture and destruction or permanent sequestration of the gas." It appears that the term 'non-fuel chemicals' is intended to cover some of the non-CO₂ Kyoto gases. If so, the bill should make this clear. As currently written, section 1202 could be interpreted to require manufacturers to submit allowances to cover possible future emissions of CO₂ resulting from combustion of any product throughout the value chain containing any organic chemical.

Enabling Technologies

ACC also evaluates climate legislation on its dedication to research, development, and deployment of enabling technologies. While we applaud the bill's dedication to enabling carbon capture and sequestration, it is difficult to determine the exact funding that would be applied to this technology. The legislation would require that as much as 40% of the Climate Change Credit Corporation auction funds would be used for developing CO₂ capture from electric generation from coal and sequestration of CO₂. The Electric Power Research Institute (EPRI) estimates that \$17 billion is needed over the next 25 years in order to undertake the necessary RD&D that would avoid a \$1 trillion reduction in economic growth by 2050 with additional funds needed for deployment of CCS. Due to the uncertainty in allowance price, it is not known what quantity of funding would result from 40% of the auction funds. For this reason, it is difficult to determine whether the legislation is sufficiently enabling CCS technology development.

This provision should not be limited to electric generation units. Industrial facilities are also capable of capturing and storing carbon emissions and should be eligible for this program. Industrial facilities that compete in a global market must be included in a technology program that could help reduce emissions costs.

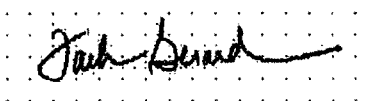
Linkage to International Emitters

The legislation is insufficiently linked to large international emitters. After approximately 8 years, the legislation could require importers of GHG-intensive manufactured products to submit allowances of a value equivalent to the allowances in the US system if those exporting countries were not acting to reduce emissions. This

provision is insufficient because American industry needs to produce globally competitive products at the onset of any carbon regulating program. To "level the playing field", Congress should carefully consider requiring importers of GHG-intensive manufactured products to submit allowances from the beginning of the program.

American chemistry wants to support a national climate policy that protects the environment and protects the economy. We believe that the energy efficient materials that we make are a vital component of climate protection solutions. We have and continue to do our part to reduce our own GHG footprint. Due to the bill's potential impact on energy markets, the economy, our ability to compete in global markets, the uncertainty associated with dedication to enabling technologies and the weak links to actions by other high-emitting nations, we believe modifications to the provisions in this legislation are required. We hope to continue working with the committee to develop effective and workable climate policies and thank the bill's authors for advancing this important debate.

Sincerely,

A handwritten signature in black ink, appearing to read "Jack Gerard", is written over a rectangular grid of small dots.

Jack N. Gerard
President and CEO

Cc: Members of the Senate Committee on Environment and Public Works



The Fertilizer Institute

Nourish, Replenish, Grow

S. 2191, the Lieberman/Warner Climate Security Act

Would cause:

- 1) Closure of remaining U.S. fertilizer production facilities;
- 2) Dramatically higher fertilizer costs for U.S. farmers;
- 3) U.S. farmers to be even more dependent on fertilizer products from overseas sources.

Fertilizer is the 'food' that plants need to produce a healthy and bountiful crop. Experts estimate that without commercial fertilizers, the world would be without one-third of its food supply.

U.S. Farmers Already Paying Record High Fertilizer Prices

Testifying before the U.S. House of Representatives Agriculture Committee on Oct. 18, U.S. Department of Agriculture Chief Economist Dr. Keith Collins stated "*prices of natural gas, the major component of nitrogen, rose more in the United States than in other key regions causing a shift in both ammonia and urea nitrogen production to overseas suppliers. Nitrogen imports now account for more than 50 percent of available U.S. supplies, compared with only 21 percent of available supplies in 1996/97.*

Nutrient demand by U.S. and foreign farmers is expected to remain strong over the next several years reflecting high global commodity prices and expanding crop production. Thus fertilizer prices, and nitrogen in particular, are expected to remain at or near record-high levels. For the past 3 years, farmers have paid record prices for fertilizer materials."

S. 2191 Would Cripple the Already Struggling U.S. Fertilizer Industry

America's Climate Security Act, S. 2191 presents a grave threat to the domestic fertilizer industry. First, the Act would cause a dramatic increase in the price of natural gas, as users of coal and oil rush to shift away from those fuels in order to reduce their greenhouse gas emissions. Second, the Act would require fertilizer manufacturers, retailers that mix and blend products and fertilizer importers to purchase a huge number of emissions allowances, sufficient to cover not just the emissions from their own facilities, but also the emissions that release from farmers' fields when the fertilizers are eventually used. The total cost of these two impacts could cripple what remains of the U.S. fertilizer industry and would lead to significantly higher fertilizer prices for U.S. farmers.

Natural Gas Prices

Unlike virtually all other industries addressed in S. 2191, nitrogen fertilizer manufacturers do not utilize gas as a fossil fuel used to produce steam or heat for their industrial processes. Rather, they use the vast majority of their natural gas as a chemical feedstock, taking hydrogen from the methane molecule and reacting it with nitrogen from the atmosphere to produce ammonia (NH₃).

Because natural gas serves as the basic chemical feedstock in their production process, it comprises the largest single component of their production costs. When gas prices reach the \$7 per MMBtu level, natural gas costs can represent over 90 percent of the total cost of production of ammonia. This means that nitrogen fertilizer manufacturers not only use natural gas in a unique way (as compared to other industries), but that they have a unique interest in its cost.

Because ammonia is a commodity product that is traded in the world market, domestic fertilizer manufacturers cannot simply “pass-along” the cost increases that result from rising gas prices. Instead, as domestic natural gas prices rise, imported ammonia from countries with lower natural gas prices (Russia, Trinidad, Saudi Arabia) has begun to displace domestic production. This development has accelerated dramatically in recent years. There were 58 domestic ammonia plants in 1998, but there are a total of only 33 today – and four of these are temporarily idle due to their inability to compete with foreign producers who have access to dramatically cheaper natural gas. Meanwhile, the volume of imports has continued to grow – increasing by 80 percent in just the past five years – and today more than half of the nation’s nitrogen supplies are imported.

During calendar year 2005, the domestic nitrogen fertilizer industry spent \$246 on natural gas for each ton of ammonia produced – or a total of \$2.75 billion for the 11.181 million short tons of ammonia produced in that year. If natural gas prices were to increase by 25 percent – as they are widely expected to do under the proposed legislation – then the total natural gas cost to the industry would increase from \$2.75 billion to \$3.44 billion, an annual increase of \$688 million. Because domestic manufacturers could not hope to pass along this increase, U.S. farmers would be forced to buy even more of their fertilizer products from overseas sources - driving up U.S. and world fertilizer prices and jeopardizing domestic fertilizer availability in the future.

Emission Allowances

In addition to its impact on natural gas prices, S. 2191 would also impose a number of direct requirements on U.S. fertilizer producers, retailers that mix and blend products and fertilizer importers. Domestic manufacturers would need to submit allowances covering *both* the emissions from their own facilities *and* the emissions from any “nonfuel chemical” they either produce or import at the facility.

If this is the case, fertilizer manufacturers would be forced to purchase an *extraordinary* number of allowances. Producing a ton of ammonia generates approximately 0.66 of a ton of greenhouse gas, but when the farmer later uses that ton of ammonia to fertilize and grow his crops, approximately 2.46 tons of greenhouse gas eventually will leave the farmer’s fields. The bill would make the fertilizer manufacturer responsible for these “emissions” – in addition to the 0.66 of a ton from their own facilities. The legislation would require him to buy allowances for 3.32 tons of emissions for each ton of ammonia produced.

A similar situation applies in the case of urea. The production of ammonia is a necessary first step in producing urea. Producing a ton of urea generates (we need to account for the ammonia production too) .18 of a ton of additional greenhouse gas, but the farmer’s field eventually will release 2.62 tons of greenhouse gas for each ton that the farmer chooses to apply. If the fertilizer

manufacturer becomes responsible for these “emissions,” he will need to purchase allowances for 2.80 tons of emissions for each ton of urea produced.

If S. 2191 were to become law, much of our nation’s coal fired power generation would switch from coal as a fuel to natural gas, increasing natural gas demand and prices – as much as 25 percent or more. A 25 percent increase in the price of natural gas increases the cost of nitrogen fertilizer production by over \$60 a ton.

Additionally, it is difficult to know the price that an emission allowance will carry in the year 2012. Some say \$5 per ton, others say \$12 per ton, others say more. But regardless of where the price eventually lands, it is clear that domestic manufacturers, retailers and importers are being asked to bear an extraordinary burden. The entire invoice of additional costs for the agricultural sector is being laid at their doorstep.

Assuming the price of an allowance is \$5 per ton (a conservative assumption); each ton of ammonia would carry an allowance “tax” of \$16.60 ($\5×3.32). The total tax for the 11.181 million tons produced by the domestic industry would come to \$185.6 million per year. In addition, the domestic industry would owe an additional \$81.2 million per year in allowance fees for the 5.8 million tons of urea produced each year ($\$5 \times 2.80 \times 5.8$ million).

The industry would also bear significant costs on nitrogen fertilizer imports. The 8.4 million tons of ammonia imported into the U.S. annually would be imposed a cost of \$139.4 million. In addition, the 6.3 million tons of urea would be made to pay \$88.2 million. Therefore, a conservative estimate of the total cost of the legislation to domestically produced and imported ammonia and urea, on which U.S. farmers are highly dependent, comes to a staggering \$494 million.

When combined with the likely increase in natural gas prices, these costs to our industry would be well in excess of \$1 billion annually and are simply more than the U.S. fertilizer industry can bear. When domestic fertilizer manufacturers close their doors, the issue goes beyond the job losses and community hardships that are associated with all factory closures. In addition to these very serious problems, the nation *also* would need to increase its dependence on foreign fertilizer imports, much of that product will come from countries with unstable governments with all of the risks that this dependence entails. A disruption would endanger both the U.S. domestic food supply and the entire agricultural sector. This, of course, is the one sector that the U.S. needs to protect, with products that are far more essential than those of any other.

The Fertilizer Institute (TFI) strongly opposes S. 2191, the Lieberman/Warner Climate Security Act and similar legislation that would result in the closure of domestic fertilizer manufacturing facilities, higher fertilizer prices for U.S. farmers, an increase in imports of fertilizer products from overseas by imposing a federal mandatory greenhouse gas cap-and-trade system enforced by the Environmental Protection Agency.

International Brotherhood of
BOILERMAKERS • IRON SHIP BUILDERS

BRIDGET F. MARTIN
 ASSISTANT TO THE INTERNATIONAL PRESIDENT
 DIRECTOR OF GOVERNMENT AFFAIRS



BLACKSMITHS • FORGERS & HELPERS

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November 12, 2007

Hon. Barbara Boxer, Chair
 Committee on Environment and Public Works
 United States Senate
 Washington, DC 20510

Hon. James Inhofe, Ranking Member
 Committee on Environment and Public Works
 United States Senate
 Washington, DC 20510

Dear Senator Boxer and Senator Inhofe:

The International Brotherhood of Boilermakers, Iron Ship Builders, Blacksmiths, Forgers and Helpers is committed to working constructively with you toward the adoption of federal legislation to cap greenhouse gas (GHG) emissions. We look forward to providing our nation with the skilled workforce necessary to deploy the technology necessary to reduce emissions linked to global warming. However, we maintain some concern regarding S. 2191, America's Climate Security Act.

We appreciate that S. 2191 incorporates some provisions of the S. 1766, legislation introduced by Senators Bingaman and Specter, and endorsed by our union. We strongly support provisions to provide bonus emission allowances for reductions achieved through carbon capture and sequestration (CCS). The inclusion of bonus allowances will provide the economic incentives necessary for private investment to develop technology for responsible use of our nation's abundant coal resources. In addition, the ASCA makes significant investment in the development and deployment of job-creating technology, including zero or low-carbon energy technology, advanced coal and sequestration technology, and cellulosic biomass ethanol.

We appreciate that Senators Warner and Lieberman have recognized the need to provide a just transition for those who might suffer job dislocations as a result of this legislation and included an assistance program for workers, including job training, temporary wage coverage, and health care assistance. However, we hope the Committee will consider our suggestions to avoid the significant worker displacement and job loss that could result from some of the approaches currently proposed.

The inclusion of international provisions is an import step forward to engage the developing world in seeking a solution to global warming and ensure that responsible action by the United States does not threaten our economic competitiveness. Modest modifications to the timeline and implementation process will strengthen this section.

However, other provisions of ACSA could have a negative impact on our members and a chilling effect on necessary investments in our nation's energy infrastructure. We have significant concern regarding an overly aggressive Phase I emission reduction target, now increased to a nearly 20% reduction below 2005 levels by 2020, before the anticipated commercial availability of carbon capture and storage technologies. Such an approach will result in widespread fuel switching for power generation from affordable and abundant coal resources to more expensive natural gas.

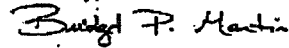
We are also concerned about the potential cost of carbon allowances and the impact on our economy should the technology necessary for reducing emissions not develop fast enough, or within the timeframes required to meet legislative targets. Therefore, we are disappointed the ACSA does not include a "safety valve" provision. The economic impact on workers could be seriously detrimental should the development of carbon capture and sequestration technology lag behind mandated reduction levels and targeted dates, driving up the cost of compliance – costs that will ultimately be borne by consumers.

Inclusion of an allowance price "safety-valve" would ensure the maximum costs of the program are known in advance, and provides the long-term certainty needed for the capital investments that will result in cleaner, more efficient energy production. Ultimately, we must recognize that the technology necessary for carbon emissions reductions – particularly in the utility sector – on the scale recognized as necessary to mitigate the worst effects of climate change are not yet commercially available. We are hopeful those technologies will develop quickly, and we look forward to providing the highly skilled workers that will be needed for widespread deployment. However, we believe the policy framework for reducing carbon emissions should provide the flexibility necessary to avoid the worst consequences for workers and consumers.

We also believe that provisions must be included to ensure that investments resulting from the allocation of free allowances promote *domestic* investment and job creation. Similarly, proceeds from the allowance auction that result in energy infrastructure development, adaptation activities, and natural resource protection must be tied to basic labor standards and protections, consistent with a vision of the future that values both environmental protection and good jobs for American workers.

Thank you for your consideration of our views on this important matter.

Sincerely,



Bridget P. Martin
Assistant to the International President
Director of Government Affairs

cc: Senator Joseph Lieberman
Senator John Warner



November 15, 2007

The Honorable Barbara Boxer, Chairman
 The Honorable Jim Inhofe, Ranking Member
 Environment and Public Works Committee
 The United States Senate
 Washington, DC 20510

Dear Chairman Boxer and Ranking Member Inhofe,

I am writing to express the views of the International Emissions Trading Association (IETA) on an issue of great importance to our members: cost control in the design of a greenhouse gas reduction program.

IETA's 175 member companies include some of America's and the world's largest industrial and financial corporations, including global leaders in oil, electricity, cement, aluminum, chemical, paper, and banking; as well as leading firms in data verification and certification, brokering and trading, legal, and consulting industries. IETA member companies represent emissions greater than the carbon emissions from Germany and the UK combined. IETA and its member companies are committed to reducing greenhouse gas emissions in a way that maximizes climate protection at the lowest possible cost.

Controlling costs is important not just to IETA member companies, but to all Americans. Americans care deeply about their environment and their climate, and want to take strong actions to protect it. At the same time, however, Americans are concerned about their pocketbooks, their electricity bills, and the price of gasoline, and do not want to pay more than necessary to protect the climate. For both Americans and IETA member companies, controlling costs while protecting the climate is critical.

Lieberman-Warner is an important step, but improvements are necessary

IETA would like to thank you, in addition to Senators Lieberman and Warner, for your leadership in working to develop a cap-and-trade approach to addressing climate change. America's Climate Security Act includes many provisions that would help to create a market capable of maximizing climate benefits. It would create a national cap-and-trade system covering a large portion of national emissions and allowing for domestic trading. This structure would provide incentives for both consumers and industry to take actions that will reduce emissions and achieve a degree of cost control. We support the provisions that authorize regulated firms to purchase emission reductions or offsets from sectors outside the cap, and allowances from other nations, for a portion of their compliance obligations.

MARKET SOLUTIONS FOR GLOBAL ENVIRONMENTAL PROBLEMS

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Nevertheless, IETA believes that the legislation needs to be improved. This letter addresses an issue of critical importance to IETA in any climate program: cost control.

Robust markets, international linkage, and offsets are the most effective means of controlling cost

Fundamentally, IETA believes that a robust domestic emissions trading market, with strong links to international markets and ready access to offsets across broad geographic boundaries, is the most effective method to protect the climate while controlling costs.

America's Climate Security Act limits regulated firms use of domestic offsets for compliance with emissions targets to 15% of required allowances while prohibiting the use of offsets created outside of the US. Experience gained by our members in these markets, and the research that has been undertaken for many years, demonstrates that quantitative and qualitative limits imposed on the use of offsets for compliance will significantly increase program costs. Offsets can play an important role in a climate protection program and provide significant benefits. They stimulate investment in environmentally beneficial activities in sectors outside the emissions cap that would not occur in the absence of a financial incentive, and allow regulated firms to hedge existing assets and maintain them until the end of their useful lives. In addition, the use of offsets, particularly in the early years of a climate control program, enables the development of key technologies that will be required to achieve the more stringent reductions that will be required during the 21st century to stabilize the climate system. While IETA strongly supports a rigorous approval process ensuring the environmental integrity of the activities creating the offsets, we believe limits imposed on the use of domestic and international offsets for compliance should be eliminated from the legislation.

The legislation includes a provision requiring that 2.5% of the allowances be allocated to international forest protection. IETA notes that this provision is neither an offset nor a cost-control provision. Offsets tap the power of the market to protect the environment while reducing costs. The Lieberman-Warner provision, in contrast, would decrease flexibility and drive up costs to American consumers and households, and at the same time is limited in its ability to protect international forests. We recommend you convert this provision to an offset program that would give American businesses an incentive to protect international forests while at the same time reducing costs to American consumers and households.

IETA also encourages you to include provisions in the legislation that provide stronger mechanisms for the US to link with international markets. Larger markets are inherently more efficient, liquid, and competitive. As such they will achieve levels of climate protection at the lowest cost. We recommend the 15% restriction on international allowances for compliance be eliminated.

In addition, in order to best achieve the powerful benefits that result from markets, the market design should avoid mechanisms seeking to directly manage the price of carbon. Caution should also be exercised with respect to provisions seeking to manage the



associated supply and demand of allowances with a view to indirectly managing the price. While IETA does not necessarily oppose all such provisions, if done improperly, such measures increase the risk for new investments and risk undercutting the value of a market-based program.

Finally, IETA notes that one of the most significant issues with respect to cost is the issue of allocation. While experience in other jurisdictions has clearly demonstrated that no single mechanism--auctioning, benchmarking, or grandfathering--can produce universally satisfactory results, IETA believes the initial high level of auctioning in Lieberman-Warner, in combination with the allocation to non-emitters, is cause for concern. We would suggest that a more gradual approach be utilized, with a careful consideration both of means of minimizing consumer costs and of the capacity of covered entities to recover allowance costs.

Opportunity for global leadership

The world is moving towards the creation of a global carbon market. Several regions and countries have either developed or are in the process of developing carbon markets and linking these to broader markets to achieve their goal of protecting the climate. More than 175 countries have participated in the development of a means for trading carbon offset credits, through the Clean Development Mechanism. In October of this year, California, along with the other member states of the Western Climate Initiative and the Regional Greenhouse Gas Initiative, joined the International Carbon Action Partnership, an intergovernmental alliance dedicated to linking regional carbon markets to help mobilize capital for the necessary transition to a global low-carbon economy.

Ultimately, protecting the climate is a global responsibility that will require a global solution. The Senate Environment and Public Works Committee has a unique opportunity to provide international leadership and reduce the risk to America's security by developing legislation that includes mechanisms that will move the world closer to addressing climate change through powerful market mechanisms. If the United States does not engage countries seeking to use offsets to reduce greenhouse gas emissions, either other countries will step in to provide this leadership and reap the economic benefits of an active offset sector, or an important opportunity to begin the process of mitigating climate change will be lost. IETA stands ready to work with you and all the members of the committee to develop the market-based solutions that are necessary to protect the climate at the lowest possible cost.

Yours truly,

Andrei Marcu
President and CEO
International Emissions Trading Association

**Testimony of
John D. Porcari, Secretary
Maryland Department of Transportation**

**Submitted to the
U.S. Senate Environment and Public Works Committee
Legislative Hearing on America's Climate Security Act of 2007, S. 2191
Thursday November 15, 2007**

Chairwoman Boxer, Ranking Member Inhofe, and members of the Committee, I respectfully submit the following comments on the important subject of climate security and transportation. Maryland's Governor, Martin O'Malley, wants to bring balance to our transportation program with a renewed emphasis on transit, and we are moving aggressively to deliver a system that is effective and environmentally responsive. Although we are taking steps to deal with increasing capacity and congestion along the Baltimore/Washington corridor in order to reduce our state's contribution to emissions, significant action to address climate change must also happen at the federal level.

In September, Governor O'Malley testified before your Committee on the need for more aggressive leadership from Washington and the steps the State is taking to lessen the impacts of climate change. Governor O'Malley has backed up his words with actions. He fought for, and signed into law, a Clean Car bill during his first legislative session; spearheaded efforts to improve the Chesapeake Bay, stop sprawl and support renewable energy; and earlier this year, he created a Commission on Climate Change.

In addition, Maryland has joined the Regional Greenhouse Gas Initiative (RGGI). The RGGI is a coalition of Northeast and Mid-Atlantic States that developed a multi-state cap-and-trade program covering greenhouse gas (GHG) emissions. The program is initially aimed at the reduction carbon dioxide emissions from power plants in participating states but could expand to consider other kinds of sources, like transportation. As a result of the Governor's leadership, the Maryland Department of Transportation (MDOT) is making transportation decisions with the environment and climate change in mind.

As Secretary of Transportation, not a day goes by that I am not faced with issues stemming from the environmental impact of our congestion issues. It is no secret that transportation is a major factor affecting climate change. In the Baltimore/Washington region, Vehicle Miles Traveled (VMT) have increased 135 percent since 1982, while new lane miles on roads have increased only 35 percent. In 2003, peak hour commuters wasted over 130 million gallons of gas sitting in traffic.

In the past, like many states, Maryland's transportation decisions were focused on roads. But as we seek additional transportation capacity, we know our vision must encompass a modally diverse transportation system capable of moving greater numbers of people while reducing transportation's impact on the environment.

This is particularly critical in Smart Growth areas like the Baltimore/Washington corridor, where one of our key transit assets is our MARC commuter rail system. It is efficient, popular, and at full capacity. We have developed a growth and investment plan with the goal of tripling MARC capacity by 2035. We also have a strong Transit Oriented Development program underway at several of our major transit hubs. These mixed-use development projects are aimed at increasing transit ridership, creating walkable communities and reducing the dependence on cars, resulting in better land use.

These are only a few of the examples of what Maryland is doing at the local level. In addition, we are looking at expanding our commuter bus system; carpool, vanpool and telework programs; implementing Express Toll Lanes (ETL); and providing additional transit rail and bus services in the region.

States depend on the transportation funding partnership with the federal government. Apportioned funds come with varying degrees of flexibility in how states may spend them. A more effective shifting of funds toward transit investments in this country can happen if Congress would change the way the federal dollars are allocated. For example, in Maryland, we have a Transportation Trust Fund (TTF) structure that contains all transportation-generated revenues in single fund. This TTF is used to support the issuance of a consolidated bonded indebtedness which allows Maryland to make multi-modal transportation funding decisions based on need, not solely on mode. Maryland looks first to create a balanced system which promotes mobility, consistent with our commitment to environmental stewardship. Unfortunately, lack of flexibility in federal funding makes it difficult to carry out the most effective and efficient local project decision-making and service delivery. We need a new Federal-State partnership that promotes greater programmatic flexibility in how states are allowed to administer funds.

MDOT supports congestion relief initiatives as an important part of a cleaner environmental future. Give us the tools to manage our emissions, such as cap-and-trade programs, and the flexibility decide the best way to utilize federal formula dollars. Continue to fund and expand programs for transit and intercity passenger rail, and encourage the development and use of new technologies to increase the efficiency of our roads and the scope of our transit systems.

We must have change in our federal policies if we are to deal effectively with transportation's impact on climate change. You can catalyze that change with federal money for reducing congestion, research and development of cleaner fuels, and improved vehicle technology. I applaud this Committee's desire to address this issue, and look forward to working with you.

TESTIMONY OF

**PAUL WILKINSON
VICE PRESIDENT, POLICY ANALYSIS
AMERICAN GAS ASSOCIATION**

**ON BEHALF OF
THE AMERICAN GAS ASSOCIATION**

**BEFORE THE
ENVIRONMENT AND PUBLIC WORKS COMMITTEE
UNITED STATES SENATE**

**POTENTIAL IMPACT OF S. 2191 ON NATURAL GAS UTILITIES AND
THEIR CUSTOMERS**

NOVEMBER 15, 2007

**American Gas Association
400 N. Capitol Street, NW
Washington, DC 20001**

This testimony is available on the AGA website. www.aga.org

Paul Wilkinson
American Gas Association
11/16/07

Executive Summary

- S. 2191 will dramatically increase the cost of natural gas to consumers due to the cost of emission allowances and because the demand for natural gas will increase. Electricity generators will shift to natural gas because most other carbon reduction options will not be available at the outset of the program.
- Under the proposed legislation, homes, small retail establishments, schools and hospitals will have to compete with electricity generators and factories to purchase emission allowances.
- There are no fuel substitution options or appliance efficiency options for small volume natural gas consumers that would allow them to meet the requirements of S. 2191. The legislation imposes a cost on consumers who have no alternative means to reduce emissions.
- Natural gas provides for the essential human needs only of small volume consumers – heat, hot water, cooking and clothes drying.
- The total greenhouse gas emissions from residential natural gas consumers have declined since the 1970's, even though the number of residential consumers served with natural gas has increased by 50 percent; from 40 million homes to 60 million.
- Natural gas homes have become more efficient. The average natural gas use per home has declined by 31 percent since 1980. These homes can continue to reduce emission gradually by tighter standards, but cannot reduce emissions by an additional 70 percent.
- Over one-third of all residential natural gas consumers are served under decoupled rate structures which allow for efficiency and conservation promotion by local gas utilities. Similar rate proceedings are underway in several states.
- Natural gas can, and should, provide greenhouse gas benefits now while other technologies are being developed. Public policy should steer consumers to the direct use of natural gas, rather than increase its cost.

Paul Wilkinson
American Gas Association
11/16/07

Introduction

The American Gas Association, founded in 1918, represents 200 local energy utility companies that deliver natural gas to more than 64 million homes and businesses throughout the United States. A total of 69 million residential, commercial and industrial customers receive natural gas in the US, and AGA's members' deliver 92 percent of all natural gas provided by the nation's natural gas utilities.

We believe that the low greenhouse gas emissions of natural gas relative to other fuels, combined with the efficiency of the natural gas system and the appliances that use natural gas, make it an extremely valuable energy source for reaching national environmental goals, particularly as we await the commercialization of other low-carbon or no-carbon options. We do not believe, however, that the inclusion of small volume natural gas consumers in a cap and trade program as suggested in the most recent version of S. 2191 will aid in meeting our climate change objectives. In fact, we believe this inclusion will increase the complexity and uncertainty of the program, and it may, in fact, be counter-productive to our climate change objectives. Natural gas utilities are committed to assisting their customers in continuing their trend of reducing greenhouse gas emissions. Including them in the cap and trade program will not alter this commitment or enhance the ultimate environmental outcome.

Statement

Natural gas is used to meet the essential human needs of small volume consumers. The majority of the homes in this country use natural gas, and in the residential sector 98 percent of all gas is used for space heating, water heating and cooking, while the remaining 2 percent is used for clothes drying and other purposes. It is not used for the plasma televisions, video games, cell phones and other battery operated devices that account for about one-third of the residential electricity market. It is not good public policy to put the health and safety of these people at risk by subjecting them to an uncertain and unproven allowance market. This is especially true given that small volume natural gas consumers account for only about 8 percent of overall U.S. greenhouse gas emissions, and emissions from these consumers have been steadily declining for several decades.

The combination of tighter homes, more efficient appliances and various conservation measures has resulted in a dramatic increase in the efficiency of small volume natural gas customer consumption for more than three decades. **In fact, greenhouse gas emissions from the residential use of natural gas from 2000 through 2006 are below 1970's levels, despite the fact that the number of natural gas households increased from 40 million to over 60 million in that timeframe.**

A portion of the success realized in terms of small volume customer efficiency gains is attributable to the aggressive promotion of conservation and efficiency by local natural gas utilities. A strong movement towards decoupled rates has enhanced this promotion. Natural gas

Paul Wilkinson
American Gas Association
11/16/07

utilities make no profit on higher gas prices – they are fundamentally a delivery service that traditionally profited by moving more natural gas through their system. Decoupled rates essentially make the utility indifferent to the volume of gas delivered and they therefore allow the utility to be a stronger proponent of conservation and efficiency. Nearly 40 percent of all residential natural gas consumers are served by gas utilities that have decoupled rates or that are engaged in state proceedings that are considering decoupled rates. There was almost no decoupling prior to 2002.

As noted above, small volume natural gas consumers are effectively reducing their greenhouse gas emissions. Placing them under a cap as suggested in the most recent version of S. 2191 would place a burden on these consumers not faced by consumers served by other less efficient and higher emitting energy forms. For example, home heating oil, the majority of which is imported and which emits about 30 percent more CO₂ per MMBtu than does natural gas, is not covered under the proposed legislation. Further, natural gas consumers unlike electricity consumers, cannot meet the ultimate 70 percent reduction target by substituting energy sources. That is, there are low-carbon or no-carbon generating options available today or in the foreseeable future for electricity customers. **Natural gas is clean and efficient, and there is no substitute fuel available for natural gas to meet the reduction requirements of S. 2191.** Also, natural gas appliances are already very efficient and there are not, in most cases, technologies available or under consideration that would be able to meet the reductions being considered. For example, natural gas heating equipment being sold today is commonly in the range of 82 percent to 94 percent efficient. Improving the efficiency of these units cannot meet the reduction mandates of S. 2191.

Changing the fuel input or the equipment efficiency is not a viable option for small volume natural gas consumers to meet the proposed reduction targets. Thus, allowances would have to be purchased in the market to cover the shortfall. **It is not good public policy to set up a system where residences, schools, hospitals and small retail establishments would compete in an allowance market with industrial facilities and electricity generators in order to have the fuel necessary for heat, hot water and cooking.** Although this competition for allowances would likely be through some agent for the small volume consumers, the effect is the same. The allowance market will be tight, competitive and expensive, and the needs of small volume natural gas consumers would have to be fulfilled in that market. Particularly over the next 10 to 20 years, when technologies for low carbon electricity generation are expected to be limited, it is unwise to increase the number of players in the allowance market.

An argument for including small volume natural gas consumers under the cap of S. 2191 is that everyone should contribute to reducing greenhouse gas emissions and everyone should share in the pain of the reduction effort. **It is a gross oversimplification and incorrect to assume that if small volume natural gas consumers are not subject to a cap they will not be affected by this legislation.** We are convinced that natural gas will be a primary compliance

Paul Wilkinson
 American Gas Association
 11/16/07

tool for electricity generators to meet their reduction targets, particularly over the next 10 to 20 years as coal with carbon capture and storage, nuclear, solar and wind and other control technologies are being developed and deployed. As a result, natural gas prices to all customers will go up – probably significantly. This expected increase in price should be viewed in the context of a natural gas market that has gone from \$2.00 per MMBtu in the 1980's and 1990's to \$6.00 to \$8.00 per MMBtu today (and, at times, more).

Multiple surveys of electric company CEOs and a study prepared for the Natural Gas Council (*Greenhouse Gas Initiatives Analysis Using the National Energy Modeling System*, prepared by SAIC for the Natural Gas Council, Oct. 2007) agree that natural gas will be a principal means of compliance for electricity generators in the near term. For example, the NGC study, using the NEMS model of the Energy Information Administration (EIA), found that by reducing EIA's projected construction of new nuclear facilities from 145 plants to a more reasonable 25 plants (by 2030) projected natural gas demand increased by 3.6 trillion cubic feet per year from 2020-2029 – equal to roughly 16 percent of current annual consumption. Increasing natural gas demand by 16 percent, especially when most potential natural gas supplies remain severely constrained, would cause dramatically higher prices for all natural gas consumers in an already tight and high-priced market.

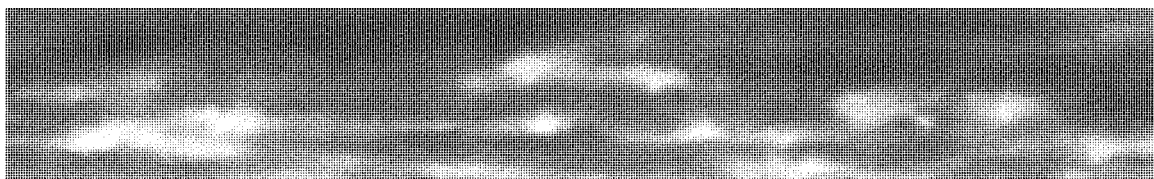
In addition to higher natural gas prices, small volume natural gas consumers will also be affected by climate change legislation due to inevitable higher prices for electricity and gasoline. It should be noted that roughly 60 percent of residential electricity is used for purposes common to all customers – lighting, refrigeration, televisions, computers, and similar devices. All electricity customers, regardless of the energy source used to heat their home, heat their water and cook their food, will share in the cost of reducing emissions from electricity generators. Additionally, small volume natural gas consumers will be affected by the tighter building codes and standards of S. 2191 as well as higher appliance efficiency standards.

Rather than discourage the use of natural gas by small volume consumers, as we believe S. 2191 does, effective climate change legislation should promote the use of gas in residential and commercial applications where it is most efficient and where greenhouse gas reduction benefits are most achievable. For example, converting residential water heaters from electricity to natural gas can often reduce greenhouse gas emissions by one-half to two-thirds. Such conversions not only reduce emissions, but they also reduce the need to build new generating plants for electricity. One of the most difficult issues in terms of reducing greenhouse gas emissions will be meeting a growing demand for electricity when options such as solar, wind, coal with carbon capture and nuclear power face severe constraints, particularly in the near- to mid-term. Natural gas can provide reduction benefits now, and there should be encouragement to do so.

Paul Wilkinson
American Gas Association
11/16/07

Conclusion

We strongly believe that the last minute revision of S. 2191 that inserted Section 1204 without discussion, debate or input from the millions who would be adversely affected was a mistake. Not only will the current version prevent natural gas from contributing to the program as it should, but it also puts nearly 70 million homes and small businesses at risk. We believe that small volume natural gas consumers can, and should, play a role in reducing greenhouse gas emissions. We also believe that local natural gas utilities can, and should, assist their customers in achieving meaningful reductions. They have served this role in the past. This role has significantly increased over the past 5 years, in part as a result of the proliferation of revenue decoupling. This role will become even more predominant in the future. However, the inclusion of small volume natural gas consumers under the cap of S.2191 will not help local natural gas utilities and their customers fulfill their potential in terms of reducing greenhouse gas emissions. In fact, it is likely to have the opposite effect.



**America's Climate Security Act of
2007—Modeling Results from the
National Energy Modeling System
*--Preliminary Results--***

**Jonathan Banks
Clean Air Task Force
November 14, 2007**

CLEAN AIR TASK FORCE

Background

- **CATF, working through its consultant OnLocation, has modeled several scenarios of ACSA at the request of Sens. Lieberman and Warner.**
- **The model runs simulate most but not all of the provisions of ACSA.**
- **The following slides summarize our latest run which looks at the version of ACSA that was passed by the subcommittee.**
- **Some of the data in this presentation is based on calculations done after the model run, but using modeled outputs.**

About NEMS

- **The National Energy Modeling System (NEMS) is a detailed computer-based, energy-economic modeling system of U.S. energy markets. NEMS projects energy supply, demand, imports, conversion, and prices to the year 2030, subject to market assumptions such as macroeconomic and investment factors, world energy markets, fuel availability, technology cost and performance characteristics of energy technologies, and more.**
- **The model was developed and is maintained by the Energy Information Administration (EIA) for use in developing annual projections (in particular the "Annual Energy Outlook") and for evaluating energy policies.**

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About OnLocation

- **OnLocation, Inc./Energy Systems Consulting, founded in 1984, is a consulting firm specializing in energy and environmental policy analysis. Their analysis supports government, non-governmental organizations, and corporate decision makers. OnLocation has been involved in the development and maintenance of NEMS since its inception and assists multiple clients by using the tool to examine proposed government policies and their associated impacts on the energy system.**

How we modeled ACSA

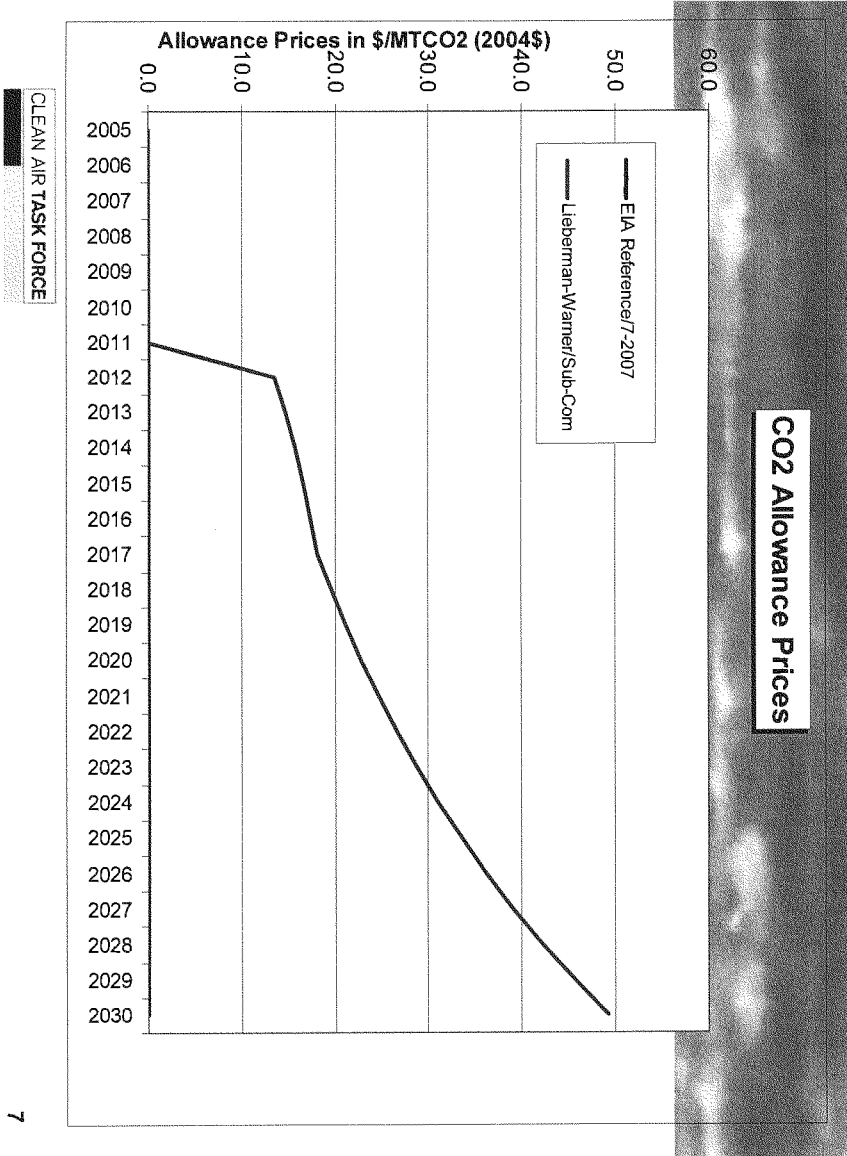
- > Covered sector emissions include: power sector, industry, transportation (upstream), residential and commercial natural gas and petroleum use.
- > Offsets are allowed up to 30% (the 15-15 split is not possible in NEMS, but the resulting output is close).
- > Unlimited banking.
- > We did not model the Carbon Market Efficiency Board.
- > We did not change any technology assumptions in NEMS, except to constrain the deployment of biomass power.
- > To simulate the use of auction revenue and direct allocation of allowances for low and no carbon power technologies, we used a production tax credit for CCS power and extended the wind production tax credit to 2030.
- > To simulate ACSA's technology and efficiency provisions, we used EIA's "Best Available Technology" case.
- > We have not yet analyzed the impact of the 5% allowance allocation to agricultural sequestration.

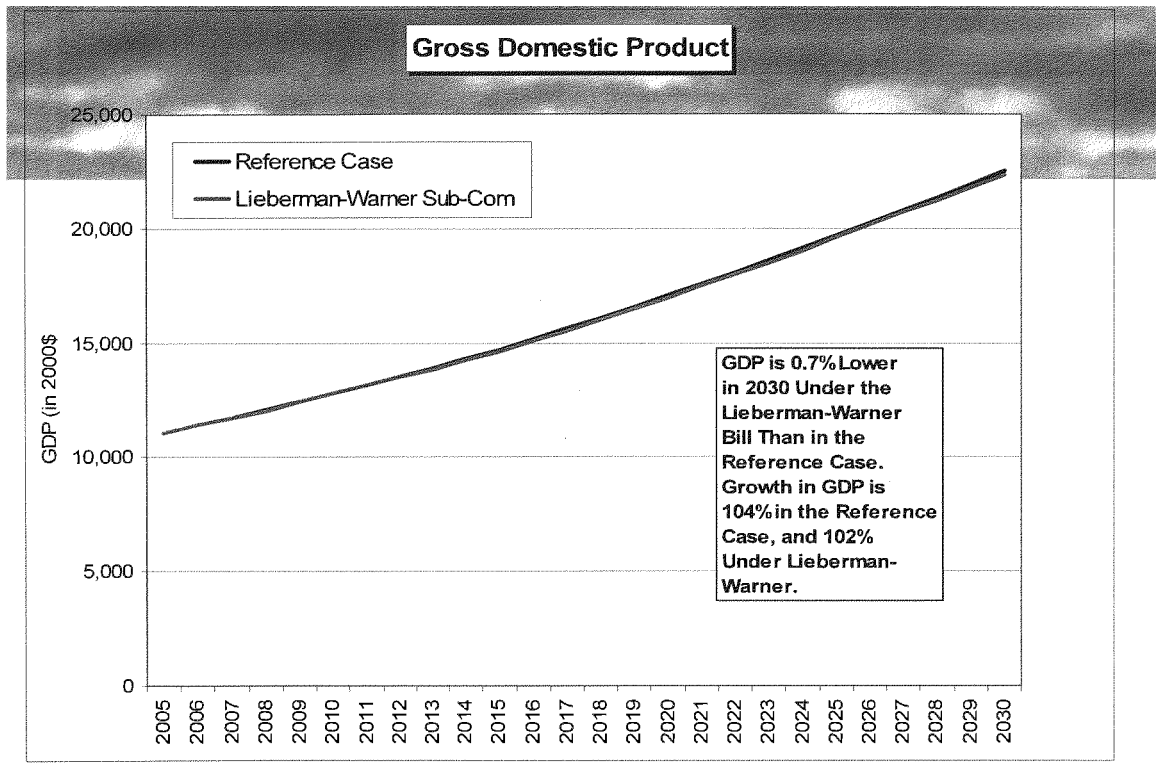
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EIA's Best Available Technology Case and Why We Used It

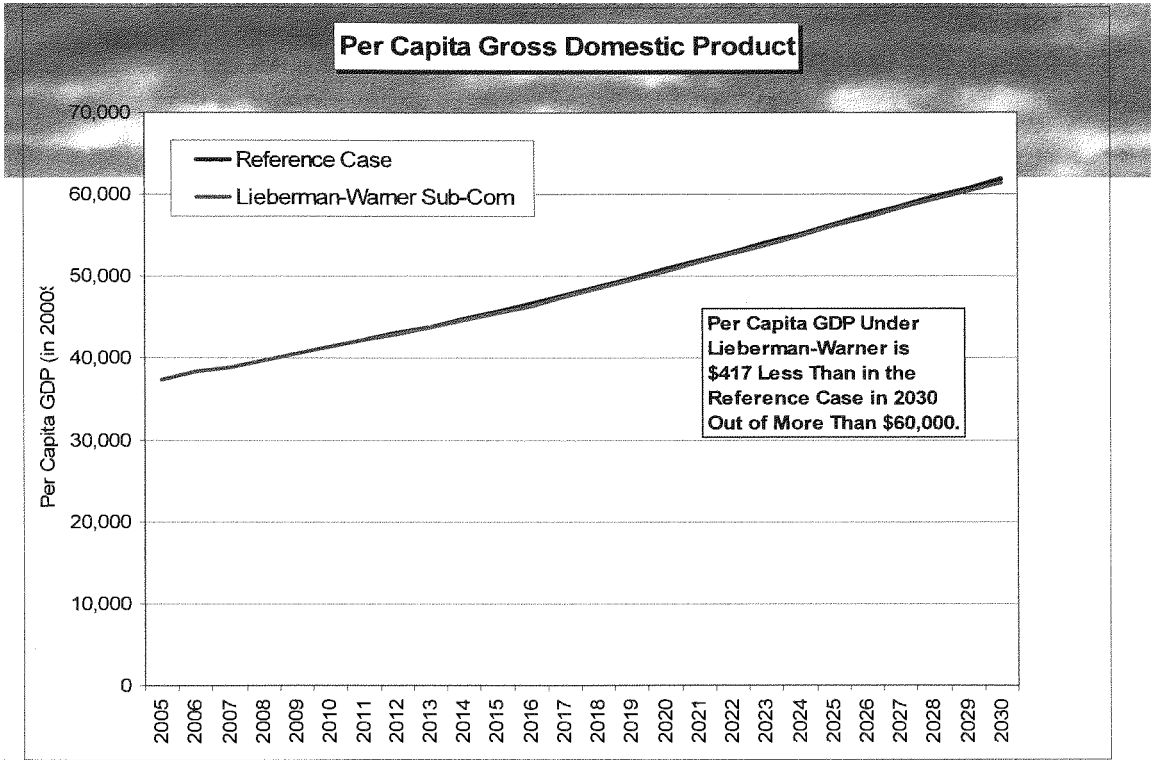
- EIA's Best Available Technology (BAT) case assumes that consumers choose the most efficient equipment (from light bulbs to boilers) available, regardless of costs within residential and commercial buildings, when replacing end-use energy equipment in residential and commercial buildings.
- EIA's BAT scenario was used as a *useful proxy* for ACSA's massive energy efficiency investment provisions, as well as ACSA's new building and energy equipment efficiency regulations.
- Through 2030, ACSA directs approximately \$290 billion to energy efficiency and new product development, and sets efficiency standards for buildings and residential boilers.

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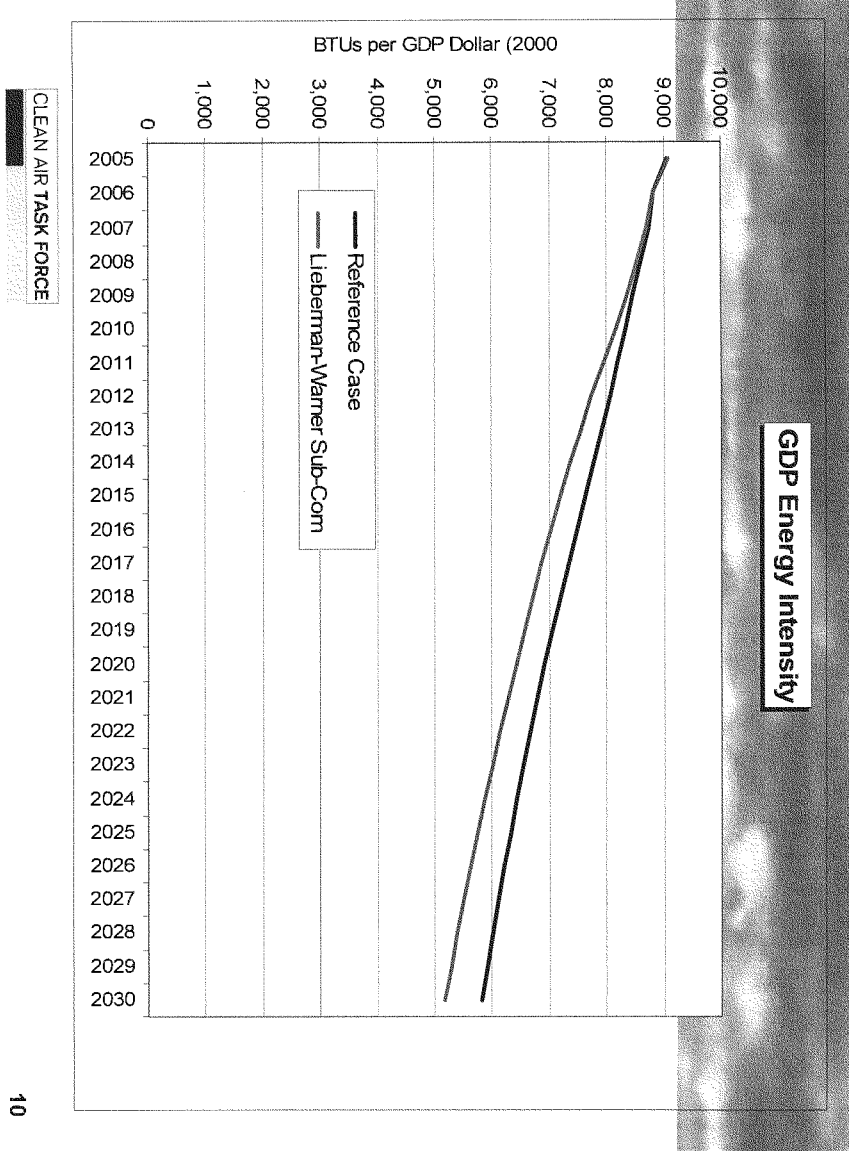




Per Capita Gross Domestic Product



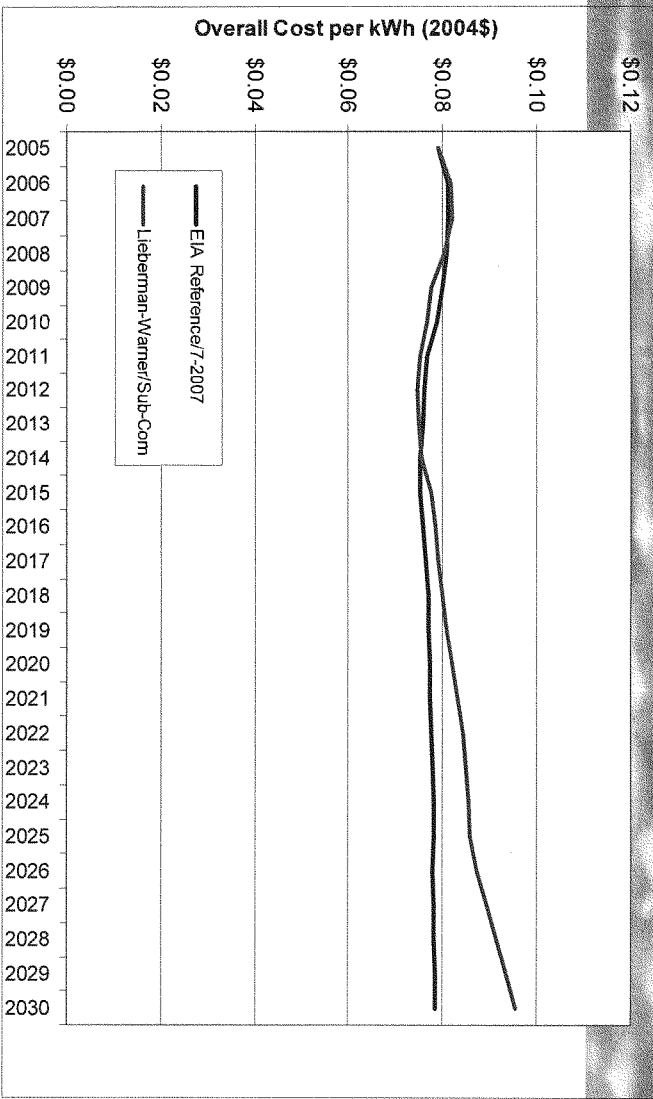
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Electricity Prices

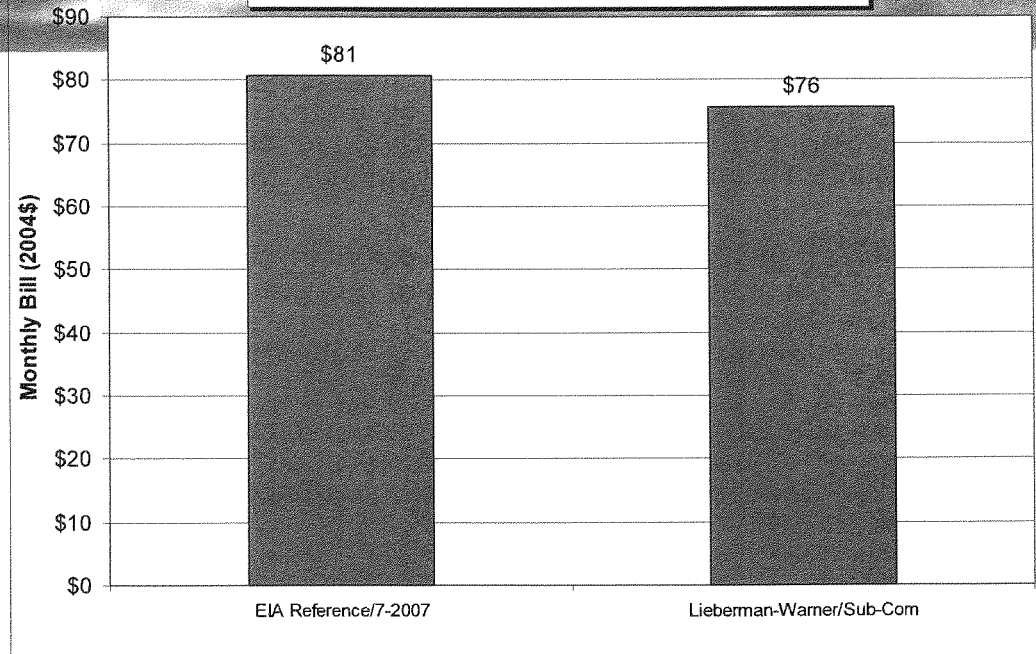
- **The average price per KWh of electricity increases from 8.3 cents per KWh in 2006 to 9.8 cents per KWh in 2030.**
- **However energy usage drops considerably, due to ACSA's energy efficiency provisions and price response.**
- **This drop in energy consumption results in lower monthly electrical bills for residential and commercial customers relative to the reference case.**
- **Roughly similar impacts on industrial energy bills would likely occur due to ACSA's energy efficiency investment provisions – but these reductions do not show up in our analysis, as EIA's BAT scenario does not include industrial energy equipment efficiency.**

Average Electricity Costs



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**Typical Residential Electricity Bill
(Based on 2030 Rates and Adjusted Usage)**



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A Safety Net for Electricity Price Increases

- **Even though monthly energy bill impacts are expected to be less than BAU for residential customers, ACSA creates a safety net to protect low and middle income consumers.**
- **Sec. 3501 sets aside 10% of the total allowance pool to be used as rebates to low and middle income energy consumers and to promote energy efficiency.
By 2030, this fund will contain nearly \$240 billion.**
- **Sec. 4302 and 4501 establishes the Energy Assistance Fund that provides additional funding to LIHEAP, the Weatherization Assistance Program, and a new Rural Energy Assistance Program.
By 2030, this fund will contain over \$200 billion.**

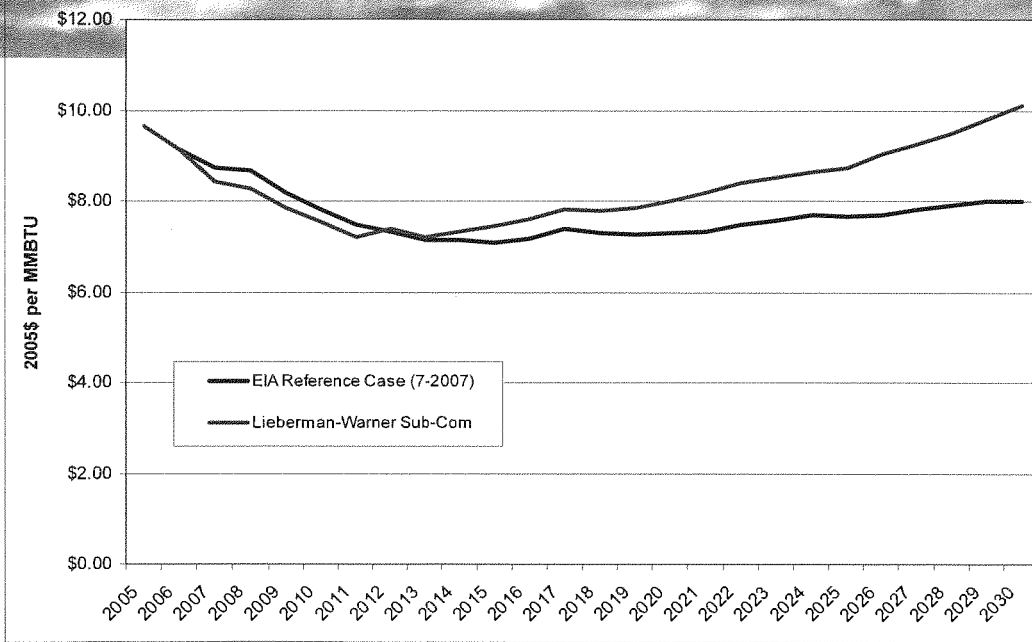
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Natural Gas Prices

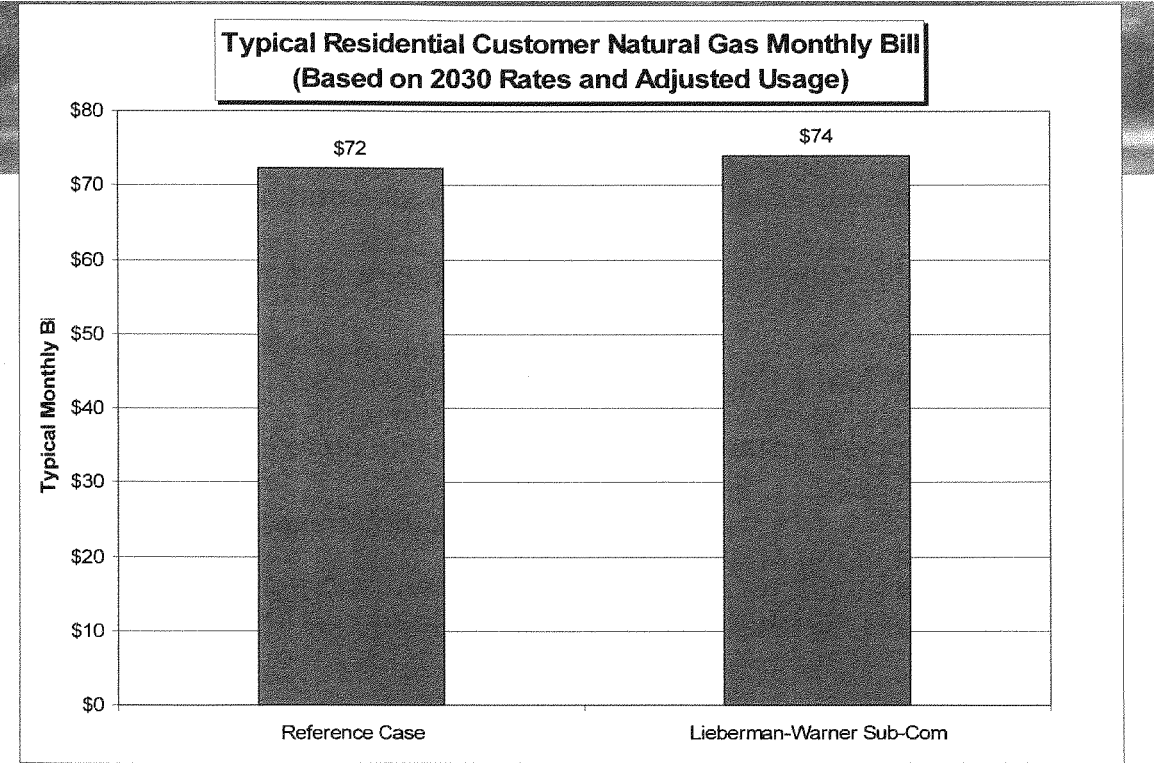
- The average price per MMBTU of natural gas increases from \$9.64 per MMBTU in 2005 to \$10.10 per MMBTU in 2030.
- However, due to ACSA's energy efficiency provisions measures in the bill and price response, energy usage drops considerably.
- This drop in actual energy needed, reduces price impacts on monthly natural gas bills for residential and commercial customers.
- Roughly similar impacts on industrial energy bills would likely occur due to ACSA's energy efficiency investment provisions – but these reductions do not show up in our analysis, as EIA's BAT scenario does not include industrial energy equipment efficiency.

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Natural Gas Prices Overall End Users



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A Safety Net for Natural Gas Price Increases

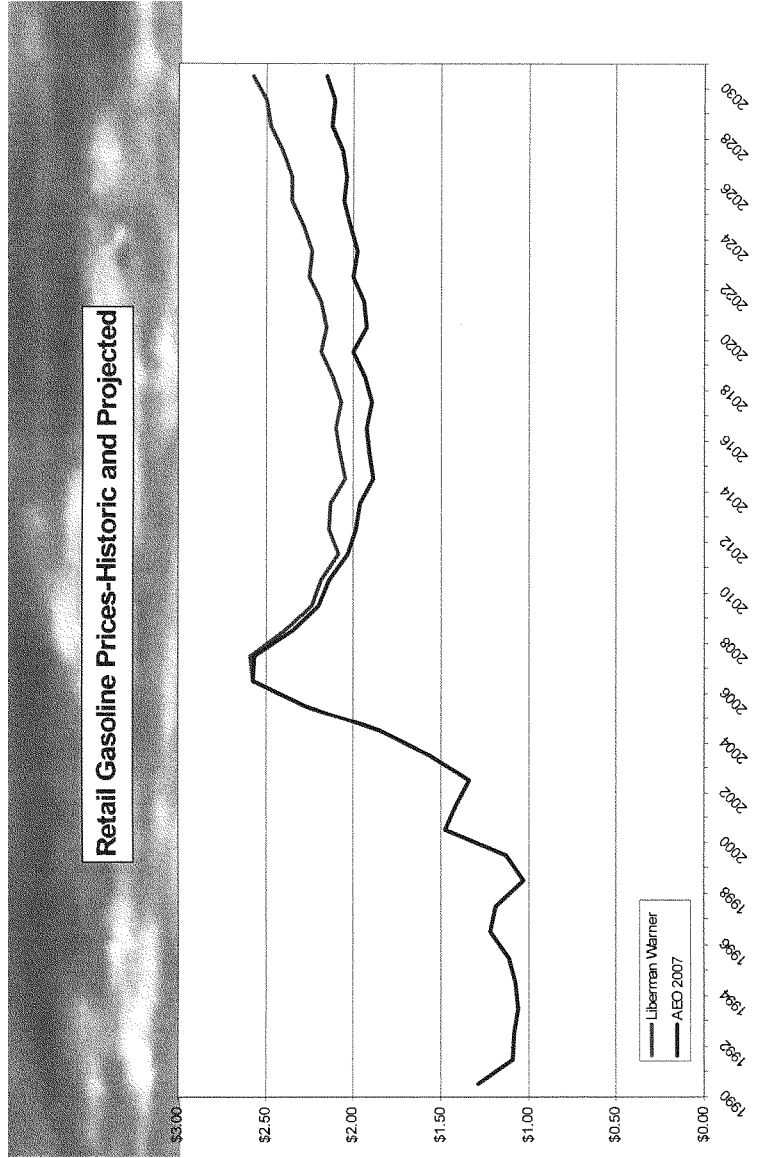
- **Even though monthly natural gas bill impacts for residential customers are expected to be quite small when compared to BAU, ACSA creates a safety net to protect low and middle income consumers.**
- **Sec. 4302 and 4501 establishes the Energy Assistance Fund that provides additional funding to LIHEAP, the Weatherization Assistance Program, and a new Rural Energy Assistance Program.**
- **By 2030, this fund will contain over \$200 billion.**
- **LIHEAP funds, as well as the Rural Energy Assistance Funds could be used to offset any price impacts that low and middle income natural gas customers might see.**

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Gasoline Prices

- Gasoline prices gradually go up over next 23 years by 42 cents by 2030.
- In just this year alone prices have increased by @ \$1.00.
- While EIA's projection for gas prices, even for the AEO 2007 case may look optimistic, the *incremental impact* that ACSA will have on actual future gasoline prices would be similar to that projected in this analysis.
- Gasoline prices under ACSA, reflect almost 100% pass-through cost of the CO2 allowance price.

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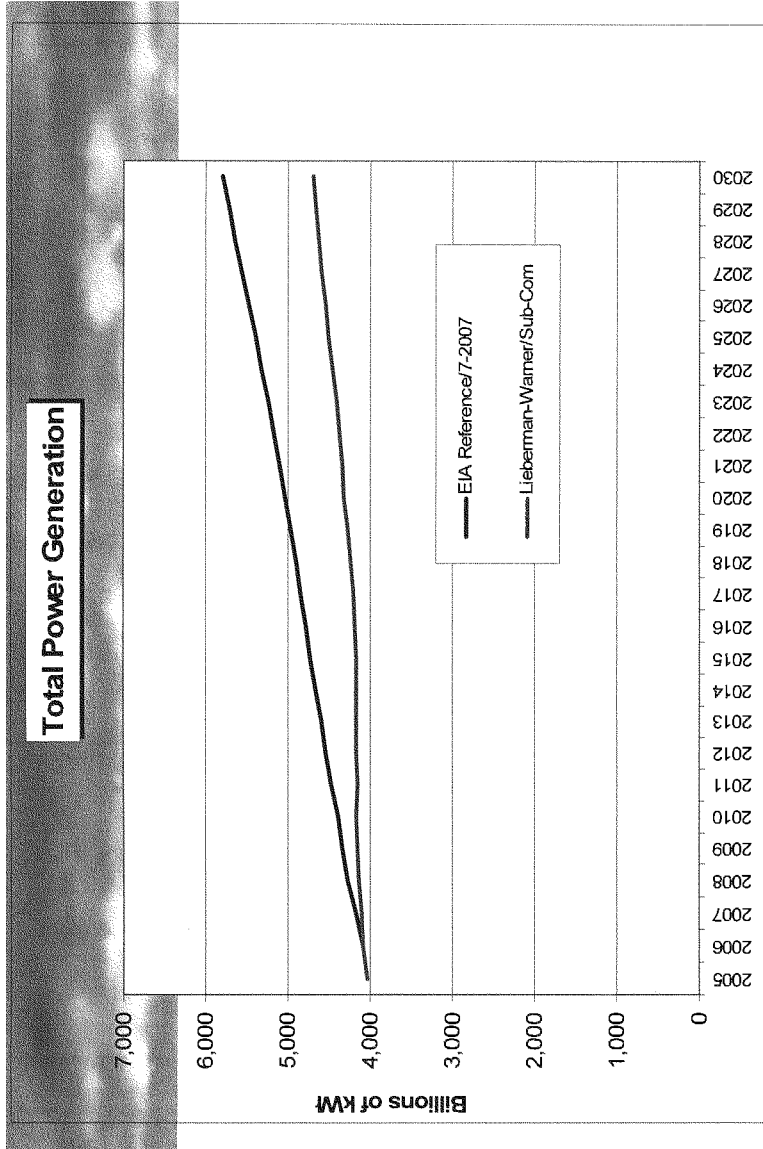


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Electricity Generation

- **Due to the technology and efficiency incentives and the standards in the bill, overall electricity generation declines by 20% as compared to projected 2030 growth in BAU generation.**
- **This is equivalent to not building 170 1000Mw power plants.**
- **This combined with the GHG cap reduces the role that traditional fossil fuels play in the power sector.**
- **However, new low carbon fossil technologies and renewable technologies, spurred by the incentives in ACSA, along with nuclear increase dramatically.**

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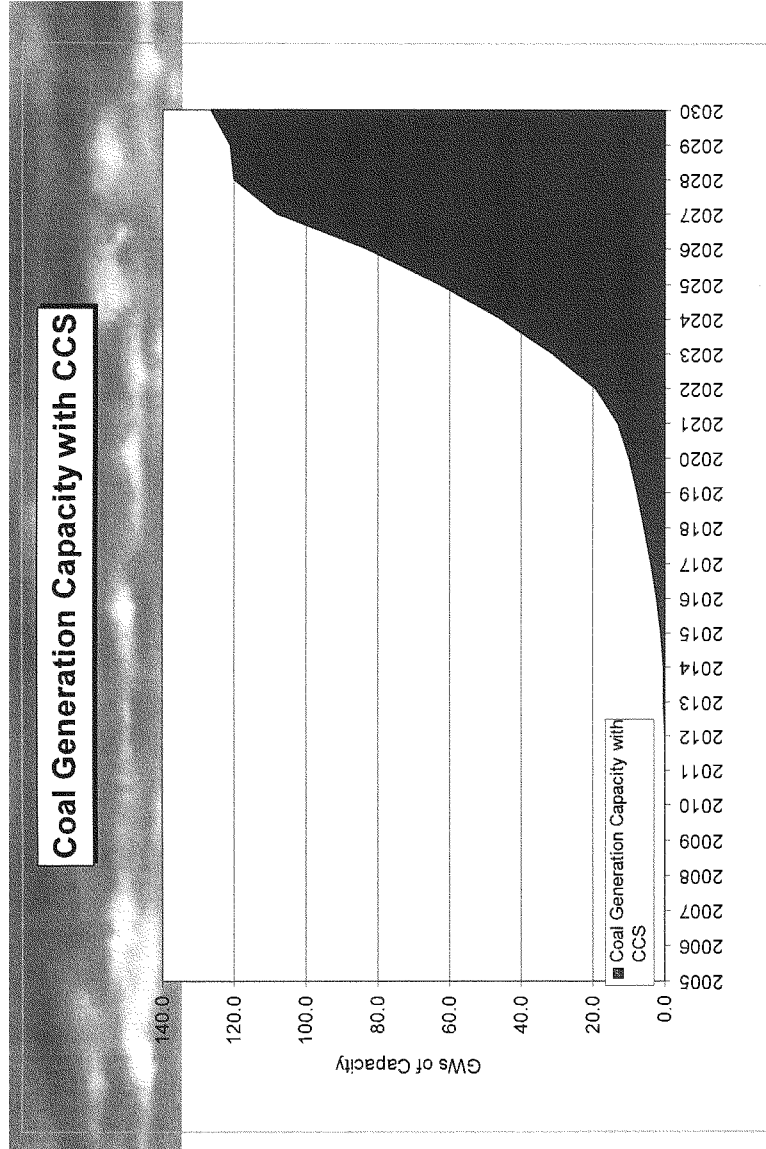


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Coal Generation

- In modeling ACSA, we used a production tax credit of 1.25 cents/KWh for coal generation with carbon capture and storage.
- This was used to mimic in part the many incentives for promoting CCS technologies in the bill.
- ACSA contains a 4% bonus allowance for CCS (the production tax credit most closely resembles this), a fund for deploying 20GWs of new IGCC/CCS, a fund for deploying new fossil and retrofit technologies with CCS, a fund for demonstrating geologic carbon storage, and the zero and low carbon generation fund which CCS power plants could qualify for.

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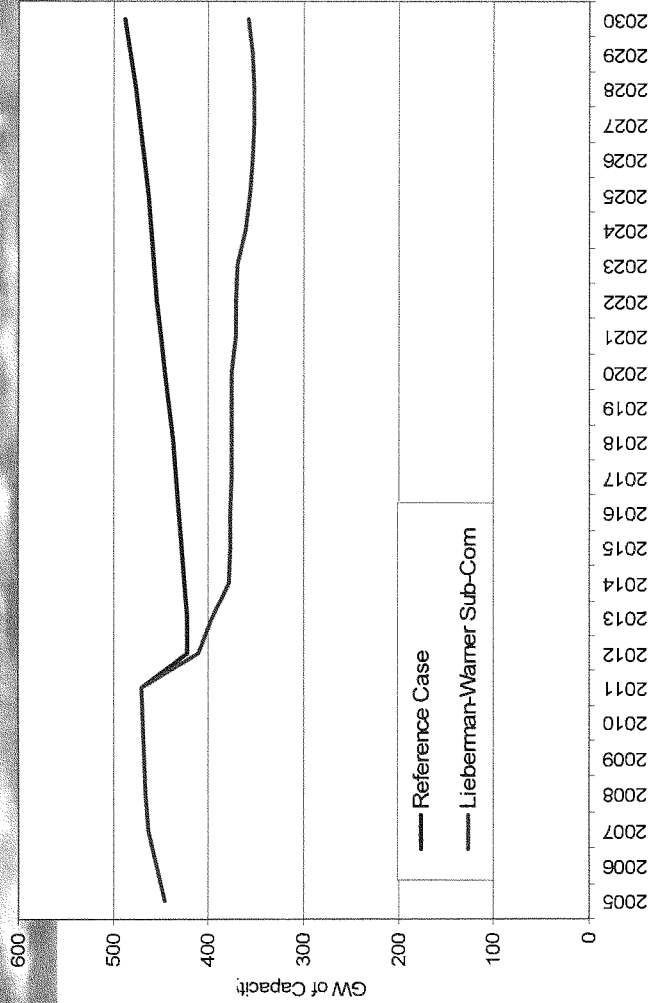
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Gas Generation

- In most climate policies, gas generation is relied on as an interim power source prior to CO₂ allowance prices reaching the point where carbon capture and sequestration becomes economic.
- Because of the incentives for CCS, and the reduction in overall energy use, natural gas generation does not show up as a “bridge” fuel.
- If CCS or nuclear is constrained below projected expansion levels in the real world, gas generation would likely fill the gap.

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Oil and Gas-Fired Generating Capacity



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Nuclear Generation

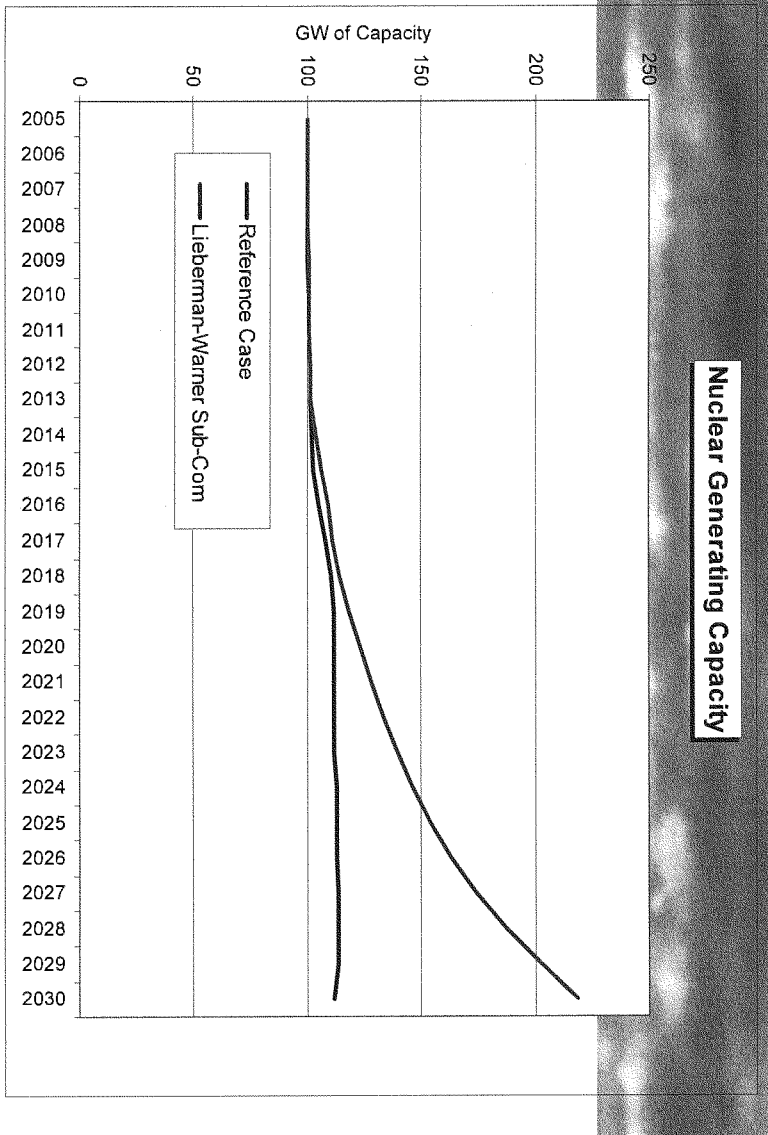
- **Nuclear power in a carbon constrained world will have an economic advantage that it does not currently have.**
- **NEMS sees nuclear as a low cost-no carbon power generation choice, and thus builds large amounts of new nuclear generation- 117GWs by 2030.**
- **We chose not to artificially constrain nuclear power within the model.**

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Nuclear Generation, Contd.

- **As of late 2006, 27 GW of new plants were on order or proposed in the US, according to the World Nuclear Association.**
- **While building a further 90GWs would be an aggressive build rate, it is entirely plausible.**
- **Between 1971-1990, the US built approximately 5GWs a year.**

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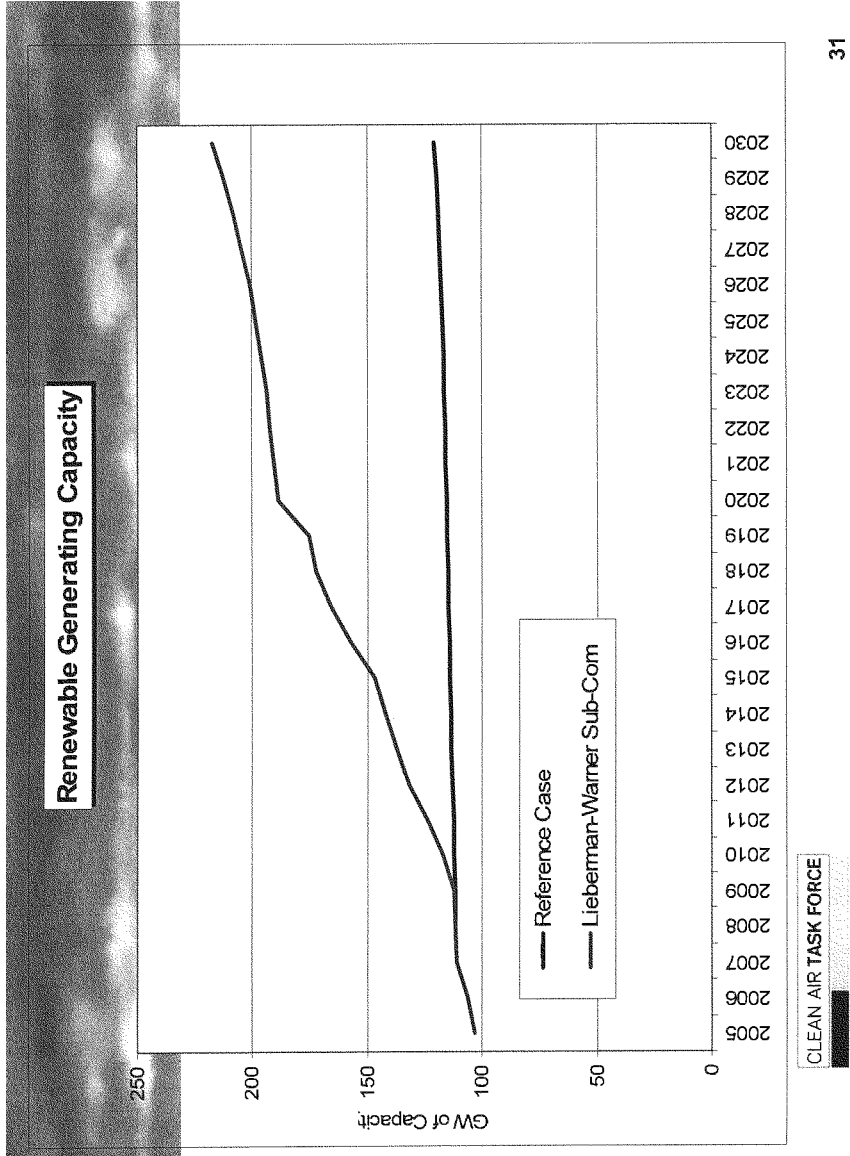
Nuclear Generating Capacity

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Renewable Generation

- **The large expansion of renewable generation is due to both the GHG cap as well as the incentives in ACSA for low and no carbon technologies.**
- **Sec. 4401 and 4402 dedicate approximately \$125 billion to zero and low carbon power generation.**
- **We extended the production tax credit for wind power to 2030 within the model to mimic the benefit of these funds.**
- **In addition, we suppressed the amount of biomass power due to the many competing uses that biomass faces (i.e. ethanol and other biofuels), as well as questions about net climate impacts and costs.**
- **Between 2012-2030, nearly 70GWs of new wind generation is deployed.**

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Introduction

This Synthesis Report is based on the assessment carried out by the three Working Groups of the IPCC. It provides an integrated view of climate change as the final part of the IPCC's Fourth Assessment Report.

A complete elaboration of the topics covered in this summary can be found in this Synthesis Report and in the underlying reports of the three Working Groups.

1. Observed changes in climate and their effects

Warming of the climate system is unequivocal, as is now evident from observations of increases in global average air and ocean temperatures, widespread melting of snow and ice, and rising global average sea level (Figure SPM.1). {1.1}

Eleven of the last twelve years (1995-2006) rank among the twelve warmest years in the instrumental record of global surface temperature (since 1850). The 100-year linear trend (1906-2005) of 0.74 [0.56 to 0.92]¹°C is larger than the corresponding trend of 0.6 [0.4 to 0.8]°C (1901-2000) given in the Third Assessment Report (TAR) (Figure SPM.1). The temperature increase is widespread over the globe, and is greater at higher northern latitudes. Land regions have warmed faster than the oceans (Figures SPM.2, SPM.4). {1.1, 1.2}

Rising sea level is consistent with warming (Figure SPM.1). Global average sea level has risen since 1961 at an average rate of 1.8 [1.3 to 2.3]mm/yr and since 1993 at 3.1 [2.4 to 3.8]mm/yr, with contributions from thermal expansion, melting glaciers and ice caps, and the polar ice sheets. Whether the faster rate for 1993 to 2003 reflects decadal variation or an increase in the longer-term trend is unclear. {1.1}

Observed decreases in snow and ice extent are also consistent with warming (Figure SPM.1). Satellite data since 1978 show that annual average Arctic sea ice extent has shrunk by 2.7 [2.1 to 3.3]% per decade, with larger decreases in summer of 7.4 [5.0 to 9.8]% per decade. Mountain glaciers and snow cover on average have declined in both hemispheres. {1.1}

From 1900 to 2005, precipitation increased significantly in eastern parts of North and South America, northern Europe and northern and central Asia but declined in the Sahel, the Mediterranean, southern Africa and parts of southern Asia. Globally, the area affected by drought has *likely*² increased since the 1970s. {1.1}

It is *very likely* that over the past 50 years: cold days, cold nights and frosts have become less frequent over most land areas, and hot days and hot nights have become more frequent. It is *likely* that: heat waves have become more frequent over most land areas, the frequency of heavy precipitation events has increased over most areas, and since 1975 the incidence of extreme high sea level³ has increased worldwide. {1.1}

There is observational evidence of an increase in intense tropical cyclone activity in the North Atlantic since about 1970, with limited evidence of increases elsewhere. There is no clear trend in the annual numbers of tropical cyclones. It is difficult to ascertain longer term trends in cyclone activity, particularly prior to 1970.

Average Northern Hemisphere temperatures during the second half of the 20th century were *very likely* higher than during any other 50-year period in the last 500 years and *likely* the highest in at least the past 1300 years. {1.1}

¹ Numbers in square brackets indicate a 90% uncertainty interval around a best estimate, i.e., there is an estimated 5% likelihood that the value could be above the range given in square brackets and 5% likelihood that the value could be below that range. Uncertainty intervals are not necessarily symmetric around the corresponding best estimate.

² Words in italics represent calibrated expressions of uncertainty and confidence. Relevant terms are explained in the Box 'Treatment of uncertainty' in the Introduction of this Synthesis Report.

³ Excluding tsunamis, which are not due to climate change. Extreme high sea level depends on average sea level and on regional weather systems. It is defined here as the highest 1% of hourly values of observed sea level at a station for a given reference period.

Changes in temperature, sea level and Northern Hemisphere snow cover

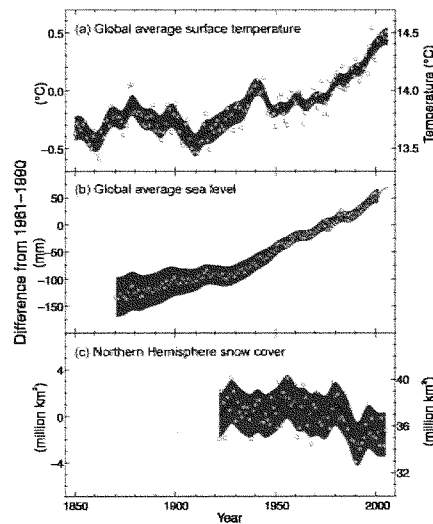


Figure SPM.1. Observed changes in (a) global average surface temperature; (b) global average sea level from tide gauge (blue) and satellite (red) data and (c) Northern Hemisphere snow cover for March-April. All differences are relative to corresponding averages for the period 1961-1990. Smoothed curves represent decadal averaged values while circles show yearly values. The shaded areas are the uncertainty intervals estimated from a comprehensive analysis of known uncertainties (a and b) and from the time series (c). (Figure 1.1)

Observational evidence⁴ from all continents and most oceans shows that many natural systems are being affected by regional climate changes, particularly temperature increases. {1.2}

Changes in snow, ice and frozen ground have with *high confidence* increased the number and size of glacial lakes, increased ground instability in mountain and other permafrost regions, and led to changes in some Arctic and Antarctic ecosystems. {1.2}

There is *high confidence* that some hydrological systems have also been affected through increased runoff and earlier spring peak discharge in many glacier- and snow-fed rivers, and effects on thermal structure and water quality of warming rivers and lakes. {1.2}

In terrestrial ecosystems, earlier timing of spring events and poleward and upward shifts in plant and animal ranges are with *very high confidence* linked to recent warming. In some marine and freshwater systems, shifts in ranges and changes in algal, plankton and fish abundance are with *high confidence* associated with rising water temperatures, as well as related changes in ice cover, salinity, oxygen levels and circulation. {1.2}

⁴ Based largely on data sets that cover the period since 1970.

Of the more than 29,000 observational data series, from 75 studies, that show significant change in many physical and biological systems, more than 89% are consistent with the direction of change expected as a response to warming (Figure SPM.2). However, there is a notable lack of geographic balance in data and literature on observed changes, with marked scarcity in developing countries. {1.3}

Changes in physical and biological systems and surface temperature 1970-2004

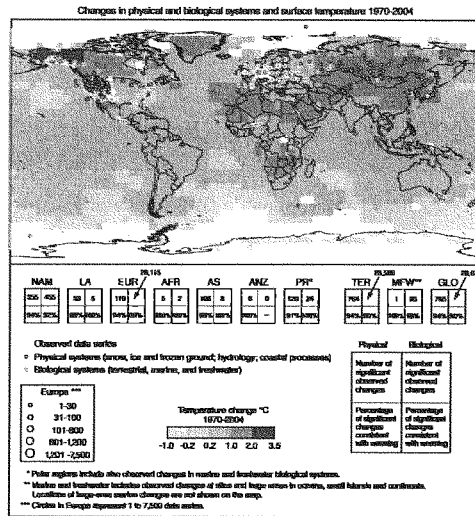


Figure SPM.2. Locations of significant changes in data series of physical systems (snow, ice and frozen ground; hydrology; and coastal processes) and biological systems (terrestrial, marine, and freshwater biological systems), are shown together with surface air temperature changes over the period 1970-2004. A subset of about 29,000 data series was selected from about 80,000 data series from 577 studies. These met the following criteria: (1) ending in 1990 or later; (2) spanning a period of at least 20 years; and (3) showing a significant change in either direction, as assessed in individual studies. These data series are from about 75 studies (of which about 70 are new since the Third Assessment) and contain about 29,000 data series, of which about 28,000 are from European studies. White areas do not contain sufficient observational climate data to estimate a temperature trend. The 2 x 2 boxes show the total number of data series with significant changes (top row) and the percentage of those consistent with warming (bottom row) for (i) continental regions: North America (NAM), Latin America (LA), Europe (EUR), Africa (AFR), Asia (AS), Australia and New Zealand (ANZ), and Polar Regions (PR) and (ii) global-scale: Terrestrial (TER), Marine and Freshwater (MFV), and Global (GLO). The numbers of studies from the seven regional boxes (NAM, EUR, AFR, AS, ANZ, PR) do not add up to the global (GLO) totals because numbers from regions except Polar do not include the numbers related to Marine and Freshwater (MFV) systems. Locations of large-area marine changes are not shown on the map. (Figure 1.2)

There is *medium confidence* that other effects of regional climate change on natural and human environments are emerging, although many are difficult to discern due to adaptation and non-climatic drivers.

They include effects of temperature increases on {1.2}

- agricultural and forestry management at Northern Hemisphere higher latitudes, such as earlier spring planting of crops, and alterations in disturbance regimes of forests due to fires and pests

- some aspects of human health, such as heat-related mortality in Europe, changes in infectious disease vectors in some areas, and allergenic pollen in Northern Hemisphere high and mid-latitudes
- some human activities in the Arctic (e.g. hunting and travel over snow and ice) and in lower-elevation alpine areas (such as mountain sports).

2. Causes of change

Changes in atmospheric concentrations of greenhouse gases (GHGs) and aerosols, land-cover and solar radiation alter the energy balance of the climate system.

Global GHG emissions due to human activities have grown since pre-industrial times, with an increase of 70% between 1970 and 2004 (Figure SPM.3).⁵ {2.1}

Carbon dioxide (CO₂) is the most important anthropogenic GHG. Its annual emissions grew by about 80% between 1970 and 2004. The long-term trend of declining CO₂ emissions per unit of energy supplied reversed after 2000. {2.1}

Global anthropogenic GHG emissions

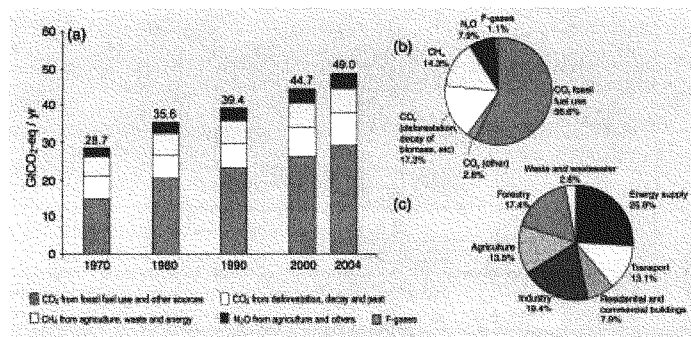


Figure SPM.3. (a) Global annual emissions of anthropogenic GHGs from 1970 to 2004.⁵ (b) Share of different anthropogenic GHGs in total emissions in 2004 in terms of CO₂-eq. (c) Share of different sectors in total anthropogenic GHG emissions in 2004 in terms of CO₂-eq. (Forestry includes deforestation). (Figure 2.1)

Global atmospheric concentrations of CO₂, methane (CH₄) and nitrous oxide (N₂O) have increased markedly as a result of human activities since 1750 and now far exceed pre-industrial values determined from ice cores spanning many thousands of years. {2.2}

Atmospheric concentrations of CO₂ (379ppm) and CH₄ (1774 ppb) in 2005 exceed by far the natural range over the last 650,000 years. Global increases in CO₂ concentrations are due primarily to fossil fuel use, with land-use change providing another significant but smaller contribution. It is *very likely* that the observed increase in CH₄ concentration is predominantly due to agriculture and fossil fuel use. Methane growth rates have declined since the early 1990s, consistent with total emission (sum of anthropogenic and natural sources) being nearly constant during this period. The increase in N₂O concentration is primarily due to agriculture. {2.2}

There is *very high confidence* that the net effect of human activities since 1750 has been one of warming.⁶ {2.2}

⁵ Includes only CO₂, CH₄, N₂O, HFCs, PFCs and SF₆ whose emissions are covered by the UNFCCC. These GHGs are weighted by their 100-year Global Warming Potentials, using values consistent with reporting under the UNFCCC.

Most of the observed increase in globally-averaged temperatures since the mid-20th century is *very likely* due to the observed increase in anthropogenic GHG concentrations.⁶ It is *likely* there has been significant anthropogenic warming over the past 50 years averaged over each continent (except Antarctica) (Figure SPM.4). {2.4}

During the past 50 years, the sum of solar and volcanic forcings would *likely* have produced cooling. Observed patterns of warming and their changes are simulated only by models that include anthropogenic forcings. Difficulties remain in simulating and attributing observed temperature changes at smaller than continental scales. {2.4}

Global and continental temperature change

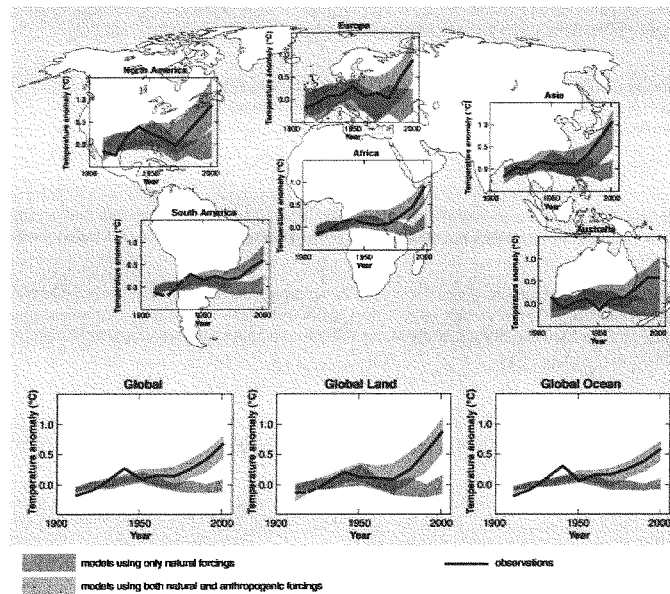


Figure SPM.4. Comparison of observed continental- and global-scale changes in surface temperature with results simulated by climate models using either natural or both natural and anthropogenic forcings. Decadal averages of observations are shown for the period 1906-2005 (black line) plotted against the centre of the decade and relative to the corresponding average for the period 1901-1950. Lines are dashed where spatial coverage is less than 50%. Blue shaded bands show the 5-95% range for 19 simulations from 5 climate models using only the natural forcings due to solar activity and volcanoes. Red shaded bands show the 5-95% range for 58 simulations from 14 climate models using both natural and anthropogenic forcings. (Figure 2.5)

⁶ Increases in GHGs tend to warm the surface while the net effect of increases in aerosols tends to cool it. The net effect due to human activities since the pre-industrial era is one of warming (+1.6 [+0.6 to +2.4]W/m²). In comparison, changes in solar irradiance are estimated to have caused a small warming effect (+0.12 [+0.06 to +0.30]W/m²).

⁷ Consideration of remaining uncertainty is based on current methodologies.

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Advances since the TAR show that discernible human influences extend beyond average temperature to other aspects of climate. {2.4}

Human influences have: {2.4}

- *very likely* contributed to sea level rise during the latter half of the 20th century
- *likely* contributed to changes in wind patterns, affecting extra-tropical storm tracks and temperature patterns
- *likely* increased temperatures of extreme hot nights, cold nights and cold days
- *more likely than not* increased risk of heat waves, area affected by drought since the 1970s and frequency of heavy precipitation events.

Anthropogenic warming over the last three decades has *likely* had a discernible influence at the global scale on observed changes in many physical and biological systems. {2.4}

Spatial agreement between regions of significant warming across the globe and locations of significant observed changes in many systems consistent with warming is *very unlikely* to be due solely to natural variability. Several modelling studies have linked some specific responses in physical and biological systems to anthropogenic warming. {2.4}

More complete attribution of observed natural system responses to anthropogenic warming is currently prevented by the short time scales of many impact studies, greater natural climate variability at regional scales, contributions of non-climate factors and limited spatial coverage of studies. {2.4}

3. Projected climate change and its impacts

There is *high agreement* and *much evidence* that with current climate change mitigation policies and related sustainable development practices, global GHG emissions will continue to grow over the next few decades. {3.1}

The IPCC Special Report on Emission Scenarios (SRES, 2000) projects an increase of global GHG emissions by 25-90% (CO₂-eq) between 2000 and 2030 (Figure SPM.5), with fossil fuels maintaining their dominant position in the global energy mix to 2030 and beyond. More recent scenarios without additional emissions mitigation are comparable in range.^{8,9} {3.1}

Continued GHG emissions at or above current rates would cause further warming and induce many changes in the global climate system during the 21st century that would *very likely* be larger than those observed during the 20th century (Table SPM.1, Figure SPM.5). {3.2.1}

For the next two decades a warming of about 0.2°C per decade is projected for a range of SRES emissions scenarios. Even if the concentrations of all greenhouse gases and aerosols had been kept constant at year 2000 levels, a further warming of about 0.1°C per decade would be expected. Afterwards, temperature projections increasingly depend on specific emission scenarios. {3.2}

⁸ For an explanation of SRES emission scenarios, see Box 'SRES scenarios' of this Synthesis Report. These scenarios do not include additional climate policy above current ones; more recent studies differ with respect to UNFCCC and Kyoto Protocol inclusion.

⁹ Emission pathways of mitigation scenarios are discussed in Section 5.

Scenarios for GHG emissions from 2000 to 2100 (in the absence of additional climate policies) and projections of surface temperatures

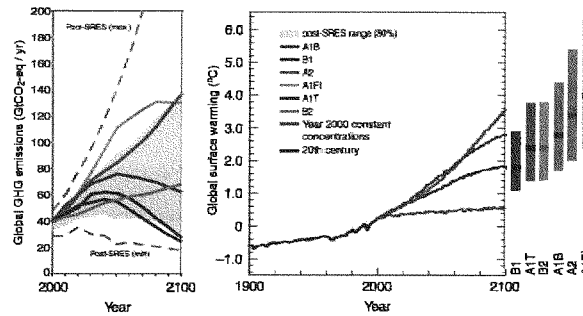


Figure SPM-5. Left Panel: Global GHG emissions (in CO₂-eq) in the absence of climate policies: six illustrative SRES marker scenarios (coloured lines) and the 80th percentile range of recent scenarios published since SRES (post-SRES) (gray shaded area). Dashed lines show the full range of post-SRES scenarios. The emissions cover CO₂, CH₄, N₂O, and F-gases. Right Panel: Solid lines are multi-model global averages of surface warming for scenarios A2, A1B and B1, shown as continuations of the 20th century simulations. These projections also take into account emissions of short-lived GHGs and aerosols. The pink line is not a scenario, but is for AOGCM simulations where atmospheric concentrations are held constant at year 2000 values. The bars at the right of the figure indicate the best estimate (solid line within each bar) and the *likely* range assessed for the six SRES marker scenarios at 2090-2099. All temperatures are relative to the period 1980-1999. (Figure 3.1, Figure 3.2)

Table SPM.1. Projected global averaged surface warming and sea level rise at the end of the 21st century. (Table 3.1)

Case	Temperature change (°C at 2090-2099 relative to 1980-1999) ^{a, c}		Sea level rise (m at 2090-2099 relative to 1980-1999)
	Best estimate	Likely range	Model-based range excluding future rapid dynamical changes in ice flow
Constant year 2000 concentrations ^b	0.6	0.3 – 0.9	Not available
B1 scenario	1.8	1.1 – 2.9	0.18 – 0.38
A1T scenario	2.4	1.4 – 3.8	0.20 – 0.45
B2 scenario	2.4	1.4 – 3.8	0.20 – 0.43
A1B scenario	2.8	1.7 – 4.4	0.21 – 0.48
A2 scenario	3.4	2.0 – 5.4	0.23 – 0.51
A1FI scenario	4.0	2.4 – 6.4	0.26 – 0.59

Notes:

- a) Temperatures are assessed best estimates and likely uncertainty ranges from a hierarchy of models of varying complexity as well as observational constraints.
- b) Year 2000 constant composition is derived from Atmosphere-Ocean General Circulation Models (AOGCMs) only.
- c) All scenarios above are six SRES marker scenarios. Approximate carbon dioxide equivalent concentrations corresponding to the computed radiative forcing due to anthropogenic GHGs and aerosols in 2100 (see p. 823 of the TAR) for the SRES B1, A1T, B2, A1B, A2 and A1FI illustrative marker scenarios are about 600, 700, 800, 850, 1250 and 1550 ppm, respectively.
- d) Temperature changes are expressed as the difference from the period 1980-1999. To express the change relative to the period 1850-1899 add 0.5 °C.

The range of projections (Table SPM.1) is broadly consistent with the TAR, but uncertainties and upper ranges for temperature are larger mainly because the broader range of available models suggests stronger climate-carbon cycle feedbacks. Warming reduces terrestrial and ocean uptake of atmospheric CO₂, increasing the fraction of anthropogenic emissions remaining in the atmosphere. The strength of this feedback effect varies markedly among models. {2.3, 3.2.1}

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Because understanding of some important effects driving sea level rise is too limited, this report does not assess the likelihood, nor provide a best estimate or an upper bound for sea level rise. Table SPM.1 shows model-based projections of global average sea level rise for 2090-2099.¹⁰ The projections do not include uncertainties in climate-carbon cycle feedbacks nor the full effects of changes in ice sheet flow, therefore the upper values of the ranges are not to be considered upper bounds for sea level rise. They include a contribution from increased Greenland and Antarctic ice flow at the rates observed for 1993-2003, but this could increase or decrease in the future.¹¹ {3.2.1}

There is now higher confidence than in the TAR in projected patterns of warming and other regional-scale features, including changes in wind patterns, precipitation, and some aspects of extremes and sea ice. {3.2.2}

Regional-scale changes include: {3.2.2}

- warming greatest over land and at most high northern latitudes and least over Southern Ocean and parts of the North Atlantic Ocean, continuing recent observed trends (Figure SPM.6) in contraction of snow cover area, increases in thaw depth over most permafrost regions, and decrease in sea ice extent; in some projections using SRES scenarios, Arctic late-summer sea ice disappears almost entirely by the latter part of the 21st century
- *very likely* increase in frequency of hot extremes, heat waves, and heavy precipitation
- *likely* increase in tropical cyclone intensity; less confidence in global decrease of tropical cyclone numbers
- poleward shift of extra-tropical storm tracks with consequent changes in wind, precipitation, and temperature patterns
- *very likely* precipitation increases in high latitudes and *likely* decreases in most subtropical land regions, continuing observed recent trends

There is *high confidence* that by mid-century, annual river runoff and water availability are projected to increase at high latitudes (and in some tropical wet areas) and decrease in some dry regions in the mid-latitudes and tropics. There is also *high confidence* that many semi-arid areas (e.g. Mediterranean basin, western United States, southern Africa and northeast Brazil) will suffer a decrease in water resources due to climate change. {3.2; Figure 3.4}

Geographical pattern of surface warming

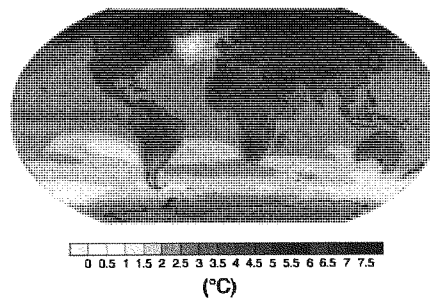


Figure SPM. 6. Projected surface temperature changes for the late 21st century (2090-2099). The map shows the multi-AOGCM average projection for the A1B SRES scenario. All temperatures are relative to the period 1980-1999. {Figure 3.2}

¹⁰ TAR projections were made for 2100, whereas the projections for this report are for 2090-2099. The TAR would have had similar ranges to those in Table SPM.1 if it had treated uncertainties in the same way.

¹¹ For discussion of the longer term see material below.

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Studies since the TAR have enabled more systematic understanding of the timing and magnitude of impacts related to differing amounts and rates of climate change. {3.3.1, 3.3.2}

Figure SPM.7 presents examples of this new information for systems and sectors. The top panel shows impacts increasing with increasing temperature change. Their estimated magnitude and timing is also affected by development pathway (lower panel). {3.3.1, 3.3.2}

Examples of impacts associated with global average temperature change
 (Impacts will vary by extent of adaptation, rate of temperature change, and socio-economic pathway)

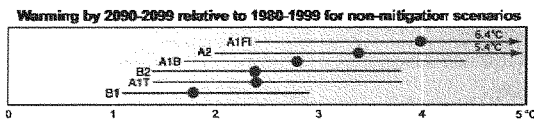
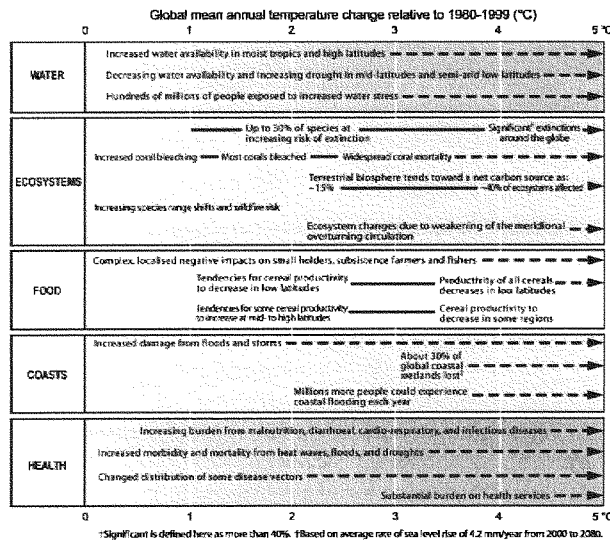


Figure SPM.7. Examples of impacts associated with projected global average surface warming. Upper panel: Illustrative examples of global impacts projected for climate changes (and sea level and atmospheric CO₂ where relevant) associated with different amounts of increase in global average surface temperature in the 21st century. The black lines link impacts; broken-line arrows indicate impacts continuing with increasing temperature. Entries are placed so that the left hand side of text indicates the approximate level of warming that is associated with the onset of a given impact. Quantitative entries for water scarcity and flooding represent the additional impacts of climate change relative to the conditions projected across the range of SRES scenarios A1F1, A2, B1 and B2. Adaptation to climate change is not included in these estimations. Confidence levels for all statements are *high*. Lower panel: Dots and bars indicate the best estimate and *likely* ranges of warming assessed for the six SRES marker scenarios for 2090-2099 relative to 1980-1999. (Figure 3.5)

Examples of some projected impacts for different regions are given in Table SPM.2.

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Table SPM.2. Examples of some projected regional impacts*

Africa	<ul style="list-style-type: none"> By 2020, between 75 and 250 million of people are projected to be exposed to increased water stress due to climate change; By 2020, in some countries, yields from rain-fed agriculture could be reduced by up to 50%. Agricultural production, including access to food, in many African countries is projected to be severely compromised. This would further adversely affect food security and exacerbate malnutrition; Towards the end of the 21st century, projected sea-level rise will affect low-lying coastal areas with large populations. The cost of adaptation could amount to at least 5-10% of Gross Domestic Product (GDP); By 2080, an increase of 5-8% of arid and semi-arid land in Africa is projected under a range of climate scenarios (TS).
Asia	<ul style="list-style-type: none"> By the 2050s, freshwater availability in Central, South, East and South-East Asia, particularly in large river basins, is projected to decrease; Coastal areas, especially heavily-populated megadelta regions in South, East and South-East Asia, will be at greatest risk due to increased flooding from the sea and, in some megadeltas, flooding from the rivers; Climate change is projected to compound the pressures on natural resources and the environment, associated with rapid urbanization, industrialization and economic development; Endemic morbidity and mortality due to diarrhoeal disease primarily associated with floods and droughts are expected to rise in East, South and South-East Asia due to projected changes in the hydrological cycle.
Australia and New Zealand	<ul style="list-style-type: none"> By 2020, significant loss of biodiversity is projected to occur in some ecologically rich sites including the Great Barrier Reef and Queensland Wet Tropics; By 2030, water security problems are projected to intensify in southern and eastern Australia and, in New Zealand, in Northland and some eastern regions; By 2030, production from agriculture and forestry is projected to decline over much of southern and eastern Australia, and over parts of eastern New Zealand, due to increased drought and fire. However, in New Zealand, initial benefits are projected in some other regions; By 2050, ongoing coastal development and population growth in some areas of Australia and New Zealand are projected to exacerbate risks from sea level rise and increases in the severity and frequency of storms and coastal flooding.
Europe	<ul style="list-style-type: none"> Climate change is expected to magnify regional differences in Europe's natural resources and assets. Negative impacts will include increased risk of inland flash floods, and more frequent coastal flooding and increased erosion (due to storminess and sea-level rise); Mountainous areas will face glacier retreat, reduced snow cover and winter tourism, and extensive species losses (in some areas up to 60% under high emissions scenarios by 2080); In Southern Europe, climate change is projected to worsen conditions (high temperatures and drought) in a region already vulnerable to climate variability, and to reduce water availability, hydropower potential, summer tourism and, in general, crop productivity; Climate change is also projected to increase the health risks due to heat-waves, and the frequency of wildfires.
Latin America	<ul style="list-style-type: none"> By mid century, increases in temperature and associated decreases in soil water are projected to lead to gradual replacement of tropical forest by savanna in eastern Amazonia. Semi-arid vegetation will tend to be replaced by arid-land vegetation. There is a risk of significant biodiversity loss through species extinction in many areas of tropical Latin America; Productivity of some important crops is projected to decrease and livestock productivity to decline, with adverse consequences for food security. In temperate zones soybean yields are projected to increase. Overall, the number of people at risk of hunger is projected to increase (TS; <i>medium confidence</i>). Changes in precipitation patterns and the disappearance of glaciers are projected to significantly affect water availability for human consumption, agriculture and energy generation.
North America	<ul style="list-style-type: none"> Warming in western mountains is projected to cause decreased snowpack, more winter flooding, and reduced summer flows, exacerbating competition for over-allocated water resources; In the early decades of the century, moderate climate change is projected to increase aggregate yields of rain-fed agriculture by 5-20%, but with important variability among regions. Major challenges are projected for crops that are near the warm end of their suitable range or which depend on highly utilized water resources; During the course of this century, cities that currently experience heatwaves are expected to be further challenged by an increased number, intensity and duration of heatwaves during the course of the century, with potential for adverse health impacts; Coastal communities and habitats will be increasingly stressed by climate change impacts interacting with development and pollution.
Polar Regions	<ul style="list-style-type: none"> The main projected biophysical effects are reductions in thickness and extent of glaciers and ice sheets and sea ice, and changes in natural ecosystems with detrimental effects on many organisms including migratory birds, mammals and higher predators; For human communities in the Arctic, impacts, particularly those resulting from changing snow and ice conditions are projected to be mixed; Detrimental impacts would include those on infrastructure and traditional indigenous ways of life; In both polar regions, specific ecosystems and habitats are projected to be vulnerable, as climatic barriers to species invasions are lowered.

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Table SPM.2. (cont.)

Small Islands	<ul style="list-style-type: none"> • Sea-level rise is expected to exacerbate inundation, storm surge, erosion and other coastal hazards, thus threatening vital infrastructure, settlements and facilities that support the livelihood of island communities; • Deterioration in coastal conditions, for example through erosion of beaches and coral bleaching is expected to affect local resources; • By mid-century, climate change is expected to reduce water resources in many small islands, e.g., in the Caribbean and Pacific, to the point where they become insufficient to meet demand during low-rainfall periods. • With higher temperatures, increased invasion by non-native species is expected to occur, particularly on mid- and high-latitude islands.
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**Unless stated explicitly, all entries are from WGII SPM text, and are either very high confidence or high confidence statements, reflecting different sectors (Agriculture, Ecosystems, Water, Coasts, Health, Industry and Settlements). The WGII SPM refers to the source of the statements, timelines and temperatures. The magnitude and timing of impacts that will ultimately be realized will vary with the amount and rate of climate change, emission scenarios, development pathways and adaptation.*

Some systems, sectors and regions are *likely* to be especially affected by climate change.¹²

Systems and sectors: {3.3.4}

- particular ecosystems:
 - terrestrial: tundra, boreal forest and mountain regions because of sensitivity to warming; mediterranean-type ecosystems because of reduction in rainfall; and tropical rainforests where precipitation declines
 - coastal: mangroves and salt marshes, due to multiple stresses
 - marine: coral reefs due to multiple stresses; the sea ice biome because of sensitivity to warming
- water resources in some dry regions at mid-latitudes¹³ and in the dry tropics, due to changes in rainfall and evapotranspiration, and in areas dependent on snow and ice melt
- agriculture in low-latitudes, due to reduced water availability
- low-lying coastal systems, due to threat of sea level rise and increased risk from extreme weather events
- human health in populations with low adaptive capacity.

Regions: {3.3.4}

- the Arctic, because of the impacts of high rates of projected warming on natural systems and human communities
- Africa, because of low adaptive capacity and projected climate change impacts
- small islands, where there is high exposure of population and infrastructure to projected climate change impacts
- Asian and African megadeltas, due to large populations and high exposure to sea level rise, storm surges and river flooding.

Within other areas, even those with high incomes, some people (such as the poor, young children, and the elderly) can be particularly at risk, and also some areas and some activities. {3.3.4}

Ocean Acidification

The uptake of anthropogenic carbon since 1750 has led to the ocean becoming more acidic with an average decrease in pH of 0.1 units. Increasing atmospheric CO₂ concentrations lead to further acidification. Projections based on SRES scenarios give a reduction in average global surface ocean pH of between 0.14 and 0.35 units over the 21st century. While the effects of observed ocean acidification on the marine biosphere are as yet undocumented, the progressive acidification of oceans is expected to have negative impacts on marine shell-forming organisms (e.g. corals) and their dependent species. {3.3.1}

¹² Identified on the basis of expert judgement of the assessed literature and considering the magnitude, timing and projected rate of climate change, sensitivity and adaptive capacity.

¹³ Including arid and semi-arid regions.

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Altered frequencies and intensities of extreme weather, together with sea level rise, are expected to have mostly adverse effects on natural and human systems. {3.3.3}

Examples for selected extremes and sectors are shown in Table SPM.3. {Table 3.2}

Table SPM.3. Examples of possible impacts of climate change due to changes in extreme weather and climate events, based on projections to the mid- to late 21st century. These do not take into account any changes or developments in adaptive capacity. The likelihood estimates in column 2 relate to the phenomena listed in column 1. (WGI Table SPM.1)

Phenomenon ^a and direction of trend	Likelihood of future trends based on projections for 21 st century using SRES scenarios	Examples of major projected impacts by sector			
		Agriculture, forestry and ecosystems (WGI 4.4, 5.4)	Water resources (WGI 3.4)	Human health (WGI 8.2, 8.4)	Industry, settlement and society (WGI 7.4)
Over most land areas, warmer and fewer cold days and nights, warmer and more frequent hot days and nights	Virtually certain ^b	Increased yields in colder environments; decreased yields in warmer environments; increased insect outbreaks	Effects on water resources relying on snowmelt; effects on some water supplies	Reduced human mortality from decreased cold exposure	Reduced energy demand for heating; increased demand for cooling; declining air quality in cities; reduced disruption to transport due to snow, ice, effects on winter tourism
Warm spells/heat waves. Frequency increased over most land areas	Very likely	Reduced yields in warmer regions due to heat stress; increased danger of wildfire	Increased water demand; water quality problems, e.g. algal blooms	Increased risk of heat-related mortality, especially for the elderly, chronically sick, very young and socially isolated	Reduction in quality of life for people in warm areas without appropriate housing; impacts on the elderly, very young and poor
Heavy precipitation events. Frequency increases over most areas	Very likely	Damage to crops; soil erosion; inability to cultivate land due to waterlogging of soils	Adverse effects on quality of surface and groundwater; contamination of water supply; water scarcity may be relieved	Increased risk of deaths, injuries and infectious, respiratory and skin diseases	Disruption of settlements, commerce, transport and societies due to flooding; pressures on urban and rural infrastructures; loss of property
Area affected by drought increases	Likely	Land degradation; lower yields/crop damage and failure; increased livestock deaths; increased risk of wildfire	More widespread water stress	Increased risk of food and water shortage; increased risk of malnutrition; increased risk of water- and food-borne diseases	Water shortage for settlements, industry and societies; reduced hydropower generation potentials; potential for population migration
Intense tropical cyclone activity increases	Likely	Damage to crops; windthrow (uprooting) of trees; damage to coral reefs	Power outages causing disruption of public water supply	Increased risk of deaths, injuries, water- and food-borne diseases; post-traumatic stress disorders	Disruption by flood and high winds; withdrawal of risk coverage in vulnerable areas by private insurers; potential for population migrations, loss of property
Increased incidence of extreme high sea level (excludes tsunamis) ^c	Likely ^d	Salinisation of irrigation water, estuaries and freshwater systems	Decreased freshwater availability due to saltwater intrusion	Increased risk of deaths and injuries by drowning in floods; migration-related health effects	Costs of coastal protection versus costs of land-use relocation; potential for movement of populations and infrastructure; also see tropical cyclones above

Notes:

- See WGI Table 3.7 for further details regarding definitions.
- Warming of the most extreme days and nights each year.
- Extreme high sea level depends on average sea level and on regional weather systems. It is defined as the highest 1% of hourly values of observed sea level at a station for a given reference period.
- In all scenarios, the projected global average sea level at 2100 is higher than in the reference period (WGI 10.6). The effect of changes in regional weather systems on sea level extremes has not been assessed.

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Anthropogenic warming and sea level rise would continue for centuries due to the timescales associated with climate processes and feedbacks, even if GHG concentrations were to be stabilised. {3.2.3}

Estimated long term (multi-century) warming corresponding to the six AR4 WG III stabilisation categories is shown in Figure SPM.8.

Estimated multi-century warming relative to 1980-1999 for AR4 stabilisation categories

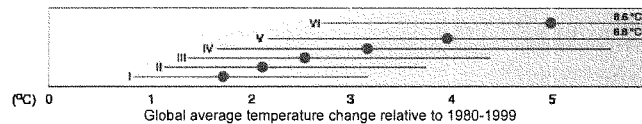


Figure SPM.8. Estimated long term (multi-century) warming corresponding to the six AR4 WGIII stabilisation categories (Table SPM.3). Temperature scale has been shifted by -0.5°C compared to Table SPM.3 to account approximately for the warming between pre-industrial and 1980-1999. For most stabilisation levels global average temperature is approaching the equilibrium level over a few centuries. For GHG emission scenarios that lead to stabilisation by 2100 at levels comparable to SRES B1 and A1B (600 and 850 $\text{CO}_2\text{-eq. ppm}$; category IV and V) assessed models project that about 65-70% of the estimated global equilibrium temperature increase assuming a climate sensitivity of 3°C would be realised at the time of stabilisation (WGI 10.7.2). For the much lower stabilisation scenarios (category I and II), the equilibrium temperature may be reached earlier (Figure SPM.11).

Contraction of the Greenland ice sheet is projected to continue to contribute to sea level rise after 2100. Current models suggest virtually complete elimination of the Greenland ice sheet and a resulting contribution to sea level rise of about 7 m if global average warming were sustained for millennia in excess of 1.9 to 4.6°C relative to pre-industrial values. The corresponding future temperatures in Greenland are comparable to those inferred for the last interglacial period 125,000 years ago, when paleoclimatic information suggests reductions of polar land ice extent and 4 to 6 m of sea level rise. {3.2.3}

Current global model studies project that the Antarctic ice sheet will remain too cold for widespread surface melting and gain mass due to increased snowfall. However, net loss of ice mass could occur if dynamical ice discharge dominates the ice sheet mass balance. {3.2.3}

Anthropogenic warming could lead to some impacts that are abrupt or irreversible, depending upon the rate and magnitude of the climate change. {3.4}

Partial loss of ice sheets on polar land could imply metres of sea level rise, major changes in coastlines and inundation of low-lying areas, with greatest effects in river deltas and low-lying islands. Such changes are projected to occur over millennial time scales, but more rapid sea level rise on century time scales cannot be excluded. {3.4}

Climate change is *likely* to lead to some irreversible impacts. There is *medium confidence* that approximately 20-30% of species assessed so far are *likely* to be at increased risk of extinction if increases in global average warming exceed 1.5 - 2.5°C (relative to 1980-1999). As global average temperature increase exceeds about 3.5°C , model projections suggest significant extinctions (40-70% of species assessed) around the globe. {3.4}

Based on current model simulations, the meridional overturning circulation (MOC) of the Atlantic Ocean will *very likely* slow down during the 21st century; nevertheless temperatures over the Atlantic and Europe are projected to increase. The MOC is *very unlikely* to undergo a large abrupt transition during the 21st century. Longer-term MOC changes cannot be assessed with confidence. Impacts of large-scale and persistent changes in the MOC are *likely* to include changes in marine ecosystem productivity, fisheries, ocean CO_2 uptake, oceanic oxygen concentrations and terrestrial vegetation. Changes in terrestrial and ocean CO_2 uptake may feed back on the climate system. {3.4}

4. Adaptation and mitigation options¹⁴

A wide array of adaptation options is available, but more extensive adaptation than is currently occurring is required to reduce vulnerability to climate change. There are barriers, limits and costs, which are not fully understood. {4.2}

Societies have a long record of managing the impacts of weather- and climate-related events. Nevertheless, additional adaptation measures will be required to reduce the adverse impacts of projected climate change and variability, regardless of the scale of mitigation undertaken over the next two to three decades. Moreover, vulnerability to climate change can be exacerbated by other stresses. These arise from, for example, current climate hazards, poverty and unequal access to resources, food insecurity, trends in economic globalisation, conflict and incidence of diseases such as HIV/AIDS. {4.2}

Some planned adaptation to climate change is already occurring on a limited basis. Adaptation can reduce vulnerability especially when it is embedded within broader sectoral initiatives (Table SPM.4). There is *high confidence* that there are viable adaptation options that can be implemented in some sectors at low cost, and/or with high benefit-cost ratios. However, comprehensive estimates of global costs and benefits of adaptation are limited. {4.2, Table 4.1}

Adaptive capacity is intimately connected to social and economic development but is unevenly distributed across and within societies. {4.2}

A range of barriers limit both the implementation and effectiveness of adaptation measures. The capacity to adapt is dynamic and is influenced by a society's productive base including: natural and man-made capital assets, social networks and entitlements, human capital and institutions, governance, national income, health and technology. Even societies with high adaptive capacity remain vulnerable to climate change, variability and extremes. {4.2}

Both bottom-up and top-down studies indicate that there is *high agreement* and *much evidence* of substantial economic potential for the mitigation of global GHG emissions over the coming decades that could offset the projected growth of global emissions or reduce emissions below current levels (Figure SPM.9, SPM.10)¹⁵. While top-down and bottom-up studies are in line at the global level (Figure SPM.9) there are considerable differences at the sectoral level. {4.3}

No single technology can provide all of the mitigation potential in any sector. The economic mitigation potential, which is generally greater than the market mitigation potential, can only be achieved when adequate policies are in place and barriers removed (Table SPM.5).

Bottom-up studies suggest that mitigation opportunities with net negative costs have the potential to reduce emissions by around 6 GtCO₂-eq/yr in 2030, realizing which requires dealing with implementation barriers. {4.3}

¹⁴ While this section deals with adaptation and mitigation separately, these responses can be complementary. This theme is discussed in section 5.

¹⁵ The concept of "mitigation potential" has been developed to assess the scale of CHG reductions that could be made, relative to emission baselines, for a given level of carbon price (expressed in cost per unit of carbon dioxide equivalent emissions avoided or reduced). Mitigation potential is further differentiated in terms of "market mitigation potential" and "economic mitigation potential".

Market mitigation potential is the mitigation potential based on private costs and private discount rates (reflecting the perspective of private consumers and companies), which might be expected to occur under forecast market conditions, including policies and measures currently in place, noting that barriers limit actual uptake.

Economic mitigation potential is the mitigation potential, which takes into account social costs and benefits and social discount rates (reflecting the perspective of society, social discount rates are lower than those used by private investors), assuming that market efficiency is improved by policies and measures and barriers are removed.

Mitigation potential is estimated using different types of approaches. **Bottom-up studies** are based on assessment of mitigation options, emphasizing specific technologies and regulations. They are typically sectoral studies taking the macro-economy as unchanged. **Top-down studies** assess the economy-wide potential of mitigation options. They use globally consistent frameworks and aggregated information about mitigation options and capture macro-economic and market feedbacks.

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Table SPM-4. Selected examples of planned adaptation by sector.

Sector	Adaptation option/strategy	Underlying policy framework	Key constraints and opportunities to implementation (Normal font = constraints; <i>italics</i> = opportunities)
Water	Expanded rainwater harvesting; water storage and conservation techniques; water re-use; desalination; water-use and irrigation efficiency	National water policies and integrated water resources management; water-related hazards management	Financial, human resources and physical barriers; <i>integrated water resources management; synergies with other sectors</i>
Agriculture	Adjustment of planting dates and crop variety; crop relocation; improved land management, e.g. erosion control and soil protection through tree planting	R&D policies; institutional reform; land tenure and land reform; training; capacity building; crop insurance; financial incentives, e.g. subsidies and tax credits	Technological & financial constraints; access to new varieties; markets; <i>longer growing season in higher latitudes; revenues from 'new' products</i>
Infrastructure/settlement (including coastal zones)	Relocation; seawalls and storm surge barriers; dune reinforcement; land acquisition and creation of marshlands/wetlands as buffer against sea level rise and flooding; protection of existing natural barriers	Standards and regulations that integrate climate change considerations into design; land use policies; building codes; insurance	Financial and technological barriers; availability of relocation space; <i>integrated policies and managements; synergies with sustainable development goals</i>
Human health	Heat-health action plans; emergency medical services; improved climate-sensitive disease surveillance and control; safe water and improved sanitation	Public health policies that recognise climate risk; strengthened health services; regional and international cooperation	Limits to human tolerance (vulnerable groups); knowledge limitations; financial capacity; <i>upgraded health services; improved quality of life</i>
Tourism	Diversification of tourism attractions & revenues; shifting ski slopes to higher altitudes and glaciers; artificial snow-making	Integrated planning (e.g. carrying capacity; linkages with other sectors); financial incentives, e.g. subsidies and tax credits	Appeal/marketing of new attractions; financial and logistical challenges; potential adverse impact on other sectors (e.g. artificial snow-making may increase energy use); <i>revenues from 'new' attractions; involvement of wider group of stakeholders</i>
Transport	Realignment/relocation; design standards and planning for roads, rail, and other infrastructure to cope with warming and drainage	Integrating climate change considerations into national transport policy; investment in R&D for special situations, e.g. permafrost areas	Financial & technological barriers; availability of less vulnerable routes; <i>improved technologies and integration with key sectors (e.g. energy)</i>
Energy	Strengthening of overhead transmission and distribution infrastructure; underground cabling for utilities; energy efficiency; use of renewable sources; reduced dependence on single sources of energy	National energy policies, regulations, and fiscal and financial incentives to encourage use of alternative sources; incorporating climate change in design standards	Access to viable alternatives; financial and technological barriers; acceptance of new technologies; <i>stimulation of new technologies; use of local resources</i>

Note: Other examples from many sectors would include early warning systems.

Comparison between global economic mitigation potential and projected emissions increase in 2030

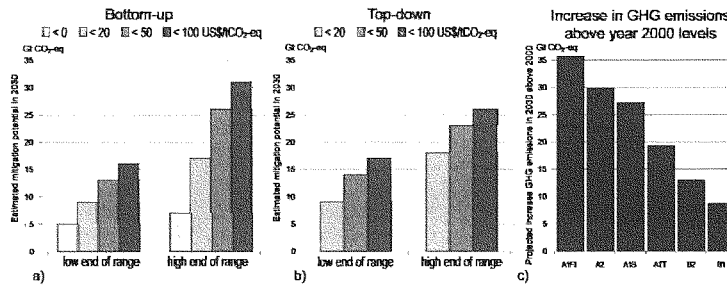


Figure SPM.9. Global economic mitigation potential in 2030 estimated from bottom-up (Panel a) and top-down (Panel b) studies, compared with the projected emission increases from SRES scenarios relative to 2000 GHG emissions of 40.8 GtCO₂-eq (Panel c). Note: GHG emissions in 2000 are exclusive of emissions of decay of above ground biomass that remains after logging and deforestation and from peat fires and drained peat soils, to ensure consistency with the SRES emission results.

Economic mitigation potential by sector in 2030 estimated from bottom-up studies

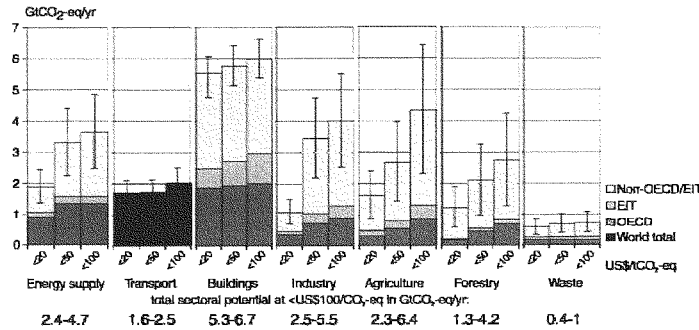


Figure SPM.10. Estimated economic mitigation potential by sector in 2030 from bottom-up studies, compared to the respective baselines assumed in the sector assessments. The potentials do not include non-technical options such as lifestyle changes. (Figure 4.1)

Notes:
 a) The ranges for global economic potentials as assessed in each sector are shown by vertical lines. The ranges are based on end-use allocations of emissions, meaning that emissions of electricity use are counted towards the end-use sectors and not to the energy supply sector.
 b) The estimated potentials have been constrained by the availability of studies particularly at high carbon price levels.
 c) Sectors used different baselines. For industry the SRES B2 baseline was taken, for energy supply and transport the WEO 2004 baseline was used; the building sector is based on a baseline in between SRES B2 and A1B; for waste, SRES A1B driving forces were used to construct a waste specific baseline; agriculture and forestry used baselines that mostly used B2 driving forces.
 d) Only global totals for transport are shown because international aviation is included.
 e) Categories excluded are: non-CO₂ emissions in buildings and transport, part of material efficiency options, heat production and cogeneration in energy supply, heavy duty vehicles, shipping and high-occupancy passenger transport, most high-cost options for buildings, wastewater treatment, emission reduction from coal mines and gas pipelines, fluorinated gases from energy supply and transport. The underestimation of the total economic potential from these emissions is of the order of 10-15%.

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Table SPM-5. Selected examples of key sectoral mitigation technologies, policies and measures, constraints and opportunities. (WGIII, Tables SPM.3, SPM.7)

Sector	Key mitigation technologies and practices currently commercially available. <i>Key mitigation technologies and practices projected to be commercialised before 2030 shown in italics.</i>	Policies, measures and instruments shown to be environmentally effective	Key constraints or opportunities (Normal font = constraints; <i>Italics = opportunities</i>)
Energy Supply	Improved supply and distribution efficiency; fuel switching from coal to gas; nuclear power; renewable heat and power (hydropower, solar, wind, geothermal and bioenergy); combined heat and power; early applications of Carbon Dioxide Capture and Storage (CCS) (e.g. storage of removed CO ₂ from natural gas); <i>CCS for gas, biomass and coal-fired electricity generating facilities; advanced nuclear power; advanced renewable energy, including tidal and wave energy, concentrating solar, and solar photovoltaics</i>	Reduction of fossil fuel subsidies; Taxes or carbon charges on fossil fuels	Resistance by vested interests may make them difficult to implement
		Feed-in tariffs for renewable energy technologies; Renewable energy obligations; Producer subsidies	<i>May be appropriate to create markets for low emissions technologies</i>
Transport	More fuel efficient vehicles; hybrid vehicles; cleaner diesel vehicles; biofuels; modal shifts from road transport to rail and public transport systems; non-motorised transport (cycling, walking); land-use and transport planning; <i>Second generation biofuels; higher efficiency aircraft; advanced electric and hybrid vehicles with more powerful and reliable batteries</i>	Mandatory fuel economy, biofuel blending and CO ₂ standards for road transport	Partial coverage of vehicle fleet may limit effectiveness
		Taxes on vehicle purchase, registration, use and motor fuels, road and parking pricing	Effectiveness may drop with higher incomes
		Influence mobility needs through land use regulations, and infrastructure planning; Investment in attractive public transport facilities and non-motorised forms of transport	<i>Particularly appropriate for countries that are building up their transportation systems</i>
Buildings	Efficient lighting and daylighting; more efficient electrical appliances and heating and cooling devices; improved cook stoves; improved insulation; passive and active solar design for heating and cooling; alternative refrigeration fluids, recovery and recycling of fluorinated gases; <i>Integrated design of commercial buildings including technologies, such as intelligent meters that provide feedback and control; solar photovoltaics integrated in buildings</i>	Appliance standards and labelling	Periodic revision of standards needed
		Building codes and certification	<i>Attractive for new buildings.</i> Enforcement can be difficult
		Demand-side management programmes	Need for regulations so that utilities may profit
		Public sector leadership programmes, including procurement	<i>Government purchasing can expand demand for energy-efficient products</i>
Industry	More efficient end-use electrical equipment; heat and power recovery; material recycling and substitution; control of non-CO ₂ gas emissions; and a wide array of process-specific technologies; <i>Advanced energy efficiency, CCS for cement, ammonia, and iron manufacture; inert electrodes for aluminium manufacture</i>	Provision of benchmark information; Performance standards; Subsidies, tax credits	<i>May be appropriate to stimulate technology uptake.</i> Stability of national policy important in view of international competitiveness
		Tradable permits	Predictable allocation mechanisms and stable price signals important for investments
		Voluntary agreements	Success factors include: clear targets, a baseline scenario, third party involvement in design and review and formal provisions of monitoring, close cooperation between government and industry
Agriculture	Improved crop and grazing land management to increase soil carbon storage; restoration of cultivated peaty soils and degraded lands; improved rice cultivation techniques and livestock and manure management to reduce CH ₄ emissions; improved nitrogen fertiliser application techniques to reduce N ₂ O emissions; dedicated energy crops to replace fossil fuel use; improved energy efficiency; <i>improvements of crop yields</i>	Financial incentives and regulations for improved land management, maintaining soil carbon content, efficient use of fertilisers and irrigation	<i>May encourage synergy with sustainable development and with reducing vulnerability to climate change, thereby overcoming barriers to implementation</i>

Table SPM-5. (cont.)

Sector	Key mitigation technologies and practices currently commercially available. Key mitigation technologies and practices projected to be commercialised before 2030 shown in italics.	Policies, measures and instruments shown to be environmentally effective	Key constraints or opportunities (Normal font = constraints; italics = opportunities)
Forestry/forests	Afforestation; reforestation; forest management; reduced deforestation; harvested wood product management; use of forestry products for bioenergy to replace fossil fuel use; <i>Tree species improvement to increase biomass productivity and carbon sequestration. Improved remote sensing technologies for analysis of vegetation/soil carbon sequestration potential and mapping land use change</i>	Financial incentives (national and international) to increase forest area, to reduce deforestation, and to maintain and manage forests; Land-use regulation and enforcement	Constraints include lack of investment capital and land tenure issues. <i>Can help poverty alleviation.</i>
Waste	Landfill CH ₄ recovery; waste incineration with energy recovery; composting of organic waste; controlled waste water treatment; recycling and waste minimisation; <i>biocovers and biofilters to optimise CH₄ oxidation</i>	Financial incentives for improved waste and wastewater management	<i>May stimulate technology diffusion</i>
		Renewable energy incentives or obligations	Local availability of low-cost fuel
		Waste management regulations	Most effectively applied at national level with enforcement strategies

Future energy infrastructure investment decisions, expected to exceed 20 trillion US\$¹⁶ between 2005 and 2030, will have long-term impacts on GHG emissions, because of the long life-times of energy plants and other infrastructure capital stock. The widespread diffusion of low-carbon technologies may take many decades, even if early investments in these technologies are made attractive. Initial estimates show that returning global energy-related CO₂ emissions to 2005 levels by 2030 would require a large shift in investment patterns, although the net additional investment required ranges from negligible to 5-10%. {4.3}

A wide variety of policies and instruments are available to governments to create the incentives for mitigation action. Their applicability depends on national circumstances and sectoral context (Table SPM5). {4.3}

They include integrating climate policies in wider development policies, regulations and standards, taxes and charges, tradable permits, financial incentives, voluntary agreements, information instruments, and research, development and demonstration (RD&D). {4.3}

An effective carbon-price signal could realise significant mitigation potential in all sectors. Modelling studies show global carbon prices rising to 20-80 US\$/tCO₂-eq by 2030 are consistent with stabilisation at around 550 ppm CO₂-eq by 2100. For the same stabilisation level, induced technological change may lower these price ranges to 5-65 US\$/tCO₂-eq in 2030.¹⁷ {4.3}

There is *high agreement* and *much evidence* that mitigation actions can result in near-term co-benefits (e.g. improved health due to reduced air pollution) that may offset a substantial fraction of mitigation costs. {4.3}

There is *high agreement* and *medium evidence* that Annex I countries' actions may affect the global economy and global emissions, although the scale of carbon leakage remains uncertain.¹⁸ {4.3}

¹⁶ 20 trillion = 20,000 billion = 20 × 10¹²

¹⁷ Studies on mitigation portfolios and macro-economic costs assessed in this report are based on top-down modelling. Most models use a global least cost approach to mitigation portfolios, with universal emissions trading, assuming transparent markets, no transaction cost, and thus perfect implementation of mitigation measures throughout the 21st century. Costs are given for a specific point in time. Global modelled costs will increase if some regions, sectors (e.g. land-use), options or gases are excluded. Global modelled costs will decrease with lower baselines, use of revenues from carbon taxes and auctioned permits, and if induced technological learning is included. These models do not consider climate benefits and generally also co-benefits of mitigation measures, or equity issues. Significant progress has been achieved in applying approaches based on induced technological change to stabilisation studies; however, conceptual issues remain. In the models that consider induced technological change, projected costs for a given stabilisation level are reduced; the reductions are greater at lower stabilisation level.

¹⁸ Further details may be found in Topic 4 of the Synthesis Report.

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Fossil fuel exporting nations (in both Annex I and non-Annex I countries) may expect, as indicated in the TAR, lower demand and prices and lower GDP growth due to mitigation policies. The extent of this spill over depends strongly on assumptions related to policy decisions and oil market conditions.

There is also *high agreement* and *medium evidence* that changes in lifestyle, behaviour patterns and management practices can contribute to climate change mitigation across all sectors. {4.3}

Many options for reducing global GHG emissions through international cooperation exist. There is *high agreement* and *much evidence* that notable achievements of the UNFCCC and its Kyoto Protocol are the establishment of a global response to climate change, stimulation of an array of national policies, and the creation of an international carbon market and new institutional mechanisms that may provide the foundation for future mitigation efforts. Progress has also been made in addressing adaptation within the UNFCCC and additional international initiatives have been suggested. {4.5}

Greater cooperative efforts and expansion of market mechanisms will help to reduce global costs for achieving a given level of mitigation, or will improve environmental effectiveness. Efforts can include diverse elements such as emissions targets; sectoral, local, sub-national and regional actions; RD&D programmes; adopting common policies; implementing development oriented actions; or expanding financing instruments. {4.5}

In several sectors, climate response options can be implemented to realise synergies and avoid conflicts with other dimensions of sustainable development. Decisions about macroeconomic and other non-climate policies can significantly affect emissions, adaptive capacity and vulnerability. {4.4, 5.8}

Making development more sustainable can enhance mitigative and adaptive capacities, reduce emissions, and reduce vulnerability, but there may be barriers to implementation. On the other hand, it is *very likely* that climate change can slow the pace of progress towards sustainable development. Over the next half-century, climate change could impede achievement of the Millennium Development Goals. {5.8}

5. The long-term perspective

Determining what constitutes “dangerous anthropogenic interference with the climate system” in relation to Article 2 of the UNFCCC involves value judgements. Science can support informed decisions on this issue, including by providing criteria for judging which vulnerabilities might be labelled “key”. {Box ‘Key Vulnerabilities and Article 2 of the UNFCCC’, topic 5}

Key vulnerabilities¹⁹ may be associated with many climate sensitive systems including food supply, infrastructure, health, water resources, coastal systems, ecosystems, global biogeochemical cycles, ice sheets, and modes of oceanic and atmospheric circulation. {Box ‘Key Vulnerabilities and Article 2 of the UNFCCC’, topic 5}

The five “reasons for concern” identified in the TAR remain a viable framework to consider key vulnerabilities. These “reasons” are assessed here to be stronger than in the TAR. Many risks are identified with higher confidence. Some risks are projected to be larger or to occur at lower increases in temperature. Understanding about the relationship between impacts (the basis for “reasons for concern” in the TAR) and vulnerability (that includes the ability to adapt to impacts) has improved. {5.2}

This is due to more precise identification of the circumstances that make systems, sectors and regions especially vulnerable, and growing evidence of the risks of very large impacts on multiple century time scales. {5.2}

¹⁹ Key Vulnerabilities can be identified based on a number of criteria in the literature, including magnitude, timing, persistence/reversibility, the potential for adaptation, distributional aspects, likelihood and ‘importance’ of the impacts.

- **Risks to unique and threatened systems.** There is new and stronger evidence of observed impacts of climate change on unique and vulnerable systems (such as polar and high mountain communities and ecosystems), with increasing levels of adverse impacts as temperatures increase further. An increasing risk of species extinction and coral reef damage is projected with higher confidence than in the TAR as warming proceeds. There is *medium confidence* that approximately 20-30% of plant and animal species assessed so far are *likely* to be at increased risk of extinction if increases in global average temperature exceed 1.5-2.5°C over 1980-1999 levels. Confidence has increased that a 1-2°C increase in global mean temperature above 1990 levels (about 1.5-2.5°C above pre-industrial) poses significant risks to many unique and threatened systems including many biodiversity hotspots. Corals are vulnerable to thermal stress and have low adaptive capacity. Increases in sea surface temperature of about 1-3°C are projected to result in more frequent coral bleaching events and widespread mortality, unless there is thermal adaptation or acclimatization by corals. Increasing vulnerability of indigenous communities in the Arctic and small island communities to warming is projected.
- **Risks of extreme weather events.** Responses to some recent extreme events reveal higher levels of vulnerability than the TAR. There is now higher confidence in the projected increases in droughts, heatwaves, and floods as well as their adverse impacts.
- **Distribution of impacts and vulnerabilities.** There are sharp differences across regions and those in the weakest economic position are often the most vulnerable to climate change. There is increasing evidence of greater vulnerability of specific groups such as the poor and elderly in not only developing but also developed countries. Moreover, there is increased evidence that low-latitude and less-developed areas generally face greater risk, for example in dry areas and mega-deltas.
- **Aggregate impacts.** Compared to the TAR, initial net market-based benefits from climate change are projected to peak at a lower magnitude of warming, while damages would be higher for larger magnitudes of warming. The net costs of impacts of increased warming are projected to increase over time.
- **Risks of large-scale singularities.** There is *high confidence* that global warming over many centuries would lead to a sea level rise contribution from thermal expansion alone which is projected to be much larger than observed over the 20th century, with loss of coastal area and associated impacts. There is better understanding than in the TAR that the risk of additional contributions to sea level rise from both the Greenland and possibly Antarctic ice sheets may be larger than projected by ice sheet models and could occur on century time scales. This is because ice dynamical processes seen in recent observations but not fully included in ice sheet models assessed in AR4 could increase the rate of ice loss.

There is *high confidence* that neither adaptation nor mitigation alone can avoid all climate change impacts; however, they can complement each other and together can significantly reduce the risks of climate change. {5.3}

Adaptation is necessary in the short and longer term to address impacts resulting from the warming that would occur even for the lowest stabilisation scenarios assessed. There are barriers, limits and costs, but these are not fully understood. Unmitigated climate change would, in the long term, be *likely* to exceed the capacity of natural, managed and human systems to adapt. The time at which such limits could be reached will vary between sectors and regions. Early mitigation actions would avoid further locking in carbon intensive infrastructure and reduce climate change and associated adaptation needs. {5.2, 5.3}

Many impacts can be reduced, delayed or avoided by mitigation. Mitigation efforts and investments over the next two to three decades will have a large impact on opportunities to achieve lower stabilisation levels. Delayed emission reductions significantly constrain the opportunities to achieve lower stabilisation levels and increase the risk of more severe climate change impacts. {5.3, 5.4, 5.7}

In order to stabilise the concentration of GHGs in the atmosphere, emissions would need to peak and decline thereafter. The lower the stabilisation level, the more quickly this peak and decline would need to occur.²⁰ {5.4}

²⁰ For the lowest mitigation scenario category assessed, emissions would need to peak by 2015 and for the highest by 2090 (see Table SPM.3). Scenarios that use alternative emission pathways show substantial differences in the rate of global climate change.

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Table SPM.6 and Figure SPM.11 summarise the required emission levels for different groups of stabilisation concentrations and the resulting equilibrium global warming and long-term sea level rise due to thermal expansion only.²¹ The timing and level of mitigation to reach a given temperature stabilisation level is earlier and more stringent if climate sensitivity is high than if it is low. {5.4, 5.7}

Sea level rise under warming is inevitable. Thermal expansion would continue for many centuries after GHG concentrations have stabilised, for any of the stabilisation levels assessed, causing an eventual sea level rise much larger than projected for the 21st century. The eventual contributions from Greenland ice sheet loss could be several metres, and larger than from thermal expansion, should warming in excess of 1.9-4.6°C above pre-industrial be sustained over many centuries. The long time scales of thermal expansion and ice sheet response to warming imply that stabilisation of GHG concentrations at or above present levels would not stabilise sea level for many centuries. {5.3, 5.4}

Table SPM.6. Characteristics of post-TAR stabilisation scenarios and resulting long-term equilibrium global average temperature and the sea level rise component from thermal expansion only. (Table 5.1)^a

Category	CO ₂ concentration at stabilization (2005 = 379 ppm) ^b	CO ₂ -equivalent concentration at stabilization including GHGs and aerosols (2005 = 375 ppm) ^b	Peaking year for CO ₂ emissions ^{c, d}	Change in global CO ₂ emissions in 2050 (% of 2000 emissions) ^{b, c, d}	Global average temperature increase above pre-industrial at equilibrium, using "best estimate" climate sensitivity ^{e, f}	Global average sea level rise above pre-industrial at equilibrium from thermal expansion only ^f	Number of assessed scenarios
	ppm	ppm	Year	Percent	°C	metres	
I	350 – 400	445 – 490	2000 – 2015	-85 to -50	2.0 – 2.4	0.4 – 1.4	6
II	400 – 440	490 – 535	2000 – 2020	-60 to -30	2.4 – 2.8	0.5 – 1.7	18
III	440 – 485	535 – 590	2010 – 2030	-30 to +5	2.8 – 3.2	0.6 – 1.9	21
IV	485 – 570	590 – 710	2020 – 2060	+10 to +60	3.2 – 4.0	0.6 – 2.4	118
V	570 – 660	710 – 855	2050 – 2080	+25 to +85	4.0 – 4.9	0.8 – 2.9	9
VI	660 – 790	855 – 1130	2060 – 2090	+90 to +140	4.9 – 6.1	1.0 – 3.7	5

Notes:

- The emission reductions to meet a particular stabilization level reported in the mitigation studies assessed here might be underestimated due to missing carbon cycle feedbacks (see also Topic 2).
- Atmospheric CO₂ concentrations were 379 ppm in 2005. The best estimate of total CO₂-eq concentration in 2005 for all long-lived GHGs is about 455 ppm, while the corresponding value including the net effect of all anthropogenic forcing agents is 375 ppm CO₂-eq.
- Ranges correspond to the 15th to 85th percentile of the post-TAR scenario distribution. CO₂ emissions are shown so multi-gas scenarios can be compared with CO₂-only scenarios (see Figure SPM.3).
- The best estimate of climate sensitivity is 3°C.
- Note that global average temperature at equilibrium is different from expected global average temperature at the time of stabilization of GHG concentrations due to the inertia of the climate system. For the majority of scenarios assessed, stabilisation of GHG concentrations occurs between 2100 and 2150 (see also Footnote 9).
- Equilibrium sea level rise is for the contribution from ocean thermal expansion only and does not reach equilibrium for at least many centuries. These values have been estimated using relatively simple climate models (one low resolution AOGCM and several EMICs based on the best estimate of 3°C climate sensitivity) and do not include contributions from melting ice sheets, glaciers and ice caps. Long-term thermal expansion is projected to result in 0.2 to 0.6 m per degree Celsius of global average warming above preindustrial. (AOGCM refers to Atmosphere Ocean General Circulation Models and EMICs to Earth System Models of Intermediate Complexity.)

²¹ Estimates for the evolution of temperature over the course of this century are not available in the AR4 for the stabilisation scenarios. For most stabilisation levels global average temperature is approaching the equilibrium level over a few centuries. For the much lower stabilisation scenarios (category I and II, Figure SPM.11), the equilibrium temperature may be reached earlier.

CO₂ emissions and equilibrium temperature increases for a range of stabilisation levels

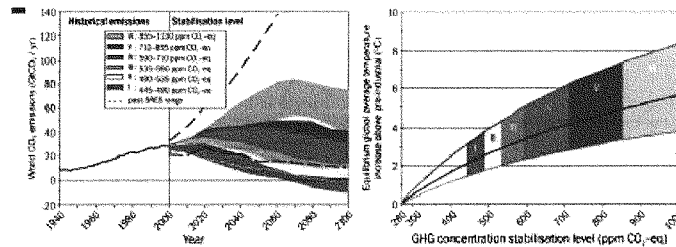


Figure SPM.11. Global CO₂ emissions for 1940 to 2000 and emissions ranges for categories of stabilisation scenarios from 2000 to 2100 (left-hand panel); and the corresponding relationship between the stabilisation target and the *likely* equilibrium global average temperature increase above pre-industrial (right-hand panel). Approaching equilibrium can take several centuries, especially for scenarios with higher levels of stabilisation. Coloured shadings show stabilisation scenarios grouped according to different targets (stabilisation category I to VI). Right-hand panel shows ranges of global average temperature change above pre-industrial, using (i) “best estimate” climate sensitivity of 3°C (black line in middle of shaded area), (ii) upper bound of *likely* range of climate sensitivity of 4.5°C (red line at top of shaded area) (iii) lower bound of *likely* range of climate sensitivity of 2°C (blue line at bottom of shaded area). Black dashed lines in the left panel give the emissions range of recent baseline scenarios published since the SRES (2000). Emissions ranges of the stabilisation scenarios comprise CO₂-only and multigas scenarios and correspond to the 10th-90th percentile of the full scenario distribution. Note: CO₂ emissions in most models do not include emissions from decay of above ground biomass that remains after logging and deforestation, and from peat fires and drained peat soils. (Figure 5.1)

There is *high agreement* and *much evidence* that all stabilisation levels assessed can be achieved by deployment of a portfolio of technologies that are either currently available or expected to be commercialised in coming decades, assuming appropriate and effective incentives are in place for their development, acquisition, deployment and diffusion and addressing related barriers. {5.5}

All assessed stabilisation scenarios indicate that 60-80% of the reductions would come from energy supply and use, and industrial processes, with energy efficiency playing a key role in many scenarios. Including non-CO₂ and CO₂ land-use and forestry mitigation options provides greater flexibility and cost-effectiveness. Low stabilisation levels require early investments and substantially more rapid diffusion and commercialisation of advanced low-emissions technologies.

Without substantial investment flows and effective technology transfer, it may be difficult to achieve emission reduction at a significant scale. Mobilizing financing of incremental costs of low-carbon technologies is important. {5.5}

The macro-economic costs of mitigation generally rise with the stringency of the stabilisation target (Table SPM.7). For specific countries and sectors, costs vary considerably from the global average.²² {5.6}

In 2050, global average macro-economic costs for mitigation towards stabilisation between 710 and 445ppm CO₂-eq are between a 1% gain and 5.5% decrease of global GDP (Table SPM.7). This corresponds to slowing average annual global GDP growth by less than 0.12 percentage points. {5.6}

²² See footnote 17 for more detail on cost estimates and model assumptions.

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Table SPM.7. Estimated global macro-economic costs in 2030 and 2050. Costs are relative to the baseline for least-cost trajectories towards different long-term stabilisation levels. (Table 5.2)

Stabilisation levels (ppm CO ₂ -eq)	Median GDP reduction ^(a) (%)		Range of GDP reduction ^(b) (%)		Reduction of average annual GDP growth rates (percentage points) ^{(c), (d)}	
	2030	2050	2030	2050	2030	2050
445 – 535 ^(e)	Not available		< 3	< 5.5	< 0.12	< 0.12
535 – 590	0.6	1.3	0.2 to 2.5	slightly negative to 4	< 0.1	< 0.1
590 – 710	0.2	0.5	-0.6 to 1.2	-1 to 2	< 0.06	< 0.05

Notes: Values given in this table correspond to the full literature across all baselines and mitigation scenarios that provide GDP numbers.

a) Global GDP based on market exchange rates.

b) The 10th and 90th percentile range of the analysed data are given where applicable. Negative values indicate GDP gain. The first row (445-535 ppm CO₂-eq) gives the upper bound estimate of the literature only.

c) The calculation of the reduction of the annual growth rate is based on the average reduction during the assessed period that would result in the indicated GDP decrease by 2030 and 2050 respectively.

d) The number of studies is relatively small and they generally use low baselines. High emissions baselines generally lead to higher costs.

e) The values correspond to the highest estimate for GDP reduction shown in column three.

Responding to climate change involves an iterative risk management process that includes both adaptation and mitigation and takes into account climate change damages, co-benefits, sustainability, equity, and attitudes to risk. {5.1}

Impacts of climate change are *very likely* to impose net annual costs which will increase over time as global temperatures increase. Peer-reviewed estimates of the social cost of carbon²³ in 2005 average US\$12 per tonne of CO₂, but the range from 100 estimates is large (-\$3 to \$95/tCO₂). This is due in large part to differences in assumptions regarding climate sensitivity, response lags, the treatment of risk and equity, economic and non-economic impacts, the inclusion of potentially catastrophic losses, and discount rates. Aggregate estimates of costs mask significant differences in impacts across sectors, regions and populations and *very likely* underestimate damage costs because they cannot include many non-quantifiable impacts. {5.7}

Limited and early analytical results from integrated analyses of the costs and benefits of mitigation indicate that they are broadly comparable in magnitude, but do not as yet permit an unambiguous determination of an emissions pathway or stabilisation level where benefits exceed costs. {5.7}

Climate sensitivity is a key uncertainty for mitigation scenarios for specific temperature levels.

Choices about the scale and timing of GHG mitigation involve balancing the economic costs of more rapid emission reductions now against the corresponding medium-term and long-term climate risks of delay. {5.4}

²³ Net economic costs of damages from climate change aggregated across the globe and discounted to the specified year.