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EIA ANALYSIS OF DRAFT CLIMATE CHANGE LEGISLATION

HEARING

BEFORE THE

COMMITTEE ON ENERGY AND NATURAL RESOURCES UNITED STATES SENATE

ONE HUNDRED TENTH CONGRESS

FIRST SESSION

ON

ANALYSIS RECENTLY COMPLETED BY THE ENERGY INFORMATION ADMINISTRATION, "ENERGY MARKET AND ECONOMIC IMPACTS OF A PROPOSAL TO REDUCE GREENHOUSE GAS INTENSITY WITH A CAP AND TRADE SYSTEM"

JANUARY 24, 2007

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EIA ANALYSIS OF DRAFT CLIMATE CHANGE LEGISLATION

WEDNESDAY, JANUARY 24, 2007

U.S. SENATE,
COMMITTEE ON ENERGY AND NATURAL RESOURCES,
Washington, DC.

The committee met, pursuant to notice, at 9:45 a.m., in room SD–366, Dirksen Senate Office Building, Hon. Jeff Bingaman, chairman, presiding.

OPENING STATEMENT OF HON. JEFF BINGAMAN, U.S. SENATOR FROM NEW MEXICO

The CHAIRMAN. Alright, why don't we go ahead and get the committee hearing started. Let me indicate that today we are going to have testimony on the Energy Information Administration's report on Draft Climate Change Legislation. Also, we are going to take action on three routine business matters.

In the interest of time, rather than waiting to get a reporting quorum, I think we need to just start with our hearing and advise everybody that if we get 12 Senators in the room we are going to interrupt everyone at that point and do these three business items which need to be done with the 12 Senators, but that may be a while. So, let me just welcome all the witnesses and make a short statement here and then ask Senator Domenici for the statement that he has and then introduce the witnesses.

Thank you all for being here. This hearing will focus on this Energy Information Administration Analysis of the Draft Global Warming Legislation and the economic impact that that would have on our country. Last year several of us, Senators Specter and Lugar as well as Senators Landrieu, Salazar, and Murkowski here on this committee, submitted draft legislation to the EIA asking them to look at it and I appreciate those members joining in that request. The draft was the culmination of over a years worth of work. It began with an EIA analysis of the Climate Proposal by the National Commission on Energy Policy which was 18 months or more ago.

Over the past Congress we visited the issue on the floor; we had, under Senator Domenici's leadership, a day-long workshop here in this committee with 29 participants to explore the design features of a cap and trade proposal. We received this EIA analysis as a next step. We asked for it as a next step in trying to craft legislation that would be appropriate to deal with this issue. We circulated this draft. Senator Specter and I have initiated the process of trying to improve on the draft and having this hearing, which

I think gets us started in that process. We also hope to have more hearings on the issue of climate change. Sir Nicholas Stern is scheduled to testify before our committee next month. I hope that will give the committee another chance to review the impacts of global warming and the impacts of delaying action on global warming.

There are obviously a lot of different parts to this issue. It is a complex issue. I hope that as many members as are willing to, will engage themselves and take the time to try to understand and settle on their views on the various issues that are raised, so I appreciate very much the time and the effort that Senator Domenici and his staff have committed to this very difficult set of issues, as well as other members of the committee. I call on Senator Domenici for his statement before we hear from the witnesses.

STATEMENT OF HON. PETE V. DOMENICI, U.S. SENATOR FROM NEW MEXICO

Senator DOMENICI. Thank you very much, Senator Bingaman. I note that we might let it be known to the staff that if we get a couple of more Senators, we have 12, and that whenever there's 12, we will stop and turn it back over to you so you can have the business meeting and pass the three business items that are sitting around and I think that would be good.

I want to add my thanks to yours regarding the witnesses for taking time out of their busy schedules for participation in this hearing today. I thank each one of you. I did not get a chance here this morning yet, but I do now.

In his State of the Union address last night, the President laid out an ambitious, but worthy, goal to reduce the consumption of gasoline by 20 percent in 10 years. I applaud the President's leadership in emphasizing the importance of alternative fuels and vehicle fuel efficiency. The efforts will enhance our National Energy Security, as well as decrease emissions from greenhouse gases. However, I was disappointed that the President gave little attention to the tremendous promise that nuclear energy holds for this Nation. Expanding our use of nuclear power is the single most significant thing we can do to confront climate change. In the last Congress, Senator Bingaman and I started a bipartisan discussion in this committee to consider the climate change issues. I am pleased that we are continuing the discussion into the 110th Congress. Another Senator has arrived. Senator Bingaman and I released a white paper on climate change which laid out the key questions and the design challenges for a mandatory program for limiting greenhouse gas emissions. At our Climate Conference last April, we received more than 150 submissions at our Climate Conference, excuse me, that contained more than 500 individual documents. Imagine that, people truly are interested and go a long way and give a lot of their time and energy to help us understand what is happening. We have had a very productive discussion on climate, and we have learned a lot so far.

I am aware that many in the scientific community are warning us that something needs to be done. We still have a lot of questions before us, though. With this hearing we are continuing a search for answers that are meaningful, economically feasible and that will

produce real reductions in greenhouse gas emissions. It is clear to me that developing a system of mandatory controls on carbon emissions could be a daunting task. Controls must be effective. They must produce significant emission reductions to be meaningful. The cost of such controls should have the least possible overall negative effect on our economy and any burdens must be quite as equitable as they have been, as they can possibly be. And we must be sure that we do not impose costs on our industry that will drive them to impose costs that will drive them to relocate in countries such as India and China that do not have similar controls on carbons. I believe an essential part of any response to climate change is to double, maybe triple, our commitment to developing new technologies. Research and development funding, both public and private, is vital to addressing any of our Nation's energy challenges, and the climate change issue is no exception. I look forward to learning more from today's hearings.

Thank you Mr. Chairman and thank the Senators who are here and the others who will be coming that are interested in this issue.

The CHAIRMAN. Thank you very much. Why don't we just start? Let me introduce the panel of witnesses here and then we will start from the left and just go across and hear the testimony of each. Our first witness is Howard Gruenspecht, who is the Deputy Administrator with the Energy Information Administration in the Department of Energy and he is the person who has been the lead on this analysis that we have asked for. In addition, of course, Jeff Sterba is chairman and president and CEO of the PNM Resources in New Mexico, a company we are very proud of in our State. We appreciate Jeff's leadership and willingness to testify today. Daniel Lashof who is the climate center deputy director for the Natural Resources Defense Council, we very much appreciate you being here. Anne Smith who is the vice president for CRA International here in Washington, thank you for being here and Jason Grumet who is the executive director for this National Commission on Energy Policy that the Hewlett Foundation established a couple of years ago and has been the moving force behind getting the draft legislation that is being analyzed by the Energy Information Administration prepared.

Why don't we do this, Howard, would you go ahead and take whatever time you need to give us the analysis you went through and then your conclusions and then I will ask each of the other witnesses to take 5 minutes or so and summarize their comments, either about the analysis or any other point they want to make and then we will take questions. Howard, go ahead.

STATEMENT OF HOWARD GRUENSPECHT, DEPUTY ADMINISTRATOR, ENERGY INFORMATION ADMINISTRATION, DEPARTMENT OF ENERGY

Dr. GRUENSPECHT. Thank you Mr. Chairman, Senator Domenici and members of the committee. I appreciate the opportunity to appear before you today.

The Energy Information Administration is the independent statistical and analytical agency in the Department of Energy. We do not promote, formulate or take positions on policy issues and our views should not be construed as representing those of the Depart-

ment or the administration. As requested, my testimony focuses on EIA's recent analysis of the energy and economic impacts of a cap-and-trade program for greenhouse gas emissions. Our report compares energy and economic outcomes incorporating the proposal provided to us by the chairman and five colleagues to those of the reference case of the Annual Energy Outlook 2006. As noted in my written testimony there are many uncertainties inherent in any long term projection, particularly over a 25-year period, but the examination of differences across cases can provide some robust insights. Also, while EIA has recently updated its reference case in the Annual Energy Outlook 2007, an analysis starting from the new outlook would likely produce results that are very similar to those in our report, given the relatively modest changes between the 2006 and 2007 outlooks. My discussion of key findings will focus on the Phased Auction case, which was one of the cases we were asked to look at, which provides for the direct allocation of some emissions allowances and the auctioning of others with the share that would be auctioned rising over time as specified in the proposal.

Starting with energy price impacts, the cap-and-trade proposal requires fossil fuel suppliers to submit emissions allowances that reflect the carbon dioxide emitted when the fuel is burned. The cost of the allowances raises the energy prices paid by the end users. Figures 1 and 2 of my written testimony summarize the price impacts, which are all expressed in real 2004 dollars and include the value of allowances. The average retail gasoline price under the program is 3 percent higher in 2020 and 5 percent or 0.11 cents higher in 2030 compared to the reference case. The price impact in 2030 reflects the operation of the safety valve feature of the program. In terms of natural gas, the program is projected to increase the average delivered natural gas price by about 6 percent in 2020 and by 11 percent in 2030.

The projected percentage increase in delivered coal prices to electric generators, 48 percent in 2020 and 81 percent in 2030, is significantly larger than those expected for oil products and natural gas. This result reflects coal's higher carbon content per unit of energy and its lower price in the reference case compared to both oil and natural gas.

In the Phased Auction case, where significant quantities of allowances are given free of charge to electricity generators, electricity prices are estimated to be 4 percent higher than in the reference case in 2020 and 11 percent higher in 2030. Projected electricity price impacts—another sensitivity we were asked to look at—in the Full Auction case, where all allowances are auctioned, are somewhat greater. The difference in impacts reflects the assumed pass-through to ratepayers of the value of allowances given to electric generators who are subject to State-level, cost-of-service regulation in the Phased Auction case. So this is an example where State and Federal policies interact. It is also the case that electricity price impacts vary across States and regions, so I am giving a national number, but there is definitely a different impact across different parts of the country that we can talk about.

Projected effects on oil and natural gas use are limited by the modest changes in their delivered prices and the limited avail-

ability of economical substitute fuels in the transport sector and other applications where these fuels are used. However, projected coal consumption is reduced relative to the reference case by 4 percent in 2020 and by 20 percent in 2030, due mainly to the shift in the generation fuel mix that is driven by higher delivered coal prices. The displaced coal generation is largely replaced by generation from nuclear and renewable energy. So, Senator Domenici would be happy to hear that given his remarks.

Figure 4 of my written testimony shows the projected impacts on electric generation capacity additions of this program and if you look at the Figure you can see that the amount of projected coal capacity additions falls rather dramatically, but the projected nuclear capacity additions and renewable capacity additions increase rather dramatically. The proposal also significantly reduces the economic attractiveness of coal-to-liquids conversions, so again it is the coal prices that are mostly affected and it is the new builds of coal plants and coal-to-liquids that are affected. However, despite the reduction in coal power generation and CTL conversion relative to baseline growth estimates, coal use is still projected to remain above its 2004 level through 2030.

Figure 5 of the written testimony shows projected emissions reductions and they consist of a mix of non-energy related reductions which play an important, but declining role over time. They account for 57 percent of the reductions that are projected to occur in 2020 and 35 percent of the reductions that are expected to occur in 2030. So over time, the share that energy-related reductions contributes increases. Because the Safety Valve in the proposal is projected to be triggered in 2026 the specified greenhouse gas intensity targets are not fully attained beyond that date. Emissions rise slowly during the first phase of the program, but decline thereafter.

Turning finally to economic impacts, Figure 6 shows projected effects on the level of real Gross Domestic Product and personal consumption. By 2030, real GDP in the Phased Auction case is projected to be 0.26 percent lower than the reference case level; 0.26 percent is $59 billion in year-2000 dollars. The economy is very big so even small percentage changes are a lot of money. The total reduction in discounted real GDP over the 2009-2030 period is 0.10 percent, which is $232 billion, relative to the reference case. Should I stop?

The CHAIRMAN. Howard, could I just ask you to interrupt your testimony for a minute. We have our 12 Senators to do this business meeting. Let me just get that out of the way.

[RECESS]

The CHAIRMAN. Howard, why don't you continue with your excellent testimony? Now the exit of a few of these members should not be seen as any lack of confidence in your testimony.

Dr. GRUENSPECHT. I have a thick skin, but in any event, I was saying that real total reduction in discounted real GDP over the 2009 to 2030 period is 0.10 percent, relative to the reference case. Impacts on projected real consumption—I know there is a lot of focus on GDP but consumption is probably a different way to look at well-being—shown in figure 6 are somewhat larger. GDP and consumption impacts for the Full Auction case are larger than those for the Phased Auction case, due to the assumption that the

much higher auction revenues in the Full Auction case—when all of the permits, all the allowances, are auctioned, rather than some of them being given away—are not re-circulated into the economy beyond the $50 billion in expenditures from the proposed Climate Change Trust Fund that is part of the proposal. This result could change under a different revenue recycling assumption and does not imply a general conclusion that a Full Auction will necessarily have larger impacts than a Phased Auction. Mr. Chairman, that concludes my testimony and I would be happy to answer any questions you might have.

[The prepared statement of Dr. Gruenspecht follows:]

PREPARED STATEMENT OF HOWARD GRUENSPECHT, DEPUTY ADMINISTRATOR, ENERGY INFORMATION ADMINISTRATION, DEPARTMENT OF ENERGY

Mr. Chairman, and members of the Committee, I appreciate the opportunity to appear before you today. As requested in your invitation, my testimony focuses on the Energy Information Administration's (EIA's) recent analysis of the energy and economic impacts of a cap-and-trade program for greenhouse gas (GHG) emissions. The proposal we evaluated, sent to us by Chairman Bingaman and Senators Landrieu, Lugar, Murkowski, Salazar, and Specter in September 2006, would set specific targets for the reduction of GHG emissions intensity of the U.S. economy and incorporate a safety valve to assure that allowance prices remain at or below a ceiling that rises over time.

EIA is the independent statistical and analytical agency within the Department of Energy. We are charged with providing objective, timely, and relevant data, analyses, and projections for the use of the Congress, the Administration, and the public. Although we do not take positions on policy issues, we do produce data and analyses to help inform energy policy deliberations. Because we have an element of statutory independence with respect to this work, our views are strictly those of EIA and should not be construed as representing those of the Department of Energy, the Administration, or any other organization.

EIA's analysis (*Energy Market and Economic Impacts of a Proposal to Reduce Greenhouse Gas Intensity with a Cap and Trade System* (SR/OIAF/2007-1)), released earlier this month, compares cases incorporating the cap-and-trade proposal to those in the reference case of the *Annual Energy Outlook 2006 (AEO2006).* AEO2006 is based on Federal and State laws and regulations in effect as of October 2005. It has recently been superseded by AEO2007, which updates the projections to current laws and regulations and our current analysis of market conditions. However, given the relatively modest changes between *AEO2006* and *AEO2007,* an analysis starting from the new *Outlook* would likely produce results that are very similar to those I will review today.

The projections included in EIA's reference and policy cases, which extend through 2030, are not meant to be exact predictions of the future but represent likely energy futures, given technological and demographic trends, fixed laws and regulations, and consumer behavior as derived from available data. EIA recognizes that projections of energy markets over a 25-year period are highly uncertain and subject to many events that cannot be foreseen such as supply disruptions, policy changes, and technological breakthroughs. In addition to these phenomena, long-term trends in technology development, demographics, economic growth, and energy resources may evolve along a different path than expected in the projections. For this reason, the *AEO* includes many alternative cases intended to examine these uncertainties. Generally, projected differences between cases, which are the focus of our report, are likely to be more robust than the specific projections for any one case.

EIA's complete report, which includes a description of the proposal (and its full text as an Appendix), our modeling approach and our results, as well as a discussion of uncertainties and caveats, has been provided to the Committee and is publicly available on our web site. My testimony summarizes key findings, focusing on the Phased Auction case, which provides for the direct allocation of some emissions allowances and the auctioning of others, with the share to be auctioned rising over time as specified in the proposal. It outlines projected impacts on energy prices, energy use, GHG emissions, and economic activity, as well as the sensitivity of the results to technology and other uncertainties. It also provides some comparisons to results from other EIA analyses of policies to limit GHG emissions.

ENERGY PRICES

The cap-and-trade proposal requires that fossil fuel suppliers submit emission allowances that reflect the carbon dioxide emitted when the fuel is burned. Fuel suppliers would presumably pass on the cost of the allowances to consumers, leading to increases in fuel prices. As a secondary effect, however, reduced demand for fossil fuels could lower their supply cost at the wellhead or the minemouth, offsetting some of the price increase due to allowances. When these effects are taken together, however, the cost of allowances tends to dominate, so the energy prices paid by end users generally rise.

Figures 1 and 2* summarize the program's impacts on energy prices, which are all expressed in real 2004 dollars and include the value of allowances. The average retail gasoline price is 6 cents per gallon (3 percent) higher in 2020 and 11 cents per gallon (5 percent) higher in 2030 than in the reference case. Because the safety valve caps the price of GHG allowances at $5.89 per metric ton of carbon dioxide (CO_2) in 2012, rising to $14.18 per metric ton in 2030, the maximum direct effect of the cap-and-trade policy on the delivered price of gasoline in 2030 is roughly 11 cents per gallon (2004 dollars).

The average delivered natural gas price is $0.41 per thousand cubic feet (6 percent) higher in 2020 and $0.88 per thousand cubic feet (11 percent) higher in 2030, largely because of the allowance price which is added to the delivered fuel costs.

The average delivered coal price to electric generators, including the cost of emissions allowances, is $0.67 per million British thermal units (Btu) (48 percent) higher in 2020 and $1.22 per million Btu (81 percent) higher in 2030 than in the reference case. The much higher percentage change in delivered coal prices compared to the other fossil fuels reflects both coal's high carbon content per unit of energy and its relatively low price in the reference case.

Because electricity consumers capture the economic benefits of the allocation of GHG allowances to regulated utilities in areas of the country where electricity rates are set under cost-of-service regulation at the state level, projected impacts on the average delivered price of electricity are sensitive to decisions made regarding the allocation or auctioning of allowances. In the Phased Auction case, where significant quantities of allowances are given free of charge to electricity generators, electricity prices are estimated to be 4 percent higher than in the reference case in 2020 and 11 percent higher in 2030. In the Full Auction case, where all allowances are auctioned, electricity prices are estimated to be 6 percent higher than in the reference case in 2020 and 13 percent higher in 2030. The difference between the Phased and Full Auction cases reflects the assumed passthrough to ratepayers of the value of allowances given to electric generators who are subject to state-level cost-of-service regulation in the Phased Auction case. Electricity price impacts also vary across states and regions.

ENERGY USE

Impacts on energy use generally reflect both the size of the change in energy prices and the availability of substitutes and alternatives for each type of affected energy. Figure 3 summarizes projected impacts on energy use. Projected primary energy use is 1.7 quadrillion Btu (1 percent) lower in 2020 and 2.4 quadrillion Btu (2 percent) lower in 2030 as the cost of GHG allowances is passed through to consumers, providing an incentive to lower energy use and shift away from fossil fuels, particularly in the electric power sector. Relative to the reference case, fossil fuel energy consumption is 1.9 quadrillion Btu (2 percent) lower in 2020 and 8.1 quadrillion Btu (7 percent) lower in 2030, with almost all of the change accounted for by a reduction in the otherwise expected growth in coal use.

The reduction in petroleum use relative to the reference case projection is less than 1 percent in 2020 and about 3 percent in 2030. Over 70 percent of oil is used in the transportation sector, where alternatives are limited. With impacts on retail gasoline prices starting at 6 cents per gallon in 2012 and growing to only 11 cents per gallon by 2030, only modest changes in vehicle purchase and travel decisions are expected, and there is no significant impetus to fuel switching.

Impacts on projected natural gas use are also small. Natural gas consumption is 0.3 quadrillion Btu (1 percent) lower in 2020 and 0.3 quadrillion Btu (1 percent) higher in 2030. The electric power sector reduces its use of natural gas in 2020, but increases its gas use in 2030, reflecting the impact of the proposal in substantially reducing the switch away from gas generation over the 2020 to 2030 period, when

*Figures 1-6 have been retained in committee files.

the reference case, by comparison, projects a substantial increase in new coal-fired capacity and coal generation.

Projected coal consumption is significantly affected by the program. Relative to reference case projections, coal use is reduced by 1.2 quadrillion Btu, or 4 percent, in 2020 and more significantly reduced by 6.8 quadrillion Btu (20 percent) in 2030, due mainly to the shift in the generation fuel mix that is driven by higher delivered coal prices. In contrast to the situation in the transportation sector, a program that places even a modest value on GHG emissions encourages a significant shift towards alternative technologies such as nuclear and renewables in the electric generation sector. The proposal also significantly impacts the economic attractiveness of coal-to-liquids (CTL) conversion. Almost all of the CTL capacity that is projected to be built and operated in the reference case is not expected to be built if the cap-and-trade proposal is implemented.

Figure 4 shows how the cap-and-trade proposal affects projected electric generation capacity additions over the 2004 to 2030 period. The projected capacity additions of conventional coal-fired technology decline to less than a third of the reference case level. Notwithstanding the decline in coal generation relative to the reference case, overall use of coal is expected to increase from its 2004 level, mainly due to increased utilization of existing coal plants. Thus, although allowance prices under the proposal are high enough to dissuade much of the construction of new coal plants that would otherwise occur in the 2015 to 2030 period, they are low enough that it is still attractive to use available coal capacity through 2030. As the program continues beyond 2030, allowance prices would likely continue to rise as the GHG emissions cap tightens and the price trigger for the safety valve increases, eventually resulting in the retirement of significant amounts of existing coal plants for economic reasons. Under such a scenario, the level of coal use beyond 2030 would likely be sensitive to the future competitiveness of coal with carbon capture and sequestration relative to other very-low-carbon or carbon-free generating technologies.

EMISSIONS

As shown in Figure 5, reductions in emissions of non-CO_2 GHG emissions in the proposed program, which are not represented in a detailed fashion in the EIA National Energy Modeling System, are projected to account for 57 percent of the covered GHG emissions reductions in 2020 and 35 percent of the covered GHG emissions reductions in 2030. Estimates for non-CO_2 GHG emissions were developed using emissions baselines and abatement cost curves based on engineering cost estimates that were supplied by the U.S. Environmental Protection Agency. Real-world factors affecting the behavior of decisionmakers and the use of incomplete cost information may result in an overstatement of the actual level of non-CO_2 abatement achieved at each level of the allowance price. However, due to the safety-valve feature of the proposed cap-and-trade program, the projected energy sector and economic impacts would not change significantly even if the assumptions used regarding the supply of GHG abatement opportunities were too optimistic. Rather, such a situation would tend to drive the allowance price up to the safety-valve level earlier than projected in our analysis.

Because the safety-valve in the cap-and-trade program is projected to be triggered in 2026, the specified GHG intensity targets in the proposal are not fully attained beyond that date. Total emission reductions in 2030 are estimated to be 654 million metric tons CO_2 equivalent short of the level that would satisfy the GHG intensity reduction goal.

ECONOMIC IMPACTS

Figure 6 shows the projected effect of the cap-and-trade policy on the projected level of real gross domestic product (GDP) and personal consumption for both the Phased Auction and Full Auction cases. By 2030, real GDP in the Phased Auction case is projected to be 0.26 percent ($59 billion in year-2000 dollars) below the reference case levels. The total reduction in discounted real GDP over the 2009 to 2030 period is 0.10 percent ($232 billion) relative to the reference case. Impacts on projected real consumption, also shown in Figure 6, are somewhat larger, reaching 0.36 percent ($55 billion) in 2030. The reduction in discounted real consumption over the 2009 to 2030 period is 0.14 percent ($236 billion).

As requested, EIA's analysis also included a Full Auction case in which 100 percent of emissions allowances are auctioned beginning from the start of the cap-and-trade program in 2012. GDP and consumption impacts for this case are larger than those for the Phased Auction case, due to the assumption that the much higher auction revenues are not re-circulated into the economy beyond the $50 billion in ex-

penditures from the proposed Climate Change Trust Fund. This result could change under a different revenue recycling assumption, and does not imply a general conclusion that a Full Auction will necessarily have larger GDP impacts than a Phased Auction.

TECHNOLOGY SENSITIVITIES

While the *AEO2006* reference case used as the baseline in our analysis incorporates significant improvements in technology cost and performance over time, it may either overstate or understate the actual future pace of improvement, since the rate at which the characteristics of energy-using and producing technologies will change is highly uncertain.

Although the cap-and-trade program includes provisions that allocate a portion of the allowance auction revenues for increased federal funding for research, development and deployment, EIA, consistent with its established practice in other recent studies, did not attempt to estimate how increased government spending might specifically impact technology development. In previous analyses, EIA has illustrated how the use of more optimistic assumptions about the timing and cost of advanced energy technologies tends to reduce projected energy use in both baseline and policy cases. Under more optimistic technology assumptions, specified emissions reduction targets can generally be reached at lower cost, and the safety-valve is less likely to be triggered.

RELATIONSHIP TO PREVIOUS EIA GREENHOUSE GAS ANALYSES

In recent years, EIA has completed several other reports on policy proposals to limit or reduce GHG emissions. Our new report builds on these prior analyses (all of which are available on our web site), which taken together suggest that the economic impacts are largely determined by the *size of the energy market change* required to satisfy the policy *and the speed* with which the change must occur. From an energy and economic perspective, one key factor is the extent to which a proposed policy causes the economic obsolescence of existing energy system capital.

In April 2005, EIA analyzed of the original policy proposal made by the National Commission on Energy Policy (NCEP), a nongovernmental, privately-funded entity. That proposal included a cap-and-trade program along with other recommendations. The emission reduction targets for the cap-and-trade program in the original NCEP proposal were less stringent than those evaluated in our new report, but the proposed program began in 2010 rather than 2012. In February 2006, EIA reported on the energy and economic impacts of several alternative cap-and-trade options, ranging from less stringent to more stringent than the one considered in our new report.

Two EIA studies issued in 2003 and 2004 considered the original version of the Climate Stewardship Act (S. 139), which would cap GHG emissions at the 2000 level in 2010 and the 1990 level from 2016 on, and an amended version of that bill (S.A. 2028) that removed a provision for a tightening of the emissions cap beginning in 2016. These proposals have the same 2010 start date as the original NCEP proposal but they do not have a safety valve, and emissions are capped at a lower level than in the proposal analyzed in our new study. The reference cases for all studies completed before 2006, including EIA's analyses of the Kyoto Protocol, differ significantly from the reference case for the present study, which incorporates significantly higher long-term real prices for oil and natural gas.

Finally, while all reference and policy case projections are inherently uncertain, policy design differences can significantly affect the nature of uncertainty surrounding the projected energy and economic impacts of alternative policies to limit GHG emissions. Inclusion of a safety-valve feature in a cap-and-trade program would allow GHG emissions to rise above the level projected in our report in the event that emissions reduction inside or outside the energy sector proves to be more costly than we expect, while protecting against the prospect of larger energy system and economic impacts in these circumstances. In contrast, policies that impose a "hard" cap on emissions without a safety-valve price for GHG credits would force the fixed GHG emissions target to be met regardless of cost, reducing uncertainty surrounding the GHG emissions outcome but increasing uncertainty regarding energy and economic impacts. Policy design differences can also influence the behavior of stakeholders after a policy is implemented. For example, interests primarily focused on the achievement of GHG emissions reduction targets are more likely to support the broad availability of low-cost options to reduce emissions, rather than insist on the use of particular technologies and the avoidance of others if a safety-valve provision is included in a policy.

This concludes my testimony, Mr. Chairman and members of the Committee. I would be pleased to answer any questions you may have.

The CHAIRMAN. Thank you very much. Before we present any questions to you why don't we hear from each of the other witnesses on any points they think we need to understand either about this study or otherwise on the subject. Jeff Sterba, why don't we start with you?

STATEMENT OF JEFFRY E. STERBA, CHAIRMAN, PRESIDENT AND CEO, PNM RESOURCES

Mr. STERBA. Good morning Chairman Bingaman, Senator Domenici and members of the committee. Thank you for inviting me here today. I am Jeff Sterba, chairman of the board, president and CEO of PNM Resources an energy holding company headquartered in New Mexico with subsidiaries in New Mexico and Texas. We operate in both competitive and regulated markets in both the wholesale and the retail arenas. I appreciate this opportunity to discuss what I believe is the single greatest long term environmental and economic challenge facing my industry, climate change. I would like to thank Chairman Bingaman and Senator Domenici for the bipartisan leadership that you have demonstrated on this issue. Previously, I have testified before this committee on key architectural details necessary for a comprehensive climate bill and I provided additional details in my testimony.

This morning I would like to use my comment time to focus particularly on technology and certain economic elements associated with this issue. I believe the most significant risk facing my industry when it comes to addressing climate change is the duel challenge of meeting the growing electricity demand in an increasing cost environment and the state of low and zero emitting technologies and their costs. We need to address climate change in a three phase cost effective approach, partially to allow technology to catch up that is to slow it, stop it and then reduce the rate of growth, or reduce the actual level. The technologies needed to achieve the maximum goals in each of these phases have serious impediments to full deployment. We need to remove the barriers and provide gap funding to allow full deployment of technology that is available today such as nuclear and in the near future, such as carbon capture and sequestration that can slow greenhouse gas emissions and this must include renewables, nuclear energy efficiency, advanced coal and also cross over technologies, like plug-in hybrids. We must more rapidly advance the capacity to and the policy for capturing and storing CO at a much larger scale than is currently planned. This is integral to enabling coal to remain a viable fuel source for both economic and energy security reasons.

Senator DOMENICI. Can we go back again in your testimony and talk again about the concept of slow it, stop it and then what else

Mr. STERBA. And reduce. This is a concept that we have spoken of before in the last hearing and one that I strongly support. We must first work on slowing the rate of growth of carbon dioxide emissions and the key to that is increases in efficiency. For example, there are technologies where we can take existing coal fired powerplants and make them more efficient by for example, reblading the turbines which will effectively allow us to produce more energy for the same amount of fuel input. So the amount of carbon dioxide being emitted related to the amount of energy we are pro-

ducing goes down. Alternatively, energy efficiency, the use of renewables, so we can slow the rate of growth then bring the rate of growth to zero and then decline so we reduce the emissions, that, the actual declination, must occur. But the question is, when must it occur and what are the technologies and their cost that we can use to get it to reduce and this slow, stop and reverse strategy which has been put forward by this piece of legislation that has been evaluated by EIA is a critical component to it Senator.

Senator DOMENICI. Alright, thank you. Thank you for your time.

Mr. STERBA. We also need a long term price signal to promote investment in cutting edge major capital projects such as clean coal and advanced nuclear so we can stop emissions growth while fueling our nation's economic growth. I believe this is consistent with the application of a safety valve to mitigate economic impacts while low and zero carbon alternatives are limited and expensive. We need sufficient financial support for basic research but more importantly development, demonstration and deployment. The biggest gap we must address is from promising technology in the lab to the ability to purchase commercialized technology. Funding for near and mid-term technology initiatives, needs to begin occurring well in advance of mandated reductions so that cost effective means to achieve reductions are available when they are required.

Let me recommend four specific actions that Congress and this committee can begin to take action on. First is the authorization and full funding of research, but particularly development, demonstration and deployment of more climate friendly technologies and applications; second, the development of large scale carbon capture and storage demonstration projects and addressing the licensing and liability issues of such facilities so we can maintain the viability of coal for the future. The current projects that we have are at best 25,000 metric tons. The deployment of the regional partnerships that are underway are in the range of 100,000 tons. A 500 mega watt single coal unit will produce about 4 million metric tons a year. There is a huge gap between what we are exploring and what we have got to be ready to implement. Third, promote and facilitate aggressive deployment of renewable energy and energy efficiency programs of which the simplest and most important steps can be authorizing the production tax credit for a 7 to 10 year period instead of the 2 year extensions that we have had to live with. And second, to encourage the decoupling and other incentive mechanisms to fully use and develop energy efficiency alternatives at the State level. Last, moving toward a rational climate legislation that is capable of gaining essential bipartisan support for most the development of climate friendly technologies that could be achieved with existing and affordable technology in the short term and emerging and new technologies as they become available and economically viable and it also mitigates adverse economic impacts that may occur in the interim. I do believe that there is adequate information to move forward on all three, on all four of these points. I believe that we must have a long term market price signal but that does not impair the ability or is not impede the ability in effectiveness of short term mitigation that can come in the form of a safety valve or something of that nature.

I believe the committee draft to address climate change is a very good start to this process. It provides many of the elements that I think are integral to being able to address this issue and that it can be the focal point for climate debate in the Senate. Thank you for your time and consideration.

[The prepared statement of Mr. Sterba follows:]

PREPARED STATEMENT OF JEFFRY E. STERBA, CHAIRMAN, PRESIDENT AND CEO, PNM RESOURCES

INTRODUCTION

Good morning Chairman Bingaman, Senator Domenici, and distinguished Members of the Committee on Energy and Natural Resources. Thank you for inviting me here today. I am Jeffry Sterba, Chairman of the Board, President, and Chief Executive Officer of the PNM Resources.

I appreciate this opportunity to discuss what I believe is the single greatest long-term environmental and economic challenge facing the utility industry: climate change. Rather than critiquing what I expect is a thorough economic analysis by EIA, I will share with you my views on what legislative design elements are required to forge a political consensus on climate change legislation during the 110th Congress.

PNM RESOURCES

But first, let me be clear that I am here today representing PNM Resources. PNM Resources is an energy holding company based in Albuquerque, N.M., with consolidated operating revenues of $2.3 billion. Our electric generation is primarily a mix of coal, nuclear, wind and natural gas. Through its utility and energy service subsidiaries, PNM Resources supplies electricity to 738,000 homes and businesses in New Mexico and Texas, natural gas to 470,000 customers in New Mexico, and electricity to numerous wholesale customers throughout the southwest. Its utility subsidiaries are PNM, Texas-New Mexico Power and First Choice Power, a deregulated competitive retail electric provider in Texas. In November 2006, we announced a Joint Venture with Cascade Investments for the purpose of long-term investment in both in wholesale and retail electricity sales, electricity generation and energy trading.

As the CEO of an electric and gas utility holding company, I believe that prudent risk management dictates that deliberate steps be taken to position PNM Resources and its subsidiaries to operate in a carbon-constrained world. For example, in 2003 our Board of Directors adopted the goal of reducing the intensity of greenhouse gas emissions from our utility operations in New Mexico by 7 percent by 2009. Other actions we have voluntarily undertaken to manage and reduce emissions of greenhouse gases at PNM and our other utility subsidiaries include:

- Greenhouse Gas Emissions Inventory: We have completed an inventory of GHG emissions for our New Mexico operations and in 2007 will complete a similar company-wide inventory for all of our operations.
- Pricing Carbon in Resource Planning: We are internalizing the costs of carbon dioxide emissions into our electric supply planning processes to account for potential future greenhouse gas regulations. This will enable us to make more informed resource decisions and allocate capital based on expected future costs of compliance with greenhouse gas regulation.
- Diversifying Our Generation: We have created a diverse portfolio of generation assets that include pulverized coal, pressurized fluidized-bed technology, natural gas combined-cycle, nuclear, wind, distributed solar, and demand-side resources to provide our customers with a cleaner, less carbon-intensive portfolio of resources.
- Renewable Energy: We have a 25-year power purchase agreement for all of the output from the New Mexico Wind Energy Center. The 204 MW of capacity from this facility represents over 8% of our generation capacity. In 2005, we issued an RFP for non-wind renewable energy and a deal for independent developers to supply power to PNM Resources from a 32 MW biomass project, which has been signed. We have also launched a program that pays customers $.21 per kWh in incentives payments and credits for power produced from customer-owned solar PV systems.
- Biodiesel: We have switched to using biodiesel fuel in 57 percent of our diesel-powered vehicle fleet in New Mexico.

- Carbon Sequestration: We have participated in a number of programs aimed at reducing or sequestering greenhouse gasses, and
- Energy Efficiency: We have made significant investments in energy efficiency to offset 10% of annual energy demand growth in our Texas service territory. In 2006, we introduced natural gas efficiency programs to our New Mexico customers and will be filing a suite of electric energy efficiency programs in January 2007.

SENATE ENERGY AND NATURAL RESOURCES COMMITTEE WORKSHOP ON CLIMATE CHANGE

Nine months ago, I appeared before this Committee and testified on the Committee's thought-provoking white paper, *Design Elements of a mandatory Market-Based Greenhouse Gas Regulatory System.* Today, I want to thank both Chairman Bingaman and Senator Domenici for that hearing and for your bipartisan leadership on this vital national issue. You demonstrate the kind of political leadership needed to steer our country during this important debate towards an environmentally sound, economically viable and equitable legislative solution to climate change.

In addition to your leadership, the workshop was also timely as it created a public dialogue around what politicians, utilities, environmental organizations, energy producers and manufacturers and industry believed were very polarizing issues. But it also became clear there were potential areas of agreement among these diverse stakeholders.

THE ELECTRIC UTILITY INDUSTRY

As I am sure you are aware, there are varying opinions within the electric utility industry on mandating reductions and genuine concerns about cost impacts on consumers and the availability of low and non-greenhouse gas emitting technologies that can deliver electricity at affordable prices and provide reliable service. Yet, I think there is agreement that significant greenhouse gas emission reductions are attainable only with a full suite of technology options, including continued development of renewable resources, advanced clean-coal technologies including but not limited to IGCC, carbon capture and storage, advanced nuclear and increased energy efficiency and the potential of plug-in hybrid vehicles. While a few of these options currently are commercially available—though at a higher cost—many are not. Making all of these technologies commercially available at a reasonable cost is critical to addressing climate change in both the short and long term.

NEXT STEPS

Our legislative process is famously characterized as "deliberative" and there are many excellent reasons for that, but deliberative can also mean terribly slow. I urge this Committee and Congress to begin taking immediate action, including:

1. We need authorization and full funding of research, development, demonstration, and deployment of more climate friendly technologies and applications;
2. We must develop large-scale carbon capture and storage demonstration projects and address the licensing and liability issues of such facilities, as it is essential we maintain the viability of coal to meet our country's energy needs;
3. We need to promote aggressive deployment of renewable energy and energy efficiency programs, including smart metering and plug-in hybrids; and
4. We need to move toward rational climate legislation that is capable of gaining essential bipartisan support and promotes the development of climate friendly technologies that can be achieved with existing and affordable technology in the short term, and emerging and new technologies as they become available and economically viable.

In the past, we have seen numerous climate bills that—based on the state of current technologies—are unrealistic approaches to addressing climate change on a national level. We will not make real progress in addressing this critical issue if we continue to spend valuable time on legislation that only works in one region or state, only addresses one sector or only promotes one or a few technologies.

Chairman Bingaman, the Committee has devoted significant time and careful thought in the development of a comprehensive proposal to address climate change. More than any other proposal, the Committee draft recognizes the limits of today's commercial technology and the economic risks currently associated with addressing climate change for my industry and our ratepayers. It begins with modest reductions but through the five-year review has the flexibility to implement more aggressive emission reductions made possible by technology advancement. The draft cre-

ates and allocates funds for critical technology advancement, though we need to find means to advance the availability of such funding. And, it utilizes a cost control mechanism that avoids adverse economic impact while enabling a long-term price signal for major capital projects. For all of these reasons, I believe the Committee draft to address climate change should be the focal point of the climate debate in the Senate.

CONCLUSION

Thank you for your time and consideration. I would be pleased to answer any questions you might have and I look forward to being of service in any way I can to this Committee.

The CHAIRMAN. Thank you very much.

Mr. Lashof, thank you for being here.

STATEMENT OF DANIEL A. LASHOF, Ph.D., CLIMATE CENTER SCIENCE DIRECTOR, NATURAL RESOURCES DEFENSE COUNCIL

Dr. LASHOF. Thank you. Thank you, Mr. Chairman. I appreciate the opportunity to be here, Senator Domenici and members of the committee. I am Daniel Lashof. I am the science director and deputy director of the Climate Center at NRDC and I want to start by just underlining what has been said before appreciating your leadership and working on the critical details of global warming legislation that are going to be needed to move the legislative process forward.

I believe that with Monday's call to action from the U.S. Climate Action Partnership that Mr. Sterba is part of along with NRDC and many other leading organizations and companies that that really changes the political landscape on global warming and I think we have a real opportunity to enact effective climate legislation this year so I look forward to working with you and members of this committee to seize that opportunity.

In summarizing my testimony I would like to make three points about the EIA analysis and then three more general points about emission allowance allocation. First, EIA's analysis clearly shows that the discussion draft proposal would have minimal macro-economic impacts on the U.S. economy. EIA projects that GDP would grow from $10.8 trillion in 2004 to $17.5 trillion in 2020 and over $23 trillion in 2030 with or without the emission caps and the discussion draft and regardless of how the emission allowance is allocated so robust economic growth, very small deltas which get magnified in some of the charts, but we need to keep it in mind. This is a growing economy under all of these cases. The analysis also indicates however, that the proposal would not reduce greenhouse gas emissions below current levels even through 2030, and there are two reasons for this, one is the intensity targets themselves don't decline fast enough to get emissions down below current levels over that time frame and second, the safety valve part of the proposal means the actual emissions that are projected by EIA would be higher than the nominal caps in the proposal. While in my view the discussion draft contains many valuable proposals regarding emission allowance allocation, faster and deeper emission reductions, such as those proposed in the U.S. Climate Action Partnership, are essential to prevent dangerous global warming.

My second point is that the small differences in GDP that EIA projects under the Phased Auction verses the Full Auction ap-

proach as I think, Mr. Gruenspecht indicated are primarily related to the assumptions the EIA made about deficit reduction verses tax cuts. They assume that under the Full Auction the extra revenues would be dedicated to deficit reduction. In their model that tends to dampen current consumption over this time frame. If they had made a different assumption holding say the deficit constant, and using the extra revenue for tax cuts, I think they would have found the opposite, that the Full Auction would actually have a slightly higher GDP than under the Phased Auction approach.

My third point and this is probably the most important one on the EIA analysis is that it does not reflect important provisions of the discussion draft designed to promote energy efficiency and deployment of advanced technology. Appropriate analysis of these provisions would show that I think much deeper emission reductions could be achieved with minimal macro-economic impacts or possibly with an economic benefit. The two primary ways in which the proposal would achieve this, first, their provisions promote increases in energy efficiency by overcoming barriers in the marketplace to energy efficiency and provisions to advance the deployment of low and zero emission carbon technologies. For example, the proposal includes a Climate Change Trust Fund, funded through the allowance allocation system as well as proposing dedicating allocating allowances to States or the President to use the revenues for similar purposes. I particularly favor the idea of allocating a substantial portion of the allowances to States. We are in a very good position to particularly promote energy efficiency. EIA's analysis does not incorporate the benefits of those critical parts of this proposal and I think it is important that as this committee looks at this and other proposals that include deeper emission reductions those benefits need to really be fully taken into account.

Now let me turn to a couple more general points. First, the emission allowances created under any Greenhouse Gas Cap and Trade program are a valuable public asset. Deciding how to use that asset and how to allocate it is a critical public policy decision that Congress has to wrestle with. The stakes are very high. If you look at EIA's projection for this proposal in 2020 the value of emission allowances allocated just in that year would be over $50 billion. That is a lot of money by anybody's calculation. That is not the cost of the program. That is the value of the allowances. So it is a distributional question how those are used. I think the allocation of these resources should start from the principle that no one has an entitlement to put carbon dioxide emissions into the atmosphere. Economists widely recognize that most efficient and fair way to allocate emission allowances is through a public auction and I believe the revenues from that auction should be dedicated to the purposes of the program in protecting climate change and to other public purposes and this is precisely the approach that New York and Massachusetts have announced that they are planning to take in implementing the Regional Greenhouse Gas Initiative in their States.

Second, I think that most allowances should be allocated in a way that lowers the cost of implementing the program both to consumers and to businesses by strategically promoting increases in energy efficiency and widespread use of the new technology as this

discussion draft indeed does, I think that it can go further in that direction, more of the allowances could be allocated to those programs. As you know Mr. Chairman, these benefits are not just theoretical, we have realized in practice where energy efficiency is effectively promoted major benefits. For example, in California where there have been robust programs for many years, the per capita electricity consumption has been stabilized over the last 30 years while in the rest of the Nation it is increased by 50 percent. So these types of programs make a real difference and it would make it much less expensive to achieve emission caps at any level.

Third, I would suggest a slightly different approach to allocating allowances in the electricity industry. Allocating allowances to generating companies is likely to provide some inequitable outcomes that depend on whether a particular jurisdiction is under cost of service regulation or in a competitive market and we know about 40 percent of the country has competitive wholesale markets, the rest under more traditional cost of service regulation and this problem has already surfaced in European markets where the United Kingdom authorities have concluded that their allocation system which was to generators on a grandfathered basis has produced a significant windfall profits and they are looking to change that. Electricity distribution companies on the other hand, are under continuous cost of service regulation in all jurisdictions. This would give regulators a way to ensure that the value of the allowances is used to benefit customers through both energy efficiency and adjustments in rates. Now for some companies like Mr. Sterba's at least in New Mexico there is no difference between the two, it is the same thing but in other jurisdictions where there is wholesale competitive markets it would make a difference and so I urge you to consider that. Exelon proposed something similar in the workshop that you held earlier last year.

So in conclusion, let me just finish by saying I think EIA's analysis provides an upper bound on the cost of implementing the discussion draft but it fails to account for important provisions designed to promote increases in efficiency and deployment of low carbon technologies. Congress should allocate emission allowances strategically to reduce compliance costs and account for the benefits of this approach in the analysis that it considers of proposals. This will be particularly important for proposals that would require emissions to be reduced substantially below current levels which I believe is necessary to prevent dangerous global warming. Thank you, Mr. Chairman.

[The prepared statement of Dr. Lashof follows:]

PREPARED STATEMENT OF DANIEL A. LASHOF, PH.D., CLIMATE CENTER SCIENCE DIRECTOR, NATURAL RESOURCES DEFENSE COUNCIL

INTRODUCTION

Thank you for the opportunity to share my views regarding the Energy Information Administration's analysis of Chairman Bingaman's greenhouse gas cap-and-trade discussion draft proposal.[1] My name is Daniel A. Lashof, and I am the science director of the Climate Center at the Natural Resources Defense Council (NRDC).

[1] Energy Information Administration, 2007. Energy Market and Economic Impacts of a Proposal to Reduce Greenhouse Gas Intensity with a Cap and Trade System. U.S. Department of Energy, Washington, DC. SR/OIAF/2007-01 (January).

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.

My testimony will discuss EIA's key findings and shortcomings of EIA's analysis, particularly with respect to the treatment of energy efficiency and technology deployment programs. I will then turn to more general comments on the emission allowance allocation system proposed in the discussion draft.

EMISSIONS RISE INSTEAD OF FALL

The Energy Information Administration (EIA) analysis of Chairman Bingaman's greenhouse gas cap and trade discussion draft demonstrates that the proposal would have minimal macroeconomic impacts on the U.S. economy regardless of how emission allowances are allocated. The analysis also indicates, however, that the proposal would not reduce greenhouse gas emissions below current levels through at least 2030, although it would slow the rate of emission growth. Emissions grow under the proposal for two reasons: First, the specified reductions in emissions intensity are not rapid enough to reduce emissions below current levels by 2030, and second the "safety valve" provision of the proposal allows emissions to substantially exceed the nominal cap.

While the discussion draft contains many valuable proposals regarding the allocation of emission allowances, faster and deeper emission reductions, such as those proposed by the U.S. Climate Action Partnership in its January 22nd *Call for Action*,[2] are essential to prevent dangerous global warming.

MACROECONOMIC IMPACTS ARE MINIMAL

EIA's conclusion that there would be minimal macroeconomic impacts from a greenhouse gas emissions cap and trade program such as the Bingaman discussion draft is robust. Regardless of how emission allowances are allocated EIA finds that the impact on the present value of Gross Domestic Product (GDP) would be less than 0.2 percent, not accounting for the health and environmental benefits the program would produce.

EIA's analysis suggests that macroeconomic costs would be somewhat higher if all the emission allowances issued under the program are auctioned than under the "Phased Auction" approach outlined in the discussion draft. This conclusion appears to be primarily related to the way EIA analyzed the "Full Auction" case, rather than the inherent merits of this approach relative to the Phased Auction alternative. In particular, EIA assumes that all of the additional revenue generated under the Full Auction would be devoted to deficit reduction, which has a dampening effect on consumption in EIA's model over the analysis time horizon. This result is not primarily related to the cap-and-trade program, however. Any deficit reduction policy considered in this model would likely yield similar results. Conversely, had EIA assumed that the additional revenue from the Full Auction was used to cut taxes, holding the deficit constant, the model would likely project slightly more economic output under the Full Auction compared with the Phased Auction.

This does not imply that allowance allocation is unimportant. To the contrary, emission allowances created under any greenhouse gas cap and trade program will be a valuable public asset and deciding how to use this asset fairly and effectively is a critical part of Congressional deliberation on global warming legislation.

ALLOWANCES ARE A VALUABLE PUBLIC ASSET

Policy decisions about how allowances will be allocated should start from the principle that no one has an entitlement to pollute the atmosphere with heat-trapping gases. An emission allowance represents a limited permission to release one ton of carbon dioxide into the atmosphere. This is not a property right and there is no inherent policy rationale for allocating allowances based on historic emissions. Rather, the atmosphere's limited capacity to accommodate emissions is a public asset, much like the radio frequency spectrum. Economists widely recognize that the most efficient and fair way to allocate this asset is through a public auction. Revenues from such an auction should be used to further the goal of solving global warming and for other public purposes. This is precisely the approach that New York and Massachusetts are adopting to allocate emission allowances under the Regional Greenhouse Gas Initiative. While there may be a number of policy and practical reasons to deviate from this principle by allocating some emission allowances without

[2] www.us-cap.org.

charge, any free allocations to the private sector should be limited and phased out over time, and the burden should be on those proposing free allocations to justify this approach.

The stakes are considerable. EIA projects that covered greenhouse gas emissions under the discussion draft proposal would be 7.1 billion tons in 2020. For each ton emitted covered entities will have to retire one emission allowance, which EIA projects will have a market value of $7.15 in that year. Thus the total value of emission allowances used in 2020 would be over $50 billion. Analysis by Dallas Burtraw and others at Resources For the Future,[3] as well as experience with the pilot phase of the European Union Emissions Trading Scheme, shows that the value of emission allowances greatly exceeds the impact of the emissions cap on the profitability of firms covered by the program. Hence, there would be substantial windfall profits were all of the emission allowances to be distributed for free to the private sector, particularly for firms operating in competitive markets in which increased marginal costs will be passed through to consumers.

ALLOWANCES SHOULD BE ALLOCATED STRATEGICALLY

In addition to being fair, the allowance allocation approach should strategically promote increases in energy efficiency and widespread use of available low carbon technologies. NRDC recommends devoting most of the value of emission allowances to these purposes in order to reduce costs for both. consumers and businesses. While the discussion draft proposal stops short of this, it does appropriately devote a substantial portion of the value of allowances to promoting increased energy efficiency and deployment of advanced zero- and low-carbon technologies. This includes not only the $50 billion Climate Change Trust Fund, but also the value of the portion of allowances allocated to States or the President. Unfortunately, EIA did not analyze the impact of these important provisions of the proposal. While analyzing these provisions is challenging, ignoring them is misleading.

Appropriate analysis of the energy efficiency and technology deployment provisions of the proposal would show that much deeper emission reductions could be achieved with minimal macroeconomic impacts or even with net economic benefits. There are two primary ways in which these provisions would promote low cost emission reductions: First, by overcoming market failures that prevent cost-effective increases in energy productivity, and second by accelerating technology innovations that reduce costs and improve performance as a function of learning-by-doing. Neither of these effects is appropriately reflected in the EIA analysis.

EIA NEGLECTS ENERGY PRODUCTIVITY GAINS FROM ALLOWANCE ALLOCATION

The proposed incentives for energy efficiency would overcome barriers to cost-effective energy productivity improvements. Satisfying energy service demands with less primary energy is the fastest, cheapest, and cleanest way to reduce global warming pollution, and will make it much less expensive to achieve any greenhouse gas emission cap. This opportunity is large and consequential, as documented recently at the global level in the Stem Review of the Economics of Climate Change[4] and the McKinsey Global Institute report on energy productivity.[5] Numerous reports have reached similar conclusions for the United States at both the state and federal level. For example, last week NRDC released a report prepared by Optimal Energy which shows that cost-effective energy efficiency, demand response, and combined heat and power investments in Texas could eliminate projected electricity demand growth and obviate the claimed need for more than a dozen new high-emitting coal fired power plants in the state, avoiding 400 million tons of CO_2 emissions over the life of the efficiency measures.[6] I have attached a copy of this report to my testimony and ask that it be included in the record of this hearing.

The benefits of robust energy efficiency policies are not just theoretical. They have been demonstrated in practice. In California per capita electricity consumption has been held constant over the last 30 years while the rest of the nation's per capita consumption increased by more than 50 percent.[7] This is no accident: over the period California has had the nation's strongest building and appliance efficiency standards and most aggressive utility efficiency programs. Nonetheless, EIA only considered energy demand changes related to their projections of small changes in

[3] http://www.rff.org/Documents/RFF-DP-05-55.pdf.

[4] www.hmtreasury.gov.uk/independent__reviews/stern__review__economics__climate__change/stern__review__report.cfm.

[5] http://www.mckinsey.com/mgi/publications/Global__Energy__Demand/index.asp.

[6] http://docs.nrdc.org/globalwarming/glo__07011701A.pdf.

[7] http://www.nrdc.org/air/energy/fcagoals.asp.

retail prices associated with the discussion draft proposal, and made no attempt to analyze the effects of federal or state incentives provided through the Climate Change Trust Fund or through the allowances allocated to States. As a result EIA projects that residential energy consumption in 2020 under the discussion draft proposal (Phased Auction case) would be only 0.4 percent lower than in the Reference case. Similarly, EIA projects just 1 percent less transportation sector energy consumption in 2020 due to the proposal.

EIA NEGLECTS TECHNOLOGY DEPLOYMENT DRIVEN BY ALLOWANCE ALLOCATION

EIA's analysis also fails to account for the deployment of zero- and low-emission energy technologies induced by the Climate Change Trust Fund and State efforts. There are two important mechanisms that should be considered. First, the low-emission facilities that would be built as a direct result of the proposed deployment incentives. Second, early deployment will result in technological learning that would improve the performance and reduce the cost of next generation facilities, making these technologies more competitive with higher-emitting competitors regardless of the availability of additional incentives. Because EIA did not consider these effects, and because allowance prices are relatively low under the discussion draft proposal, EIA does not project any use of carbon capture and geologic disposal technology for power plants during the timeframe of their analysis. (It also appears that EIA did not consider the opportunity to use industrial CO_2 for enhanced oil recovery in conjunction with geologic disposal, or they likely would have found that at least *some* carbon capture and disposal would be cost effective at the allowance prices they forecast).

ALLOCATE A PORTION OF ALLOWANCES TO STATES

NRDC supports the idea of allocating at least 30 percent of the available allowances to States as proposed in the discussion draft. States are in the best position to address specific equity concerns and promote energy efficiency and infrastructure investments that will help achieve the cap at the lowest possible cost. For example, States are primarily responsible for enforcing building codes and planning transportation infrastructure, both of which can have a substantial impact on carbon dioxide emissions.

EFFECTIVELY ADDRESSES COMPETITIVENESS CONCERNS

Special consideration is needed to ensure that energy-intensive industries facing international competition are not put at a significant disadvantage by the program. A grandfathered allocation to these firms will not necessarily achieve this goal, however, because their most profitable course may still be to shut down domestic production and sell their allowances. To prevent this without creating a perverse incentive to keep operating the least efficient, highest polluting plants, the allocation to energy intensive firms could be reduced in proportion to any reductions in their regional employment. (From a broader perspective, the most efficient policy for addressing this concern is border tax adjustments for energy intensive products traded with countries that don't have equivalent emission reduction programs).

ALLOCATE TO ELECTRICITY DISTRIBUTION COMPANIES RATHER THAN GENERATORS

The discussion draft proposes to initially allocate 30 percent of the total allowance pool to electricity generators based on their share of emissions during 2004-2006. Although this free allocation begins to decline in 2017, nearly 15 percent of allowances would still be allocated on this basis in 2030. This appears to be substantially in excess of the amount that can be justified on the basis of mitigating economic transition costs to relatively more adversely affected firms. As a result, allocating allowances in this manner would likely result in substantial inequities. This is because about 40 percent of ITS generation sells its output at market prices into various largely unregulated wholesale markets, while the rest remains subject to diverse forms of cost-of-service price regulation.[8] Impacts of allocations on consumers and shareholders will vary widely and state regulators will not be able to respond to real or perceived inequities. In many cases, generators can be expected to pass through the increased price of carbon regulation in their wholesale prices, and also to keep the proceeds from the sale of allowances allocated to them initially. Consumers obviously will see the price signal, but not the benefits from the allowance allocation. The problem has already surfaced in European markets, leading United

[8] This is the estimate of the Electric Power Supply Association, which represents competitive power suppliers.

Kingdom authorities to conclude that initial allocation to electric generators serving competitive markets resulted in large windfall profits.[9]

Electricity distribution companies, by contrast, provide service under continuous price regulation from either state commissions (for investor-owned utilities, accounting for about three-fourths of retail sales) or local boards (for publicly owned utilities and cooperatives, which serve the rest of the nation). Regulators can therefore ensure that consumers benefit from any allowances allocated to distribution companies by directing funds to energy efficiency investments and long-term emissions reductions, and by adjusting rates. Many in the utility industry and its regulators are likely to prefer distribution company allocation to a generator-based system (e.g., see Exelon's comments on the Energy Committee White Paper).

Congress would have a wide range of options in making allocations to distribution utilities, ranging from the carbon content of electricity delivered by distribution companies to the volumes of electricity delivered (with numerous intermediate compromise possibilities). Utilities that distribute mostly coal-fired electricity are likely to advocate an emissions-based formula on the grounds that they will see the largest increase in electricity costs as a result of the CO_2 emissions cap. Utilities that distribute mostly low-emission resources are likely to advocate a formula based on electricity sales on the grounds that their customers are already paying higher prices for a cleaner generation portfolio.

Whether or not the allocations should be updated over time is an independent question. The proposed phase-out of free allocations to the private sector diminishes the case for updating in general (the more rapid the phase-out the less need to update the free allocation). Any allocation based on carbon content should definitely not be updated because that would create a perverse incentive to increase emissions in order to obtain a larger allocation, raising the overall cost of achieving the emission cap (or increasing actual emissions if the safety valve is open). There is a stronger argument for updating a sales-based formula as a matter of equity between high-growth and low-growth areas.

Such an approach would need to include an adjustment for independently verified energy efficiency to ensure that updating does not create a disincentive for additional energy efficiency improvements.

The simplest approach would be to allocate based on electricity sales during the same historical period used for allocating to other sectors. If Congress decides to allocate (in part or in whole) based on historical emissions, however, calculating the carbon content of those electricity sales is certainly feasible and should not be seen as an obstacle to allocating to distribution companies. As long as the allocation is to distribution companies (to avoid windfall profits) and is not updated in a way that creates perverse incentives (to avoid raising costs or emissions), then the specific allocation formula is a matter of regional equity and an appropriate subject for negotiations during the legislative process.

To prevent state regulators from masking price signals to consumers through their regulation of distribution companies, it would be appropriate for Congress to condition the grant of free allowances on a requirement that a portion be used to promote energy efficiency and that they not be used to mask the cost of carbon emissions in the form of directly offsetting subsidies for retail electricity costs.

Of course state regulators cannot change or hide a very potent price signal, which is the added cost of carbon-intensive generation to its utility purchasers (and to other entities that buy power in wholesale markets to serve retail customers). This is the most important economic element of any cap-and-trade system for the generation sector, because it shapes the long-term investment and operational decisions that drive the sector's total emissions. Carbon-intensive generation will increase in price to these decision-makers as the cap takes effect and tightens, regardless of how retail-price regulators decide to deal with proceeds from the sales of allowances allocated initially to their distribution companies.

CONCLUSION

EIA's analysis provides an upper bound on the costs of implementing Chairman Bingaman's discussion draft proposal, but it fails to account for important provisions designed to promote increases in energy efficiency and deployment of zero- and low-carbon technologies. Congress should allocate emission allowances strategically to reduce compliance costs and account for the benefits of this approach as it considers a range of legislative proposals. This will be particularly important for proposals

[9] House of Commons, Environmental-Audit Committee, "The International Problem of Climate Change: UK Leadership in the G8 and EU," p. 17 (Mar. 16, 2005).

that would require emissions to be reduced substantially below current levels, which is essential to prevent dangerous global warming.

The CHAIRMAN. Thank you very much.

Anne Smith, we are very glad to have you today. Go right ahead.

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

Dr. SMITH. Thank you Mr. Chairman and members of the committee. Thank you for inviting me to participate in today's hearing. My name is Anne Smith. I am an economist and vice president at CRA International. The opinions I present are my own and not those of CRA.

EIA's analysis of the draft bill finds a small but not cost lest impact on the U.S. economy. The 0.1 percent reduction in GDP that we have heard about implies a present value cost per person to every person in the United States of $800. The bill also finds, the analysis also finds, significant shifts in certain parts in the economy. EIA reports that coal demand remains stable under the bill but this also says that the bill would almost entirely eradicate this sectors prospects for growth. For a business plan, that is a devastating outcome. Nevertheless, the draft bill probably would not have devastating impacts to the economy as a whole. This is directly attributable to its safety valve feature and to the specific price level associated in this bill with the safety valve. In earlier EIA analysis showed that carbon prices would be two to four times higher if the safety valve were to be removed and we have every reason to expect that the current draft bill's costs would balloon upwards in the same way if the safety valve were to be removed from it. So if Congress wants to keep the costs of this policy low it must keep the safety valve price low.

EIA's analysis also tells us that the emission reductions achieved on the proposed safety valve are small. In fact, emissions continue to rise even through 2030 in the projections. If this is all that the draft bill would accomplish does it make sense to pay even the small amount for it. The emissions reductions needed to stabilize climate change are huge. Many, many times more than this draft bill is projected to accomplish and they have to accomplished on a global scale. EIA's analyses shows that this simply cannot be done at a low cost with all of our current technological options. An affordable reduction in climate change risks will require revolutionary transformation of energy technology through intensive and reformed R&D policy. The current draft bill misses this need all together and for that reason I do not feel it is a good first step in developing a reasonable climate policy. Some people will argue back that the draft bill's Climate Change Trust Fund is an R&D provision including someone sitting directly to my right who has just made that point. It is not an R&D provision. It only provides deployment incentives which are subsidies to technologies that are already, almost ready, to enter the market. These trust fund subsidies also are redundant. The carbon price serves as the deployment incentive in this bill and by offering a second subsidy for technologies that are going to enter the market anyway, the draft bill creates free rider-ship at its worse. It makes the subsidies a waste of the valuable allowance auction revenues.

The Trust Fund also reflects bad R&D policy practice as evidenced in the past. It attempts to pick winners by rigidly allocating funding across types of technologies rather than letting all these types of technologies to compete for those resources based on their successes. Also, the subsidy rules determining which companies will win the subsidies do not pick the projects that would provide the lowest dollar per ton removed reductions and that should be the goal. But most importantly of all, the subsidies fail to address the kind of R&D that is needed to start the world down the path towards huge, a huge emissions reduction goal without going bankrupt along the way. The kind of R&D that I believe is needed is basic research and basic research that seeks breakthroughs in science and applications of science's technologies. The challenges for us is to design effective incentives to guide basic science researchers towards those successful outcomes in new energy systems solutions and the draft bill never considers these needs. What we need is a bill with provisions for dramatically reforming basic R&D institutions, incentives and funding. Carbon pricing provisions should support this core role not supplant it. The low safety valve price needs to be paired with a vision and a plan for how we will create the astounding degree of technological change necessary to reduce emissions at such low prices and without this businesses facing this cap will continue to face planning uncertainty, uncertainty that costly caps might be imposed at some point within their investment planning horizon. So this kind of R&D policy must be initiated immediately. The hope for any new solutions by a time frame such as 2030 yet the policy community is transfixed by overly complex cap and trade schemes. They cannot have meaningful impact on emissions until decades after such an R&D policy has been established. The draft bill has the cart but not the horse.

Thank you for this opportunity to share my views on this important topic. My written statement makes additional comments that I hope will be inserted into the record.

[The prepared statement of Dr. Smith follows:]

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

Mr. 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. For the past fifteen years I have focused my attention on the design of policies to address climate change risks, with a particular interest in the implications of different ways of implementing greenhouse (GHG) gas emissions trading programs. I thank you for the opportunity to share my findings and climate policy design insights with you. My written and oral testimony reflect my own research and opinions, and do not represent any positions of my company, CRA International.

The topic of today's hearing is a proposal to reduce greenhouse gas intensity with a cap and trade system that Senator Bingaman's office has prepared. (I will call this the "Proposed Policy" in my testimony). At Senator Bingaman's request, the Energy Information Administration (EIA) has prepared estimates of the energy market impacts and economic impacts of this proposal using its NEMS model combined with a macroeconomic model from Global Insight, Inc.[1] (I will refer to this as the "EIA report" in my testimony.) EIA's results are widely reported to find only small eco-

[1] EIA, *Energy Market and Economic Impacts of a Proposal to Reduce Greenhouse Gas Intensity with a Cap and Trade System,* SR/OIAF/2007-01, January 2007.

nomic impacts, with one of the most frequently cited results being that GDP would be reduced by only 0.1% through 2030.

While a 0.1% reduction is small relative to total GDP, it is important to keep in mind that GDP is a very large number. A small fraction of GDP can still be a quite significant cost in absolute terms. For example, this small loss of GDP is equal to a present value cost of $800 per person in the U.S. Also, it is possible to affect the apparent size of an impact estimate by changing the benchmark that it is compared to. For example, one could choose to compare the estimated reduction in GDP to the total growth in GDP that would be expected in the absence of the proposed policy. The same absolute GDP loss would eliminate about 0.7% of the future anticipated growth in GDP.

None of these alternative ways of stating the estimated costs indicate that the Proposed Policy's impacts are severe, or that one should characterize the Proposed Policy as "unaffordable." Clearly, the Proposed Policy is far less costly than some of the other climate policy proposals that are currently in play. However, the primary reason its costs are lower is because the emissions reductions that it offers are so much smaller. This unavoidable trade-off between emissions reduction and policy cost was made quite clear in the earlier analysis that EIA performed at the request of Senator Salazar for a range of different safety valve prices.[2] It is also apparent in the two safety valve sensitivity cases in the current EIA report. As the cost of the policy rises or falls, so too do the emissions reductions achieved. In short, "you get what you pay for."

Thus, the EIA report offers no epiphany that we have finally found a greenhouse gas policy approach that achieves meaningful emissions reductions at an affordable cost. The EIA report only shows that the degree of emissions reduction required can be reduced to the point where the expected costs of the policy are small. The key question, then, is whether this is a good climate policy proposal that is worth the cost that it does impose on us. In my judgment, the Proposed Policy can be viewed as one of the more efficient ways of imposing a cap on emissions, but this does not make it an effective first step to a national policy to manage and mitigate risks of climate change.

IS THE PROPOSED POLICY AN EFFICIENT WAY TO CAP EMISSIONS?

I will first address why the Proposed Policy is one of the more efficient ways of imposing a cap on U.S. greenhouse gas emissions:

- The Proposed Policy uses an "upstream" approach, which offers the most comprehensive coverage of national greenhouse gas emissions subject to the policy mechanism known as cap-and-trade. Greater coverage of emissions translates into greater economic efficiency for each incremental degree of emissions reduction. The policy merits of the upstream approach for greenhouse gas emissions have been known for a long time,[3,4] but unfortunately have rarely been included in proposed policies.
- An additional advantage of the Proposed Policy is that it relies solely on the market-based measures, eschewing costly technology standards such as automobile fuel economy standards (e.g., CAFE). An earlier EIA report found that the CAFE standard that was in the 2005-era "Bingaman Amendment" was a very costly way of increasing emissions reductions that could be achieved.[5] Fortunately, it has been omitted in Senator Bingaman's current proposal.
- The Proposed Policy uses a "safety valve" to establish a firm limit on the costs of the policy. Hard caps on emissions (whether for greenhouse gases or any other emission) inevitably produce high price volatility as well as risks of imposing an unintentionally and unnecessarily costly emissions reduction target. The experience with the EU ETS is a prime example. In the case of a stock pollutant such as greenhouse gases, there is no need to absorb high costs in return for

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[2] EIA, *Energy Market Impacts of Alternative Greenhouse Intensity Reduction Goals,* SR/OIAF/2006-01, March 2006.

[3] Anne E. Smith, Anders Gjerde, et al., CO_2 *Trading Issues, Volume 2: Choosing the Market Level for Trading,* Final report of Decision Focus Incorporated to Office of Policy, Planning and Evaluation, U.S. Environmental Protection Agency, EPA Contract No. 68-CO-0021, May 1992.

[4] E.J. Balistreri, P.M. Bernstein et al., "Analysis of the Reduction of Carbon Emissions Through Tradable Permits or Technology Standards in a CGE Framework," *AERE/Harvard Workshop on Market-Based Instruments for Environmental Protection,* Cambridge, MA, July 18-20, 1999.

[5] EIA, *Impacts of Modeled Recommendations of the National Commission on Energy Policy,* SR/OIAF/2005-02, April 2005.

great specificity in achieving each year's emissions cap.[6] 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.

It is important that people understand that the analysis method used by EIA does not capture the important benefit of price certainty that is associated with the safety valve. If it could do so then EIA reports on costs of various greenhouse gas caps proposals would find much greater cost-effectiveness for policies with a safety-valve than for policies of a comparable cap stringency but with hard caps. It is unfortunate that the analysis method being used by the U.S. Government to assess the merits of greenhouse gas cap proposals is unable to demonstrate the important efficiency improvements that a safety valve provision provides.

Thus, the Proposed Policy has three important attributes for ensuring that the emissions caps are imposed in an efficient manner. It would be more efficient than any cap policies that do not embody these attributes.

IS THE PROPOSED POLICY A GOOD FIRST STEP FOR REDUCING CLIMATE RISKS?

Although the Proposed Policy would achieve domestic emissions reductions in a manner that is generally cost-effective, I do not feel that this makes it an effective first step towards a national policy to reduce the risks of climate change. Three key features that are critical elements of a cost-effective policy to mitigate global climate risks are:

- Provisions to address a pressing need for research and development (R&D) to transform global energy systems
- Consideration of developing country emissions
- Long-run business planning certainty

Although the Proposed Policy has provisions that some might argue address each of these, I feel that it fails at all three, for the reasons I explain below.

R&D NEEDS

The Proposed Policy would create a "Climate Change Trust Fund" that is supposed to provide for R&D. However, this Trust Fund only provides subsidies to technologies that are far enough along in the development process to have clear constituencies, yet not far enough along to be cost-effective in the market without a subsidy. This is a "deployment subsidy" and should not be confused with the need for fundamental R&D that is the central challenge for climate policy.

Further, the carbon price imposed by the cap in the Proposed Policy provides exactly the type of subsidy that these technologies need; additional subsidies for deployment do not need to be handed out by Congress in the form of the Trust Fund provisions. The Trust Fund thus creates a "double-subsidy" that is unneeded and wasteful.

The specific provisions for disbursement of funds under the Trust Fund also reflect some of the worst features of bad R&D policy. A good R&D policy for climate policy would establish incentives that align the motivations of researchers with finding the most cost-effective carbon emissions reductions. Once well-aligned incentives are established, the incentives would determine the direction of R&D. In contrast, the subsidy provisions of the Proposed Policy's Trust Fund pre-ordain the distribution of funding among technologies. It attempts to "pick winners," an approach to publicly-funded R&D has a long history of waste and failure. The specific allocation of subsidies among technology categories appears to have no rationale or basis in analysis, and even worse, the award of subsidies is not even nominally aligned with achieving the lowest dollar per ton of carbon reduction.[7]

More importantly, however, the Proposed Policy's subsidy provisions—whether well or poorly constructed—*fail to address the kind of R&D needs that are requisite to begin to actually reduce greenhouse gas emissions in meaningful amounts.*

It is known, but not widely appreciated, that stabilization of atmospheric concentrations of greenhouse gases will require the world (not just the U.S.) to reduce greenhouse gas emissions intensity to near-zero levels. While small greenhouse gas reductions may be cost-beneficial, they cannot halt or even dramatically slow cli-

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

[7] For example, Section 1627(C)(3) calls for awards based on bids into a reverse auction for subsidies stated in terms of dollars per megawatt-hour of electricity generated, rather than based on dollars per ton of emissions reduced.

mate change. Halting climate change is possible only if the large-scale greenhouse gas emission reductions can be implemented at costs that are both politically and economically acceptable. Incremental cost improvements in currently developed technologies, and more rapid deployment of technologies just now becoming affordable will not meet this need. The magnitude of possible reductions in the next decade or two achievable with today's technology is dwarfed by the magnitude of reductions that successful innovation would supply through these routes.[8]

Hoffert *et al.* report that "the most effective way to reduce CO_2 emissions with economic growth and equity is to develop revolutionary changes in the technology of energy production, distribution, storage and conversion."[9] They identify an entire portfolio of technologies requiring intensive R&D, suggesting that the solution will lie in achieving advances in many categories of research. They conclude that developing a sufficient supply of technologies to enable near-zero carbon intensity on a global scale will require basic science and fundamental breakthroughs in multiple disciplines.

Therefore, Herculean technological improvements beyond those that are already projected and accounted for in cost models appear to be the only way to hope to achieve meaningful reduction of climate change risks. As a result, no cap and trade scheme should be placed into law that does not simultaneously incorporate specific provisions that directly support a substantially enhanced focus on energy technology R&D. *I use the term R&D as a distinctly different concept from providing subsidies for the initial uptake of existing but yet-to-be deployed technologies.* By R&D, I mean investment to create technologies that do not exist today, and which would require major new scientific breakthroughs before they could become an option that any private entity might consider proposing in a competition for actual implementation under a subsidy program. The R&D may entail basic science as well as work that is identifiably on an energy technology with low or zero carbon emissions. Subsidies aimed at bringing existing technologies into the market, and achieving incremental improvements in their costs, do not fit my definition of the term R&D.

Placing a price on carbon emissions, as a cap and trade program would do, would affect the pattern of private sector R&D. However, this so-called "induced-innovation effect" would be small. Economic analysis shows that market forces produce a less than socially optimal quantity of R&D. Once a private sector innovator demonstrates the feasibility and profitability of a new technology, competitors are likely to imitate it. Copycats can escape the high fixed costs required to make the original discovery. Therefore, they may gain market share by undercutting the innovator's prices. In that case, the initial developer may fail to realize much financial gain. Foreseeing this competitive outcome, firms avoid investment in many R&D projects that, at the level of society as a whole, would yield net benefits.[10]

The task of developing new carbon-free energy sources is likely to be especially incompatible with the private sector's incentives. With no large emissions-free energy sources lying just over the technological horizon, successful innovation in this area will require unusually high risks and long lead times. As Hoffert *et al.* pointed out, developing the needed technologies will entail breakthroughs in basic science, placing much of the most essential R&D results beyond the boundaries of patent protection. These are precisely the conditions under which for-profit firms are least likely to rely on R&D as an approach to problem-solving. Thus, greenhouse gas caps on their own would insufficiently increase private sector R&D directed toward technological solutions to abatement.[11]

Realistically, then, government must play an important role in creating the correct private sector incentives for climate-related R&D, as well as in providing funding to support such incentives. This role must be built into any cap and trade policy,

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[8] For example, if all of the existing U.S. natural gas-fired combined cycle generating capacity were to suddenly be fully utilized, we estimate based on our models of the U.S. power sector that current annual U.S. CO_2 emissions would be reduced by about 80 MMTC—about a 4% reduction in total US GHG emissions—and it would come at a cost of about $80/tonne C, even if gas prices would not be inflated by the sudden surge in natural gas demand.

[9] M.I. Hoffert *et al.,* "Advanced Technology Paths to Global Climate Stability: Energy for a Greenhouse Planet" *Science,* Vol. 298, Nov. 1, 2002, p. 981.

[10] These points are developed in a more rigorous fashion in W.D. Montgomery and Anne E. Smith "Price, Quantity and Technology Strategies for Climate Change Policy," in M. Schlesinger et al (eds.) *Human-Induced Climate Change: An Interdisciplinary Assessment,* Cambridge University Press, forthcoming 2007.

[11] Further, the "safety valve" in the Proposed Policy is designed to provide assurance that the price of emission allowances will not reach economically unsustainable levels. But that causes the carbon prices to be set at a level far too low to provide an adequate incentive for private investors to develop radically new technologies. Removal of the safety valve provision also is not an option, as a hard cap would impose a degree of market risk that would be unsustainable politically.

in order to avoid establishing an emissions policy that cannot fulfill expectations, and to avoid wasteful diversion of key resources for the requisite forms of R&D. The Proposed Policy does not appear to recognize the need for enhanced emphasis on basic research rather than additional subsidies for specific technologies that are already far along in the development process. It also does not clearly define government's role or an appropriate division of labor or risk between the public and private sectors in the development of new technologies, whether as commercialization and incremental improvement of existing low-carbon technologies, or R&D for new, breakthrough technologies. Creating an effective R&D program will not be easy, but it ultimately has to happen if climate risks are to be reduced. The difficult decisions are how much to spend now, and how to design programs to stimulate R&D that avoid mistakes of the past.

DEVELOPING COUNTRY EMISSIONS

As discussed above, the most important feature of any policy initiative is the impact it will have on investment in effective forms of R&D and the successful development of radically new technologies to provide large quantities of carbon-free energy at an affordable cost. However, that critical attribute of a sound climate policy only addresses emissions in the long-term. Near-term emissions reductions are also an interest (although they should not be the primary interest, as in most current policy proposals).

For near-term emission reductions, developing countries offer far larger and more cost-effective opportunity for emission reduction that mandatory emission limits on U.S. businesses and consumers. Thus, a sound national policy for managing climate risk would place a high priority of its near-term control policies to bring about changes in how energy is used in developing countries. The Proposed Policy fails to make clear linkage of its near-term reduction requirements with the critical need to reduce emissions growth in developing country emissions.

There are a number of ways in which the U.S. Congress could act to increase technology transfer and encourage foreign investment in developing countries, and these actions could lead to near-term reductions in emissions larger than any of the mandatory limits on U.S. emissions under considerations. A great deal of the difference in greenhouse gas intensity between developing countries and industrial countries can be explained by fundamental failures of markets and institutions in developing countries. Although the most cost-effective near-term emission reductions can be found in developing countries, fundamental institutional and market reforms are prerequisites to create the property rights and investment climate required for private foreign direct investment and technology transfer.[12] These important needs are already a focus of the Climate Change Title (Title XVI) of the Energy Policy Act of 2005; the Proposed Policy would be improved if it were contain provisions to further the goals of Title XVI.

LONG-RUN PLANNING CERTAINTY

The Proposed Policy attempts to address the need for business planning certainty. However, the certainty it offers covers only what Federally-imposed carbon prices will be. The Proposed Policy contains no provision to preempt state greenhouse gas caps that are starting to proliferate. This omission undermines any ability for its stable Federal carbon price expectations to offer U.S. businesses any true planning certainty.

Even if preemption of state cap policies were included, another attribute of the Proposed Policy undermines the effectiveness of the long-run planning certainty that its safety valve provides. The proposal itself does not expect—even by 2030—emissions reductions that begin to match the large reductions that are viewed as necessary by mid-century for greenhouse gas stabilization by the end of the century. As noted at the outset, the Proposed Policy does not promise large reductions in emissions so that it can keep its costs "low." Unfortunately, as noted in my section on R&D, the Proposed Policy also fails to include any measures to address the central challenge of reducing the cost of large reductions, which would at least provide a vision of eventual long-run emissions reductions. Thus, supporters of the Proposed Policy will be hard pressed to characterize this specific policy as a first step towards a meaningful policy to manage climate change risks. Because of this, if enacted, there would probably be little relief in pressures to impose yet more stringent emis-

[12] Such policies are discussed at greater length in W. David Montgomery & Sugandha D. Tuladhar, "Impact of Economic Liberalization on GHG Emission Trends In India," Climate Policy Center, May, 2005.

sions limits within the U.S. These continued pressures would leave businesses with much less long-run planning certainty than the Proposed Policy wishes to provide.

SUMMARY

In summary, the Proposed Policy does not offer any of the critical attributes of an effective policy to reduce climate change risks. It does not impose much cost on the economy, but that does not make it worth that small cost. To nudge the Proposal towards being a low cost policy that is worth its cost, I would recommend at least the following steps:

1. Replace the current provisions for subsidies for nearly-commercialized technologies with provisions to initiate of a research program focused on expanded basic scientific inquiry with relevance to energy system applications. Such provisions should also call for a careful evaluation of the best ways to establish effective R&D incentives for both public and private sector spending.
2. Provide support for further efforts to promote technology transfer to developing countries.
3. Add a provision that would cause the Federal policy to preempt all present and future greenhouse gas caps in the U.S.
4. Maintain the provision for a carbon price ceiling, and an upstream imposition of that carbon price to offer the widest possible regulatory coverage within reasonable administrative bounds.

Even if the proposal were to be substantially revised to focus on true R&D needs, one might still reasonably question the need for imposing a cap and trade form of policy. A modest carbon tax could provide the same stable carbon price expectations and a source of funding for enhanced R&D. A carbon tax would provide identical emissions reduction incentives at identical costs to those of the safety valve proposal without the political, institutional, and analytical complications apparent in today's safety valve proposals. The inherent complexity of a safety valve approach does not appear to me to be justified compared to a simpler carbon tax.

DOES THE PROPOSED POLICY DISTRIBUTE ALLOWANCES "FAIRLY"?

The complexity of setting up a cap and trade scheme is evident in the detailed provisions of the Proposed Policy for how carbon permits would be allocated. The language of the Proposed Policy does not suggest that these allocation rules are "fair" or that they offer any particular degree of compensation to those bearing the cost of the policy. However, Appendix C of the EIA report contains a "Discussion Draft" by Senator Bingaman's staff that explains the rationale for the various provisions in the Proposed Policy. It describes the distribution of allowances as "an approach that fairly compensates sectors for past investments in carbon-intensive technologies."[13] The following pages then discuss the specific numerical allocations proposed for each sector as if they were a computed estimate of the relative needs for compensatory values of each sector.

Although the staff Discussion Draft makes several allusions to estimates "provided by EIA" as a basis for the allocation shares selected, there appears not to have been any true analysis of compensation needs by sector. In fact, EIA states in the EIA report itself: "NEMS is not designed to evaluate the distributional impacts of whether industries are better or worse off under a given allocation scheme."[14]

As someone who has performed quantitative analyses of compensation needs under different greenhouse gas policies,[15,16] I do not think that the allocation formulas in the Proposed Policy appear to even roughly approximate the relative needs for compensation of the various sectors. As an example, the EIA report establishes that railroads will suffer the most concentrated impacts to demand of all the transportation activities because of the linkage of its business outcomes to the delivery of coal, yet the Proposed Policy does not appear to offer any allocation at all to the transportation sector. At the same time, the Proposed Policy would give 2/55 of the allowance pool to natural gas processors (a value of about $1.5 billion per year in

[13] EIA Report, p. 85.
[14] EIA Report, p. 17.
[15] Smith, Anne E., Martin T. Ross, and W. David Montgomery, Implications of Trading Implementation Design for Equity-Efficiency Trade-Offs in Carbon Permit Allocations (Charles River Associates, December 2002).
[16] Smith, Anne E. and Martin T. Ross, Allowance Allocation: Who Wins and Loses Under a Carbon Dioxide Control Program? Prepared for the Center for Clean Air Policy (Charles River Associates), February 2002.

2012 alone), even though there is no clear reason why natural gas processors would suffer any financial impact under a greenhouse gas cap.

I could continue the list of inconsistencies between the allocation formulas in the Proposed Policy with likely requirements for "fair compensation," but the more important point is that people should not be misled into thinking that the allocation formulas in the Proposed Policy are "fair" in light of any specific objective. Their specificity does not reflect precision in, or indeed any formal estimation of, the relative compensation claims of various sectors, or of businesses within sectors.

The CHAIRMAN. Thank you very much.

Jason Grumet, we are glad to have you here and thank you for all your good work in getting this proposal to where it is at this point.

STATEMENT OF JASON S. GRUMET, EXECUTIVE DIRECTOR, NATIONAL COMMISSION ON ENERGY POLICY

Mr. GRUMET. Thank you Chairman Bingaman. This new technology, I guess I am just not quite up to it. Chairman Bingaman, I thank you and also Senator Domenici for the opportunity to be here on behalf of the Energy Commission. Chairman Bingaman, I think what I would like to do is just speak for a moment upon the world in which we find ourselves in which means the opportunities to advance this discussion and then focus on the EIA analysis and on some of the comments that we have just heard to inform the discussion on how to move ahead.

This committee, Chairman Bingaman, has done a great service by advancing the discussion on the specific aspects of what it will take to move legislation forward in a bipartisan fashion that could generate the kind of support necessary to act. The sense of the Senate resolution passed in the summer of 2005 did two very important things. First of all, it asserted that we have an imperative to act that as long as the price of venting a ton of carbon into the atmosphere is zero there will not be incentives for the very kind of logical things that Mr. Sterba was suggesting should take effect. At the same time that resolution identified some obvious parameters that would be necessary in order for this country, I think, to move forward in a mandatory way and those are that we have to have a mandatory economy wide market based program that does not harm the economy and that is linked to actions in developing countries. Most significant, I believe what we hear today is that the EIA analysis confirms that while certainly imperfect, I think Dr. Smith and Dr. Lashof have both made very good points about opportunities to improve the legislation that the basic structure of the bill fulfills that mandate in the sense of the Senate resolution and I think just pausing for a moment, that is a very important realization. We are now at the point of trying to figure out very important details, but the basic framework has been established.

Also important to recognize is there are very different approaches being put forward in the U.S. Congress for dealing with climate change and they all are supported by good science. There are those supported by good atmospheric science which indicate as the Commission believes, that we must achieve a 60 to 80 percent reduction in global emissions and then we must do so with urgency and those bills therefore assert that we have to have absolute hard caps that achieve those reductions. Those are consistent with good atmospheric science. There are bills that have good economic

science behind them. Those are bills that understand the uncertainties inherent in technological progress and the inability to know exactly what those costs will be and they also recognize the uncertainty and actions of other nations and recognize the competitive issues that Senator Domenici mentioned early on. So when, when our Commission sat back and kind of reflected on good political science we came to the conclusion that what was necessary was a first step that was designed to address those very real and serious economic uncertainties while providing an architecture on a robust basis for moving a country forward and I think that is really what the EIA results suggest is possible. Now sadly, this approach wins enthusiasm from very few. It is neither absolutely protective enough to satisfy those who rightly recognize the urgency of the environmental challenge nor is it absolutely clear that it will have no costs or will have no negative impacts on industries that many of us care deeply about. But, we believe it is ultimately the only way to move the Nation forward, not only to reduce our own emissions but to bring us back into a posture where we can act effectively to get China and India and the rest of the world to join us in an effective approach.

So let me comment for a moment on the specifics of the EIA analysis. There was a certain intent to make sure that this proposal would not harm the economy and some of our mutual friends, Senator, I think that we outdid ourselves. It is clear that these costs are extremely low. Dr. Lashof indicates that EIA also has not incorporated certain aspects of the technological benefits that could bring prices lower and for that reason I think we share the sense that there are opportunities to strengthen aspects of the legislation while still abiding by the requisite requirement, not to harm the economy.

Our Commission is meeting on Friday actually. We are going to be evaluating options and looking at questions whether we could suggest strengthening the reduction targets, strengthening the cost cap or I think most significantly trying to speed the transition from the slow to the stop phase. We very much believe there has to be a slow phase. We have a lot of momentum in the system and if we try to throw it in reverse right away there could be some disruption. We initially had proposed a 10 year slowing of emissions but I think now we are believing that something shorter than that, possibly a 5 year transition from slow to stop may be more appropriate. We hope to come back to you with suggestions, but Mr. Chairman, no matter how we move forward we think there are three fundamentals that have to be sustained if we are going to have real progress.

The first is that this has to be a gradual approach initially and it has to be supported by real technological support, both to bring commercialization forward more quickly and I think as Dr. Smith suggests for that longer term goal. It is that combination of a modest reduction target and real support for technology that brought unusual organizations like the United Mine Workers, the United Steel Workers, the United Auto Workers to support our proposal and the legislation you were considering because they recognize that there was an opportunity if things were done thoughtfully to provide new technology that would allow those industries to move

forward and succeed before the costs of the emission reductions became really damaging to their future.

Second Mr. Chairman, we believe that this has to be an iterative approach. The collective action nature of the problem is this me, Mr. Chairman or is this the vote? I have this effect on people. Well, maybe that did it. We believe that this has to be an iterative approach. The collective action nature of the problem, the fact that we can not solve the problem unless we have action by all developed and developing countries leads us to believe that no matter how much we desire a 50 year certainty, it is just not realistic. I think it is more political cosmetics than reality whether you are articulating a 10 or 15 year path saying that you are going to iterate or whether you are asserting a 50 year path and asserting that it is locked in. The truth is that this is an issue that Congress is going to have to revisit on a regular basis and we believe that that should be understood and explicit from the outset.

And finally, we believe that the program has to be cost certain. This is still a rather polarized debate going from one camp to the other and saying trust me, it is going to be cheap, does not tend to have a lot of beneficial impact.

I think we heard from all of the folks speaking today that there are differences of opinion about how quickly technology will advance. Those are the differences that lead you to believe that the program will either be expensive or cheap. I personally tend to be more of a technology optimist. I do not think that a safety valve is going to in fact reduce the ultimate impact of the programs significantly but I also recognize that the person I am trying to convince is not myself and we have found that when we have tried to move this discussion forward and broaden the coalition, the ability to say that absolutely under no circumstances can the cost of the program be higher than a set, you know, predetermined price has been incredibly important to bring this discussion, I think, closer to a central point from which you can actually now try to come up with some details.

So let me close by simply saying that we continue to greatly appreciate the opportunity for this discussion. We think this committee is having the kind of discussion that is necessary to really advance the debate and in particular, the decision to submit the draft proposal for the rigorous analysis EIA has done allows us to have a public discussion where you have equal attentions of the costs and benefits on the table at the same time and we think that is the kind of discussion that is going to, that will ultimately allow us to build the coalition necessary for action. Thank you.

[The prepared statement of Mr. Jason Grumet follows:]

PREPARED STATEMENT OF JASON S. GRUMET, EXECUTIVE DIRECTOR, NATIONAL COMMISSION ON ENERGY POLICY

Good morning Chairman Bingaman and Members of the Committee. I speak to you today on behalf of the bipartisan National Commission on Energy Policy. The Commission is gratified that our recommendations on climate change continue to inform this Committee's deliberations and I appreciate the opportunity to speak with you today regarding the Energy Information Administration's analysis of Chairman Bingaman's draft legislation. In the summer of 2005, this Committee played a critical role in moving the Congressional debate on climate change forward by winning Senate adoption of a landmark resolution recognizing the importance of the climate problem and, for the first time, putting this body on record in support of the need

for mandatory efforts to reduce greenhouse gas emissions. I continue to believe that in years to come, passage of this resolution will come to be seen as a pivotal moment in the evolution of our collective response to the risks posed by climate change. I commend Chairman Bingaman, Senator Domenici and many others on this Committee for their leadership on this issue.

The Sense of the Senate resolution represents a critical milestone because it recognizes the urgency of taking mandatory action on climate while also establishing conditions that must be met to craft an effective, responsible, and politically viable path forward. The resolution calls for an approach that will slow, stop, and reverse the growth of greenhouse gas emissions. But it also emphasizes the need to adopt an approach that is market-based, will not significantly harm the U.S. economy, and encourages comparable action by other nations that are major trading partners and key contributors to global emissions.

We are now moving to the next phase of the legislative process, in which the laudable goals of the Senate resolution must be translated into specific language that can win the support of Congress. The Commission is very supportive of the process this Committee is pursuing to reduce the polarization that has dominated past climate-change debates and build the bipartisan consensus necessary to enact legislation. It is clear that the draft bill analyzed by EIA benefited greatly from detailed input received as a result of the program design workshop this Committee conducted last year. New provisions that address key issues such as permit allocation and emissions offsets with greater specificity than ever before will add much to the continuing discussion. It should also be noted that the bill under discussion proposes somewhat stronger emission reduction targets than the similar legislation EIA analyzed in 2005. The Commission believes that further opportunities exist to strengthen this legislation while still abiding by the requirements of the Sense of the Senate Resolution and we hope to share more specific suggestions—as well as our current thinking on other key design issues such as allocation, point-of-regulation, and emission offsets—with the Committee in the coming weeks.

Chairman Bingaman, the Commission is very encouraged by your and Senator Specter's decision to circulate a discussion draft and initiate an ongoing series of staff working sessions to hammer out the tough questions that remain. Submitting your legislation for detailed economic analysis prior to entertaining a larger public discussion reflects a continued commitment to serious engagement with the concerns that must be overcome to advance this debate. We hope that advocates of other climate proposals will also see the value of subjecting their ideas to a similar degree of scrutiny.

For the remainder of my testimony, I would like to focus first on the substance of EIA's findings and then on the implications of these findings as Congress goes forward to design an effective legislative approach, on climate change.

SUMMARY OF IMPACTS

The EIA analysis of Senator Bingaman's proposal allows us to directly address one of the questions at the heart of the debate over climate legislation: Is it possible to take a meaningful first step to limit greenhouse gas emissions without harming the economy? EIA's most recent analysis again demonstrates that the answer is yes. This conclusion is in line with EIA's assessment of a similar proposal from NCEP that was analyzed at the request of Senator Bingaman in 2005. EIA said of that proposal that the overall growth rate of the economy during the period of analysis was "not materially altered." For Senator Bingaman's current proposal, EIA found similarly minor impacts: according to its analysis, U.S. GDP in 2030 is reduced by only one quarter of 1 percent compared to the baseline case. This is equal to slowing the rate of economic growth by roughly one month over the next 20+ years.

It is also important to emphasize that EIA's analysis does not include positive benefits from the $50 billion the current proposal would generate over the next 20 years for technology incentive programs. These funds would accelerate the development and deployment of the breakthrough technologies—such as advanced coal gasification with carbon sequestration, cellulosic ethanol, and renewable energy—that will be necessary to achieve significantly deeper emissions reductions in the future. In other words, if EIA had used more optimistic technology assumptions to reflect the bill's significant technology incentives, the analysis would likely have shown larger emission reductions at even lower cost.

EIA's analysis also shows modest impacts on energy use and prices. While growth in coal use is projected to slow by more than 50 percent compared to the business-as-usual (BAU) baseline case, EIA predicts that overall coal use will continue increase under the proposed policy even without accounting for the new markets that will be created by IGCC and sequestration. When crafting its recommendations, the

Commission worked closely with the United Mine Workers to develop a strategy that would initiate the transition toward a low-carbon future while providing an opportunity for carbon sequestration and other carbon management approaches to mature before rising carbon prices would render coal-based energy uneconomic. By pairing initially modest emission reduction targets with a robust package of technology incentives, this legislative draft aims to effectively address the legitimate concerns of the coal sector.

Another important concern addressed in the EIA analysis is the impact of carbon constraints on already tight U.S. natural gas markets. Here again, the new results are reassuring: natural gas consumption remains essentially unchanged despite somewhat more stringent program targets. Throughout the forecast period, natural gas use ranges from 2 percent below the BAU level to 1 percent above the BAU level.

Of course, a very small fraction of a very large economy can still look like a lot of money if taken out of context. You will undoubtedly hear from critics that the proposal will cost $232 billion in lost GDP between 2009 and 2030. What the critics are less likely to mention is that this is just a tiny fraction (one-tenth of 1 percent) of the more than $240 trillion of cumulative growth in GDP the economy is expected to generate over the same time period.

To say that greenhouse gas limits can be imposed without harming the economy is not to claim that the program is costless. Any honest debate will need to acknowledge that there *are* costs and that—as with any public policy intervention—there will be winners and losers. We do not doubt that innovative and efficient companies can prosper under a carbon mitigation regime. Moreover we believe that the technological innovation sparked by a carbon price signal could well produce net benefits for our entire economy in the long run. In the near term, however, the same price signal will impose new costs on fossil fuel consumption and reduce the value of carbon-intensive capital stock. So yes, there will be costs. But as always, the real choice is not between some cost and no cost. Rather the relevant question is whether the costs of action are reasonable and justified when compared to the liabilities of inaction. Two years after the Senate adopted its landmark resolution we think the answer to that question is clearer than ever. We also remain convinced that the quite modest economic impacts of the approach we have proposed can be effectively mitigated by thoughtful program design and through the equitable allocation of emission permits.

IMPLICATIONS OF THE EIA ANALYSIS

The trade-off for the modest costs found by EIA is that the program being analyzed also achieves relatively modest emission reduction benefits, at least in its early stages. In light of recent scientific developments and the time that has passed since NCEP's 2004 recommendations, the Commission has begun evaluating opportunities to strengthen its original proposal and still meet the criteria of the Sense of the Senate resolution. In particular, we are analyzing modifications that would strengthen program targets as well as possibly increase the starting price of the safety valve and/or the rate at which that price rises over time. We are also evaluating options for speeding the transition between the slow and stop phases of the program's target emissions trajectory. Our original report recommended a ten-year period aimed at slowing emissions growth, followed by a ten-year period designed to stop further growth. We are presently examining approaches that would stop emissions growth within five years and reduce overall emissions no later than ten years after program implementation. It is important to stress that any changes in our recommendations will be predicated on the conclusion that a moderate strengthening of the program can be achieved while still meeting the test of no significant harm to the economy.

Even as we examine opportunities to strengthen our original recommendations, the Commission remains firmly convinced that certain elements are essential to the economic and political viability of any climate proposal. We start with an acknowledgment that trade-offs between the timeliness and stringency of action are unavoidable. It's clear that significant reductions in absolute emissions will eventually be necessary to stabilize atmospheric greenhouse gas concentrations. But faced with a disconnect between what is required and what is politically feasible in the near-term, we conclude that timely adoption of a policy that sets initially modest targets while establishing a robust basis for long-term progress is more ecologically protective than continued delay in pursuit of more aggressive targets. Simply put, there is no time to lose, especially when one considers that mandatory action by the United States remains the necessary predicate for action by other major emitting nations such as China and India.

The Commission's emphasis on the necessity of a major technology program to spur the development and deployment of lower-carbon technologies follows directly from our judgment that near-term progress demands a policy with modest initial costs. The $50 billion package of technology incentives created and funded by the draft legislation provides a critical complement to the long-term market signal created by the emissions trading program. We strongly believe that a combined strategy of market signals and robust technology incentives is the most effective and least costly way to achieve a meaningful shift from business-as-usual trends, while equitably sharing the burden of emissions mitigation among shareholders and taxpayers.

We also continue to believe that cost certainty is critical to forging the political consensus needed to move forward without further delay. The Commission recognizes that the decision to include a "safety-valve" to cap costs under an emissions trading program is highly controversial. Nevertheless, we remain convinced that this approach provides a uniquely effective response to the economic and competitiveness concerns that continue to motivate opposition to mandatory action. At some point in the future, we anticipate that the need for environmental certainty is likely to outweigh the need for cost certainty. Indeed, once there is greater international consensus about the ultimate goal of emission reduction efforts and about the means necessary to achieve that goal it will likely be appropriate to transition away from the safety valve toward firm emission caps. Again, our hope is that near-term action by the United States will hasten progress toward a truly effective and equitable global response to the climate problem. Meanwhile, we recognize that other legislative proposals propose alternative approaches to containing program costs and welcome further analysis and debate on which mechanisms best address the cost and competitiveness concerns that have been raised by labor unions, energy-intensive industries, consumer groups, and others.

Finally, although it is not specifically the subject of this hearing, we continue to believe that any successful national policy must place considerable emphasis on promoting wider international cooperation. By some accounts, China is now adding new coal capacity at the rate of one large power plant every week to ten days and is set to surpass the United States in total carbon emissions as early as 2009.[1] Though some will argue that this sobering development weakens the case for unilateral action by the United States, the Commission draws the opposite conclusion. In our view, the current trajectory of global emissions instead underscores the liabilities of continued paralysis. If one accepts that rapidly industrializing countries like China and India are likely to accept emissions limits only after the United States and other wealthy nations have demonstrated a willingness to take the lead, it follows that postponing action will come at a high price—not just in terms of U.S. emissions but in terms of prolonging business-as-usual trends in other countries. At the same time, we continue to believe that once the United States takes action, it is imperative that our major trade partners and other large emitters follow suit. We therefore support the five-year review provision in the Bingaman proposal, which would link continued tightening of the emissions target and further increases in the safety valve price to significant action by these countries.

In closing, the Commission believes that the discussion draft you have circulated presents a sound framework for legislative action. The results of the EIA analysis are very helpful and give grounds for optimism that a viable policy consensus is in reach. Indeed, as we have indicated in this testimony, the EIA results suggest to us that there is room to further improve the bill consistent with the requirements of the Sense of the Senate Resolution. We look forward to exploring those opportunities and addressing other key details of program design with the Committee and other stakeholders as this process moves forward.

The CHAIRMAN. Thank you very much.

Let me ask a few questions, then we will have 5 minute rounds and Senator Domenici will follow me.

Howard, let me ask you first. One issue that I believe Ms. Smith raised is whether or not it is really worth doing this considering the modest benefit that would be achieved. You, EIA did an analysis this last year I believe of the impact of EPAct, the 2005 energy bill on carbon dioxide emissions and I have that in front of me. It says in sum, EIA's analyses suggest that roughly 30 EPAct 2005

[1] See http://select.nytimes.com/search/restricted/article?res=F50B 12F83A5B0C748CDDA 80994DE404482.

provisions that were explicitly modeled are projected to reduce energy related CO emissions by approximately 90 million metric tons in both 2020 and 2030. That is your conclusion?

Dr. GRUENSPECHT. Yes, that is correct.

The CHAIRMAN. Now, as I understand this analysis you testified on today, you say that this draft proposal instead of reducing the 90 million metric tons, would reduce greenhouse gases during that same period well in 2020. I think the figure you got is that it would reduce it to 562 million metric tons and in 2030 it would be 1,259 metric tons. Am I right about that?

Dr. GRUENSPECHT. That is correct, 1,259 million metric tons.

The CHAIRMAN. Yes, 1,259 million. So that by 2030 if this provision were adopted your best guess is that we would be reducing greenhouse gas emissions by somewhere in the range of 12 to——

Dr. GRUENSPECHT. 15.

The CHAIRMAN. 12 to 15 times as much reduction as would be the case in absence of some kind of cap and trade system. Is that a fair statement or not?

Dr. GRUENSPECHT. That is a very fair statement, sir.

The CHAIRMAN. Okay. Maybe you would want to respond and give your thoughts on Dr. Lashof's comments about how you did not take into account some of the energy efficiency benefits as I understood what he said that there are energy efficiency benefits to be realized from the investment of research dollars in this fund. I think that was the point that he was making and maybe other benefits as well. Maybe you could respond to that.

Dr. GRUENSPECHT. I could do that, sir, thank you. I guess the easiest and cheapest response would be a Goldilocks answer. I know there was a press release I saw yesterday that some other group criticized us for low-balling the cost and I guess with Dan saying we are high-balling the cost I could say gee, we must be just right if we are being criticized from both sides, but that is not a substantive answer. I do not want to say that. I actually think Dan's comments raised some interesting issues, but I really do disagree with their implication that EIA's study is biased. Our analysis is very clear about what is included and what we do not include and why. Without doubt, there are many cross-cutting forces and additional complexities we do not address, and we state that clearly in the study, but these do not all cut in one direction as I think Dan's testimony suggests. Starting first with technology, our report prominently

The CHAIRMAN. Give us the short version here because I wanted to ask another question.

Dr. GRUENSPECHT. I will give you the pretty short version.

The CHAIRMAN. Good.

Dr. GRUENSPECHT. Basically we have done a lot of work on technology in our previous reports—both the one done in response to your original request and Senator Salazar had a request last year.

Clearly, more advanced technology lowers the cost of achieving emissions reductions but we really cannot see any correct way to link increased Federal expenditures to the state of energy technology. So we have looked at the effect of better technology and it is to reduce the cost of reductions. We also agree on energy efficiency, but I would say that some of the policies that NRDC sug-

gests have a decidedly mixed historical experience. For example, some demand-side management programs and some, I guess what is called, strategic promotion of technology programs, I am sure many of you in this committee are familiar with something called PURPA, which I think you repealed last year. There was a lot of strategic technology promotion in that statute. Some of that strategic technology promotion ended up being quite expensive, and I recall that some of the States that took the strongest efforts under PURPA actually were some of the States that had the highest, that ended up with the highest electricity prices and because of that got led into restructuring in the late 1990's. That had problems of its own, frankly, but the notion that all this strategic promotion and targeting is going to make things work better is not necessarily the case. Again, their testimony talks about allocating allowances based on moving off the historical allocation to some kind of incentive or strategic allocation, to the extent that allocations are used to buy down consumer costs. You are going to attenuate the consumption response to the extent that you tie allowances to specific technologies; you may not get the lowest-cost responses. So there are a lot of issues here. The bottom line—in my world, when you want to make an omelet you break some eggs, although you try to do as careful a job as you can to hold down the number. Dan's sort of suggesting that when he makes an omelet he finds more eggs in his refrigerator than he started with. Again it is a nice thought, but there is a lot going on here. It is difficult to see how reducing use of technologies and processes that the market finds economically attractive, like burning coal, and replacing them with more expensive options is likely to raise overall economic performance. That does not say we should not do it.

Even if limiting emissions engenders some cost, it can still be very desirable public policy if the environmental benefits are such that the limitations serve to increase overall social welfare. You guys all have a hard task in front of you. EIA does not look at benefits. We have a very limited role in this. We try to do that role well. We think we have done it well. It is not easy.

The CHAIRMAN. Thank you very much. Let me stop with that and call on Senator Domenici for his questions.

Senator DOMENICI. Well, with all of that I don't know whether I have any but, let me go with you, Doctor, a little bit more if you can stand it. The EIA analysis projects a small decrease in the Gross Domestic Product under the proposal and the EIA model tell us more about the impacts, specific industries, for example which U.S. industries would see job loses. Can the EIA model tell us anything about regional impacts? I don't want you to give us the whole, the result today; I want you to just tell us, can you?

Dr. GRUENSPECHT. Yes, we can do some of that.

[The following was received for the record:]

The National Energy Modeling System (NEMS) used in this analysis does produce energy market results at various regional levels [1] and industrial sector economic results at the national level. With respect to the energy sector, significant variations in regional results are seen in the electricity and coal markets. In the industrial sector, the most significant impacts occur in the energy-intensive industries.

[1] For example, electricity markets are represented for 13 regions based on the regions and subregions of the North American Reliability Council (NERC).

ELECTRICITY AND COAL MARKETS

All regions of the country are projected to face higher electricity prices in the Phased Auction case of the September 2006 proposal that EIA was asked to analyze (Figures 1 and 2).* The largest price increases are projected in regions where electricity prices are set competitively and where coal generation accounts for a large share of total generation. In these regions, the costs of holding all the needed emission allowances will be fully reflected in consumer prices. For example, electricity prices in the MAAC and ECAR regions are projected to be 17 percent and 14 percent higher, respectively, in the Phased Auction case in 2030. Conversely, the electricity price impacts are projected to be smaller in regions that still have an average cost pricing regime and do not depend as heavily on coal. For example, 2030 electricity prices in the California and NWP regions are projected to only be 4 percent and 5 percent higher, respectively, in the Phased Auction case.

The reduced use of coal in the power and liquid fuels (i.e., coal-to-liquids diesel production) sectors affects coal production in all areas of the country (Figure 3). In absolute terms, western coal production is projected to be most impacted, falling 253 million tons (24 percent) below the reference case in the Phased Auction case in 2030. This occurs because, in the reference case, western coal regions, particularly the Powder River Basin in Wyoming and Montana, were expected to be the dominate growth areas for coal production. In the Phased Auction case, power companies turn to new nuclear, natural gas, and renewable plants to meet growth in the demand for electricity, reducing the need for greater coal production. Even with this change, western coal production in 2030 in the Phased Auction case is 30 percent higher than 2004 production. Eastern coal production in 2030 is projected to be 142 million tons (22 percent) below the reference case level in the Phased Auction case, about the same level that was produced in 2004.

IMPACTS ON INDUSTRY OUTPUT

In the Phased Auction case, the price of allowances directly increases the costs in emitting sectors and leads to increases in energy prices that raise the factor input costs for all industries. This leads to changes in the demand for goods and services, as reflected in the final demand categories of consumer spending, investment, government spending and trade, and causes industries to adjust their production accordingly. Figure 4 shows the average annual loss in gross output relative to the reference case for the period 2009 to 2030 for the Phased Auction case. The energy-intensive manufacturing industries[2] are impacted the most, with output projected to be reduced by an average of 0.82 percent. Non-energy-intensive manufacturing is reduced by an average of 0.57 percent, non-manufacturing industries by 0.32 percent and services by 0.10 percent.

Among the detailed energy-intensive industries, aluminum production, which is a heavy user of electricity, is expected to fall by 5.0 percent on average. Production of glass, iron and steel, cement, agricultural chemicals and basic inorganic chemicals are also expected to fall by more than 1 percent. Among the non-manufacturing industries, coal mining is projected to fall by 8.9 percent, with oil and natural gas extraction falling by 0.4 percent.

Senator DOMENICI. Okay, has it been done, or would it have to get done, or going on?

Dr. GRUENSPECHT. Some of the work on electricity has been done, the different regional price impacts.

Senator DOMENICI. We would like you to do that and submit it to the record through the chairman.

Dr. GRUENSPECHT. Be glad to do that, sir.

Senator DOMENICI. Higher energy prices under the proposal drive energy intensive industries to relocate to countries like China and India where there are no restrictions on greenhouse gases. Is that a true statement?

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*Figures 1-4 have been retained in committee files.

[2]Energy-intensive manufacturing industries in NEMS include food, paper, inorganic and organic chemicals, resins, agricultural chemicals, petroleum refining, glass, cement, iron and steel, and aluminum.

Dr. GRUENSPECHT. What we looked at was a U.S. model, not a global one, so there is logic in what you say, but we have not evaluated it in the context of this study.

Senator DOMENICI. Alright, you mean you didn't study it. You just kept an American one.

Dr. GRUENSPECHT. The focus is on United States, yes.

Senator DOMENICI. Right, thank you. Why do you believe that nations like China and India will act to limit greenhouse gas emissions if the United States does it first? Would these large developing countries have an advantage if they kept their energy price as low as possible? This is a question for Jason Grumet. Jason?

Mr. GRUMET. Thanks, Senator Domenici. I guess I would have to flip the question around and say that I think that action by the United States is certainly necessary to imagine that we can have action from other countries, but it is not sufficient. There are absolutely no guarantees that the United States once we re-enter the discussion in the postural leadership are capable of moving the world, but if you look to history when it comes to our foreign policy we are not great followers. We are pretty good at getting other people to follow us and we have had a lot of success with the CFC treaty. We have a tremendous opportunity to, I think, to encourage other countries to join us in that approach and the last thing that I would say is that they see the risks of climate change too. I think that they are suffering the same kinds of anxieties about, you know, they have a billion people to feed and a billion people who need clean drinking water. They are already having a lot of stresses there. So my hope and this goes back to I think where the first President Bush entered the discussions that we would seek to have differentiated commitments. We would not sit back and say we are going to wait for China to lead us, nor would we go off willy-nilly and say we are going to commit to an 80 percent reduction absent assurance that they are coming with us, but as this bill does, we would basically trust and verify. We would take a step; we would do everything we can to make that then bring about an effective global program. If that happens we would take second and third steps. If that does not happen, I think that we would stand down.

Senator DOMENICI. Okay. This last question is of Dr. Anne Smith. Dr. Smith, you made an important point that the United States industry needs certainty if we are going to put a price on carbon. Would a carbon tax give industry more certainty than a cap and trade system?

Dr. SMITH. The safety valve feature, if it goes in as said, is almost the same amount of certainty however it is far more complex as you have probably started to realize in setting up a cap and trade system with all of the allocations and the issues of the rules for the trading and it imposes a lot of costs on businesses to manage that trading and the management, the accounting for the emissions etcetera that could be much more simple under a simple carbon tax. Essentially with a safety valve, if it is stable, you get almost the same outcome but at much greater administrative cost and complexity and it might even, I think, hold up the passage of the bill, that complexity.

I would also like to point out, Jason mentioned that we need to not deal, not even think that we can get certainty with any bill that obviously we will have to revisit what the caps are over time and I agree with that. There is no way either a tax that would be imposed or a cap and trade program with the safety valve would really provide true certainty over all time, but what we do need is a policy that will eliminate the cause for dramatic new shifts towards a different philosophical approach to dealing with the climate policy into the future, into the next 20 years and that is why I am saying pairing the safety valve feature or carbon tax with a true R&D plan envisioned for getting technology down is how you can get a stable expectations within that general philosophical approach and that is the essential piece that is missing right now, I think.

Senator DOMENICI. I wanted to thank Jeff Sterba in particular for coming up here today and testifying and being a leader among some industry people who would seek to move us to get started. I am not, we normally agree, Sterba, you and I, that isn't necessary, but we normally do for some strange reason. At this point we are not in agreement on this bill, but we are moving so I guess as long as that is there you can be somewhat satisfied that the number of trips you will make to Washington can be minimized in some way pretty soon. Thank you.

Mr. STERBA. Thank you, Senator.

Senator DOMENICI. Thank you, Senator Bingaman.

The CHAIRMAN. Thank you very much.

Senator Akaka.

Senator AKAKA. Thank you very much, Mr. Chairman. Mr. Gruenspecht, thank you for your analysis and hard work on this report. In general, I support a cap and trade system to reduce carbon emissions in the United States. However, as you know, Hawaii has the highest gasoline and electricity costs in the Nation. Your analysis shows increases in gasoline costs over time up 0.11 cents by 2030 and also in electricity costs. Can you expand a little bit more on the economic effects on the State of Hawaii due to its unique circumstances?

Dr. GRUENSPECHT. Well, thank you, sir. First I should give, it is not my hard work it is the work of all the people at EIA because it took a lot of people to do this and I want to say that first. We do not have really detail into the individual State-level impacts in this type of framework. I do not know what to say. What I would do if I was thinking about this is draw some analogies to some of the recent events. Gasoline prices have changed a lot for other reasons, as we all know. More recently, in a direction that I think a lot of us like but over the past couple of years in a direction that a lot of us do not like and those changes were a lot bigger than 0.11 cents. Maybe by comparing how those changes have effected things would be a context for thinking about the question that you pose. That is not a real formal answer, but I think that is probably the best I can do.

Senator AKAKA. Well, with the new proposals of this committee with Jeff Bingaman there may be some other changes that may come sooner than we think. Mr. Lashof, I fully agree with your point that allowances are a public asset and I am encouraged by

your suggestion that a significant portion that is 30 percent be allocated to States. As you know my State of Hawaii could probably use some of the allowances to address concerns in particular sectors that hopefully could benefit families and consumers in Hawaii. Is this something that, the State use, can use to help with the impact on gas and electricity prices?

Dr. LASHOF. Ah, thank you, Senator and first of all I want to say that this idea of allocating some, 30 percent of the allowances, is not my idea, it is Senator Bingaman's idea and I think it is a good one so I want to endorse it and I think that it is there precisely because each State has some different circumstances and the way Hawaii would use those resources will be different then the way New Mexico will use those resources so I think it makes a lot of sense to go down that road and Hawaii could, for example, has enormous renewable energy potential that could actually allow your State to produce all the electricity it needs without burning fossil fuels. I think in the long run that would lower costs to consumers and those resources could be used for that as an example. It could be used to help in the transportation. I think you do want to be careful not to have States use the resources in a way that would subsidize activities that would cause emissions to go up because that would defeat the purpose of the program, and I think the provisions here are intended to ensure that States use the resources in ways that further the program. In general I think this is a good approach to include in any cap and trade program.

Senator AKAKA. I look forward to working with Senator Bingaman to explore the possibility. Mr. Grumet, thank you for your work with the National Commission on Energy Policy. It has launched us in the right direction. I want to follow on Senator Domenici's question. I agree with your point that we must place a renewed emphasis on promoting wider international cooperation in reducing carbon emissions. Are there signs that China and India will take action if the United States self regulates carbon emissions and if there are what are the next steps for the United States?

Mr. GRUMET. Well, Senator I have to admit that domestic policies are more my expertise than foreign policy but I can suggest a couple of things happening and maybe you can reflect on what you think the possibilities are. China, in particular, is actually reducing the carbon intensity of its economy at a much faster pace then the United States or any developing, of any developed country. What they aspire to, of course, is advanced technology and at a very simple level and I think Mr. Sterba has spoken to this in the past and moving from very inefficient, largely uncontrolled, small utility coal combustion to a modern facility in and of itself has a tremendously beneficial impact on reducing the carbon per kilowatt.

It is also the case that the Chinese government has a very serious appreciation of the perils that can befall China if in fact we have the kind of drought and the strong cyclical changes in which we have snow melt much faster and all the different varieties of anxiety that I think that everyone who looks at these should seriously just starts to feel. So again I think I have to flip the question back around and recognize that the United States is responsible for about 80 percent in the developed world of the emissions in the atmosphere. We now have China struggling to move from a devel-

oping Nation to a country that has some of the amenities that we have come to take for granted and we have to find a way to meet them in some kind of iterative approach. I think they look at us in kind of aghast to think that we would come to them and say please, you, China have to take the exact same steps as we do when you compare our GDP's and relative quality of life, so it is going to be an iterative relationship.

Senator AKAKA. Briefly, what about India?

Mr. GRUMET. I think that the dynamics are somewhat similar in India. India is in fact has the greater ability of making existing kind of technological base. They are moving forward with a number of rather significant low carbon activities both India and China are of course moving as strongly as they can towards nuclear power, which they both hold some significant hope and but again, this is a question about the United States and our, you know, great international might rejoining this discussion and trying to develop global process that in fact would be equitable and ultimately effective.

Senator AKAKA. Thank you. Thank you, Mr. Chairman.

The CHAIRMAN. Senator Craig.

Senator CRAIG. Well, Mr. Chairman, thank you very much. Let me first thank you for the hearing and the effort put forth and I must also say your thoughtful approach toward the cap and trade concept. I think that is reflected in the testimony we have heard today. I must also tell you that I continue to oppose what I think is an obsolete approach that is a post Kyoto holdover of a command and control type that creates imbalances or disincentives and certain other kinds of abnormal incentives to a market that all of us are and should be concerned about.

As you know I helped co-author the Hagel-Pryor Climate Title, title 17 in EPAct that you and Senator Domenici are certainly receiving accolades for as you should and frankly that opposed the cap and trade amendment approach. Having said that I think your latest draft demonstrates a lot of work on your part and I am encouraged by it. You have included greenhouse gas intensity as a measurement of emissions in the terms of the GDP. I guess my frustration beyond that because I see a phenomenal opportunity for our country to do a good number of things. First and foremost for us to lead and help the world, I do not dispute that. I think that is in part what Jason is referencing and we can do that not through existing technology, but new technologies. We gain very little to focus on ourselves and ourselves alone and let China and India wander off into the future continuing to be the large emitters they are. It is just simply counterproductive. We are investing more, we should invest more, I think Anne has it right. This may be the cart but there is no horse and I must tell you I am extremely frustrated with an administration that is talking the talk right now but they are not administratively, by rule and regulation, walking it and by that I mean we are still lagging dramatically with the implementation of all of the new technology ideas and the guaranteed loans and all of that that in part, many of you have included in your discussion today on this piece of legislation. That does not mean it is all inclusive for the work we have done and there should not be more work done and I am certainly willing to be part of that, but I am going to jab this administration a little

bit for the very counterproductive discussion between DOE and OMB about who is on first and who is on second.

Now I will take another step forward. The unwillingness of the current Senate and House to move forward on an Appropriations bill approach to fund these new efforts that we are now going to deny ourselves, steps us back another year, in many of the new technologies in the advancement of something that we all now generally agree with, nuclear. Here we are attempting to look into the future and we are not handling the present very well as it relates to the work we have already done and it is not untypical of a Congress to always look at what may be publicly pleasing tomorrow but failing to carry through on the very work we have done that is phenomenally substantive today. Am I frustrated, yes, I am. Am I going to change an attitude that I have grown to be comfortable with because I spend a lot of time on this issue with scientists and others? I am not surprised with Daniel's testimony. It is okay, but it is not enough we need to do a lot more. We probably do, but I am not going to shut down this economy to accomplish it and I am not going to create an artificial market in which there are winners and losers in a way that distorts it. We ought to be all about incentivizing. We ought to be all about new technologies and as I have traveled the world to the Climate Change Conferences. I am very proud of the fact that what we do is open, transferable as it relates to the rest of the world and that is what we ought to be about. It is a technology we develop for the coal industry of this country that is immediately applied to the coal industry and the generating capacity of China. That is a quantum leap for, by all measurable amounts. So, I get it.

I thank you for the work done. I am not sure that I am willing to accept a nose under the tent approach to cap and trade when in fact it gets us so short a distance, that I think as Anne said, we are picking winners and we are picking losers and somebody's going to pay for it and I am not sure it is productive at that point. Whereas, coal gasification a whole combination of new things clearly to get this administration off its back and moving on nuclear and other areas of new technologies make, to me, a whole lot of sense. I guess that is more of a statement than a question. I have used up my time, but I think it also demonstrates at least for me, that this committee is moving generally in the right direction and I thank you very much for that, Mr. Chairman.

The CHAIRMAN. Thank you very much.

Senator Sanders.

Senator SANDERS. Well, thank you very much, Mr. Chairman and I want to thank all of our distinguished guests for being with us. Let me start off with Dr. Gruenspecht and I know you are not here representing the administration per say, but be very brief. Does the administration today in the year 2007 recognize global warming as a man-made phenomenon? Do they still consider it a hoax? Where is the administration, I mean, are they on board in saying it is a man-made phenomenon or not?

Dr. GRUENSPECHT. As you said I am really not here representing the administration.

Senator SANDERS. Give me your best guess on it.

Dr. GRUENSPECHT. You probably know better than I do. I do not get the impression that they think it is a hoax.

Senator SANDERS. OK, OK. Do they see it as a man-made phenomenon?

Dr. GRUENSPECHT. I think they see both man-made and other causes.

Senator SANDERS. Let me ask Dr. Lashof a question. Obviously all of us, I do not think there is any debate up here that we all want a strong economy, nobody wants to do anything that is going to create more unemployment or lower wages. That goes without saying, but on the other hand, I am sure I speak for everybody up here that they do not want to see a planetary catastrophe. Nobody here wants to see that as well. How much time do we have, I mean, there are some people who are saying that if we do not act in a very dramatic fashion in terms of reducing greenhouse gas emissions that we are going to reach irreversible situations which will permanently damage the entire planet and will result in increased drought, flooding, the severity of hurricanes, the loss of agricultural land, the rising of the seas, which obviously nobody here wants to see. How severe, very briefly, is the problem? How quickly do we have to act if we are going to reverse it?

Dr. LASHOF. Well, very briefly, it is a very severe problem and we need to act very quickly. I mean, I am persuaded by Dr. Hanson's analysis which says that unless emissions are headed sharply downwards within the decade, we start to lose our window of opportunity to prevent the most dangerous consequences.

Senator SANDERS. Now maybe I was a little opportunistic asking you that question because along with Senator Boxer and nine other of my Senate colleagues, I have introduced S. 309 which is the strongest global warming bill introduced in the Senate and this bill would reduce U.S. emissions to 1990 levels by the year 2020 and by 2050 the level of emissions would be reduced to a level below 1990 levels. Is that the kind of program that we need, do you think?

Dr. LASHOF. Well, Senator, I think it is. I think that the level of reductions that you have in your bill are exactly the kind of leadership that the United States needs to take. That, that is, as Jason Grumet said, that the good atmospheric science in this process and that is the direction. What I am encouraged by is the fact that we now have a growing recognition including in major businesses.

Senator SANDERS. Right.

Dr. LASHOF. In the U.S. Climate Action Partnership calling for reductions that are consistent with your proposal.

Senator SANDERS. OK, and I agree with that. Let me ask Mr. Grumet a question which, I think ordinary citizens would have a hard time understanding, given the severity of the crisis that we face, in your judgment, why as a Nation do we still have a situation where today we are driving vehicles that get worse mileage per gallon than 20 years ago? How is this comprehensible? How do we have a mass rail system, which is far inferior to what exists in Japan, exists throughout Europe and in fact, China is in some ways moving ahead of us in terms of mass transportation? How is it that we continue to provide substantially more funding for fossil fuels and nuclear energy than for all of the potential breakthroughs

that are sitting there with solar, with wind, with geothermal and so forth and so on?

Mr. GRUMET. Senator, let me say, I appreciate being able to talk about something other than cap and trade for a moment.

Senator SANDERS. Me, too.

Mr. GRUMET. Our Commission in another significant recommendation argue that we have to significantly reform and significantly strengthen vehicle fuel economy standards. There is no question that the most significant single thing we can do to improve our energy security and address greenhouse gas emissions is to increase fuel economy.

Senator SANDERS. Do you support raising the CAFE standards?

Mr. GRUMET. Very much, sir and I think that you are absolutely right that we have had stagnant standards since 1985 that the Nation of China now actually, Senator Akaka, has fuel economy standards stricter than those here in the United States and while the fuel economy standards have stagnated, technology sir, has not. Vehicles are now 50 percent more powerful, 25 percent larger than they were 20 years ago.

So, the last thing I will note though, and I think this is what Senator Domenici referred to early on, despite the fact that the President did not make a major announcement on climate change or nuclear power. He did make, I think, a very significant statement on fuel economy. Last night the President of the United States called upon Congress to both reform and significantly strengthen fuel economy standards, asking for direction that the fuel economy standards be strengthened by 4 percent a year which is a mile per gallon a year. That is a very aggressive increase in fuel economy standards. That is equal to the increase that Senator Inouye and others are asking for on the Commerce Committee, so this is gone a little bit beneath the radar, but I would hope that this Congress, in a bipartisan way would send him a bill in the next 3 weeks that provide that very authority and that obligation.

Senator SANDERS. OK, let me ask both Dr. Lashof and you, Mr. Grumet. There has been talk obviously about nuclear power and we all know the positive and negatives of that but I think there is no debate that nuclear, investing in new nuclear powerplants is a very, very expensive proposition, not to mention the issue of what we do with the radioactive waste. In your judgment, let us start off with Dr. Lashof, if we invested similar amounts of money in sustainable energy and in an energy efficiency, would that be in fact a better investment and a safer investment?

Dr. LASHOF. In my——

The CHAIRMAN. Why do not you give us short versions of answers to those so we can get the other members to ask some questions?

Dr. LASHOF. Very briefly our analysis shows that investments in energy efficiency is the cheapest, fastest and cleanest way to make progress on global warming so I put the most emphasis on that.

Mr. GRUMET. I would agree that energy efficiencies are more cost effective than almost any new generation, but our views, we have no option. We have to go after every possible opportunity for low carbon energy and so if nuclear can be made cost effective and we can deal with the proliferation of waste issues, our group believes we have to advance those as well.

Senator SANDERS. OK, thank you. Mr. Chairman, thank you very much.

The CHAIRMAN. Thank you very much.

Senator Sessions.

Senator SESSIONS. Thank you, Mr. Chairman. This is a very interesting hearing and I appreciate your thoughtful approach to the issue and it is something that we needed to discuss in these kind of open forum. With regard to nuclear power, Tennessee Valley Authority is, has assured me that their nuclear production of electricity comes in, considering lifetime capital costs, well below coal and far, far below natural gas and that it is economical and it is got to be a major part of the mix to me. It just cannot be otherwise or it is breathtaking that it is not the number one matter that we discuss, but we do have and will have carbon emission problems, I guess we say carbon, carbon dioxide, which is not a pollutant, but it is a global warming gas. This is what I am thinking and I would like to ask each of you if you would comment on it and I will leave my questioning at this subject.

I have come to be a believer, and a bipartisan Congress believes that we have unhealthy dependence on foreign energy, particularly oil and therefore we have a national security interest in reducing that dependency which includes, then we are able to use all sorts of things, like, ethanol and bio-fuels and cellulosic ethanol. I think we have a national consensus that pollutants are bad, the NO and SO and particulates and all of those issues are unhealthy for our economy and we want to maintain that, maintain our progress in improving the quality of our air and water. We also have a strong interest in keeping the cost of energy low. I do not think we need to have a national policy to see how high we can make energy be. One of the things that makes life healthy in America is low cost energy and as I am informed, the life span of countries that have readily available power is twice that of the life span of countries that do not, so that is important. So, why would not we want to develop policies that focus on those goals and if we do so, can't we at the same time positively impact and reduce CO_2 emissions and get more birds with one stone, so to speak, and not create a system that focuses solely on carbon dioxide emissions?

Dr. Gruenspecht, can you start?

Dr. GRUENSPECHT. Sure; a very thought provoking question and I think there are ways to go about it. Put it this way, energy security, I think, is primarily about oil. Reducing greenhouse gases at the lowest cost within the United States, our study suggests, is primarily about coal. Greenhouse gas reduction and energy security goals—there are some synergies and I think that is what your question is pointing to, but probably if we are honest about it, there are also some conflicts and I think that is where you guys have a much tougher job that I have. Improved vehicle efficiency is one of the things that was mentioned; that one seems to have some synergies. It lowers greenhouse gas emissions and it lowers oil demand and imports of oil, whether that increases energy security is itself a real complex question.

Coal-to-liquids conflict—clearly coal to liquids reduces oil imports. You can produce some very high quality diesel by converting coal to liquids like they do in South Africa right now. Not very

helpful on greenhouse gases, so that is a scenario where there is conflict. There are some where it is even trickier, there are sort of synergies and conflicts, such as biomass. Using biomass to back out oil in transport fuels: reduces oil imports and it reduces greenhouse gases; however you could take the same biomass and get a larger greenhouse gas reduction by using biomass to back out coal in electricity generation. I do not want to go on, but, you know, life is complicated and it is good to look for a way of killing all the birds with one stone and ending up with more eggs in your refrigerator at the same time, but it is hard. That is why you guys, you Senators, are here.

Senator SESSIONS. Any others like to comment on that?

Mr. STERBA. Senator, if I may, a couple of comments. I generally agree with what Howard said, but I would add two other pieces. One of the areas where there is a cross-over between the electricity generation sector and then transportation is the potential development of plug-in hybrids and we are seeing a significant move in the technology front from the regular hybrid to the potential for a plug-in hybrid. If we looked at the same kind of penetration of plug-in hybrids as we have seen in regular hybrids and we assume that plug-in hybrids are available in 2010, we could have a million of those on the roads in 2020. That is an enormous amount of two things, No. 1, vehicles that have reduced their use of petroleum product and No. 2, they also are creating the potential for a distributed energy storage device and the electric grid. So that is one cross-over technology where I think the two can go together.

The second one is just, I agree with Howard that coal is one of the main issues, not the only issue, but one of the main issues associated with greenhouse gas emissions, but natural gas is also a fundamental fuel that today we do not import that much from other countries other than Canada, but that is increasing as we move more to having LNG be the natural gas on the margin we can be, we can get in a similar position with natural gas on importation and the issues on where is that fuel coming from, so and natural gas is a fuel used in generation of electricity and in fact got to the point that over 90 percent of all of the generators billed through the 1990's were natural gas fire generation. We have to be very careful that we do not do something as we address climate change that triggers significant increases in natural gas usage because that will drive us even more to having to import natural gas and drive prices up for natural gas which in addition to heating is a fundamental input for a lot of feed stock opportunities, whether it is fertilizers and plastics and all of that. So, there are points where these things come together and when we think about the natural gas application across and the plug-in hybrid application across that is where, I believe you see strong justification for renewables and energy efficiency and those kinds of things that while they focus on the electricity sector they have the indirect benefit of addressing petroleum use because of the transportation sector and then also on the natural gas sector.

Senator SESSIONS. My time is up but if nuclear would fit that role of a multiple benefit energy source, would it not?

Mr. STERBA. It, absolutely.

Senator SESSIONS. And it would work; help with the plug-in hybrids and things of that nature?

Mr. STERBA. Absolutely and one of the things that makes me very concerned about the ability to achieve these goals, I personally do not see how we get there without nuclear. It is a low cost source. The challenge even in this EIA analysis, we have five times the amount of nuclear, and that is one of the things that helps hold costs down, five times the amount of nuclear then we currently have, by 2030. That is a significant, well maybe not quite that much.

Dr. GRUENSPECHT. The increase in nuclear is five times as much as——

Mr. STERBA. As the base case——

Dr. GRUENSPECHT [continuing]. We have a small increase in the base case of——

Mr. STERBA. Right.

Dr. GRUENSPECHT [continuing]. About nine gigawatts and capacity——

Mr. STERBA. Right.

Dr. GRUENSPECHT [continued]. Compared to a hundred gigawatts that we have now that increases by nine in the base case and by a little bit under 50. So going from a hundred to a hundred and ten in the base case, going from a hundred to a hundred and fifty in this analysis.

Mr. STERBA. So, we are having about a 50 percent increase, I apologize, but a 50 percent increase in the amount of nuclear and frankly we are not moving very far on that.

Senator SESSIONS. I would agree, thank you.

The CHAIRMAN. Thank you.

Senator Lincoln.

Senator LINCOLN. Thank you, Mr. Chairman and thank you so much for your leadership on this issue. I think we have all, certainly, I have, in the last several years, have felt a heightened awareness as well as a heightened sense of responsibility that we need to do something and to do it sooner than later, so we appreciate your leadership and I am delighted to be back on the committee.

The CHAIRMAN. Welcome back.

Senator LINCOLN. Absolutely, thank you. On that last point that Senator Sessions, you all were just discussing, if the assumption then in this study or in analysis is that there is a 50 percent increase and we have not had a new nuclear facility in 30 years, is that about, 30 or more, 30 more years and then we are also seeing that the re-licensing of nuclear facilities is becoming more difficult. That is over a 10 year period, I believe, isn't it, the re-licensing? Is that a safe assumption?

Dr. GRUENSPECHT. As I tried to say in the testimony, there is a lot of uncertainty about all projections over a 25-year period, but I think it is important to note that the proposal we were asked to evaluate has a safety valve so, as discussed in my written testimony, the economic effects would not really be much different even if that nuclear could not be built.

Senator LINCOLN. But does not, would with what you have just said that with the safety valve and the economic effects not, does

that mean that, quite frankly, that it is going to be a lot easier to just, for companies to trade credit as opposed to invest in technologies and in less expensive or more reasonable forms of energy production. I mean, I know Ms. Smith has somewhat eluded to a little bit of that in your testimony and I, you, at least have stated that you feel the emissions reductions that are achieved in the bill are short of other proposals being really not an effective first step I guess is kind of the words that you used in your testimony. Maybe you want to elaborate on that a little bit, I mean, what are the long term costs, I guess, kind, my question to you is, the long term cost of doing nothing or doing too little verses what we have really talked about here today, which are the short term cost.

Dr. SMITH. The long term costs of doing too little could become large if there are significant impacts associated with climate change, so there is a risk to be managed. What I was trying to explain in my testimony is that it will be very costly if we try to push beyond that safety valve price with the technologies we have today. So the first step towards a long run solution is to create new technologies that are simply not in the tool kit, they are not in the list, they are not in the models, they are not in anything that has been talked about in this room today.

Senator LINCOLN. Right.

Dr. SMITH. Those need to be created and those take 20, 30 year lead times to get created so we could create a plan to have significant emissions reductions by mid-century at low cost but only if we start with a true basic R&D policy reformation of our R&D policy for energy.

Senator LINCOLN. So is it your opinion that the cap is at a level that is going to encourage that investment or incentivize the need for newer technology sooner?

Dr. SMITH. A low safety valve price will not provide the appropriate incentives for that kind of R&D and that is the kind of R&D that we need. That low safety valve price is very useful for bringing new technologies that do exist into the marketplace to reduce carbon emissions where they are cost effective to do so, now, as well as on into the future and for establishing some expectations for long term investments.

Senator LINCOLN. So existing technologies as opposed to newer technologies.

Dr. SMITH. It is useful for picking up the low cost reductions that are existing today which are meaningful to undertake if they are in that cost range.

Senator LINCOLN. Mr. Grumet, did you have a comment?

Mr. GRUMET. Yes, thank you, Senator Lincoln. You know we tend to have this discussion a lot about whether the answer is technology or a price signal. People tend to feel more comfortable in one of those two places and our——

Senator LINCOLN. Kind of got to be both though.

Mr. GRUMET. Well, exactly, Senator.

Senator LINCOLN. Yes.

Mr. GRUMET. And I think that to Senator Craig's discussion about the liabilities of government and the frustration we are having about the inability of government to move forward on these specific technology programs. Most people look at that as one of the

liabilities of a program that just depends upon government competence to pick the right technologies. So the technology only approach assumes the taxpayer comes up with the money and government is smart enough to give it to the right people and those are incentives that we do not talk about the taxes, we talk about the incentives and those feel great. On the other hand, people who just talk about strict, strict caps, you know, we are having economic impacts far higher than anything that we would be willing to tolerate and if you have just a low cap, you do not get the kind of technologies. So the messy mill, which I think you either love or you hate, is that you have a modest carbon price, as Dr. Smith says, this brings forward the low hanging good stuff. You get reductions, you get energy efficiency, you get people to pay more attention to their operations, you get coal mine methane, you get reductions and you generate a bunch of cash because one of the real problems with our R&D program is we do not have any kind of dedicated revenues from it so you have a market signal, you get into the game, you start learning your way through the system, you cap the costs so that you have some confidence and hopefully you get a bill to become law and you generate a bunch of cash.

Senator LINCOLN. But you know with what you have said there and then that superimposed on top the idea that we do not have a whole lot of time. I mean, I think there is an anxiousness that becoming more prevalent among many people in terms of this issue and with all of that considered maybe you could help by telling me a little bit more or going a little more in depth and maybe you have and I have missed it and I apologize for running late this morning. The methods that you used to come up with that safety valve price mean, maybe, I think there were probably political considerations, cost considerations, but were the time considerations in terms of the time that we have or that we are coming to know that we have of where there is a break even point of what we do as doctors will tell you that if you smoked all your life and you do not quit before you are 45 or 50, then, you know, you have pretty much lost your shot at it or supposedly, I don't know, I do not smoke, but it is the same thing here that we are beginning to hear that there is a judgment day.

Mr. GRUMET. It is the right question and I am glad that Senator Bingaman, I think in the discussion draft that you have circulated has indicated the desire to re-engage this question. I tell you that it was some art and some science in our Commission. There was a real question about what people think the market could bear, look at the price increases that would result, about a 10 percent electricity price. When we worked very closely with the mine workers we came to believe and I believe that their support at some point will be critical, that they were willing to have the growth in coal decrease significantly by the price as long as there was a view that there would be resources for things like IGCC and sequestration that could come in and save the industry before the cost got so high that they would actually start to really lose in absolute terms. A $7 a ton safety valve would basically reduce the growth in coal by about half. That is what I think, EIA says, that coal growth would be about 20 percent instead of about 50 percent, now when you look 2 years later at the urgency of the science, I believe

our Commission's going to come back and think well, maybe we should try and do something better than that, but if you go too much farther, I think, and I should not be here telling you about politics, but you know, I think we, everyone goes back to their Kyoto corners and we keep yelling at each other for another decade and that clearly is not going to solve.

Senator LINCOLN. Yes, that is unacceptable.

Mr. GRUMET. I think a messy middle that is heroically inadequate is the kind of action that is going to bring, hopefully, the Congress together, but that is not the kind of political science you like to hear. Go take on every industry in the country and have them and the environmental community angry at you, and we will clap, but we are very small, little people.

Senator LINCOLN. Thank you, Mr. Chairman.

The CHAIRMAN. Thank you very much. Let me just ask a couple more questions. First, let me just say that when you are in public office, it is hard to run for office on a platform that I have championed and messy middle that is heroically inadequate, that is not exactly a winning platform.

Let me ask, Jeff Sterba, you were a part of this U.S. Climate Action Partnership and I believe I heard Dr. Lashof characterize your position, the Partnership's position, as essentially endorsing the cuts that were in the Jeffords bill, and now the Boxer and Sanders bill, that level of reduction in it, or that intensity targets or level of reduction of emissions. I guess I would ask you first of all if you think that is an accurate characterization of what the Partnership did and second, how much more can we do to get these targets to decline, these intensity targets to decline more quickly without doing significant damage to the economy?

Mr. STERBA. Thank you, Senator. First, the U.S. cap is not formed to take a position or advocate on any bill, that is not its purpose and it is, as far as I am concerned, that group will never do that. So I do not believe it is appropriate to apply the U.S. cap principles at this stage to any specific bill. I think the principles stand on their own and they stand as a collective package. In my judgment, there are many pieces of legislation and approaches to legislation that can be encompassed within the principles of that bill and so I would not agree that that legislation is anyway representative of the U.S. cap.

Second thing relative to the second piece of your question, Senator, I think there are a number of things that can be done to bring, to more rapidly accelerate the action and that, you have hit the nail on the head. The first one goes to what Senator Lincoln raised. There is a challenge about the raising of money to invest in both R&D and only tied to when caps get put in place and we start to generate revenues off the auctioning of allowances. That money needs to be made available now. We need to find a way to fund the technology in advance of the imposition of significant reductions in the emissions, in the allowance of emissions. So that would be the first thing is there is more rapid funding associated with the technology both on basic research for the next breakthroughs.

I would take a slightly different view than Dr. Smith did about the deployment demonstration and development funding, the need

for that. I agree basic research is a significant piece, but frankly there are funding mechanisms within the DOE for that. We need to advance those, but it is really getting from the concept out of the lab to its commercially available. That is the gap that we do not do very well. Part of it is because we have utilities that are regulated who are not incentivized to take an action to take a nascent technology and deploy it. It is because by nature, already the notion of having a technology that may have a 60 or 70 percent hit rate is not something that regulators want to pay for. So, there is a challenge institutionally to making that happen.

Dr. LASHOF. Senator, may I?

The CHAIRMAN. Ah yes, Dr. Lashof, why do not you give us the final answer here and then if there is still time we will have Senator Craig ask any questions he has, but we do have a vote that has started, a cloture vote.

Dr. LASHOF. So, just quickly, I just wanted to clarify what I was trying to say about U.S. cap and Senator Sanders bill because I do not want to leave the wrong impression. Jeff's absolutely right; U.S. cap did not review any specific pieces of legislation. We laid out some principles and recommendations. What I was trying to do and what I think I said is that in my views Senator Sanders targets are consistent with the recommendations of U.S. cap, not that the group has endorsed it because we did in this U.S. cap group recommend some specific emission reductions that go along with this slow, stop and reverse, first phase within 5 years of enactment, low emissions limit them to within 100 percent to 105 percent of current levels, 10 years after enactment, 10 percent below to current levels and then 15 years after enactment at 10 to 30 percent reduction and then looking to a 60 to 80 percent reduction by midcentury. So there is an envelope there and we can look at any bill that is introduced and see if it falls within that envelope. The Sanders bill is one bill that falls within that envelope. That is what I was trying to say. Thank you.

The CHAIRMAN. Very good.

Senator Craig, did you have a final question?

Senator CRAIG. I will be very brief because I am always a little frustrated by a sense of urgency that causes us to react in a way that maybe is not consistent where we ought to be. I would suggest to Senator Lincoln that the sense of urgency is the 2008 election for a good many people as it relates to how they express their public policy intent and then once we are past that, then it will be another 2 years and another sense of urgency. I think what has to come out of this committee is a pattern of consistency and predictability for industries to make the kind of investment we are expecting they should make and we should make with them to incentivize this process. For example I am very pleased to see Howard, who in 2005, incrementally hardly recognized nuclear as a growth industry. Today has jumped substantially into the forefront with his figures and that is positive.

The CHAIRMAN. That is only if we pass my bill.

[Laughter]

Senator CRAIG. I think that is in part consistent with you know, not only your bill.

Dr. GRUENSPECHT. You also get something out of the 2005 Energy Policy Act.

Senator CRAIG. Thank you, I thought we would and we did, but now

The CHAIRMAN. Bottom line; let us be clear, we go 99,000 mega watts——

Dr. GRUENSPECHT. Yes.

The CHAIRMAN [continuing]. Under the 2005 bill. If this draft legislation we just analyzed——

Dr. GRUENSPECHT. You get a lot for——

The CHAIRMAN [continuing]. 48,000 mega watts.

Dr. GRUENSPECHT. Right, the coal and the nuclear are alternative technologies for base load.

The CHAIRMAN. Right.

Senator CRAIG. Right and having said that, Mr. Chairman, you have now found yourself in Jason's murky middle, whether you like it or not.

[Laughter]

The CHAIRMAN. Heroically inadequate.

Mr. GRUMET. Yes.

The CHAIRMAN. Alright, thank you all very much. It is a very useful hearing.

[Whereupon, at 11:38 a.m., the hearing was adjourned.]

APPENDIX

RESPONSES TO ADDITIONAL QUESTIONS

DEPARTMENT OF ENERGY,
CONGRESSIONAL AND INTERGOVERNMENTAL AFFAIRS,
Washington, DC, February 21, 2007.

Hon. JEFF BINGAMAN,
Chairman, Committee on Energy and Natural Resources, U.S. Senate, Washington, DC.

DEAR MR. CHAIRMAN: On January 24, 2007, Howard Gruenspecht, Deputy Administrator, Energy Information Administration, testified regarding the Energy Market and Economic Impacts of a Proposal to Reduce Greenhouse Gas Intensity with a Cap and Trade System.

Enclosed are the answers to nine questions that were submitted by Senators Menendez, Thomas, and you for the hearing record.

If we can be of further assistance, please have your staff contact our Congressional Hearing Coordinator, Lillian Owen, at (202) 586-2031.

Sincerely,

JILL L. SIGAL,
Assistant Secretary.

[Enclosures.]

RESPONSES OF HOWARD GRUENSPECHT TO QUESTIONS FROM SENATOR BINGAMAN

Question 1. Two years ago we passed an energy bill, EPAct 2005. I understand that my staff has asked you to model the impacts of the Energy Bill on greenhouse gas emissions. I have a document here that I would like to enter to the Record. Can you very quickly tell us how the proposed draft's impacts on GHG emissions compares to the Energy Bill?

Answer. In April 2006, EIA prepared a brief summary of the impacts of the provisions of the Energy Policy Act of 2005 (EPAct 2005) that we were able to model (see below). The key finding was that the modeled provisions of EPAct 2005 reduced CO_2 emissions by about 90 million metric tons, roughly 1 percent of total emissions, in 2020 and 2030. In comparison, the impacts of the September 2006 draft proposal that you and 5 other senators asked EIA to analyze are found to be larger, reducing CO_2 emissions by 193 million tons in 2020 and 727 million tons in 2030. Furthermore, the proposed draft also reduces the emissions of other greenhouse gases by 369 million tons and 532 million tons in 2020 and 2030, respectively, and establishes a pilot program to stimulate biological carbon sequestration.

The text of the April 2006 paper outlining EIA's views on the projected impact of EPAct 2005 on energy-related carbon dioxide emissions follows:

PROJECTED IMPACT OF EPACT 2005 ON ENERGY-RELATED CARBON DIOXIDE EMISSIONS APRIL 2006

The Energy Information Administration (EIA) has some capability to assess the effects of the Energy Policy Act of 2005 (EPAct 2005) on energy-related carbon dioxide (CO_2) emissions. However, the extent to which studies or programs authorized by EPAct 2005, but not directly implemented by that legislation, might advance the timing and/or lower the cost of advanced energy technology represent a key uncertainty in such an assessment.

The *Annual Energy Outlook 2006 (AE02006)* Reference case [1] includes roughly 30 specific provisions implemented by EPAct 2005. Many of these provisions, which are outlined in the Legislation and Regulations section of the *AEO2006,* are intended to increase energy efficiency and encourage use of nuclear power and renewable fuels, which have the ancillary benefit of reducing CO_2 emissions. Removal of these provisions in a No-EPAct 2005 case resulted in projected CO_2 emissions that are 90 million metric tons (1.3 percent) higher than in the Reference case in 2020, and 92 million metric tons (1.1 percent) higher in 2030. About 90 percent of the CO_2 emission reductions directly attributed to EPAct 2005 in 2030 are associated with electricity, some of which result from reduced electricity demand due to efficiency standards and some from incentives for new nuclear power and renewable generation.

It is important to recognize that many other EPAct 2005 provisions were not explicitly considered in the *AEO2006* Reference case. EIA did not try to anticipate policy responses to the many studies required by EPAct 2005, nor did it try to predict the impact of research, development, and deployment (RD&D) authorizations and loan guarantee programs in the bill that require future appropriations. However, recent EIA technology sensitivity analyses not directly tied to EPAct 2005 show that assumptions about the availability and cost of advanced technologies can significantly impact future energy use and emissions.[2] For example, the Integrated High Technology Case in *AEO2006,* which assumes reduced costs and accelerated timing of advanced technologies, projects CO_2 emissions that are 385 million metric tons (5.4 percent) lower than in the Reference case in 2020, and 694 million metric tons lower (8.5 percent) in 2030. What part, if any, of the accelerated timing and lower costs assumed in this case might be realized specifically due to the enactment of the research, development and deployment provisions of EPAct 2005 is highly uncertain.

In sum, EIA's analyses suggest that the roughly 30 EPAct 2005 provisions that were explicitly modeled are projected to reduce energy-related CO_2 emissions by approximately 90 million metric tons in both 2020 and 2030. Any impact resulting from the non-modeled authorizations, loan guarantees, studies and other miscellaneous provisions that served to advance the availability and cost of advanced energy technologies would add to projected reductions in energy-related CO_2 emissions.

Table 1 compares results of the *AEO2006* Reference case, the No-EPAct 2005 case, and the *AEO2006* Integrated High Technology Case.

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[1] Energy Information Administration, *Annual Energy Outlook 2006,* DOE/EIA-0383(2006) (Washington, DC, February 2006), web site www.eia.doe.gov/oiaf/aeo/index.html.

[2] A further discussion of this issue in another context is provided in EIA's April 2005 analysis of the recommendations of the National Commission on Energy Policy, web site www.eia.doe.gov/oiaf/servicerpy/bingaman/pdf/sroiaf(2005)02.pdf.

Table 1.—COMPARISON OF ENERGY CONSUMPTION AND ENERGY-RELATED CARBON DIOXIDE EMISSIONS IN THE AEO2006 REFERENCE, NO-EPACT 2005, AND HIGH TECHNOLOGY CASES (2004, 2020, and 2030)

Indicator	2004	2020			2030		
		Reference	No EPAct 2005	High technology	Reference	No EPAct 2005	High technology
Consumption (quadrillion Btu)							
Petroleum Products	40.08	48.14	48.16	45.49	53.58	53.59	49.70
Natural Gas	23.07	27.70	27.88	26.43	27.66	27.95	28.72
Coal	22.53	27.65	28.49	25.95	34.49	35.28	30.17
Nuclear Power	8.23	9.09	8.59	8.93	9.09	8.59	9.47
Renewable Energy	5.74	8.00	8.00	8.34	9.02	9.14	9.59
Other	0.04	0.05	0.05	0.04	0.05	0.05	0.05
Total	99.68	120.63	121.16	115.19	133.88	134.61	125.70
Carbon Dioxide Emissions by Fuel (million metric tons)							
Petroleum Products	2,595	3,061	3,063	2,899	3,421	3,424	3,178
Natural Gas	1,203	1,455	1,464	1,388	1,452	1,468	1,403
Coal	2,090	2,589	2,668	2,432	3,226	3,300	2,825
Other	11	14	14	14	15	15	15
Total	5,900	7,119	7,209	6,734	8,114	8,207	7,421
Carbon Dioxide Emissions by Sector (million metric tons)							
Electric Power	2,299	2,835	2,914	2,677	3,318	3,402	2,957
Residential	1,208	1,434	1,477	1,366	1,576	1,631	1,432
Direct Fuel	375	398	398	384	398	397	372
Electricity	833	1,036	1,079	982	1,178	1,234	1,060
Commercial	1,020	1,339	1,367	1,293	1,620	1,645	1,502
Direct Fuel	229	260	263	260	284	287	283
Electricity	792	1,079	1,104	1,033	1,336	1,357	1,220
Industrial	1,727	1,924	1,941	1,778	2,184	2,195	1,946
Direct Fuel	1,069	1,222	1,229	1,132	1,400	1,405	1,284
Electricity	658	703	712	646	784	790	662
Transportation	1,945	2,422	2,424	2,297	2,734	2,736	2,541
Direct Fuel	1,929	2,404	2,406	2,281	2,715	2,716	2,525
Electricity	16	18	18	16	20	20	16
Total	6,900	7,119	7,209	6,734	8,114	8,207	7,421

Source: National Energy Modeling System runs AEO2006.D111905A, NRGBILL0.D041006A, and HTRKITEN.D121905A

Question 2. Also, I understand that my staff asked you to create this chart on the impacts of this proposal on GDP. I have that chart here. Did you make this chart? Can you quickly explain it?

Answer. The figure below* was prepared by EIA at the request of your staff to put the projected impact of the September 2006 proposal (represented by the Phased Auction case on U.S. gross domestic product (GDP) in the context of the overall level of real U.S. GDP. U.S. real GDP (measured in 2000 dollars) currently exceeds $11 trillion, and is expected to grow over time, reaching over $22.5 trillion in 2030. Under the proposal, real GDP is estimated to be reduced by $59 billion, or 0.26 percent of its projected level, in 2030.

Question 3. Dr. Gruenspecht, I recently read a statement from a trade association that criticized EIA's analysis of the Bingaman proposal for underestimating the costs of the climate proposal. Specifically, the analysis claimed that natural gas prices would rise dramatically due to fuel switching from coal to natural gas caused by the mandatory climate constraint. Could you react to that claim? I'm attaching the statement and will put it in the Record. Could you please respond to claims made about the EIA modeling?

Answer. EIA stands behind the results of its analysis, and disagrees with the position of the Industrial Energy Consumers of America (IECA) stated in their January 22, 2007, press release that EIA's analysis "misinforms the Congress."

We do not take issue with IECA's view that projections of natural gas production, increased LNG imports, and increased nuclear capacity over a 25-year period are inherently uncertain—in fact, EIA's report and its January 24th testimony explicitly and repeatedly note this.

The IECA review of EIA's analysis, however, fails to take account of a key provision of the proposal EIA was asked to evaluate—the safety valve. As discussed in the EIA testimony and analysis, inclusion of a safety-valve feature in a cap-and-trade program would implicitly relax the emissions cap in the event that emissions reduction inside or outside the energy sector proves to be more costly than expected, while protecting against the prospect of larger energy system and economic impacts in these circumstances.

The delivered price for coal under the proposal EIA reviewed is the "no policy" delivered price plus the cost of allowances. Under the proposal, the price of allowances will never exceed the safety valve level, regardless of future developments in nuclear, renewable energy, or energy efficiency technologies; natural gas production; or the rate of economic growth. Therefore, a calculation made using the assumption that the cost of allowances is always at the safety valve level sets an upper bound on the delivered coal price under the proposal. To the extent that expanded use of existing or new coal plants at such a delivered coal price is cheaper than using natural gas, IECA's concern about "diversion" of natural gas away from their constituents towards the electric power sector, would appear to be unfounded.

Other considerations also mitigate strongly against the position outlined in the IECA press release. For example, IECA legitimately notes the significant uncertainty surrounding EIA's reference case projections of future domestic natural gas production, future LNG imports, and future industrial natural gas demand. EIA certainly recognizes these uncertainties and routinely seeks to address their impact in numerous sensitivity cases in our yearly *Annual Energy Outlook* (AEO) and in the service reports we prepare at the request of the Congress, even though the energy price, energy availability, and economic impact results for the proposal we analyzed are not sensitive to them given the availability of the safety value. EIA, however, does not routinely consider uncertainty regarding future policy actions in its AEO projections. Ironically, uncertainty regarding future actions to limit greenhouse gas emissions, which IECA does not address in its review of the EIA analysis, could have exactly the effects on natural gas use for electric power generation that IECA states that it is concerned about. For example, to the extent that potential investors in long-lived power generation capital are sensitive to uncertainty over future policies that could significantly affect the market value of their projects, they may be reluctant to make such investments, which would tend to promote the use of existing capacity and the cheapest possible capacity expansions where new investment is unavoidable, until such time as the direction of policy becomes more clear.

In sum, while EIA takes no position on the desirability of the specific policy proposal we were asked to analyze or on any other policy matter, we strongly believe that our analysis of the proposal is both reasonable and informative.

Question 4. Dr. Gruenspecht, does the EIA modeling account for advances in technology that would result from additional government R&D funded through auctions of allowances?

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*The graph has been retained in committee files.

a. If not, would you expect the impact on electricity prices and GDP to be lower if those advances were factored into the model?

Answer. EIA's analysis of the proposal does not explicitly represent the potential impacts of government expenditures associated with revenue collected in the Climate Change Trust Fund. As stated in this analysis, "All of the analysis cases incorporate the economic and technology assumptions used in the AEO2006 reference case. While increased expenditures for research and development (R&D) resulting from the creation of the Climate Change Trust Fund are expected to lead to some technology improvements, a statistically reliable relationship between the level of R&D spending for specific technologies and the impacts of those expenditures has not been developed. Furthermore, the impact of Federal R&D is also difficult to assess, because the levels of private sector R&D expenditures usually are unknown and often far exceed R&D spending by the Federal Government." (page vi) It is certainly possible that the Climate Change Trust Fund expenditures could lead to technological advances that lower the costs of complying with the proposal.

Question 5. Dr. Gruenspecht, Some of my colleagues have introduced legislation that calls for percentage reductions by specific dates in the future, but leaves the implementation details to be determined through regulation. Can you discuss how draft legislation that has no specific mechanisms for constraining greenhouse gas emissions complicates efforts to model economic impacts?

Answer. Due to the ubiquitous nature of greenhouse gas (GHG) emissions in the US energy-economy, assessing the potential impacts of any proposal to reduce them is extremely complex. Details about the emissions target level, the policy instrument(s) to be used, what GHGs are covered, what sectors or entities are covered, whether domestic or international offsets are allowed, whether carbon capture and sequestration is allowed or limited, whether biological sequestration is allowed or limited, and whether the potential costs are limited by a safety-valve mechanism are all important in the assessment of any policy proposal. Assessing the potential economic impacts of a proposal without these details would be very challenging.

Question 6. Dr. Gruenspecht, please discuss the limitations, both at EIA and in the academic community, of economic modeling scenarios more than 30 years in the future.

Answer. There is enormous uncertainty in any projections that look 25 years or more into the future. As stated in EIA's analysis of the September 2006 proposal, "NEMS, like all models, is a simplified representation of reality. Projections are dependent on the data, methodologies, model structure, and assumptions used to develop them. Since many of the events that shape energy markets are random and cannot be anticipated (including severe weather, technological breakthroughs, and geopolitical developments), energy markets are subject to uncertainty. Moreover, future developments in technologies, demographics, and resources cannot be foreseen with certainty. Nevertheless, well-formulated models are useful in analyzing complex policies, because they ensure consistency in accounting and represent key interrelationships, albeit imperfectly, to provide insights."

Furthermore, all long-term projections engender considerable uncertainty. It is particularly difficult to foresee how existing technologies might evolve or what new technologies might emerge as market conditions change, particularly when those changes are fairly dramatic. As a result, to comply with the GHG emissions growth limits necessary to meet the intensity reduction targets, all energy providers, particularly electricity producers, likely will increasingly rely on technologies that play a relatively small role today or have not been built in the United States in many years. Sensitivity analyses included in previous EIA studies of cap-and-trade systems for GHG show that estimates of both energy and economic impacts of such programs can change significantly under alternative assumptions regarding the cost and availability of new technologies.

Finally, as noted in my testimony, policy design differences can significantly affect the nature of uncertainty surrounding the projected energy and economic impacts of alternative policies to limit GHG emissions. Inclusion of a safety-valve feature in a cap-and-trade program would allow GHG emissions to rise above the level projected in our analysis in the event that emissions reduction inside or outside the energy sector proves to be more costly than we expect, while protecting against the prospect of larger energy system and economic impacts in these circumstances. In contrast, policies that impose a "hard" cap on emissions without a safety-valve price for GHG credits, would force the fixed GHG emissions target to be met regardless of cost, reducing uncertainty surrounding the GHG emissions outcome but increasing uncertainty regarding energy and economic impacts.

RESPONSES OF HOWARD GRUENSPECHT TO QUESTIONS FROM SENATOR MENENDEZ

Question 1. Mr. Gruenspecht, the Intergovernmental Panel on Climate Change has warned us of the potentially devastating effect that global warming may have on our and the world's economy if we do not act quickly and decisively. In fact, Sir Nicolas Stern, head of the British Government's Economics Service, found that globally the costs of dealing with these effects may amount to 5 percent of global GDP. What assumptions, if any, does the EIA report make of these potential costs?

Answer. The EIA analysis only assesses the impacts on the U.S. energy-economy of the specific proposal that EIA was asked to examine. EIA has not examined the analysis prepared by Sir Nicolas Stern, nor made an assessment of the global costs of dealing with global warming. Furthermore, as stated in the report, "This report, like other EIA analyses of energy and environmental policy proposals, focuses on the impacts of those proposals on energy choices made by consumers in all sectors and the implications of those decisions for the economy. This focus is consistent with ETA's statutory mission and expertise. The study does not account for any possible health or environmental benefits that might be associated with curtailing GHG emissions."

Question 2. Mr. Gruenspecht, I realize that these costs are difficult to predict with certainty. Some have and continue to argue that these costs are exaggerated. Others, as mentioned in the previous question, have a less optimistic outlook. Regardless, could you provide us with a middle ground for what the mitigation costs are likely to be?

Answer. The EIA analysis only assesses the impacts on the US energy-economy of the specific proposal that EIA was asked to examine. This focus is consistent with ETA's statutory mission and expertise. As mentioned in the previous answer, EIA has not examined the analysis prepared by Sir Nicolas Stern, nor made an assessment of the global costs of dealing with global warming.

RESPONSES OF HOWARD GRUENSPECHT TO QUESTIONS FROM SENATOR THOMAS

Question 1. Please provide an economic analysis, comparable in detail to that which was prepared from a national perspective, of the impact that the proposed legislation would have, for each of the 50 states.

Answer. EIA is not able to provide an analysis at the level of each of the 50 States as requested. However, the National Energy Modeling System (NEMS) used in this analysis does produce energy market results at various regional levels[3] and industrial sector economic results at the national level. With respect to the energy sector, significant variations in regional results are seen in the electricity and coal markets. In the industrial sector, the most significant impacts occur in the energy intensive industries.

ELECTRICITY AND COAL MARKETS

All regions of the country are projected to face higher electricity prices in the Phased Auction case of the September 2006 proposal that EIA was asked to analyze (Figures 1 and 2).* The largest price increases are projected in regions where electricity prices are set competitively and where coal generation accounts for a large share of total generation. In these regions, the costs of holding all the needed emission allowances will be fully reflected in consumer prices. For example, electricity prices in the MAAC and ECAR regions are projected to be 17 percent and 14 percent higher, respectively, in the Phased Auction case in 2030. Conversely, the electricity price impacts are projected to be smaller in regions that still have an average cost pricing regime and do not depend as heavily on coal. For example, 2030 electricity prices in the California and NWP regions are projected to only be 4 percent and 5 percent higher, respectively, in the Phased Auction case.

The reduced use of coal in the power and liquid fuels (i.e., coal-to-liquids diesel production) sectors affects coal production in all areas of the country (Figure 3). In absolute terms, western coal production is projected to be most impacted, falling 253 million tons (24 percent) below the reference case in the Phased Auction case in 2030. This occurs because, in the reference case, western coal regions, particularly the Powder River Basin in Wyoming and Montana, were expected to be the dominate growth areas for coal production. In the Phased Auction case, power companies turn to new nuclear, natural gas, and renewable plants to meet growth in the demand for electricity, reducing the need for greater coal production. Even with this

[3] For example, electricity markets are represented for 13 regions based on the regions and subregions of the North American Reliability Council (NERC).

* Figures 1-4 have been retained in committee files.

change, western coal production in 2030 in the Phased Auction case is 30 percent higher than 2004 production. Eastern coal production in 2030 is projected to be 142 million tons (22 percent) below the reference case level in the Phased Auction case, about the same level that was produced in 2004.

IMPACTS ON INDUSTRY OUTPUT

In the Phased Auction case, the price of allowances directly increases the costs in emitting sectors and leads to increases in energy prices that raise the factor input costs for all industries. This leads to changes in the demand for goods and services, as reflected in the final demand categories of consumer spending, investment, government spending and trade, and causes industries to adjust their production accordingly. Figure 4 shows the average annual loss in gross output relative to the reference ease for the period 2009 to 2030 for the Phased Auction case. The energy-intensive manufacturing industries [4] are impacted the most, with output projected to be reduced by an average of 0.82 percent. Non-energy-intensive manufacturing is reduced by an average of 0.57 percent, non-manufacturing industries by 0.32 percent and services by 0.10 percent.

Among the detailed energy-intensive industries, aluminum production, which is a heavy user of electricity, is expected to fall by 5.0 percent on average. Production of glass, iron and steel, cement, agricultural chemicals and basic inorganic chemicals are also expected to fall by more than 1 percent. Among the non-manufacturing industries, coal mining is projected to fall by 8.9 percent, with oil and natural gas extraction falling by 0.4 percent.

[Responses to the following questions were not received at the time this hearing went to press:]

QUESTIONS FOR JASON GRUMET FROM SENATOR BINGAMAN

Question 1. Mr. Grumet, in your testimony, you noted that cost control measures other than the safety valve have been proposed. Could you elaborate on that? How should we evaluate the pluses and minuses of these different measures?

Question 2. Mr.Grumet, in your testimony you note that the Commission believes that the Safety Valve is instrumental at the outset of a program but may not be appropriate in the longer term. Can you please explain?

Question 3. Mr. Grumet, competitiveness concerns—in particular with regard to China—are often raised by those opposing mandatory action to address climate change. What are the best ways to address these concerns?

Question 4. Mr. Grumet, do you have any views on how the President's announcement last night to promote alternative fuels and CAFE increases bears upon economy-wide approaches to GHG reductions.

QUESTIONS FOR JASON GRUMET FROM SENATOR MENENDEZ

Question 1. Mr. Grumet, you stated that if the EIA had used a more optimistic technology assumption to reflect the hill's significant technology incentives, the analysis would likely have shown larger emission reductions at even lower costs. What is your best guess as to the difference in emission reductions and costs that would result from a more optimistic view?

Question 2. Mr. Grumet, you indicated that the Commission has begun evaluating opportunities to strengthen its original proposal while still meeting the test of no significant harm to the economy. Could you elaborate on any preliminary findings?

Question 3. Mr. Grumet, the European Union's Emissions Trading Scheme (ETS) is set to enter into its second phase next year. As I'm sure you know, the ETS reduction targets are much more stringent than those found in the proposal that the FIA recently analyzed. Additionally, there is no safety-valve price mechanism in the EU system. Are you familiar with any statistical analysis that may have been conducted of the ETS that have measured or predicted the costs to the EU economy? If so are there any valuable lessons that we can take from the EU's experience thus far?

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[4] Energy-intensive manufacturing industries in NEMS include food, paper, inorganic and organic chemicals, resins, agricultural chemicals, petroleum refining, glass, cement, iron and steel, and aluminum.

QUESTIONS FOR DAN LASHOF FROM SENATOR BINGAMAN

Question 1. Dr. Lashof you have mentioned target levels that you believe would be necessary to reach ecologically necessary levels of greenhouse gas concentrations. Have you or your colleagues looked at the costs of those targets and could you compare them to the proposal that we are discussing today?

Question 2. Dr. Lashof, what would be the impacts on coal use under the low-end and high-end reduction ranges. you are supporting?

Question 3. Dr. Lashof, how do you believe the U.S. can most effectively encourage developing countries to join in reducing GHG emissions?

QUESTIONS FOR ANNE SMITH FROM SENATOR BINGAMAN

Question 1. Dr. Smith, your testimony implies that some level of mandatory price signal, either through a safety valve or a carbon tax could be justified as part of climate change policy. Could you elaborate?

Question 2. Dr. Smith, the safety valve is often talked about in largely political terms. You make the point that you believe it increases the economic efficiency of the program. Can you please explain?

Question 3. Dr. Smith, in your testimony, you say that the allocation scheme in the proposal does not reach the goal of "fair compensation" for the impacts of the program. I would like to hear more about that, but could you first tell us whether you think this type of compensation approach is a valid way to allocate allowances? In your view, is it better or worse that an approach based on historic emissions or fuel use?

QUESTIONS FOR JEFF STERBA FROM SENATOR BINGAMAN

Question 1. Mr. Sterba, you lead a company that gets a significant percentage of its generation from coal, Clearly, new coal technologies will be important to your company. In your view, how will this proposal help speed the deployment of these technologies? Are there ways to improve the bill in this area?

Question 2. Mr. Sterba, in addition to heading up one of the nation's leading energy companies, you have a prominent role in the Edison Electric institute which represents the majority of investor owned utilities. Do you believe that it is possible to design legislation that could win the support of a majority of the utility industry this Congress?

Question 3. Mr. Sterba, your company was one of the signatories to the US Climate Action Partnership announced yesterday. I congratulate you on your leadership role in this important initiative. The report appears to endorse a safety provision similar to the one in the Bingaman proposal. Also, if I've understood you correctly, I believe you have just endorsed such a provision in your testimony. On the other hand, I have heard statements by some of the organizations involved in US CAP that the principles do not allow such a provision. Could you clear this up for us?

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