Prepared Statement of
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on
"Energy Market and Economic Impacts of a Proposal to Reduce Greenhouse Gas Intensity with a Cap and Trade System"
before the
Committee on Energy and Natural Resources
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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 economic 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.

[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.

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

[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.

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 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 US 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.

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

[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.

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 climate 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]

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[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.

[8] For example, if all of the existing US natural gas-fired combined cycle generating capacity were to suddenly be fully utilized, we estimate based on our models of the US power sector that current annual US CO_2 emissions would be reduced by about 80 MMTC – about a 4% reduction in total US GHG emissions – and it

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

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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.

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, 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

[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.

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 emissions 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

[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.

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

[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).

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 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.

[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.