CLIMATE CHANGE: UNDERSTANDING THE DEGREE OF THE PROBLEM

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BEFORE THE

COMMITTEE ON GOVERNMENT REFORM

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THURSDAY, JULY 20, 2006,

HOUSE OF REPRESENTATIVES,
COMMITTEE ON GOVERNMENT REFORM,
Washington, DC.

The committee met, pursuant to notice, at 10:29 a.m., in room 2154, Rayburn House Office Building, Hon. Tom Davis (chairman of the committee) presiding.

Present: Representatives Davis, Shays, Duncan, Marchant, Schmidt, Waxman, Owens, Cummings, Kucinich, Davis of Illinois, Van Hollen, Ruppersberger, and Higgins.

Staff present: David Marin, staff director; Larry Halloran, deputy staff director; Keith Ausbrook, chief counsel; Jennifer Safavian, chief counsel for oversight and investigations; Brooke Bennett, counsel; Rob White, communications director; Andrea LeBlanc, deputy director of communications; Teresa Austin, chief clerk; Michael Galindo, deputy clerk; Michael Sazonov, research assistant; Mindi Walker, professional staff member; Alexandra Teitz, minority counsel; Earley Green, minority chief clerk; and Jean Gosa, minority assistant clerk.

Chairman TOM DAVIS. The committee will come to order.

Welcome to today's hearing on climate change.

I want to thank my friend and colleague and ranking member, Henry Waxman, for working with us to make this discussion of climate change a priority for the committee. We are committed to addressing this issue in a non-partisan way, and that is how it ought to be.

For too long the political dialog on climate change has been dominated by black and white grandstanding, finger wagging, or head-in-the-sand denial and denunciation. There has really been very little reasonable discourse, and that needs to change.

Over the past several years, and especially over the past 6 months in the wake of Hurricane Katrina and the release of Al Gore's film, "An Inconvenient Truth," climate change has understandably jumped to the forefront of America's discourse. We have seen the Time cover story suggesting we "be worried, be very worried," and yesterday's London Independent Newspaper reported "'Temperature set to hit 100 degrees, and global warming is to blame," and the deluge of attention to "An Inconvenient Truth," and its depictions of potential disasters of global warming.

We are here today to acknowledge that too many elected officials have for too long been missing in action on this issue. We hope to begin to change that, but first we need to step back and ask some

basic but critical questions. Exactly what is climate change? And where are we with the science?

There are not very many people left these days who would argue global warming isn't happening, per se. There is widespread agreement that the global mean temperature has gone up approximately 1 degree fahrenheit over the past century, that atmospheric carbon dioxide has also increased over the past century, and that carbon dioxide, as a minor greenhouse substance—as opposed to major substances such as water, vapor, and clouds—likely contributes to warming.

But beyond this consensus—scientific, political, technological, and moral—remains somewhat elusive. That is why we have to step in. It is our job to ask whether we are responding appropriately, whether a scientific consensus exists, and whether we are facilitating the research and ensuring an unbiased review when there is not.

Knowledge is refined through continuous inquiry and, yes, through skepticism. As Mr. Waxman said in an Energy and Commerce Committee hearing yesterday—Henry, I don't always quote you—"science is hearing both sides, looking at the evidence, reaching conclusions based on evidence."

Living and breathing through the power of evidence, science evolves. Policy needs to evolve along with it. To that end, we are fortunate to be hearing from leading researchers on climate change about climate change science and about some of their new research. But this hearing has not been spared the disappointment and politicization that has accompanied the issue for too long.

We were looking forward to hearing from Dr. Jim Hansen, NASA's preeminent climate change scientist, but we learned just days ago he was no longer available to testify. Let the record show he was not muzzled, at least not by this committee. Nor will we be hearing from Vice President Gore, who has spoken often of Congress and the administration's "blinding lack of awareness" about this "planetary emergency," and whose spokesman told the L.A. Times the Vice President would "go anywhere and talk to any audience that wants to learn about climate change and how to solve it."

This committee asked the Vice President to pick any date in June or July, but apparently ours was not one of the audiences he had in mind. While Mr. Waxman and I are disappointed, we understand movie screenings and book signings are time consuming, and we hope his book signing in northern Virginia went well yesterday.

Regardless, the panels of witnesses we have with us this morning will help us greatly in learning more about the truth, inconvenient or otherwise, surrounding climate change. We will hear from the administration about the President's climate change initiatives and the Federal Government's extensive research. We will hear from respected scientists with differing views on the science of climate change, and we will hear from companies and organizations that are responding to climate change challenges in their own important ways.

Today is about education. It is about whether we have the courage to ask the difficult questions without regard for what the answers may be. It is about beginning to get those answers so that strategies to combat climate change can become clearer, so that we

can begin to understand the complex combination of technologies, incentives, restrictions, and sacrifices that may be needed to truly tackle this problem, whatever its degree.

Policymakers need to understand this issue before we can pretend to effectively address potential solutions and debate the personal, economic, and societal impacts that will inevitably evolve. Opportunity has knocked, and today this committee at least is answering the door.

[The prepared statement of Chairman Tom Davis follows:]

Opening Statement of Chairman Tom Davis
Government Reform Committee Hearing
"Climate Change: Understanding the Degree of the Problem"
July 20, 2006

Good morning, and welcome to today's hearing on climate change. I want to thank my friend and colleague and the Ranking Member of this Committee, Henry Waxman, for working with me to make the discussion of climate change a priority for this Committee. We've committed to addressing this issue in a nonpartisan way, and that's how it should be. For too long, the political dialogue on climate change has been dominated by black-and-white grandstanding – either finger-wagging or head-in-the-sand denial and denunciation. There has been no reasonable discourse.

That has to change. Over the past several years – and especially over the past six months, in the wake of Hurricane Katrina and the release of Al Gore's *An Inconvenient Truth* – climate change has understandably jumped to the forefront of American discourse. We've seen the *Time* cover story suggesting we <QUOTE> "Be Worried. Be VERY worried." And yesterday's London *Independent* newspaper reporting <QUOTE> "Temperature set to hit 100 degrees – and global warming is to blame." And

the deluge of attention to *An Inconvenient Truth* and its depictions of the potential disasters of global warming.

We're here today to acknowledge that too many elected officials have for too long been M-I-A on this issue. We hope to begin changing that. But first we need to step back and ask some basic but critical questions.

Exactly what is climate change, and where are we with the science?

There aren't many people left these days who would argue global warming isn't happening, *per se*. There is widespread agreement that the global mean temperature has gone up approximately one degree Fahrenheit over the past century, that atmospheric carbon dioxide has also increased over the past century, and that carbon dioxide as a minor greenhouse substance (as opposed to major substances such as water vapor and clouds) likely contributes to warming.

But beyond this, consensus – scientific, political, technological, and moral – remains elusive.

That's where we must step in. It is our job to ask whether we're responding appropriately where there is scientific consensus, and whether we're facilitating the research and ensuring an unbiased review where there is not.

Knowledge is refined through continuous inquiry, and yes, through skepticism. As Mr. Waxman said at an Energy and Commerce Committee hearing yesterday, <QUOTE> "[s]cience is hearing both sides, looking at the evidence, reaching conclusions based on the evidence." Living and breathing through the power of evidence, science evolves. Policy needs to evolve along with it.

To that end, we are fortunate to be hearing from leading researchers on climate change about climate change science and about some of their new research. But this hearing has not been spared the disappointment and politicization that has accompanied this issue for so long.

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hear from companies and organizations that are responding to climate change challenges in their own, important ways.

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Policymakers need to understand this issue before we can pretend to effectively address potential solutions and debate the personal, economic, and societal impacts they will inevitable involve. Opportunity has knocked, and today this Committee at least is answering the door.

Chairman TOM DAVIS. I would now recognize the distinguished ranking member who has long been involved in expressing environmental concerns and been on the lead end of many environmental policies, Mr. Waxman, for his opening statement.

Mr. WAXMAN. Thank you, Mr. Chairman. I am really pleased that I am here, because if I had not been here you wouldn't have quoted me and you would have criticized me. So, Al Gore, pay attention. [Laughter.]

I want to commend Chairman Davis for holding this hearing on global warming today. Global warming is the greatest environmental challenge of our time, and we have a short window in which to act to prevent profound changes to the climate system. Unless we seize the opportunity to act now, our legacy to our children and grandchildren will be an unstable and dangerous planet.

I have been working to address this threat of global warming for many years. In 1992, over a decade ago, I introduced the Global Climate Protection Act of that year which would have frozen U.S. emissions of greenhouses gases at 1990 levels in 2000. This was the first bill dealing with the global climate problem. Had we acted then, the task before us today would be much easier.

Although we have long known the basic scientific facts of global warming, more recent findings have brought us an even greater urgency to the problem. Last year the national science academies of 11 nations, including the United States, Great Britain, Russia, China, India, issued a joint statement on the international scientific consensus on global warming. The academies unanimously confirmed that climate change is real and they stated the scientific understanding of climate change is now sufficiently clear to justify nations taking prompt action. It is vital that all nations identify cost-effective steps they can take now to contribute to substantial and long-term reduction in net global greenhouse gas emissions.

For decades the tobacco industry mounted a disinformation campaign to create doubt about the dangers of smoking. Major energy industries are now trying the same approach about the consequences of global warming. But no one should be deceived: global warming is real and it is an enormous threat to our Nation.

Unfortunately, the Bush administration and Congress have squandered opportunity after opportunity to address the problem of climate change. It is much easier to rack up enormous debts than to be fiscally responsible, and it is much easier to pretend global warming doesn't exist than to face the reality of dangerously overheating climate, but doing is morally irresponsible. We are literally mortgaging our children's future so that we can continue to consume unlimited amounts of fossil fuels.

It is impossible to catalog this administration's record of failures on global warming in a 5-minute statement. President Bush set a so-called target for greenhouse gas emissions that contemplates a 14 percent increase in emissions by 2012. The administration has persistently tried to derail any effective international agreement to limit emissions of greenhouse gases, and the administration denies that greenhouse gases are pollutants. And it is even in court claiming that EPA has no authority to regulate global warming pollution.

Well, we need to stop letting the coal companies, the oil companies, and the other special interests dictate our approach to global warming. Instead, we need to start listening to the scientists. That is what I tried to do earlier this year when I introduced the Safe Climate Act.

There are different approaches that can be taken to climate legislation. Some bills seek a symbolic recognition of the problem, others are premised on what may be politically achievable in the near term. The Safe Climate Act is drafted on a different premise. It reflects what the science tells us we need to do to protect our children and future generations from irreversible and catastrophic global warming.

The bill has aggressive requirements to reduce emissions of greenhouse gases, calling for an 80 percent reduction in emissions by 2050, but these are the reductions we need to preserve a safe climate for future generations.

As Dr. James Hansen, among other scientists, has been telling us, we have about 10 years to act to avoid being locked into irreversible global warming on a scale that will transform the planet.

Daunting though it may seem, these reductions are achievable with innovation and commitment. In fact, they will make our economy stronger and our Nation safer.

I hope today's hearing will help this committee and this Congress move forward to tackle the urgent problem of global warming. The scientists have been proven right on this issue time and time again, and if we continue to disregard their warnings our children and their children will pay the price.

I want to point out how remarkable it is that this committee is holding this hearing. Yesterday I was at the Energy and Commerce Committee's subcommittee hearing. The Energy and Commerce Committee has legislative jurisdiction over this issue, but in 12 years yesterday's hearing showed what their thinking was at the leadership level. They held a hearing on global warming simply to try to rebut a study done in 1998 to 1999 to argue that statistically it was in error, even though all the subsequent studies continue to reaffirm the conclusions of scientists all over the world.

That was not a real, legitimate hearing. I hope that our committee will serve the purposes for the Congress in giving a balanced approach to reviewing this issue so that we can impress upon people the problem it is now, the problem it will be tomorrow, and what we must do today to prevent the disasters of tomorrow.

Thank you, Mr. Chairman. I commend you for the hearing.

Mr. Chairman, I would like to mention one item before we turn to the witnesses for testimony and the other Members for their statement. Mr. Connaughton, who is the chairman of the White House Council on Environmental Quality, is here today to talk about the administration's views on climate change. As we are probably all aware, serious questions have been raised about whether the White House and CEQ, in particular, has deliberately suppressed and manipulated the findings of Government scientists to minimize the problem of global warming.

The chairman and I have discussed how we should handle these questions. We have both agreed that an inquiry into these matters would benefit from additional information and investigation; thus,

rather than exploring these issues today, the committee will be sending a letter to CEQ requesting communications and documents about CEQ's role in reviewing and editing Government reports on climate science.

We have also agreed that, after we have received and reviewed these documents, this committee will call Mr. Connaughton back to answer any questions raised by the documents. I think this approach makes a lot of sense, Mr. Chairman, and I appreciate your willingness to pursue it.

[The prepared statement of Hon. Henry A. Waxman follows:]

Statement of Rep. Henry A. Waxman
Committee on Government Reform Hearing on Global Warming
July 20, 2006

I commend Chairman Davis for holding this hearing on global warming today.

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Unfortunately, the Bush Administration – and Congress – have squandered opportunity after opportunity to address the problem of climate change. It's much easier to rack up enormous debts than to be fiscally responsible. And it's much easier to pretend global warming doesn't exist than to face the reality of a dangerously overheating climate. But doing is morally irresponsible. We are literally mortgaging our children's future so we can continue consume unlimited amounts of fossil fuels.

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Chairman TOM DAVIS. Thank you very much.

Mr. Shays.

Mr. SHAYS. Thank you, Mr. Chairman.

First, I want to say I think it is interesting that this hearing has begun without a thank you, a sincere thank you from me and I think the entire environmental community for the President's action to protect the largest area in our Federal Government in what was done in the Hawaiian Islands and that area. Mr. Connaughton, I want to say congratulations. I know it was a 5-year fight. You deserve tremendous credit. Generations will look back at that action as extraordinarily important.

I do want to say, in addition, that I believe we are not going to have a world to live in if we continue our neglectful ways. I believe that with all my heart and soul. I believe that future generations will look on all of us in this generation like we looked at past generations. We look at past generations and say, how could they have done that? What were they thinking to have had slaves or to have practiced segregation? And we have tremendous arrogance almost because, of course, we wouldn't be so stupid. But I think future generations will say the exact same thing, and it will apply to our stewardship of the environment. They will say, how could we have allowed this to happen? What were we thinking?

Now, I do know that it is not just a Republican problem. I would like this administration to have been more active in multilateral negotiations. They have been very active in bilateral negotiations and have achieved some tremendous results. But it is almost like the administration doesn't want to get credit for doing something well in the environment. At least that is the way I feel.

Kyoto was negotiated by President Clinton. He never submitted it to the Senate. He never submitted it to the Senate because it only had about five votes. But if you were to listen to the Senators today you would think that everyone would have voted for him.

There was a reason why he didn't submit it: because it had so few votes. It had so few votes because China wasn't basically included, India wasn't basically included, and, frankly, there were some even in the environmental community that said, well, if we have to abide by it and do it like they do in Great Britain and like they do in France and like they do throughout Europe and like they are doing in Japan, we are going to have nuclear power, and, of course, that is something we don't want to have.

So I wish with all my heart and soul that the President had submitted it to the Senate, and then we would have a more logical debate about the problem. Do we waste energy? Do we waste fuel? We sure do. Minivans, SUVs, and trucks are not under the same mileage standards as cars. Not under the same mileage standards? Why not?

Well, why not is because the senior Democrat in Congress, the senior Democrat, the senior Member of Congress stands up and opposes any fuel efficiencies, minivans, SUVs, or trucks, getting cars to have better standards, with Republicans. It is a bipartisan problem, and the environmental community can say all it wants, but until we recognize it is a bipartisan problem we are never going to solve this problem.

I thank you, Mr. Chairman, for having this hearing. This is an extraordinarily important hearing. This committee is doing things no other committee is doing.

I thank you, Mr. Waxman, for your efforts over decades on the environment. You deserve tremendous credit.

I will conclude by saying that we will solve the problem, but it won't be a Republican solution, it won't be a northeast solution, it won't be a southwest solution, it will be a solution when Democrats and Republicans stop being so gosh darn partisan and start dealing with this issue.

Chairman TOM DAVIS. Thank you very much.

Mr. Van Hollen.

Mr. VAN HOLLEN. I thank you, Mr. Chairman. Let me begin by thanking you for holding this very important hearing. I also want to thank my colleague, the ranking member, Mr. Waxman, for his leadership on this issue. I am very pleased to join him as an original cosponsor of the Safe Climate Act, which I do believe sets forth the best in scientific consensus in this country as to what we need to do to address the problem of global climate change on an urgent basis.

I think before we can move as a Nation, before this Congress will take action, we have to get consensus on the basic facts, and the scientific community is very clear in the consensus that this is a real problem, that human activity is a primary contributor to this problem, and we need to address it.

I am not going to delve into this issue too much today, but I do think at the outset it is important to underscore the issue that Mr. Waxman raised with the efforts that have gone on in this administration, well documented, to essentially have political people veto the findings of scientists, whether they are scientists at EPA, our own Government agencies or elsewhere, and essentially trying to rewrite their findings. We had an individual who was a representative of the oil and gas industry in the White House who was essentially editing the findings of scientists for political purposes.

We have to get beyond that. The President in the State of the Union Address said he was committed to addressing the issue of energy efficiency and renewable energy, and then we found out shortly after the State of the Union speech that he had actually cut positions in his budget in one of the renewable energy labs in Colorado. They were going to do a big photo op out there and they had to scramble to make the rhetoric that he gave to the American people meet the reality of the budget. Until we stop that kind of nonsense, until we really align our resources with our rhetoric, we are not going to move forward in this country.

This is a very, very serious problem, and if we don't address it now and in an urgent manner it will be too late. Hopefully it is not already too late. As Mr. Waxman said, there are things we should have done years and years ago that would have made our task now easier. The longer you wait, the more urgent your action has to be. Of course, the greater cuts you have to make over a shorter period of time than if you begin earlier, in terms of emissions of greenhouse gases.

So I really hope that we get beyond this debate as to whether or not this is a real problem, because until we get beyond that we

can't take the actions we need, and there are people who are spending an awful lot of money and time in this city committed to trying to obfuscate this issue, to confuse the issue. We need to get beyond that. I am glad we are having this hearing on this issue, but beyond acknowledging the problem we have to get to the solutions and we have to start acting.

It is not just the United States. As we know, we have growing economies in China and India that are going to be major contributors to the greenhouse gases problem. But if we don't lead, if we don't lead here in the United States, we can't go around telling people in the rest of the world that they have to address this issue. Frankly, as we all know, we are the largest producers of greenhouse gases. Per capita we are way off the charts. Yet, we have been negligent in terms of our response.

I hope, Mr. Chairman, that this hearing will be part of a wakeup call, not to the American people, I think they are beginning to get it, but to political Washington to get moving on this issue.

Thank you for having the hearing.

Chairman TOM DAVIS. Thank you, Mr. Van Hollen.

Mr. Ruppersberger.

Mr. RUPPERSBERGER. Mr. Chairman, I thank you and Mr. Waxman for addressing this extremely important issue.

We are not here to rewrite the science; we are here to act on it. Unfortunately, the debate on climate change has gotten away from science and has, instead, been driven by political opinions on whether or not global warming is happening. I hope today we can take a second look at this issue and work together to solve this challenge, because the stakes are high and the warning signs could not be clearer.

The 1990's were the hottest decade recorded over the past century, and perhaps the millennium. Water sources that were once the lifeline of communities across the globe are evaporating. In May, MIT and Purdue University separately reported new evidence that global warming is causing stronger hurricanes, and the melting of our ice caps is now visible to the naked eye, causing sea levels to rise. In fact, the Heinz Center for Science, Economics, and the Environment estimates that at least a quarter of the houses within 500 feet of the U.S. coast may be under water by the year 2060 due to rising sea levels.

Right here in the Maryland/Washington/Virginia region, a number of islands in the Chesapeake Bay have disappeared in the last few decades, including Poplar Island, a historic spot used by President Roosevelt. Now Poplar Island has to be maintained by a massive dredging project to keep the Baltimore Harbor functional.

The threat here is real and can no longer be ignored; yet, the administration has questioned whether carbon dioxide, the principal greenhouse gas responsible for global warming, was even a pollutant.

The administration created doubt about the reality of global warming and withdrew the United States from the Kyoto protocol. Now the administration says we should reduce the intensity of greenhouse emissions when we really need to focus on lowering greenhouse pollution.

In the meantime, businesses, homeowners, towns, cities, and foreign countries have moved ahead to promote greener, more energy efficient technology; 266 cities and towns across America have promised to reduce global warming pollution to levels required under the Kyoto protocol.

Businesses are using green technology to cut costs, including a new Bank of America tower in Manhattan that will convert scraps from the cafeteria into fuel for its generator, producing more than half the building's electricity. Wal-Mart has set a goal of reducing their carbon footprint by 20 percent in 7 years. And every day Americans are using solar energy to power their homes, replacing their lamps with energy efficient light bulbs to conserve electricity, and buying hybrid and flex fuel cars to reduce their gas costs.

With all these advancements happening in spite of a lack of leadership from the White House and some GOP Members of Congress, imagine what we could do if we work together in a bipartisan manner to address the serious problem of global climate change.

I challenge the administration and some of my Republican colleagues here in Congress to take a second look at the facts we have on climate change. Too much is at stake to make this another partisan issue.

Thank you, Mr. Chairman, again for calling this hearing, and to all of our witnesses for presenting your testimony. I look forward to the hearing and your comments.

Chairman TOM DAVIS. Thank you very much.

Mr. Cummings.

Mr. CUMMINGS. Thank you very much, Mr. Chairman. I want to again echo the comments of my colleagues and I want to associate myself with all the comments on both sides of the aisle. I think they have been very appropriate.

I want to thank you, Mr. Chairman and ranking member, for holding this vitally important hearing today. You know, Mr. Chairman, when children go to Disney World and they go to the Animal Kingdom there is a major sign that they have to look at because it is so big as you enter. It says, "We do not inherit our environment from our parents," it says, "We borrow it from our children."

I can tell you that in urban communities, like the one I represent in Baltimore, the impact of global warming has been great. A study conducted by researchers at Harvard University and the American Public Health Association found that America's cities are blanketed with smog and climate changing carbon dioxide, leading to an epidemic of asthma and other illnesses. Hardest hit by the epidemic are preschool-age children, like the ones that visit Disney World, whose rate of asthma rose by 160 percent between 1980 and 1994, the report says. These children are so young they are still learning to spell their names, yet they cannot breathe because of the pollutants we have put in the air.

Tragically, they are not the youngest victims. In a comparison of 86 cities in the United States, infants who lived in a highly polluted city during their first 2 months of life had a higher mortality rate than infants living in the city with the cleanest air.

We can talk about impact in other terms, too, because global warming impacts some communities more than others. In 2002, 71 percent of African Americans lived in counties that violated Fed-

eral air pollution standards, compared with 58 percent of Whites. What to know what the impact of that disparity has been? Asthma attacks in 2002 sent African Americans to the emergency room at a three times greater rate than White, and the asthma-related death rate for African Americans was nearly twice that of Whites.

As a matter of fact, just on Monday, Mr. Chairman, my colleague from your side of the aisle went with me on a tour of my District in Baltimore, and when we went to the Johns Hopkins clinic that deals with the conditions of the poor, he realized and was told that the rate of asthma in that community 40 miles from here was simply off the charts.

But that is not all. A recent study of the 15 largest U.S. cities found that global warming would increase heat-related deaths by at least 90 percent. Most African Americans live in inner cities, which tend to be about 10 degrees warmer than the surrounding areas.

We have heard time and time again the accusation that people who are sounding the alarm on global warming are a bunch of reactionaries making baseless claims. That is a dangerous line of reasoning. All one has to do is look at the most recent Al Gore movie. The threat of global warming is here and it is real. The Intergovernmental Panel on Climate Change, U.S. National Academy of Sciences, the National Research Council, and the National Academies of Sciences of 11 countries all agree when it comes to the impact of global warming has made on this planet it has been phenomenal.

But I need no further evidence than what I see happening in my own back yard in Baltimore. Adolescents can't breathe normally. Babies are dying prematurely. And African Americans are getting sick in communities where they live.

The time is past due for Congress to lead the charge in the fight against global warming. As my colleagues have said, it is time for us to act. And I pray that we are not sitting here 5 years from now having the same discussions, looking at reports that have been pulled off the shelf and warmed over, for the fact is that people are literally dying. So perhaps some of those children that might have had an opportunity to go to Disney World won't have that chance if we adults don't do what we are supposed to do.

With that, Mr. Chairman, I yield back.

Chairman TOM DAVIS. Members will have 7 days to submit opening statements.

We are going to now move to our first panel. We have Jim Connaughton, who is the chairman of the Council on Environmental Quality, and Dr. Thomas Karl, the Director of the National Climatic Data Center, National Oceanic and Atmospheric Administration. Thank you for your patience as we moved through our markup and our opening statements.

It is our policy that all witnesses be sworn before you testify, so if you would rise, please, and raise your right hands.

[Witnesses sworn.]

Chairman TOM DAVIS. We have a light in front of you. Your entire statements are part of the record. Our Members and staff have read that, and questions will be based on that. We have a green light in front of you. It will turn orange after 4 minutes, red after

5. If there is an important issue, if you feel that you need to go over, you know, we understand, but we want to keep things going because we have three panels to get through.

Mr. Connaughton, we will start with you. Thank you for being here.

STATEMENTS OF JIM CONNAUGHTON, CHAIRMAN, COUNCIL ON ENVIRONMENTAL QUALITY; AND THOMAS KARL, DIRECTOR, NATIONAL CLIMATIC DATA CENTER, NATIONAL OCEANIC AND ATMOSPHERIC ADMINISTRATION

STATEMENT OF JIM CONNAUGHTON

Mr. CONNAUGHTON. Thank you very much, Mr. Chairman, Ranking Member Waxman, and members of the committee. It is actually a delight to be here and a delight, in particular, that you have chosen to at least dedicate a portion of this session to the actions related to addressing this serious issue.

Congressman Shays, thank you for your kind words about the monument. It really was a great event. It is great for America and for the world. It was a lot of fun.

I want to begin, first and foremost, we talk a lot about the polarized debate and rhetoric on climate change. At the ground level of policy work, even of scientific work, and the ground level internationally, I think the fair characterization is actually a raging amount of consensus. I hope you will get a feel for that in my testimony.

I want to begin with the President on the science. As early as June 2001 in a major policy address and many times since, most recently in the EU last year and again earlier this year, the President has made clear that climate is a serious issue, serious problem. Humans are a big part of the problem and we need to just get on with it, and that is really where our discussion needs to focus. It is what are the serious and sensible measures that we can take to make meaningful progress toward addressing this issue.

The President is committed to doing that and he has been achieving it through a portfolio of policies that are focused on encouraging the transformational breakthroughs in technology and to take advantage of the power of markets to bring those technologies into widespread use. There is raging consensus on that point, too.

The administration's growth-oriented strategy encourages global participation—I will talk about that in a second—and focuses on actions that ensure continued economic growth and prosperity in the United States and throughout the world. This is important because economic growth is necessary to provide the resources for investment in the technologies and practices that are required to reduce greenhouse gases. You don't get those investments in sagging economies.

By the end of this year the administration will have devoted nearly $29 billion in taxpayer resources, more than any other Nation, to climate science technology, international assistance, and incentive programs. We are now implementing more than 60 Federal programs that are directed at cleaner, more efficient energy technologies, conservation, and sequestration. My 40 plus pages of testimony gives just a thumbnail of some of the more interesting ones.

For fiscal year 2007, the President has asked for an additional $6.5 billion for climate-related activities. To put that in perspective, the entire budget for the National Science Foundation is about $6 billion, the entire budget for the Department of Commerce or the entire judicial branch is about $6 billion. We are talking about a massive, bipartisan-supported commitment to this important issue.

Now, domestically the President has set an ambitious national goal to reduce the greenhouse gas intensity of our economy by 18 percent in 2012. What that means is we are working hard to slow the growth in emissions, and there is no question that under this metric emissions will grow. We are trying to have that occur at a decreasing rate. So our objective is to first significantly slow the growth of emissions and, as the science continues to inform us, stop the growth of emissions and then reverse it.

To achieve this goal, the administration is pursuing a range of activities, partnerships, incentives, mandatory programs, and helping to enable smarter consumer choice to reduce greenhouse gases.

Let me start with partnerships, just a few examples out of many. We have major new efforts, such as the Department of Energy's climate vision program, which gets specific commitments from 15 of the major emitting sectors, plus the business round table, EPA's climate leaders, which has nearly 100 leading companies such as the one the Congressman described. We have nearly 100 who are leading the way in their sectors with very aggressive greenhouse gas reduction programs, and a very interesting program called smart way transportation, which is trying to turn off diesel trucks at night and plug them in rather than emit all night long. Each of these is based on specific commitments to cut emissions and improve greenhouse gas intensity.

Now, Federal agencies and private innovators are also partnering to pursue energy supply technologies with low, and in some cases zero, carbon dioxide and air pollution emission profiles. These include solar, wind, geothermal, bioenergy, combined heat and power, and a new generation of clean, near-zero fossil fuel coal plants, as well as the next generation of nuclear.

In the State of the Union this year I think the President rocked the Nation and the world with his commitment to advancing the domestic and international dialog for renewable fuels, both ethanol, cellulosic ethanol, and the new generation of clean and really friendly to rural communities biodiesel.

On the incentive side, it is overlooked but the major tax reforms on expensing of dividends that enjoyed strong bi-partisan support in the Congress are demonstrably working to unleash substantial new capital investments, including the purchases of cleaner, more efficient facilities and buildings, so instead of maintaining the old, inefficient stuff, our economy is roaring toward the purchase of new, cleaner, more efficient equipment.

The Energy Policy Act of 2005 authorizes about $5 billion in tax credits and incentives over 5 years for clean energy systems and highly efficient vehicles, and our farmers and ranchers can now obtain substantial financial incentives from the nearly $40 billion in farm bill conservation programs to biologically sequester carbon on their working lands, while also enhancing their local ecology.

On the mandatory side—again, all of this is new since 2001—we have a 15 percent mandatory improvement in fuel economy for new light trucks now, including large SUVs and Hummers for the first time. We are calling on Congress to give us the authority to do the same for passenger vehicles, and we hope the Congress will act on that.

We have a 7.5 billion gallon renewable ethanol requirement, which enjoys strong bipartisan support, and 15 mandatory efficiency standards for new appliances. If you look at the other provisions of the Energy Policy Act, it can point to every one of them as being a new improvement in reducing greenhouses gases, whether it is clean coal, nuclear, some of the other technology programs related to hydrogen, etc. We are overlooking the fact that we have a comprehensive strategy and we have had a lot of climate-related legislation, even in the last 2 years.

These and many other efforts are working. They need to be coupled with smarter choices by consumers, and we are on track to meet the President's goal.

A June 2006, preliminary estimate by the Energy Information Administration of energy-related CO_2 emissions for 2005 show a reduction in the emission intensity of 3.3 percent. If I was sitting here in 2001, the EIA and most people would say we couldn't have done that. Well, we have. We have done it for reasons that are both good, as a matter of policy, and for reasons that are a bit of concern, which I can talk about in the Q and A. But I would note we are making accelerated progress.

This rate of progress domestically in the United States, it is also important to note, is on par with what our counterparts are achieving internationally in the developed world, whether it is the U.K., Australia, Japan, France. The major nations are making about the same rate of progress, and that is a good thing. It is a good rate of progress.

Very briefly, on the international side the President is sustaining U.S. leadership begun by his father and carried out through the Clinton/Gore administration when it comes to practical actions to address this important issue. Since 2001, not only have we established 15 bilateral climate partnerships with countries that account for about 80 percent of greenhouse gas emissions, but, very importantly, the G8 last year launched a major effort, in partnership and really led by Prime Minister Blair working with the President, to create an integrated agenda for action that addresses energy security, air pollution control, and greenhouse gases as a bundle, which is very important.

Successful projects have been initiated in the area of climate research and science, climate observation systems, many of the technologies I just highlighted, including, very importantly, carbon capture and storage, as well as other joint policy approaches. But, most importantly, the United States has found a way to engage China and India in a meaningful way with the introduction of the Asia Pacific partnership.

Along with those two countries, Australia, Japan, South Korea, and the United States, which account for about half of the world's economy, energy use, and greenhouse gas emissions, are working together to open up and accelerate market opportunities for the

best of today's technologies and create a platform for the faster introduction of the promising technologies of tomorrow. Importantly, this is working with the private sector to accomplish this goal in key areas such as power generation, cement, aluminum, mining, and buildings.

I just want to underline the importance of this initiative. Countries like China and India, these major emerging economies, not only is their air pollution now at levels beyond what we saw in America and have now taken real action to address, but their greenhouse gases, as early as 2010 to 2015, their greenhouse gases will exceed those of the developed world. We need to do this together. We have found a pathway by which we can do this together.

The Asia Pacific partnership, along with partnerships such as methane to markets and programs internationally focused on zero emission coal, renewable energy, energy efficiency, hydrogen, next generation nuclear, and even fusion are centered on the key ideas that the greatest progress will occur in the context of the broader development agenda, so if we can marry lifting people out of policy through cleaner energy systems with also their desire for clean water and improved energy security, we can make very real progress. Second, technology is the glue that binds these objectives together. Third, it only works with the private sector, which will spend more than $15 trillion in the coming decades on our entire energy infrastructure.

Our goal is we need to point that investment toward the cleanest opportunities.

I wish I had more time to get into any specific program. I hope that this hearing, as well as subsequent hearings, can begin to distill out this immense bipartisan program of work supported not just in the executive branch but supported very aggressively by the legislative branch.

Thank you very much, Mr. Chairman.

[The prepared statement of Mr. Connaughton follows:]

Testimony of
James L. Connaughton
Chairman, White House Council on Environmental Quality

Before the United States House of Representatives
Committee on Government Reform

July 20, 2006

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INTRODUCTION

Mr. Chairman, thank you for inviting me to testify on the long-term challenge of global climate change. The President and his Administration are firmly committed to taking sensible action on climate change. The Administration's climate change policy is science-based, encourages research breakthroughs that lead to technological innovation, and takes advantage of the power of markets to bring those technologies into widespread use. Our growth-oriented strategy encourages meaningful global participation through actions that will help ensure the continued economic growth and prosperity for our citizens and for citizens throughout the world. Economic growth provides the resources that enable investment in the technologies and practices we need to address the rise in greenhouse gases.

Domestically, in 2002, President Bush set an ambitious national goal to reduce the greenhouse gas intensity (emissions per unit of GDP) of the U.S. economy by 18 percent by 2012. At the time, this commitment was estimated to achieve about 100 million additional metric tons of reduced carbon-equivalent emissions in 2012, with more than 500 million metric tons of carbon-equivalent emissions in cumulative savings over the decade. Our objective is to significantly slow the growth of greenhouse gas emissions and, as the science justifies, stop it and then reverse it. While measuring progress in absolute terms is important, the most useful measure for policy management purposes is relative improvement in greenhouse gas emissions intensity. The intensity measure appropriately recognizes reductions that are achieved through increased investment in efficiency, productivity and economically valuable activities that require less energy or otherwise lead to fewer emissions. The intensity measure sharply discounts reductions produced by economic decline, job loss, or policies that simply shift greenhouse gas emitting activity from the U.S. to another country – in which case the desired emission reduction did not actually happen.

With this in mind, the Administration is now implementing more than 60 federal programs – including partnerships, consumer information campaigns, incentives, and mandatory regulations – that are directed at developing and deploying cleaner, more efficient energy technologies, conservation, biological sequestration, geological sequestration and adaptation. For example, the Department of Energy's (DOE) Climate VISION program and the Environmental Protection Agency's (EPA) Climate Leaders and SmartWay Transport Partnership programs work in voluntary partnership with specific commitments by industry to verifiably reduce emissions. In terms of incentives, new tax rules on expensing and dividends are helping to unleash substantial new capital investment, including purchases of cleaner, more efficient equipment and facilities. The EPAct of 2005 provides for approximately $5 billion in tax credits and incentives over 5 years.

The Department of Agriculture is using its conservation programs to provide substantial incentives to increase carbon sequestration in soils and trees, and to reduce methane and nitrous oxide emissions, two additional and potent green house gases, from crop and animal agricultural systems. DOE, in partnership EPA, USDA, and other federal agencies, also is pursuing many energy supply technologies with comparatively low or zero carbon dioxide emissions profiles, such as solar, wind, geothermal, bioenergy, and combined heat and power, and a new generation of nuclear power. The Bush Administration has mandated a 15 percent improvement in fuel economy of new light trucks and sport utility vehicles, required use of 7.5 billion gallons of renewable ethanol by 2012, and is establishing 15 new mandatory efficiency standards for new appliances. These programs, and several others, are highlighted in the next section of my testimony.

From 2001 to the end of 2006, the federal government will have devoted nearly $29 billion to climate science, technology, international assistance, and incentive programs, more than any other nation. The President's Fiscal Year 2007 budget calls for $6.5 billion for climate-related activities. Broad bipartisan consensus continues to sustain this high level of federal taxpayer

investment. In 2002, the President called for action at all levels of government and across all sectors. Many of our states and cities are experimenting with similar portfolios of voluntary measures, incentives, and locally relevant mandatory measures. Many of these build on or partner with related federal programs.

We expect these efforts will significantly contribute to meeting the President's 18 percent, 10-year goal, which represents an average annual rate of improvement of about 1.96 percent. A June 2006 EIA preliminary estimate of energy-related carbon dioxide emissions — which account for over four fifths of total greenhouse gas emissions — suggests an improvement in carbon dioxide emissions intensity of 3.3 percent in 2005. Although we are only a few years into the effort, the nation appears well on track to meet the President's goal.

Progress in the U.S. compares favorably with progress being made by other countries. Attachment 1 (Trends in GHG Emissions: 2000-2004) and Attachments 2 (Trends in GHG Emissions Intensity: 2000-2004) show how emission trends in the U.S. compare to other industrialized countries based on national data reported to the UN Framework Convention on Climate Change. The data in Attachment 1, which includes countries that have obligations under the Kyoto Protocol, indicate that from 2000 to 2004 the major developed economies of the world are at about the same place in terms of actual GHG emissions. In some countries, emissions are increasing slightly, in others they are decreasing slightly. Contrary to some popular misconceptions, no country is yet able to decrease its emissions massively. Note that the U.S. has seen its actual emissions increase at a slower rate that the European Union 25, 1.3 percent compared to 2.1 percent.

Attachment 2 shows progress in emissions intensity for the same countries over the same period. Major industrialized countries are all in the 10 percent range for emissions intensity improvement, showing that these economies, with very sophisticated infrastructure and systems, are

in the process of turning over capital stock to more productive and efficient technologies and practices. The ongoing focus is to take actions to help accelerate that turnover to cleaner and more advanced technologies.

Internationally, the President is working closely with key world leaders in the Asia-Pacific region and with his G-8 counterparts who agreed last year that we need a more integrated agenda of action that addresses the interlinked objectives of improved energy security, cleaner air and reduction in greenhouse gases. This integrated agenda will promote economic growth, reduce poverty, provide access to modern sanitation and clean water, enhance agricultural productivity, provide energy security, reduce pollution, and mitigate greenhouse gas emissions. Since 2001, the United States has established 15 climate partnerships with key countries and regional organizations that, together with the United States, account for almost 80 percent of global greenhouse gas emissions. Successful joint projects have been initiated in areas such as climate change research and science, climate observation systems, clean and advanced energy technologies, carbon capture, storage and sequestration, and other policy approaches to reducing greenhouse gas emissions. Among the most notable efforts with a strong, practical emphasis on expanding and accelerating both near- and long-term investment in existing and new technologies are the recently established Asia-Pacific Partnership on Clean Development and Climate, the Methane to Markets Partnership, FutureGen (zero-emission coal), the Renewable Energy and Energy Efficiency Partnership, the Carbon-Sequestration Leadership Forum, the International Partnership for a Hydrogen Economy, the emerging Global Nuclear Energy Partnership, and related bilateral initiatives promoting this vital zero-emission energy source.

Our work on practical measures at the international level is increasingly important, as total carbon dioxide emissions from fossil fuel consumption from non-Organization of Economic Cooperation and Development (OECD) countries — which includes such large developing

countries as China and India — are expected to outpace those from OECD countries, possibly as soon as 2010 according to projections in EIA's International Energy Outlook 2006 (See Attachment 3: World Carbon Dioxide Emissions by Region: 2003-2030). EIA reports that in 2003, carbon dioxide emissions from OECD countries and non-OECD countries accounted for 53 percent and 47 percent, respectively, of the world total. EIA projects that in 2030, OECD countries will account for 40 percent of world carbon dioxide emissions, and non-OECD countries will account for 60 percent. EIA also projects that non-OECD countries will account for 77 percent of the total projected increase in global emissions from 2002 to 2030. These EIA projections are consistent with recent projections from the International Energy Agency. Its World Energy Outlook 2004 suggests that well over two thirds of the projected increase in energy-related carbon dioxide emissions between now and 2030 will be from developing countries. Nevertheless, these countries also hold great promise for improvement in GHG intensity (See Attachment 4: Carbon Dioxide Intensity Improvement Projections by Selected Countries and Regions).

At the World Summit on Sustainable Development in Johannesburg, South Africa in 2002, the developing countries insisted, and the international community agreed to the Johannesburg Plan of Implementation, on the primacy of the development agenda over an agenda exclusively focusing on decarbonizing economies. Given these considerations, the reluctance of developing countries to take on Kyoto-style emissions caps — which could make achieving economic and social development goals much more difficult — is well founded. That is why the Administration believes that the most effective way to engage developing countries is to focus not solely on climate change, but rather on a broader development agenda that promotes economic growth, reduces poverty, provides access to clean water and modern sanitation, enhances agricultural productivity, provides energy security, reduces pollution, and mitigates greenhouse gas emissions.

The Administration's international efforts received a strong boost from the passage of Title XVI of the Energy Policy Act of 2005.

DOMESTIC PROGRAMS

The President has launched and is implementing a broad portfolio of groundbreaking domestic initiatives to improve our understanding of climate science and to develop new technologies. Let me take a moment to highlight some of the most interesting and consequential:

Energy Policy Act of 2005. The Energy Policy Act of 2005, which the President signed into law last year, authorized $5 billion over five years in tax incentives to encourage investments in energy efficiency and alternative renewable energy sources. The new energy law provides new performance-based tax credits of up to $3,400 for the most highly fuel efficient vehicles such as hybrids and clean diesel. It also establishes 15 new appliance efficiency mandates and a 7.5 billion gallon renewable fuel requirement by 2012. These actions will help power our growing economy, improve air quality, and reduce greenhouse gas emissions (See Attachment 5: Energy Bill Tax Incentives).

Advanced Energy Initiative. In his 2006 State of the Union Address, President Bush announced the Advanced Energy Initiative and proposed a 22 percent increase in funding for clean energy technology research at the Department of Energy. The Initiative supports new transportation and power technologies that will help achieve significant reductions of oil imports, lead to substantial reductions in air pollution and greenhouse gas emissions, and increase economic and energy security. We will change how we power our homes and offices by increasing investments in zero-emission coal-fired plants, revolutionary solar and wind technologies, and clean, safe nuclear

energy. We will also change how we power our cars by improving batteries for hybrid and plug-in hybrid vehicles, making cellulosic ethanol cost-competitive with corn-based ethanol by 2012, and by accelerating the development of zero-emission cars that run on hydrogen. To reduce oil consumption, AEI focuses on transportation technologies to advance commercialization of hybrid vehicles, cellulosic ethanol, and hydrogen-powered fuel cell vehicles and infrastructure. With an increased focus on these technologies, the AEI transportation research and development plan will also:

- Develop advanced battery technologies that allow a plug-in hybrid-electric vehicle to have a 40-mile range operating solely on battery charge.
- Foster breakthrough technologies needed to make cellulosic ethanol derived from agricultural waste products, such as wood chips, stalks, or switch grass cost-competitive with gasoline.
- Accelerate progress towards the President's goal of making it practical and cost-effective for large numbers of Americans to choose hydrogen fuel cell vehicles.
- Initiating a new Global Nuclear Energy Partnership (GNEP), which I will describe in the next section.
- Develop clean coal technologies through ventures like FutureGen, a key part of the Coal Research Initiative. FutureGen is a partnership between government and the private sector to build a near-zero atmospheric emissions demonstration coal plant that captures the carbon dioxide it produces and stores it in deep geologic formations.
- Reduce the cost of solar photovoltaic technologies so that they become cost-competitive by 2015.
- Expand access to wind energy by developing wind turbines for use in low speed wind environments, which are closer to population centers.

Global Nuclear Energy Partnership (GNEP). The Global Nuclear Energy Partnership (GNEP), announced in February 2006 as part of the Advanced Energy Initiative, seeks to develop worldwide consensus on enabling expanded use of economical, zero-emission nuclear energy to meet growing electricity demand. America will work with nations that have advanced civilian nuclear energy programs, such as France, Japan, and Russia. GNEP will use new technologies that effectively and safely recycle spent nuclear fuel. Re-processing spent uranium fuel for use in advanced reactors will allow us to extract more energy. It also has the potential to significantly reduce storage requirements for nuclear waste. With re-processing, Yucca Mountain could hold America's nuclear waste through the end of the 21st century. Through our partnership, we can also help developing countries meet their growing energy needs by providing them with small-scale reactors that will be secure and cost-effective. We will also ensure that developing nations have a reliable nuclear fuel supply. In exchange, these countries would agree to use nuclear power only for civilian purposes and forego uranium enrichment and reprocessing activities that can be used to develop nuclear weapons. The President's FY'07 budget request includes $250 million to launch this initiative. By working with other nations under the Global Nuclear Energy Partnership, we can provide the cheap, safe, and clean energy that growing economies need, while reducing the risk of nuclear proliferation.

Climate Change Technology Program (CCTP). The President's FY'07 budget seeks nearly $3 billion for the programs coordinated through the Climate Change Technology Program (CCTP), a multi-agency program that increases the development and use of key technologies aimed at reducing GHG emissions. The intent of this program is to reduce, avoid, or sequester greenhouse gas emissions by stimulating the development and use of renewable, clean coal, fusion, nuclear and

other energy technologies and by increasing energy efficiency throughout the U.S. economy. This request includes over $300 million for the National Climate Change Technology Initiative (NCCTI), a set of priority activities that address technological challenges, which, if solved, could advance breakthrough technologies that will dramatically reduce, avoid, or sequester greenhouse gas emissions.

Climate Change Science Program (CCSP). The President's 2007 Budget request includes $1.715 billion for the Climate Change Science Program (CCSP), a multi-agency program led by the Department of Commerce, charged with: investigating natural and human-induced changes in the Earth's global environmental system; monitoring, understanding, and predicting global change; and providing a sound scientific basis for national and international decision-making. The CCSP combines the near-term focus of the Administration's Climate Change Research Initiative — including a focus on advancing the understanding of aerosols and carbon sources and sinks and improvements in climate modeling — with the breadth of the long-term research elements of the US Global Change Research Program. CCSP integrates research and observational approaches across disciplinary boundaries and is also working to create more seamless approaches between theory, modeling, observations, and applications required to address the multiple scientific challenges posed by changes in climate.

In July 2002, the CCSP undertook a year-long process to prepare a new 10-year strategic plan for the program. The planning process was designed to ensure a comprehensive examination of research and observation needs, transparent review by the national and international scientific and stakeholder communities, and establishment of defined goals for research on climate and global change. Approximately 1,300 scientists and other participants were involved in the development and review of the strategic plan. In addition, the National Academy of Sciences twice reviewed the

plan and gave its approval. The plan identifies both overarching goals and core approaches for achieving those goals. The CCSP is now in the process of implementing the 10-year strategic plan.

Improved Corporate Average Fuel Economy (CAFE) Standards. Since 2003, the Bush Administration has finalized two sets of Corporate Average Fuel Economy (CAFE) regulations requiring a combined 15 percent increase in the fuel economy of light trucks. For the first time, large Sport Utility Vehicles, including Hummers, are required to meet the standards. The Administration is implementing program improvements recommended by the National Academy of Sciences to ensure that we not only save fuel, but also lives and American jobs. These actions are projected to save more than 14 billion gallons of gasoline over the lifetime of these trucks, and correspondingly avoid nearly 177 million metric tons of carbon dioxide emissions. We strongly urge Congress to give us authority to establish new rules on passenger car fuel economy based on these concepts.

Surface Transportation Programs. The Department of Transportation's surface transportation programs can be used by state and local transportation agencies to help reduce fuel usage and greenhouse gas emissions. The Congestion Mitigation and Air Quality Improvement Program and innovative finance programs can help fund projects like truck stop electrification for reduced truck idling and diesel retrofit. System management projects that relieve congestion, improve traffic flow and increase transit use also help reduce fuel usage. Transit funds are available for purchase of hydrogen-powered and other clean-fueled buses. FAA is pursuing initiatives for more efficient air traffic management, which will reduce aircraft fuel use, and FAA's Partnership for Air Transportation Noise and Emission Reduction is conducting research on climate change impacts of aviation.

SmartWay Transportation Partnership. Announced in February 2004, SmartWay is a voluntary partnership between various freight industry sectors and the Environmental Protection Agency designed to increase energy efficiency while significantly reducing greenhouse gases (or gas emissions) and air pollution. There are three primary components of the program: creating partnerships, reducing all unnecessary engine idling (for example, by upgrading truck stops and enouaging trucks to plug-in overnight instead of running their engines), and increasing the efficiency and use of rail and intermodal operations. Shipping, truck and rail companies are enrolled in the program. By 2012, this initiative aims to reduce between 33 and 66 million metric tons of carbon dioxide (CO_2) emissions and up to 200,000 tons of nitrogen oxide (NO_x) emissions per year. The State of Oregon, for example, recently announced a program of tax credits and loans available to truckers who buy SmartWay retrofit kits that reduce diesel emissions. The loans are supported through the Department of Transportation's State Infrastructure Bank program.[1]

Energy STAR. In 1992 the U.S. Environmental Protection Agency (EPA) introduced Energy STAR as a voluntary labeling program designed to identify and promote energy-efficient products to reduce greenhouse gas emissions. Computers and monitors were the first labeled products. Through 1995, EPA expanded the label to additional office equipment products and residential heating and cooling equipment. In 1996, EPA partnered with the U.S. Department of Energy for particular product categories. The Energy STAR label is now on major appliances, office equipment, lighting, home electronics, and more. EPA has also extended the label to cover new homes and commercial and industrial buildings. Through its partnerships with more than 8,000 private and public sector

[1] http://www.deq.state.or.us/msd/taxcredits/factsheets/TruckEngineTaxCreditFactSheet.pdf

organizations, Energy STAR delivers the technical information and tools that organizations and consumers need to choose energy-efficient solutions and best management practices. Over the past decade, Energy STAR has been a driving force behind the more widespread use of such technological innovations as LED traffic lights, efficient fluorescent lighting, power management systems for office equipment, and low standby energy use.[2] Smart consumer purchases informed by programs such as Energy STAR and projected to have saved consumers $12 billion on their utility bills, and avoided 44 million metric tons carbon-equivalent (MMTCE), the equivalent to emissions from 23 million cars.

Natural Gas STAR. The Natural Gas STAR Program is a flexible, voluntary partnership between EPA and the oil and natural gas industry. Through the Program, EPA works with companies to identify and promote the use of cost-effective technologies and practices to reduce emissions of methane.[3] Methane is greenhouse gas that is more than 20 times more potent than CO_2 and has a shorter atmospheric life, which means that effort to reduce it have a nearer-term benefit. Participation in Natural Gas STAR cuts across all of the major industry sectors, including gas production, processing, transmission and distribution. As of 2005, the companies participating in Natural Gas STAR represent 56 percent of the natural gas industry in the U.S. Today, the program has over 110 partner companies and is endorsed by nearly 20 major industry trade associations. Since the Program began in 1993, Natural Gas STAR partners have eliminated over 400 billion cubic feet (Bcf) of methane emissions through the implementation of the Program's core Best Management Practices (BMPs), as well other activities identified by partner companies. At the

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[2] http://www.energystar.gov/index.cfm?c=about.ab_history

[3] http://www.epa.gov/gasstar/

same time, these companies have saved over $2.8 billion by keeping more gas in their systems for sale in the market.[4]

USDA Programs. In June 2003, the Secretary of Agriculture announced that, for the first time, the Department of Agriculture (USDA) would provide targeted incentives to encourage wider use of land management practices that remove carbon from the atmosphere or reduce emissions of greenhouse gases. USDA's initiatives encourage the increased use of biomass energy, crop and grazing land conservation actions, practices to reduce emissions from agriculture, and sustainable forest management. USDA is targeting greenhouse gases and carbon sequestration through the conservation programs it administers and set a target to reduce 44 million tons of CO_2 equivalent emissions by 2012. These incentives come in part from an increase in funding for conservation programs on private lands of $17.1 billion over 10 years as authorized by the Farm Bill of 2002.

Since 2002, The Natural Resources Conservation Service (NRCS) delivered guidance to its offices nationwide to reward and recognize actions that provide greenhouse gas benefits within the Environmental Quality Incentives Program (EQIP) application ranking systems. Between 2004 and 2006, EQIP participants addressed soil erosion concerns on 4.9 million acres; irrigation water management resource concerns on 22.4 million acres; and wildlife habitat resource concerns on 2.3 million acres.

USDA and EPA are promoting the use of anaerobic digesters on farms to reduce odors and pathogens and methane emissions. Over the past two years, the number of digesters has more than doubled. For example, from 2003-2005, USDA helped to install 84 new digesters through rural development grants and another 11 digesters were funded under EQIP.

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[4] http://www.epa.gov/gasstar/accomplish.htm

As part of technical assistance efforts, NRCS developed three web-based energy tools to help farmers increase energy awareness in agriculture and identify where they can reduce their energy costs. The tools address: energy and cost savings associated with different tillage systems; nitrogen use efficiency; and energy savings associated with improved irrigation systems. Since the first energy awareness tool was released in December 2005, the three tools have had over 1.5 million hits.

The Farm Service Agency (FSA) is using the Conservation Reserve Program (CRP) to promote carbon sequestration. FSA modified the Environmental Benefits Index (EBI) used to score and rank offers to enroll land in the CRP to give more points for installing vegetative covers that sequester more carbon and issued a rule that allows the private sale of carbon credits for lands enrolled in the CRP.

FSA is targeting 500,000 acres of CRP continuous signup enrollment toward bottomland hardwood tree planting. These efforts have been slowed somewhat as Mississippi and Louisiana recover from hurricane Katrina.

Under the Conservation Security Program (CSP), NRCS is providing financial and technical assistance to promote conservation on working cropland, pasture, and rangeland. Outcomes of CSP contracts for 2004 and 2005, include: 4 million tons of additional carbon have been sequestered (14.6 million tons of CO2 equivalents); 8.5 million acres enrolled with enhancements applied to increase soil quality; 2.7 million acres enrolled with grazing management enhancements applied that exceed quality criteria; and over 5 million acres enrolled with nutrient management enhancements applied that exceed quality criteria.

Climate Leaders. Climate Leaders is an EPA partnership that encourages individual companies to develop long-term, comprehensive climate change strategies. Partner companies

develop corporation-wide GHG inventory including all emission sources of the six major gases (CO_2, CH_4, N_2O, HFCs, PFCs, SF_6), set an aggressive corporate-wide GHG emissions reduction goal to be achieved over 5 to 10 years, and report inventory data annually and document progress toward their emissions reduction goal. Since its inception in 2002, Climate Leaders has grown to include nearly 100 corporations whose revenues add up to almost 10 percent of the United States' gross domestic product and whose emissions represent 8 percent of total U.S. greenhouse gas emissions. Five organizations have achieved their GHG reduction goals – Baxter International, General Motors Corporation, IBM Corporation, National Renewable Energy Laboratory and SC Johnson.[5]

Climate VISION. In February 2003, President Bush announced the formation of Climate VISION, a public-partnership program established to contribute to the president's emission intensity reduction goal. Fourteen major industrial sectors and the Business Roundtable have committed to work with four cabinet agencies (Departments of Energy, Transportation, and Agriculture, and the Environmental Protection Agency) to reduce greenhouse gas emissions in the next decade. Participating industries include electric utilities, petroleum refiners and natural gas producers, automobile, iron and steel, chemical and magnesium manufacturers, forest and paper producers, railroads, and the cement, mining, aluminum, lime, and semiconductor industries (See Attachments 6.1 and 6.2: Climate VISION Sectors). This initiative is modeled on highly successful partnerships such as EPA's 33/50 program from the early 1990s to reduce emissions of toxics.

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[5] http://www.epa.gov/stateply/aboutus.html

Hydrogen Fuel Initiative. In his 2003 State of the Union Address, President Bush launched his Hydrogen Fuel Initiative. The goal of this initiative is to work in partnership with the private sector to accelerate the research and development required for a hydrogen economy. The President's Hydrogen Fuel Initiative and the FreedomCAR Partnership are providing nearly $1.72 billion to develop hydrogen-powered fuel cells, hydrogen infrastructure technologies, and advanced automobile technologies. The President's Initiative will enable the commercialization of fuel cell vehicles in the 2020 timeframe. Through this initiative, the cost of a fuel cell has already been cut in half, and the expected life of an automotive fuel cell has been doubled since 2003. I have driven several prototypes of such vehicles. Private sector interest and investment remains high.

Voluntary Greenhouse Gas Emissions Registry ("1605(b)"). In response to a February 2002 directive from President Bush, the Department of Energy has revised the Voluntary Greenhouse Gas Emissions Registry ("1605(b)") program guidelines to establish a more accurate and transparent national registry where businesses and institutions will be encouraged to submit comprehensive reports on their greenhouse gas emissions, sequestration and reductions. Under the revised program, utilities, industries and other large emitters of greenhouse gases can now demonstrate net, entity-wide reductions, based on emission intensity or other eligible measures, and be recognized for "registered reductions". Provisions encourage participation in the program by small emitters of greenhouse gases, such as farmers, forest owners, and small businesses. Small emitters can either report on their own or partner with a larger group to report greenhouse gas reduction benefits. The revised guidelines include new state-of-the-science guidance and tools, developed by USDA, for estimating emissions from agricultural, forestry, and conservation activities important for carbon sequestration efforts. The guidelines offer farmers and ranchers a new on-line tool called COMET-VR which provides a simple and reliable method for estimating

soil carbon sequestration. The technical guidelines for forests have recently been published as[6] a series of detailed carbon stock default tables with guidance on applying the tables for inventory purposes, direct measurement protocols, and guidance on the use of models. Actions that farmers and landowners can consider reporting include using no-till agriculture, installing a waste digester, improving nutrient management, and managing forestland. The original program guidelines, issued in 1994 following enactment of the Energy Policy Act of 1992, provided reporters considerable flexibility to decide what they reported to DOE's Energy Information Administration (EIA). This flexibility was intended to encourage participation. Over 200 utilities and other entities, large and small, report to DOE under the original program guidelines. Since its inception, participants in the existing program have reported several billion tons of CO_2 (equivalent) emission reductions to EIA. While these previous reports clearly demonstrate the commitment of participants to reducing emissions, the original program guidelines were revised to ensure that future reports provide a more accurate and comprehensive accounting of the entity-wide reductions achieved by participants. The new guidelines will govern reports submitted in 2007 and beyond.

While we do not yet have any data reported under the new guidelines, we do have 1605(b) data reported for 2004. For the 2004 reporting year, 226 U.S. companies and other organizations reported to the Energy Information Administration (EIA) that they had undertaken 2,154 projects to reduce or sequester greenhouse gases in 2004.

Carbon Sequestration. The carbon sequestration program has grown significantly under the current Administration from about $24 million in 2001 to almost $70 million in FY'06. With major

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[6] USDA FS GTR-NE343, "Methods for Calculating Forest Ecosystem & Harvested Carbon with Standard Estimates for Tree Types of the United States." USDA Forest Service, 2006.

industry cost-sharing for the total program very close to $100 million. There are approximately 40 field validation tests of geologic sequestration underway or planned world wide on carbon sequestration. Notably, the majority of these are taking place in the U.S. (See Attachment 7.1: Carbon Sequestration Program Structure; Attachment 7.2: Sequestration Program Statistics FY'06; and Attachment 7.3: Regional Carbon Sequestration Partnerships Field Validation Tests).

Federal Energy Management Program (FEMP). Chartered in 1973, the Department of Energy's Federal Energy Management Program (FEMP) works to reduce the cost and environmental impact of the Federal government by advancing energy efficiency and water conservation, promoting the use of distributed and renewable energy, and improving utility management decisions at Federal sites. With FEMP's leadership, Federal agencies have achieved nearly a 30% reduction in British Thermal Units (BTUs) per square foot energy consumption at Federal facilities sine 1985. The EPAct of 2005 established even more aggressive requirements for Federal agencies to further decrease BTU per square foot energy consumption at Federal facilities by over 2% per year for 10 years.

DOE's Super Energy Saving's Performance Contracts are among the key tools that Agencies use to reduce energy consumption. These contracts were reauthorized in the EPAct of 2005, and provide a cost-effective way for agencies to improve energy efficiency of their buildings and facilities through private sector financing and without requiring up front appropriated funding normally necessary for such projects. These contracts provide funding to enable improved energy efficiency and renewable energy utilization at the thousands of Federal buildings across the country. Agencies repay private sector investments plus interest through guaranteed energy cost savings.

Federal agencies are also leading by example in the area of renewable energy use. The Federal Government is currently the largest consumer on non-hydro renewable energy in the

country. Federal facilities consume over 2500 Giga-watt hours of non-hydro renewable energy per year. The Energy Policy Act of 2005 established new a requirement that the Federal Government use at least 3 percent renewable energy in fiscal years 2007 through 2009, not less than 5 percent in fiscal years 2010 through 2012 and not less than 7.5 percent in fiscal year 2013 and each fiscal year thereafter. Federal agencies are currently exceeding the 2012 requirements of the act by purchasing more than 5% of their energy from renewable resources.

FEMP is also guiding the Government's efforts to lead by example in greenhouse gas reductions. Federal facilities are on track to meet a goal of reducing the greenhouse gas emissions associated with Federal facilities at least 30% by 2010 based on a 1990 baseline. This goal was established under Executive Order 13123, "Greening the Government through Efficient Energy Management".

THE GLOBAL EFFORT

Of course, climate change is not just a concern domestically, it is a global issue. The United States remains a strong leader in the global effort to address climate change. It is important to recognize that government funding is only small part of the success equation globally. The International Energy Agency estimates that $17 trillion dollars will be invested by 2030[7] in energy and infrastructure to meet projected demand growth. The questions in front of us are: What is the nature of the technology being installed? What will investing in these technologies do in terms of advancing and enhancing our energy security, clean development, air pollution control and greenhouse gas mitigation?

Under President Bush's leadership, the United States has brought together key nations to tackle jointly some tough energy challenges we face. These collaborations mirror the main strategic

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[7] International Energy Agency. 2005 World Energy Outlook. http://www.worldenergyoutlook.org/

thrusts of our domestic technology research programs, and they address a number of complementary energy concerns, such as energy security, climate change, and environmental protection (See Attachments 8.1-8.2: Innovative International Technology Partnerships).

The international climate technology partnership provisions found in Title XVI of the EPAct of 2005 provide us with an important legislative foundation for sustaining and building on these partnerships. The comprehensive domestic technology provisions of EPAct are also critical to the success of the international effort. The importance of this inter-relationship has been recognized for some time. For example, Senator Byrd in the mid 1990's initiated programs to export U.S. technologies which were proposed 2002 in the Clean Energy Technology Export initiative (CETE). Many aspects of the CETE initiative are reflected in the EPAct of 2005 and are being carried out through Administration initiatives.

Developing countries such as India and China need enormous amounts of new energy to continue their economic development and to provide jobs and improved living standards for their populations. The economic, social and environmental benefits of building clean and efficient generation capacity, as well as delivering and using electricity more efficiently, are huge.

Asia-Pacific Partnership on Clean Development and Climate. Last summer, the Administration introduced one of our most consequential multilateral initiatives, the Asia-Pacific Partnership for Clean Development and Climate. The six nations in this partnership – Australia, China, India, Japan, South Korea, and the United States – account for about half of the world's economy, energy use, and greenhouse gas emissions (See Attachment 9: Asia-Pacific Partnership Significance). In announcing the Asia-Pacific Partnership on July 27, 2005, President Bush said, "This new results-oriented partnership will allow our nations to develop and accelerate deployment of cleaner, more efficient energy technologies to meet national pollution reduction, energy security, and climate

change concerns in ways that reduce poverty and promote economic development" (See Attachment 10: President's Statement: July 27, 2005).

The Asia-Pacific Partnership and our other international engagements on climate change center on five key ideas, all of which extend from and build on our own experience here in the United States. First, a successful international response to climate change requires developing country participation, which includes both near-term efforts to slow the growth in emissions and longer-term efforts to build capacity for future cooperative actions. Absent the participation of all major emitters, including developing countries, the UN Framework Convention's ultimate goal of stabilizing GHG concentrations will remain elusive.

Second, we will make more progress on this issue over time if we recognize that climate change goals fall within a broader development agenda – one that promotes economic growth, reduces poverty, provides access to modern sanitation and clean water, enhances agricultural productivity, provides energy security, reduces pollution, and mitigates greenhouse gas emissions. Countries do not look at individual development goals in a vacuum, and approaches that effectively integrate both near- and longer-term goals will yield more benefits over time.

Third, technology is the glue that can bind these development objectives together. By promoting not just the development but also the wide spread commercialization and use of cleaner and more efficient technologies, we can meet a range of diverse development and climate objectives simultaneously.

Fourth, we need to pursue our international efforts in a spirit of collaboration, not coercion, and with a true sense of partnership. This is especially true in our relations with developing countries, which have an imperative to grow their economies and provide for the welfare of their citizens. Experience has shown these countries to be quite skeptical of climate mitigation approaches that they think will divert them from these fundamental goals. It is also true that many

of the largest greenhouse gas emitters are also among our most significant trading partners. They have rapidly advancing – in many cases, world class – industries and considerable technical expertise. We view countries like China and India as responsible partners in our efforts.

Finally, we need to engage the private sector to be successful. While the right kind of government-to-government collaboration can pave the way for great progress, we will need to harness the ingenuity, resources and vision of the private sector in developing and deploying technology.

The Partnership's Charter, which I have attached to my testimony, identifies a broad range of near and long-term technologies and practices that are designed to improve energy security, reduce pollution, and address the long-term challenge of climate change. The Partnership focuses on voluntary practical measures to create new investment opportunities, build local capacity, and remove barriers to the introduction of cleaner, more efficient technologies. It is important to build on mutual interests and provide incentives to tackle shared global challenges such as climate change effectively (See Attachment 11: Asia-Pacific Partnership Focus).

We are united with our partners in recognizing that the ingenuity and energy of the private sector is crucial to our success in addressing these issues over time. This effort cannot succeed without strong private sector involvement. The Departments of State, Energy, Commerce, the Environmental Protection Agency, and other agencies and financing institutions, such as the Export-Import Bank and Asian Development Bank, are actively discussing ways of ensuring that the private sector is engaged in a meaningful way in the Partnership at every stage of its work.

This past January, I was privileged to join Energy Secretary Sam Bodman and Under Secretary of State Paula Dobriansky at the first Ministerial meeting of the Partnership in Sydney, Australia. The meeting was hosted by Australian Prime Minister John Howard and chaired by Australian Foreign Minister Alexander Downer. In addition to involving unusually high-ranking

government official representation, the meeting also included a substantive dialogue with leading CEOs and heads of industrial organizations from each country representing some of the most significant, energy-intensive and emitting sectors. The Ministerial established a Policy and Implementation Committee and its first set of Task Forces covering actions in eight areas: Cleaner Fossil Energy, Renewable Energy and Distributed Generation, Power Generation and Transmission, Steel, Aluminum, Cement, Coal Mining, and Buildings and Appliances.

Each Task Force has a government chair and co-chair (See Attachment 12). Initial details about the objectives and work plans for each task force are outlined in the accompanying charts (See Attachments 13.1-13.8). Each Task Force will consist of two senior government officials and two private sector leaders from each country to enable a relatively manageable planning and implementation dialogue of about 24 people per Task Force. The United States is chairing the Policy and Implementation Committee and chairing or co-chairing three of the Task Forces. The United States Task Force members include participants from government agencies, major companies, trade associations, and non-profit organizations.

The Task Forces currently vary in their level of organization and planning. The aluminum sector, for example, has already adopted a memorandum of understanding as to how they intend to proceed. This is not surprising, as this sector is already well-organized internationally and involves large multi-national companies. On the other hand, sectors such as cement and power generation are composed predominantly of domestic companies, that infrequently, if ever, have had reason to get together and share management strategies, relevant sector goals, best practices, technologies and financing arrangements. For many, the Asia-Pacific Partnership will afford the first opportunity for such hands-on, senior level exchanges.

The Power Generation and Transmission Task Force is demonstrating the "can-do" approach typical of the APP Task Forces. Already over twenty US utilities have agreed to engage the APP

and are standing ready to participate with the partnering nations. The American Electric Power Corporation (AEP) has already hosted representatives from the Indian National Thermal Power Corporation, the largest power utility in India where the high level India officials and engineers were shown opportunities for efficiency and environmental improvements. As a follow-up, this September, AEP and other US companies are planning to host meetings and plant visits to share "best-practices" on techniques and processes to operate power facilities more efficiently and to control emissions. Both government and industry in China and India have shown strong interest in the return visit and plan to send engineers to participate. Consideration is also being given to have US power engineers go to India and perhaps China to help do "walkdowns" of the facilities where they can help provides "hands-on" assistance as a follow-up activity.

In April of this year, the United States hosted the first Task Force working meetings in Berkeley, California. Approximately 300 senior representatives from the public and private sectors attended the nearly week-long event. The eight Task Forces met for two full days and identified actions covering several dozen discrete activities. All of the Task Forces indicated they will complete their initial action plans by August 31, at which time they will be submitted to the Policy and Implementation Committee for review and approval.

Let me outline a few of my own personal thoughts concerning the kinds of deliverables the Task Forces will explore. A principal, operational objective of the Partnership is to identify profitable technology investment opportunities and outcomes in each partner country. In addition to the more traditional discussion of "demonstration projects" related to emerging technologies in each sector, we are placing a strong emphasis on identifying opportunities for near-term outcomes that can be mass-produced using tried and true technologies and methods and investment strategies.

For example, methane capture from coal mining is a well-established and highly profitable practice in the United States that nets significant benefits in terms of worker safety, harmful

pollution reduction, and mitigation of a greenhouse gas. Under the auspices of the Methane to Markets Partnership, which I will discuss in the next section, Caterpillar and Shanxi Jincheng Anthracite Coal Mining Group Co., Ltd. in China have signed a $58 million contract to provide 60 methane-gas-powered generator sets to produce power at a Chinese coal mine. Once complete, this project is expected to be the largest of its kind in the world. Methane gas is found in coal seams which is released into the mine or atmosphere during mining operations. This methane can be very hazardous and can contribute to fires and explosion if not properly vented. Methane is also a greenhouse gas more than 20 times more potent than CO_2. On the bright side, methane is also used as a very clean burning fuel. Caterpillar will be capturing this methane gas instead of venting it to the atmosphere and burning it providing 120 megawatts of electricity to Jincheng City. It is estimated that the project will reduce GHGs by 4.5 million tons of CO_2 equivalent over its 20-year lifetime. This is also an example of the type initiative that the APP is trying to stimulate. The potential number of such projects in several of the other partner countries is quite high.

Our partner countries also have a strong interest in our substantial experience and success in improving the efficiency and capacity of our power generation. For example, in March 2006, China announced a commitment to improve its energy intensity by 20 percent and cut its sulfur-dioxide emissions by 10 percent by 2010 from 2005 levels.[8] To reach this goal, policies are being drafted that may include establishing an index to evaluate how local governments have cut energy consumption. In late 2005, the Chinese State Council, which is the equivalent of the President's Cabinet, approved a directive for the State Environmental Protection Agency (SEPA) to use an emission trading program to control SO_2 from the power sector. At the end of May 2006, SEPA and

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[8] "China Orders Coal-Fired Power Plants to Cut Emissions." People's Daily Online. http://english.people.com.cn/200605/31/eng20060531_270104.html

the Ministry of Finance reached an agreement with over 20 provinces and the six largest power companies representing approximately 50 percent of generating capacity to institute an SO_2 cap and trade program starting in the year 2009. The agreement also included the approach to be used to allocate the tradable allowances to each power plant. These remarkably ambitious objectives create a strong market force for new investment in technologies and services. The partnership will work within the context of such nationally defined outcomes to share experiences and identify needed methods, technologies, and financial arrangements to assure success. Out of such discussions should emerge a fairly concrete list of information, policy, economic, and regulatory barriers to investment and corresponding actions to address such barriers.

Another opportunity is the prospect of a better, shared inventory of each country's capabilities and commitments in key sectors. For example, Japan has a highly-evolved, partnership program of greenhouse gas mitigation goal-setting and implementation involving each of its major emitting sectors. President Bush's Climate VISION and Climate Leaders programs share common elements with the Japanese program.[9] Closer alignment and amplification of these approaches, while ensuring their relevance to each country's national circumstances, will be very valuable.

Another area of importance is the potential for further development of capacity to accurately monitor and measure performance across a number of metrics and sectors. While at different points on the continuum, each of the six countries is working aggressively to improve its ability to track improvements in efficiency, air quality and greenhouse gas emissions. Such capacity is essential to ensuring integrity, consistency, and cost-effectiveness of results.

Finally, we are working to ensure the focused and active engagement of public and private financing institutions. The operational success of this effort should be measured not by how much

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[9] http://www.climatevision.gov/

governments and their taxpayers spend on the effort, but on how much new private sector investment and financing can be unleashed and accelerated to achieve partnership security and environmental performance goals. The U.S. Department of Commerce and our Export-Import Bank are already working on business plans and trade promotion exchanges focused on Partnership priorities. The head of the Asian Development Bank participated in the Ministerial launch of the Partnership in Australia.

The President's FY07 budget calls for $52 million to support the work of the Partnership. The request is divided among the Departments of State, Energy and Commerce, and the Environmental Protection Agency. Other agencies, such as the Departments of Transportation and Agriculture, will also be participating. The Partnership is a team effort and requires a team budget.

Methane to Markets. The Methane to Markets Partnership is another highly practical major element in the series of international technology partnerships advanced by the Bush Administration. Launched in November 2004, the Methane to Markets Partnership focuses on advancing cost-effective, near-term methane recovery and use as a clean energy source from coal beds, natural gas facilities, landfills, and agricultural waste management systems. The Partnership includes 18 countries: Argentina, Australia, Brazil, Canada , China, Colombia, Ecuador, Germany, India, Italy, Japan, Mexico, Nigeria, Republic of Korea, Russia, Ukraine, United Kingdom and United States. The European Commission has announced it is joining. The Partnership will reduce global methane emissions to enhance economic growth, promote energy security, improve the environment, and reduce greenhouse gas emissions. Other benefits include improving mine safety, reducing waste, and improving local air quality. The goals of Methane to Markets will be accomplished through collaboration between developed countries, developing countries, and countries with economies in transition — together with strong participation from the private sector. Methane to Markets has the

potential to deliver by 2015 annual reductions in methane emissions of up to 50 million metric tons of carbon equivalent (MMTCE) or recovery of 500 billion cubic feet (Bcf) of natural gas. These measurable results, if achieved, could lead to stabilized or even declining levels of global atmospheric concentrations of methane relatively soon, similar to what we already achieved in the U.S. To give a sense of scale, this would be equivalent to: removing 33 million cars from the roadways for one year, growing 49 million acres of trees for one year[10], or eliminating emissions from fifty 500 megawatt coal-fired power plants; or providing enough energy to heat approximately 7.2 million households for one year. The Partnership operates in four sectors: oil and gas, coal mining, landfill, and agriculture, initially focusing on livestock waste.

Renewable Energy and Energy Efficiency Partnership. The United States is also one of several countries that participates in the Renewable Energy and Energy Efficiency Partnership (REEEP). REEEP was initiated by the United Kingdom as a WSSD partnership to assist market development of renewable and energy efficiency systems. The United States also actively participated in the Renewables 2004 conference sponsored by the German Government in June 2004 and submitted five action items to provide specific technology plans and cost targets for renewable energy technologies using solar, biomass, wind, and geothermal resources.

G-8. Building on the earlier targeted efforts in the context of the G-8, the United States worked with the United Kingdom and other G-8 partners to launch the 2005 Gleneagles Plan of Action, a landmark document containing over fifty practical, results-oriented actions to address the linked

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[10] USDA FS GTR-NE343, "Methods for Calculating Forest Ecosystem & Harvested Carbon with Standard Estimates for Tree Types of the United States." USDA Forest Service, 2006.

issues of development, energy security, energy access, climate change, and air pollution. G8 partners are engaged in ongoing ministerial-level dialogue with other major energy economies to see that the commitments in Gleneagles are carried through in an effective manner. [11] G-8 members agreed that "climate change is a serious and long-term challenge that has the potential to affect every part of the globe. We know that increased need and use of energy from fossil fuels, and other human activities, contribute in large part to increases in greenhouse gases associated with the warming of our Earth's surface. While uncertainties remain in our understanding of climate science, we know enough to act now to put ourselves on a path to slow and, as the science justifies, stop and then reverse the growth of greenhouse gases."[12] The Gleneagles Plan of Action helped launch of the Global Bioenergy Partnership (GBEP), an Italian initiative to support wider, cost effective, biomass and biofuels deployment, particularly in developing countries.

The U.S. has a significant leadership role in organizing a workshop at the G-8's request on short term opportunities for Carbon Capture and Storage in the fossil fuel sector. The workshop will be held in San Francisco during August and is being organized by the International Energy Agency and Carbon Sequestration Leadership Forum (CSLF) (discussed in more detail below).

The G-8 leaders carried their dialogue forward during last week's G-8 meetings in St. Petersburg with a particular focus on the energy security perspective including clean energy and sustainable development.

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[11] http://www.fco.gov.uk/Files/kfile/PostG8_Gleneagles_CCChangePlanofAction.pdf

[12] http://www.fco.gov.uk/Files/kfile/PostG8_Gleneagles_CCChapeau.pdf

2006 U.S.-European Summit.[13] Last month in Vienna, the President and European Union leaders they agreed to cooperate on a range of activities to promote energy security and advance cleaner and more efficient energy technologies and practices to help cut air pollution and reduce greenhouse gases. This autumn, they will initiate a U.S.-EU High Level Dialogue on Climate Change, Clean Energy and Sustainable Development to build on existing bilateral and multilateral initiatives and further advance implementation of the G-8 Gleneagles Plan of Action.

International Partnership for the Hydrogen Economy (IPHE). Recognizing the common interest in hydrogen research that many countries share, the United States called for an international hydrogen partnership in April 2003. In November 2003, representatives from 16 governments gathered in Washington, D.C. to launch IPHE.[14] IPHE provides a vehicle to organize, co-ordinate, and leverage multinational hydrogen research programs that advance the transition to a global hydrogen economy. It reviews the progress of collaborative projects, identifies promising directions for research, and provides technical assessments for policy decisions. IPHE also will develop common recommendations for internationally-recognized standards and safety protocols to speed market penetration of hydrogen technologies.

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[13] http://www.whitehouse.gov/news/releases/2006/06/20060621-2.html

[14] Founding IPHE member governments include the United States, Australia, Brazil, Canada, China, European Commission, France, Germany, Iceland, India, Italy, Japan, Norway, Republic of Korea, Russia, and the United Kingdom. In January 2005, New Zealand became the 17th member.

Carbon Sequestration Leadership Forum (CSLF). CSLF is a U.S. initiative that was established formally at a ministerial meeting held in Washington, DC in June 2003.[15] CSLF is a multilateral initiative that provides a framework for international collaboration on sequestration technologies. The Forum's main focus is assisting the development and deployment of technologies to separate, capture, transport, and store carbon dioxide safely over the long term, making carbon sequestration technologies broadly available internationally, and addressing wider issues, such as regulation and policy, relating to carbon capture and storage. In addition to these activities, CSLF members are invited to participate in the FutureGen clean coal project. There are 22 members of the CSLF, including the United States, European Commission, China, and India. Seventeen international carbon capture and storage projects, including four co-sponsored by India and China, are currently underway under the direction of CSLF member countries.

Generation IV International Forum (GIF). In 2002, nine countries and Euratom joined together with the United States to charter the Generation IV International Forum (GIF), a multilateral collaboration to fulfill the objective of the Generation IV Nuclear Energy Systems Initiative.[16] GIF's goal is to develop a fourth generation of advanced, economical, safe, and proliferation-resistant nuclear systems that can be adopted commercially no later than 2030. A technology

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[15] CSLF member governments include the United States, Australia, Brazil, Canada, China, Colombia, Denmark, European Commission, France, Germany, Greece, India, Italy, Japan, Republic of Korea, Mexico, Netherlands, Norway, Russia, Saudi Arabia, South Africa, and the United Kingdom.

[16] GIF member countries include the United States, Argentina, Brazil, Canada, France, Japan, Republic of Korea, South Africa, Switzerland, and the United Kingdom.

roadmap developed by the GIF and the Department of Energy's Nuclear Energy Research Advisory Committee in 2003 identified six technologies as candidates for future designs. Based on the roadmap, GIF countries are jointly preparing a collaborative research program to develop and demonstrate the projects.

Future Gen. In February 2003, President Bush announced that the United States would sponsor, with international and private-sector partners, the Future Gen Initiative, a $1 billion, 10-year project to build the world's first coal-based, zero-emissions electricity and hydrogen power plant. The Future Gen is designed to dramatically reduce air pollution and capture and store greenhouse gas emissions through carbon sequestration. India and South Korea have both recently joined Future Gen Initiative on the government side and will each be contributing $10 million. The U.S. has also invited other countries to join in to make this a truly international effort towards a global technology solution to climate change concerns. An industry consortium has been formed, and site selection is under way. Member companies[17] have global operations serving customers in Asia, Australia, Canada, Continental Europe, the People's Republic of China, South Africa, South America, and the United States. These member companies are committing $250 million.

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[17] USG, South Korea, India, American Electric Power – US, Anglo Coal – UK, BHP Billiton – Australia, China Huaneng Group – PRC, Consol Energy, Inc – US, Foundation Coal Corp – US, Kennecott Energy Co. - (Parent company is Rio Tinto of Australia), Peabody Energy – US, Southern Company –US, PPL - US (Used to be Pennsylvania Power and Light)

International Thermonuclear Experimental Reactor (ITER). In January 2003, President Bush announced that the U.S. was joining the negotiations for the construction and operation of the international fusion experiment, International Thermonuclear Experimental Reactor (ITER). The Bush Administration considers fusion a key element in U.S. long-term energy plans because fusion offers the potential for abundant, safe and environmentally benign energy. ITER will allow scientists to explore the physics of a burning plasma at energy densities close to that of a commercial power plant, the critical next step in producing and delivering commercially available electricity from fusion to the grid. The EU location in Cadarache, France has been selected as the ITER site, and a Director General nominee from Japan has been chosen. ITER member countries include the United States, China, European Union, India, Japan, Russia, and the Republic of Korea. Meetings held between September 2005 and February 2006 resulted in the completion of major milestones for the ITER project. Member nations are now presenting the final initialed text to their respective governments for approval.

World Summit on Sustainable Development (WSSD). At the World Summit on Sustainable Development (WSSD) in Johannesburg in 2002, the United States launched a Clean Energy Initiative (CEI). CEI consists of four market-oriented, performance-based partnerships: Global Village Energy Partnership, led by the U.S. Agency for International Development; Partnership for Clean Indoor Air and Partnership for Clean Fuels and Vehicles, led by EPA; and Efficient Energy for Sustainable Development, led by DOE. The mission of CEI is to bring together governments, international organizations, industry and civil society in partnerships to alleviate poverty and spur economic growth in the developing world by expanding access to and modernizing energy services.

Group on Earth Observations.[18] On July 31, 2003, the United States hosted 33 nations, including many developing nations, at the inaugural Earth Observation Summit (EOS), out of which came a commitment to establish an intergovernmental, comprehensive, coordinated, and sustained Earth observation system. The climate applications of the data collected by the system include the use of the data to create better climate models, to improve our knowledge of the behavior of carbon dioxide and aerosols in the atmosphere, and to develop strategies for carbon sequestration. The United States was instrumental in drafting a ten-year implementation plan for a Global Earth Observation System of Systems, which was approved by 55 nations and the European Commission at the 3rd EOS summit in Brussels in February 2005. The United States also released its contribution through the Strategic Plan for the U.S. Integrated Earth Observing System in April 2005.[19] The plan will help coordinate a wide range of environmental monitoring platforms, resources, and networks.

Bilateral Activities. Since 2001, the United States has established 15 climate partnerships with key countries and regional organizations that, together with the United States, account for almost 80 percent of global greenhouse gas emissions.[20] These partnerships encompass numerous individual activities. Joint projects have been initiated in areas such as climate change research and science, climate observation systems, clean and advanced energy technologies, carbon capture, storage and

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[18] http://earthobservations.org/

[19] http://iwgeo.ssc.nasa.gov/docs/EOCStrategic_Plan.pdf

[20] Partners include Australia, Brazil, Canada, China, Central America (Belize, Costa Rica, El Salvador, Guatemala, Honduras, Nicaragua, and Panama), European Union, Germany, India, Italy, Japan, Mexico, New Zealand, Republic of Korea, Russian Federation, and South Africa.

sequestration, and policy approaches to reducing greenhouse gas emissions (See Attachment 14: U.S. Climate Change Bilaterals). Most recently, President Bush and Prime Minister Harper of Canada agreed to establish a high-level dialogue to discuss the environment, climate change, air quality and energy issues.

MARKET DEVELOPMENT FOR COMMERCIALIZATION OF NEW TECHNOLOGIES

One of the biggest barriers to economic progress in developing countries is lack of access to affordable, modern energy services, such as electricity. Such services are instrumental to economic growth, social development, and alleviation of poverty, and their availability can amplify the impact of investments in public health, education, sanitation, clean water, agriculture, and others. Nations that develop strong, market-based institutions and the rule of law will be in the best position to make the sustained investments necessary to provide clean energy and adapt to climate change over the long term.

Therefore, an important objective of U.S. participation in many international collaborations is to mobilize private sector investment by supporting economic reforms; institutional capacity in the energy sector to strengthen markets; strengthen the rule of law; and promote innovative financing that reduces risks and transaction costs. These efforts are aimed at developing new policies and business models to create self-sustaining markets for financing energy efficiency, renewables, and infrastructure projects.

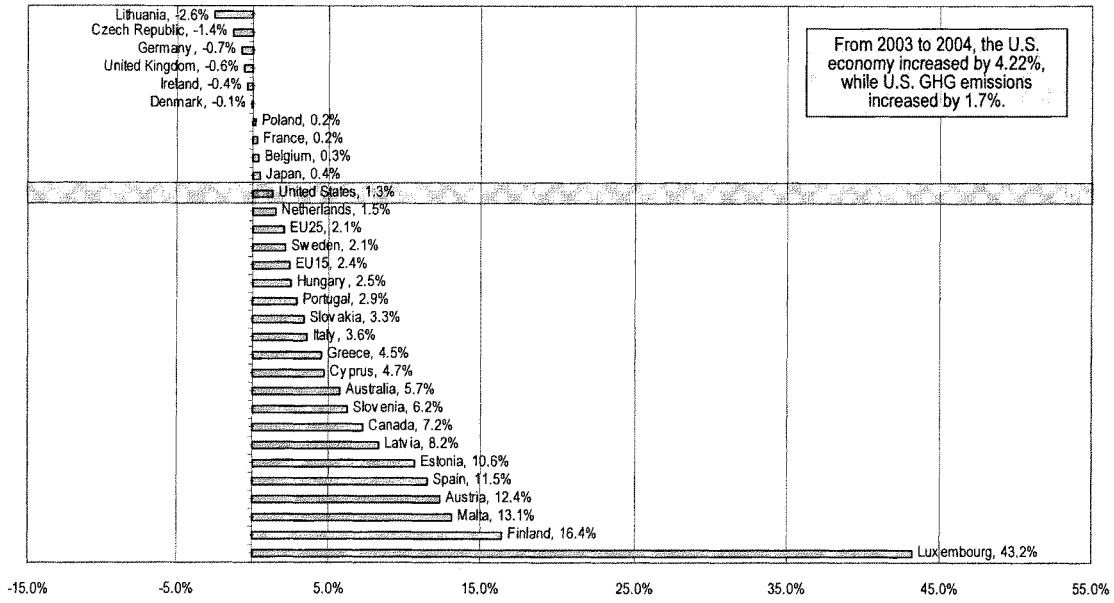
President Bush has demonstrated his commitment to opening markets and knocking down trade barriers to create new opportunities for U.S businesses, workers and farmers. The President's actions to advance free and fair trade have contributed to economic growth at home and increased prosperity and freedom around the world.

The Administration is committed to the completion of the Doha Round of multilateral trade talks, the negotiation of a number of new bilateral and regional free trade agreements (FTAs), and the active enforcement of our trade laws and international rights. As part of the Doha Round, the United States has been an active advocate for new market access for environmental goods and services, such as renewable energy technologies. The Doha negotiations have the potential to lower prices and increase availability of environmental technologies and services for the world's businesses and consumers, in particular those in developing countries. Likewise, the Office of the United States Trade Representative is negotiating the elimination of tariff and non-tariff barriers to environmental technologies that can reduce greenhouse gas intensity in U.S. FTAs.

I thank you for the opportunity to testify. I look forward to responding to any questions you may have.

ATTACHMENT 1

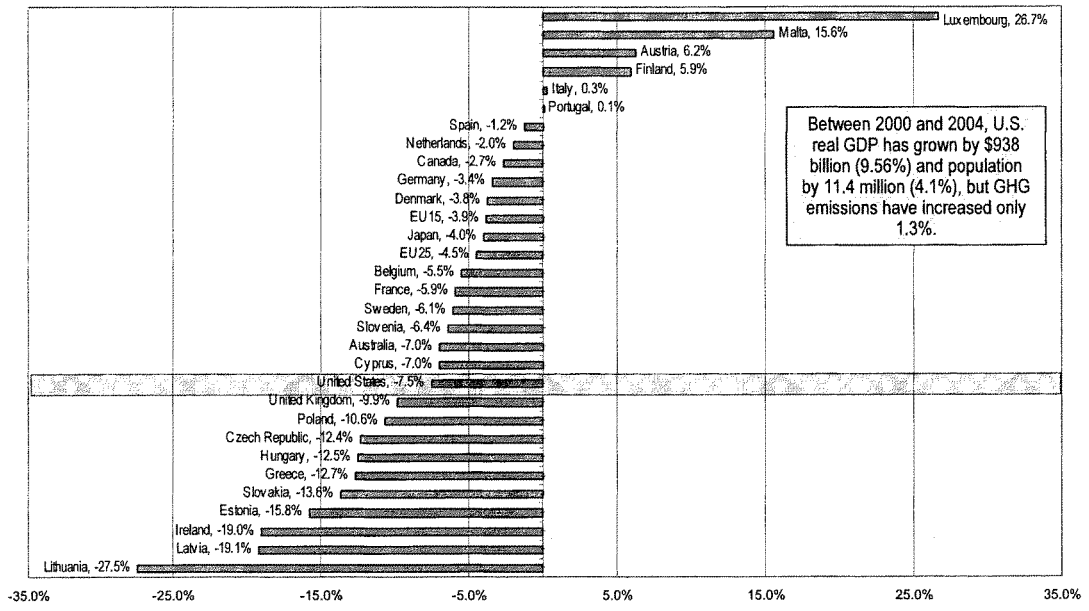
Trends in GHG Emissions: 2000-2004



Emissions Data: 2006 National Inventory Reports and Common Reporting Formats at http://unfccc.int/national_reports/annex_i_ghg_inventories/national_inventories_submissions/items/2761.php

ATTACHMENT 2

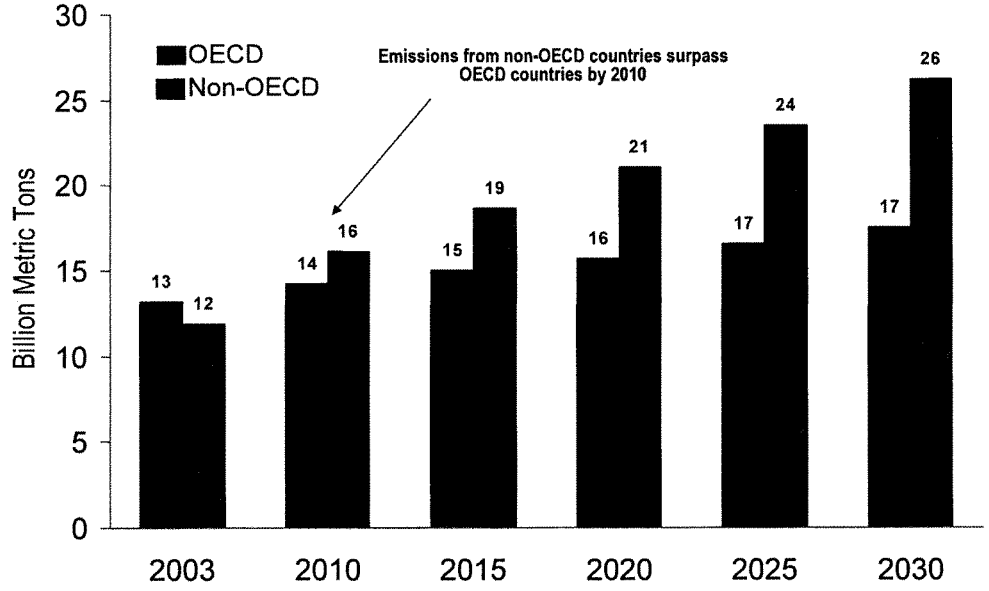
Trends in GHG Emissions Intensity: 2000-2004



Emissions Data: 2006 National Inventory Reports and Common Reporting Formats at http://unfccc.int/national_reports/annex_i_ghg_inventories/national_inventories_submissions/items/3734.php
Economic Data: Haber; These calculations are based on changes in Chained Real GDP. Since the chart is based on percent change, there should be little substantive difference from calculations using other measures of GDP such as those based on Purchase Power Parity. Since there is less controversy in using Chained Real GDP, these are the figures presented.

ATTACHMENT 1

World Carbon Dioxide Emissions by Region: 2003-2030

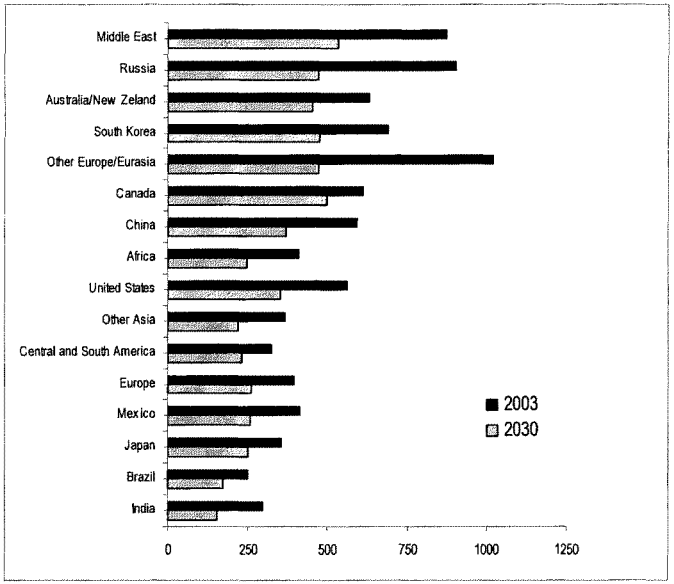


Source: Energy Information Administration, International Energy Outlook, 2006

ATTACHMENT 1

Carbon Dioxide Intensity Improvement Projections by Selected Countries and Regions

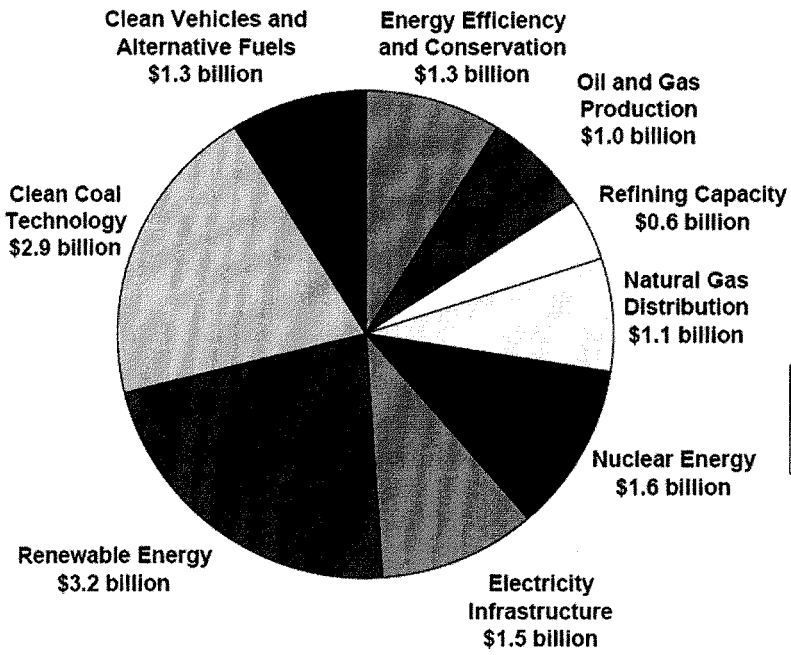
(Metric Tons per Million 2000 U.S. Dollars of Gross Domestic Product)



Source: International Energy Outlook 2006, Energy Information Administration, Department of Energy

ATTACHMENT 5

Energy Bill Tax Incentives



Incentives: $14.5 billion
Offsets: $3 billion
Total: $11.5 billion

ATTACHMENT 6.1

Climate VISION Sectors

	Aluminum	Achieved goal of an additional direct carbon intensity reduction of 25% since 2000; represents 98% of primary aluminum production.
	Railroads	By 2012, reduce the GHG emissions intensity of operations by 18% relative to 2002 levels.
	Chemical Manufacturing	By 2012, reduce overall GHG intensity by 18% relative to 1990 levels; represents 90% of U.S. chemical industry production.
	Forest Products	By 2012, reduce the forest products industry's greenhouse gas intensity by 12% relative to 2000; represents over 80% of U.S. paper, wood and forest products.
	Magnesium	By 2010, eliminate sulfur hexafluoride emissions; represents 80% of the global magnesium industry.
	Oil and Gas	Improve energy efficiency of refining operations by 10% over 2002 levels.

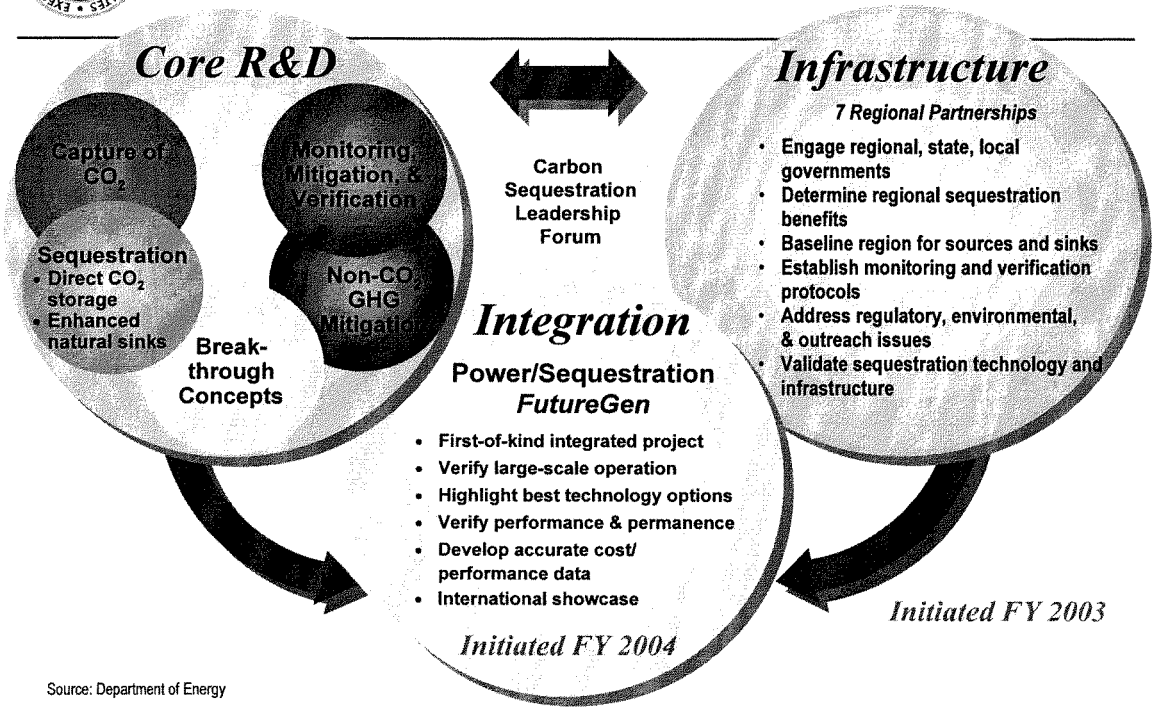
ATTACHMENT 6.2

Climate VISION Sectors

Semiconductors	By 2010, cut perfluorocompound emissions by 10% from 1995 levels; responsible for more than 85 percent of U.S. semiconductor production.
Automobile Manufacturers	By 2012, achieve a 10% reduction in GHG emissions from manufacturing relative to 2002 levels.
Cement	By 2020, reduce carbon dioxide (CO_2) emissions per ton of product by 10% relative to a 1990 baseline.
Electric Power	By 2012, reduce the power sector's carbon intensity by the equivalent of 3-5 percent by 2012; represents 100% of the power generators in the United States.
Iron and Steel	By 2012, achieve a 10% increase in sector-wide average energy efficiency relative to 1998; represents ~ 75% of U.S. and North American steel capacity.
Mining	Obtain sector-wide engagement in voluntary programs to reduce GHG emissions.
Business Roundtable	Achieve 100% participation of BRT member companies in programs fostering enhanced voluntary action on GHG emissions.
Minerals	By 2012, reduce GHG emissions from fuel combustion by 4.2% relative to 2000; represents 80% of soda ash, 100% of borates, and 60% of sodium silicate manufacturing.
Lime	By 2012, reduce greenhouse gas emissions from fuel combustion per ton of product by 8% relative to 2002; represents ~ 95% of U.S. commercial lime production.

ATTACHMENT 71

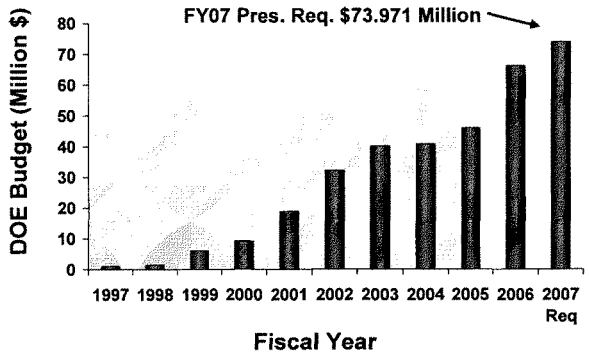
Carbon Sequestration Program Structure



Source: Department of Energy

ATTACHMENT 7.2

Sequestration Program Statistics FY'06

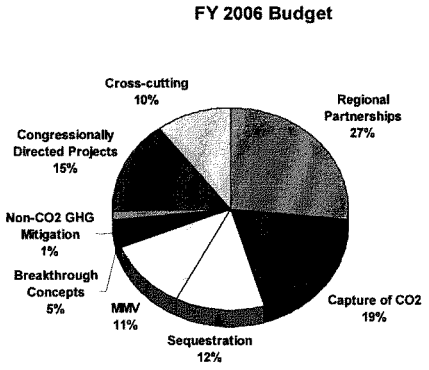


Diverse research portfolio

~ 70 R&D Projects

Strong industry support
~ 39% cost share on projects

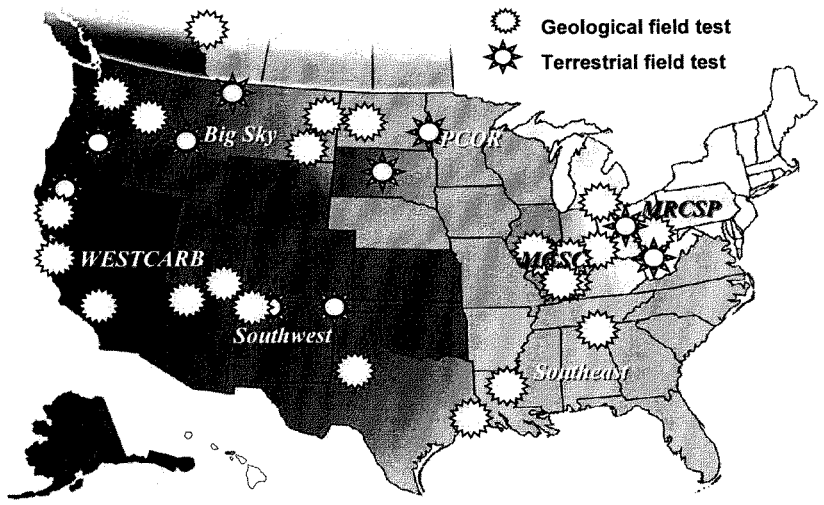
Federal Investment to Date
~ $260 Million



Source: Department of Energy

ATTACHMENT 7-3

Regional Carbon Sequestration Partnerships Field Validation Tests



Source: Department of Energy

ATTACHMENT 8.1

Innovative International Technology Partnerships

- Asia-Pacific Partnership on Clean Development and Climate — 6 member countries committed to develop and accelerate deployment of cleaner, more efficient energy technologies to meet national pollution reduction, energy security, and climate change concerns in ways that reduce poverty and promote economic development.
- Methane to Markets Partnership — 18 members: Recovery and use of methane from landfills, mines, agriculture, and natural gas production systems. Aims to capture 50 million metric tons CO_2 equivalent by 2015.
- G8 — Implementing the 2005 Gleneagles Plan of Action, a landmark document containing over fifty practical, results-oriented actions to address the linked issues of development, energy security, energy access, climate change, and air pollution. G8 partners are engaged in ongoing ministerial-level dialogue with other major energy economies to see that the commitments in Gleneagles are carried through in an effective manner. The Gleneagles Plan of Action has also led to the recent launch of the
- Global Bioenergy Partnership (GBEP), an Italian initiative to support wider, cost effective, biomass and biofuels deployment, particularly in developing countries.
- Global Nuclear Energy Partnership — Seeks to develop worldwide consensus on enabling expanded use of economical, carbon-free nuclear energy to meet growing electricity demand, using a nuclear fuel cycle that enhances energy security, while promoting non-proliferation.

Global Nuclear Energy Partnership (GNEP)

ATTACHMENT 8.2

Innovative International Technology Partnerships

- International Partnership for the Hydrogen Economy (IPHE) – 17 members: Organizes, coordinates, and leverages hydrogen RD&D programs.
- Carbon Sequestration Leadership Forum (CSLF) – 22 members: Focused on CO_2 capture & storage technologies.
- Generation IV International Forum (GIF) – 11 members: Devoted to R&D of next generation of nuclear systems.
- ITER – 7 members: Project to demonstrate the scientific and technological feasibility of fusion energy.
- Group on Earth Observations – 64 member countries, the European Commission, and more than 40 participating organizations: Design and implementation of a new Global Earth Observation System of Systems (GEOSS).
- Renewable Energy and Energy Efficiency Partnership (REEEP) –17 countries working to enhance the delivery of clean and secure energy through the use of renewable resources and energy efficiency programs in the developed and developing world.

Asia-Pacific Partnership on Clean Development and Climate

ATTACHMENT 3

Significance

Six Asia-Pacific Partners in 2003 accounted for:

- 64.7% of World GDP (MER)
- 49.8% of World GDP (PPP)
- 45.2% of World Population
- 51.0% of World Total Primary Energy Consumption
- 49.4% of World CO2 Emissions from the Fossil Fuel Consumption and Flaring
- 64.5% of World Coal Production
- 63.6% of World Coal Consumption
- 45.6% of World Petroleum Consumption
- 55.6% of World Net Conventional Thermal Electricity Generation
- 49.3% of World Total Net Electricity Generation
- 30.1% of World Dry Natural Gas Consumption

Source: Energy Information Administration, *International Energy Annual 2003*

ATTACHMENT 10

Asia-Pacific Partnership on Clean Development and Climate

President's Statement: July 27, 2005

- The United States has joined with Australia, China, India, Japan, and South Korea to create a new Asia-Pacific partnership on clean development, energy security, and climate change.

- This new results-oriented partnership will allow our nations to develop and accelerate deployment of cleaner, more efficient energy technologies to meet national pollution reduction, energy security, and climate change concerns in ways that reduce poverty and promote economic development.

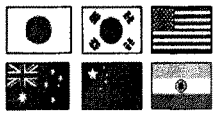
- The six Asia-Pacific partners will build on our strong history of common approaches and demonstrated cooperation on clean energy technologies.

- I have directed Secretary of State Condoleezza Rice and Secretary of Energy Sam Bodman to meet with their counterparts this fall to carry forward our new partnership and provide direction for our joint work.

Asia-Pacific Partnership on Clean Development and Climate

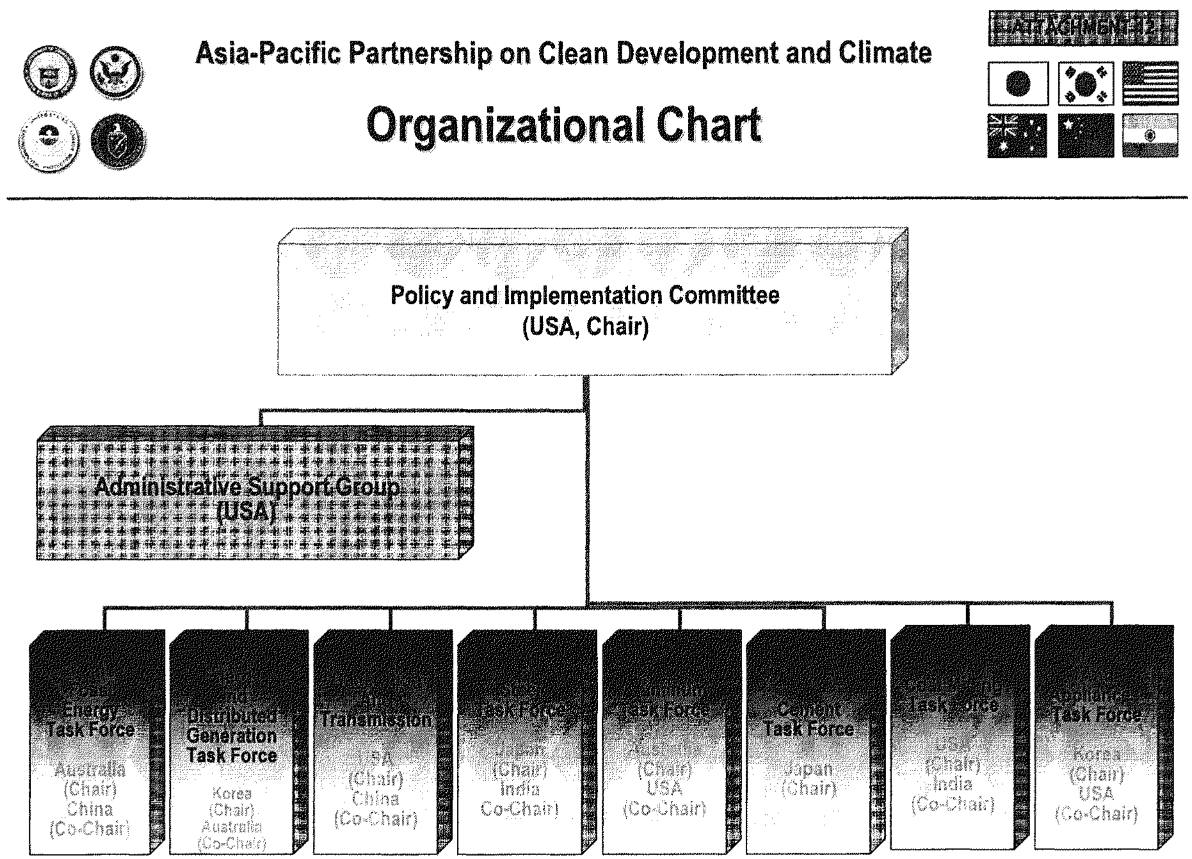
Focus

ATTACHMENT 11



- **Voluntary practical measures taken by these six countries in the Asia-Pacific region to create new investment opportunities, build local capacity, and remove barriers to the introduction of clean, more efficient technologies.**
- **Help each country meet nationally designed strategies for improving energy security, reducing pollution, and addressing the long-term challenge of climate change.**
- **Promote the development and deployment of existing and emerging cleaner, more efficient technologies and practices that will achieve practical results in areas such as:**

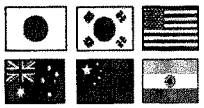
  - Energy Efficiency
  - Clean Coal
  - Natural Gas
  - Bioenergy
  - Methane Capture/Use
  - Civilian Nuclear Power
  - Geothermal
  - Agriculture/Forestry
  - Rural/Village Energy Systems
  - Advanced Transportation
  - Hydro/Wind/Solar Power
  - Building/Home Construction/Operation


Asia-Pacific Partnership on Clean Development and Climate
Organizational Chart
Policy and Implementation Committee (USA, Chair)
Administrative Support Group (USA)
Energy Task Force
Australia (Chair) China (Co-Chair)
Distributed Generation Task Force
Korea (Chair) Australia (Co-Chair)
Transmission
(Chair) China (Co-Chair)
Task Force
(Chair) India Co-Chair)
Task Force
(Chair) USA (Co-Chair)
Cement Task Force
Japan (Chair)
Task Force
USA (Chair) India (Co-Chair)
Appliances Task Force
Korea (Chair) USA (Co-Chair)

Asia-Pacific Partnership on Clean Development and Climate

Clean Fossil Energy Task Force Objectives

ATTACHMENT 12.1



- Build on the range of existing national (and other international) measures and initiatives to develop an Asia-Pacific Partnership cleaner fossil energy technology development program.

- Identify the potential for, and encourage uptake of, CO_2 geo-sequestration opportunities in Partnership countries.

- Further develop coal bed and waste coal mine methane gas and LNG/natural gas opportunities and markets in the Asia-Pacific region.

- Build the research and development base, and the market and institutional foundations of Partners through technology supporting initiatives, such as education, training and skills transfer.

ATTACHMENT 13.2

Asia-Pacific Partnership on Clean Development and Climate

Renewable Energy and Distributed Generation Objectives

- Facilitate the demonstration and deployment of renewable energy and distributed generation technologies in Partnership countries.
- Identify country development needs and the opportunities to deploy renewable energy and distributed generation technologies, systems and practices, and the enabling environments needed to support wide-spread deployment, including in rural, remote and peri-urban applications.
- Enumerate financial and engineering benefits of distributed energy systems that contribute to the Partnership's economic development and climate goals.
- Promote further collaboration between Partners on research, development and implementation of renewable energy technologies including supporting measures such as renewable resource identification, wind forecasting and energy storage technologies.
- Support cooperative projects to deploy renewable and distributed generation technologies to support rural and peri-urban economic development and poverty alleviation.
- Identify potential projects that would enable Partners to assess the applicability of renewable energy and distributed generation to their specific requirements.

ATTACHMENT 13.3

Asia-Pacific Partnership on Clean Development and Climate

Power Generation and Transmission Task Force Objectives

- Assess opportunities for practical actions to develop and deploy power generation, transmission and demand side management technologies that can aid development and climate concerns.
- Facilitate demonstration and deployment of practices, technologies and processes to improve efficiency of power production and transmission within Partnership countries.
- Enhance collaboration between Partners on research and development of such technologies and processes.
- Enhance synergy with relevant objectives of other Task Forces (i.e. Cleaner Fossil Energy, Renewable Energy and Distributed Generation and Buildings and Appliances).
- Identify potential projects that would enable Partner countries to assess the applicability of energy feedstocks to their specific requirements.
- Identify opportunities to enhance investment in efficient power supply by improving energy markets and investment climate.

Asia-Pacific Partnership on Clean Development and Climate

ATTACHMENT 13-4

Steel Task Force Objectives

- Develop sector relevant benchmark and performance indicators.
- Facilitate the deployment of best-practice steel technologies.
- Increase collaboration between relevant Partnership country government, research and industry steel-related institutions.
- Develop processes to reduce energy usage, air pollution and GHG emissions from steel production.
- Increase recycling across the Partnership.

Asia-Pacific Partnership on Clean Development and Climate

ATTACHMENT 13.5

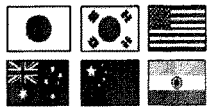
Aluminum Task Force Objectives

- Enhance current production processes of aluminum through uptake of best-practice use of existing equipment.
- Advance the development and deployment of new best practice aluminum production process and technologies across Partnership economies.
- Enhance sector-related data, including recycling and performance.
- Facilitate increased aluminum recycling rates across the Partnership.

Asia-Pacific Partnership on Clean Development and Climate

Cement Task Force Objectives

ATTACHMENT 13-6



- Facilitate demonstration and deployment of energy-efficient and cleaner product formulation technologies in Partnership countries that will significantly improve the GHG emissions intensity and the air pollutant emissions intensity of cement operations.

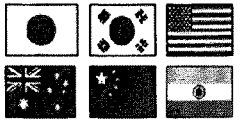
- Develop sector relevant benchmark and performance indicators.

- Take advantage of opportunities to build infrastructure in developing countries and emerging economies that uses energy efficient cement and concrete building and paving materials.

Asia-Pacific Partnership on Clean Development and Climate

Coal Mining Task Force Objectives

ATTACHMENT 13.7



- Facilitate technologies and practices that can improve the economics and efficiencies of mining and processing and continue to improve safety and reduce environmental impacts.

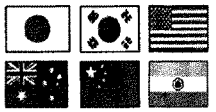
- Establish, as appropriate, efficiency and emissions intensity and mine reclamation objectives based on each nation's circumstances.

- Identify current reclamation activities in each country, as appropriate, and exchange best practice information in reclamation of surface mined lands with a focus on enhanced surface reclamation practices that improve the opportunities for carbon sequestration.

Asia-Pacific Partnership on Clean Development and Climate

Building and Appliances Task Force Objectives

ATTACHMENT 13-6



- Use cooperative mechanisms to support the further uptake of increasingly more energy efficient appliances, recognizing that extensive cooperative action is already occurring between Partner countries.

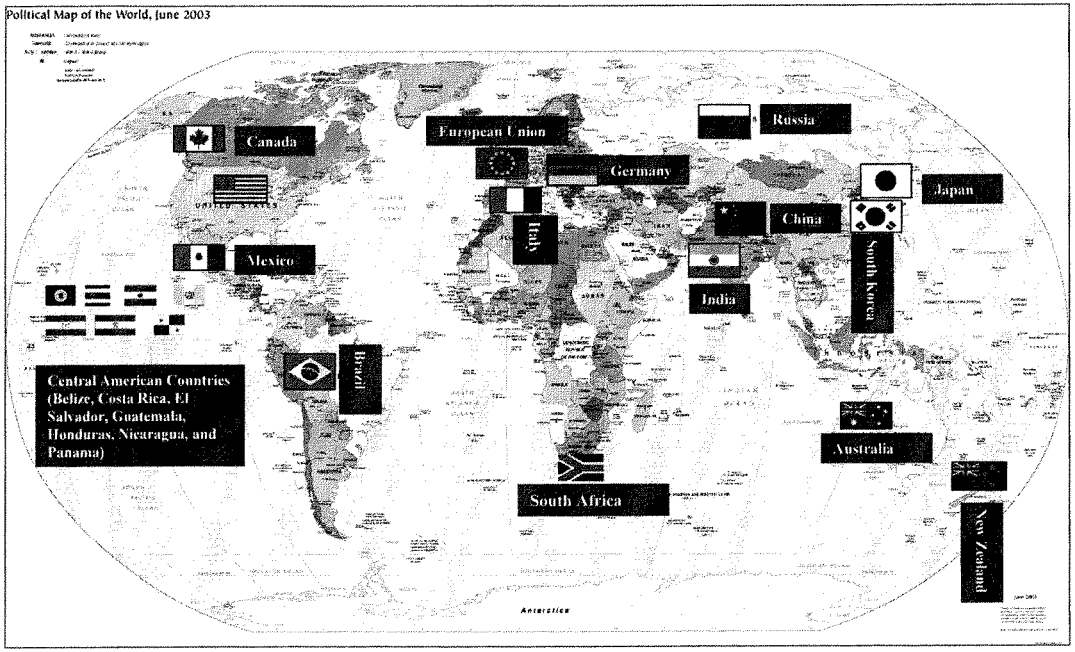
- Promote best-practice and demonstrate technologies and building design principles to increase energy efficiency in building materials and in new and existing buildings.

- Support the integration of appropriate mechanisms to increase the uptake of energy efficient buildings and appliances into broader national efforts that support sustainable development, increase energy security and reduce environmental impacts.

- Systematically identify and respond to the range of barriers that limit the implementation of end-use energy-efficiency practices and technologies.

ATTACHMENT 14

U.S. Climate Change Bilaterals



Chairman TOM DAVIS. Thank you very much.
Dr. Karl.

STATEMENT OF THOMAS KARL

Dr. KARL. Mr. Chairman, members of the committee, thank you for giving me this opportunity to speak to you about climate change today.

As you mentioned, Mr. Chairman, I am the director of NOAA's National Climatic Data Center. The National Climatic Data Center is the world's largest archive of weather and climate data. We also serve as the Nation's scorekeeper regarding trends and anomalies of weather and climate.

I would like to emphasize today that the natural greenhouse effect is real and it is an essential component of the planet's climate process driven by greenhouse gases such as carbon dioxide, water vapor, methane, and other greenhouse gases.

In the absence of these greenhouse gases, the temperature on Earth would be too cold to support life as we know it. Some greenhouse gases are increasing in the atmosphere because of human activities, and they are altering the planet's way of emitting heat it receives from the sun back to space.

Direct atmospheric measurements made during the past 50 years have documented the steady growth of carbon dioxide in the atmosphere. I have a slide that I hope will come up that can demonstrate this. Is that going to show?

Chairman TOM DAVIS. We will find out.

Dr. KARL. There we go.

As you note from that side, you can see the black line represents the increase in carbon dioxide concentrations, the blue and red bars represent global temperature anomalies. As you can see from that slide, the growth in carbon dioxide is occurring over the last several hundred years. This growth is predominately caused by the increase——

Chairman TOM DAVIS. Where does it start? What year does it start?

Dr. KARL. That is in 1880.

Chairman TOM DAVIS. OK, that starts in 1880, so it is about 120 years?

Dr. KARL. That graph goes from 1880 through 2005.

The growth in carbon dioxide is caused by the increase in combustion of fossil fuels. Once these greenhouse gases enter into the atmosphere, it stays for a long time, from decades to centuries. While slide one shows a strong positive correlation between increases in carbon dioxide, the black line, and the global temperature anomalies, the specific cause and effect relationship cannot be assumed. Climate scientists must use other tools to link climate change to human influences. This is where climate models enter into the picture.

So what exactly is a climate model? Why is it useful? The next slide shows schematically the kinds of processes that can be included in climate models. Among these are many Earth system components, such as atmospheric chemistry, ocean circulation, land surface hydrology, and many others.

Many of the scientific laws governing climate change and the processes involved can be quantified and linked by mathematic equations. Linking these equations creates mathematical models of the climate that may be run on computers or super computers.

Given the magnitude of the data and understanding of all these physical and chemical processes, it is impossible to create a single model because it would be too complex to run on any existing computer system.

The key challenge in modeling is to isolate and identify cause and effect, which requires knowledge about changes and variations of the external forces controlling climate, such as greenhouse gases, and a comprehensive understanding of climate feedbacks, such as a change in Earth's reflectivity because of a change in sea ice or cloud amount.

Climate models are used to simulate many years of weather. These simulations can be used to look either into the future or to compare them to some time in the past. This comparison enables scientists to study the output of climate model simulations to understand the effect of various modifications of those aspects of the climate system that might cause the climate to change.

An example of how climate models are used to detect the human influence on the climate system is shown on the next slide. When considering only natural changes in the Earth climate systems, the models cannot replicate the observed global temperature. You notice that on the far left. The red is the global temperature. The black lines represent model simulations, with only consideration of natural variability.

By including both natural or anthrogenic or human-induced changes in the Earth climate system, the models do, indeed, replicate the observed global temperature variations in changes. That is on the far right panel, to include both the anthropogenic changes in the models, as well as natural variations.

The scientific community has been actively working on detection attribution of climate changes related to human activities since the 1980's. Research has shown there are many other aspects of the climate system beside global surface temperature that have been influenced by human activity, such as changes in temperature, regional changes in temperature, changes in ocean heat content, extreme weather, and climate events. There is considerable confidence that the observed warming, especially since the 1970's, is mostly attributable to changes in atmospheric composition due to human influences.

In conclusion, the state of the science continues to indicate that modern climate changes is affected by human influences, primarily human induced changes in atmospheric composition. While there is considerable uncertainty about the rates of change that can be expected, it is clear these changes will be increasingly manifested in important and tangible ways. Recent evidence suggests there will be changes in extremes of temperature and precipitation, decreases in seasonal and perennial snow and ice extent, sea level rise, and increases in hurricane intensity and related heavy and extreme precipitation.

Furthermore, while there has been progress in monitoring and understanding the causes of climate change, there remain many

scientific, technical, and institutional challenges to precisely plan for, adapt to, and mitigate the effects of climate change.

The U.S. climate change science program is addressing the scientific dimensions of these challenges through research, observations, decision support, and communication. This Federal Government program, which encompasses the efforts of 13 Federal agencies, helps prioritize and integrate Federal research on global climate change. The program's vision, as guided by the 2003 climate change science strategic plan, is to improve the Nation's ability to manage the risks and opportunities of climate change and related environmental systems.

For the next 2 years the program will produce a series of synthesis and assessment reports that describe the state of the science on a range of key issues. The first report released this past May addressed the debate about the differences in detected temperature increases by satellites and surface observations. The issue has led some to cast doubt about the magnitude of global warming. Subsequent reports will further provide important contributions to the Nation's discussions on climate change.

Thank you again, Mr. Chairman, for the opportunity to testify about this important topic.

[The prepared statement of Dr. Karl follows:]

WRITTEN STATEMENT BY
DR. THOMAS R. KARL
DIRECTOR, NATIONAL CLIMATIC DATA CENTER
NATIONAL OCEANIC AND ATMOSPHERIC ADMINISTRATION (NOAA)
U.S. DEPARTMENT OF COMMERCE

FOR AN OVERSIGHT HEARING:
INTRODUCTION TO CLIMATE CHANGE

BEFORE THE
COMMITTEE ON GOVERNMENT REFORM
U.S. HOUSE OF REPRESENTATIVES

JULY 20, 2006

Mr. Chairman and Members of the Committee: As Director of the National Climatic Data Center, which is part of the National Environmental Satellite, Data, and Information Service (NESDIS) within the National Oceanic and Atmospheric Administration (NOAA), and as Program Manger for one of five different NOAA Climate Goal Programs (Climate Observations and Analysis), I am pleased to have the opportunity to testify before you today. The National Climatic Data Center is the world's largest archive of weather and climate data, which includes data critical to understanding climate variability and change, and also acts as the Nation's Scorekeeper regarding the trends and anomalies of weather and climate.

The U.S. Climate Change Science Program (CCSP) integrates federal research on global climate change, as sponsored by thirteen federal agencies.[1] CCSP is a multi-agency program charged with: investigating natural and human-induced changes in the Earth's global environmental system; monitoring, understanding, and predicting global change; and providing a sound scientific basis for national and international decision-making. The CCSP combines the near-term focus of the Administration's Climate Change Research Initiative — including a focus on advancing the understanding of aerosols and carbon sources and sinks and improvements in climate modeling — with the breadth of the long-term research elements of the US Global Change Research Program.

Since CCSP was created in 2002, the program has successfully integrated a wide range of research, climate science priorities and budgets of the thirteen CCSP agencies. CCSP integrates research and observational approaches across disciplinary boundaries and is also working to create more seamless approaches between theory, modeling,

[1] The CCSP participating agencies include the Departments of Agriculture, Commerce, Defense, Energy, Health and Human Services, the Interior, State, and Transportation, the National Science Foundation, the Environmental Protection Agency (EPA), the National Aeronautics and Space Administration (NASA), U.S. Agency for International Development, and the Smithsonian Institution. Additional CCSP liaisons reside in the Office of Science and Technology Policy, the Council on Environmental Quality, the National Economic Council and the Office of Management and Budget.

observations, and applications required to address the multiple scientific challenges posed by changes in climate. With an approximately $2 billion annual expenditure in 2006, CCSP is taking on the most challenging questions in climate science and is developing products to convey the most advanced state of knowledge to be used by federal, state and local decision makers, resource managers, the science community, the media, and the general public. Over the next two years CCSP will be completing a series of 21 Synthesis and Assessment Reports, the first of which was just released a few months ago. The collection of these Synthesis and Assessment Report will address many of the issues pertinent to this testimony.

I will provide an overview of the current understanding of the atmosphere in terms of: the role that greenhouse gases play in the atmosphere; evidence for how greenhouse gases are already influencing the climate in both general and in specific ways; an introduction to the use of global climate models, and some of the evidence that has led a number of assessments, including the IPCC (2001), the National Research Council (2002), and the Climate Change Science Program Synthesis and Assessment Report 1.1 (Karl et al., 2006) to link the rise in temperature over the past several decades to increases in greenhouse gases and related changes climate.

Atmospheric Composition and Greenhouse Gases

The natural "greenhouse" effect is real, and is an essential component of the planet's climate process. A small percentage (roughly 2 percent) of the atmosphere is, and long has been, composed of greenhouse gases (water vapor, carbon dioxide, ozone and methane). These gases effectively prevent part of the heat radiated by the Earth's surface from otherwise escaping to space. The response of the global system to this trapped heat is a climate that is warmer than it would be otherwise without the presence of these gases. In the absence of these greenhouse gases the temperature on Earth would be too cold to support life as we know it today. Of all the greenhouse gases, water vapor is by far the most dominant, but other gases are more effective at trapping heat energy from certain portions of the electromagnetic spectrum whereas water vapor is semi-transparent to heat escaping from the Earth's surface.

In addition to the natural greenhouse effect outlined above, there is a change underway in the greenhouse radiation balance. Some greenhouse gases are increasing in the atmosphere because of human activities and increasingly trapping more heat. Direct atmospheric measurements made over the past 50 years have documented the steady growth in the atmospheric abundance of carbon dioxide. In addition to these direct real-time measurements, ice cores have revealed the atmospheric carbon dioxide concentrations of the distant past. Measurements using air bubbles trapped within layers of accumulating snow show that atmospheric carbon dioxide has increased by nearly 35 percent over the Industrial Era (since 1750), compared to the relatively constant abundance of carbon dioxide over at least the preceding 750 years of the past millennium (Figure 1). The predominant cause of this increase in carbon dioxide is the combustion of fossil fuels and the burning of forests. Further, methane abundance has doubled over the Industrial Era, but the increase of methane has slowed over the recent decade for

reasons not clearly understood. Other heat-trapping gases are also increasing as a result of human activities. We are unable to state with certainty the exact rate at which these gases will continue to increase because of uncertainties in future emissions, as well as uncertainties regarding how these emissions will be taken up by the atmosphere, land, and oceans. We are certain, however, that once in the atmosphere these greenhouse gases have a relatively long residence time, on the order of decades to centuries (IPCC, 2001). This means they become well mixed throughout the globe.

Increases in heat-trapping greenhouse gases are projected to be amplified by feedback effects, such as changes in water vapor, snow cover, and sea ice. As atmospheric concentrations of carbon dioxide and other greenhouse gases increase, the resulting increase in surface temperature leads to less sea ice and snow cover helping to raise temperatures even further. As snow cover and sea ice decrease, more of the Sun's energy is absorbed by the planet, instead of being reflected back to space by the snow cover and sea ice. Present evidence also suggests that as greenhouse gases lead to temperature increases, evaporation increases leading to more atmospheric water vapor (Trenberth, et al., 2005; Soden, B.J., et al., 2005). Additional water vapor (which, as mentioned above, is the dominant greenhouse gas) acts as a very important feedback to further increase temperature. The most uncertain feedback is related to clouds. Specifically, changes in cloud frequency, location, and height. The range of uncertainty spans from a significant positive feedback to no feedback, or even a slight negative feedback. Our present understanding suggests that these feedback effects account for at least half of the warming (IPCC, 2001; Karl and Trenberth, 2003). The exact magnitude of these feedback effects remains a significant source of uncertainty related to our understanding of the impact of increasing greenhouse gases. For example, increases in evaporation and water vapor affect global climate in other ways besides increasing temperature such as increasing rainfall and snowfall rates, and accelerating drying during droughts. The increase in greenhouse gas concentrations in the atmosphere implies a positive radiative forcing, i.e., a tendency to warm the climate system.

Particles (or aerosols) in the atmosphere resulting from human activities can also affect climate. Aerosols vary considerably by region. Some aerosol types act in a sense opposite to the greenhouse gases by reflecting more solar radiation back to space than the heat they absorb, and cause a negative forcing or cooling of the climate system (e.g., sulfate aerosol). Other aerosols act in the same way as greenhouse gases, and warm the climate (e.g., soot). In contrast to the long-lived nature of carbon dioxide (centuries), aerosols are short-lived and removed from the lower atmosphere within a few days. Therefore, human-generated aerosols exert a long-term forcing on climate only because their emissions continue each day of the year. Aerosol effects on climate can be manifested directly by their ability to reflect and trap heat, but they can also have an indirect effect by changing the lifetime of clouds and changing the clouds reflectivity to sunshine. The magnitude of the negative forcing of the indirect effect of aerosols is highly uncertain, but may be larger than negative forcing of the direct effect of aerosols (IPCC, 2001).

Emissions of greenhouse gases and aerosols continue to alter the atmosphere in ways that

are expected to affect the climate, e.g., temperature and precipitation extremes, reduction in snow cover and sea ice, changes in storm track and intensity (IPCC, 2001). By altering the planet's natural energy flows changes in temperature, evaporation, precipitation, storms are affected. There are also natural factors which exert a forcing on climate, e.g., changes in the Sun's energy output and short-lived (a few years) aerosols in the stratosphere following episodic and explosive volcanic eruptions. If we sum up all the possible influences of natural and human climate forcings over the past several decades then the increase of greenhouse gases are larger than all the other forcings and continue to grow disproportionately larger (Karl and Trenberth, 2003; IPCC, 2001).

Human activities also have a large-scale impact on the land surface. Changes in land use through urbanization and agricultural practices, although not global, are often most pronounced where people live, work, and grow food, and are part of the human impact on climate. Large-scale deforestation and desertification in Amazonia and the Sahel, respectively, are two instances where evidence suggests there is likely to be human influence on regional climate (Andreae et al., 2004; Chagnon and Bras, 2005). In general, city climates differ from those in surrounding rural green areas, because of the "concrete jungle" and its effects on heat retention, runoff, and pollution, resulting in urban heat islands.[2] (Bornstein and Lin, 2000; Changnon et al., 1981; Landsberg, 1983; Karl et al., 1988; Peterson, T.C., 2003; Karl et al., 1988; Jones et al., 1990).

There is no doubt that the composition of the atmosphere is affected by human activities. Today greenhouse gases are the largest human influence on atmospheric composition.

What exactly is a climate model and why is it useful?

Many of the scientific laws governing climate change and the processes involved can be quantified and linked by mathematical equations. Figure 2 shows schematically the kinds of processes that can be included in climate models. Among these are many earth system components such as atmospheric chemistry, ocean circulation, sea-ice, land-surface hydrology, biogeochemistry[3], atmospheric circulation, etc. The physics of many, though not all, of the processes governing climate change are well understood, and may be described by mathematical equations. Linking these equations creates mathematical models of climate that may be run on computers or super-computers. Coupled climate models can include mathematical equations describing physical, chemical, and biogeochemical processes, and are used because the climate system is composed of different interacting components.

In fact, coupled climate models are the preferred way to approach climate modeling. This is because if we put all our understanding into a single model, it would be too complex to run on any existing computer systems. The decisions for how to build any given climate model includes trade-offs between the complexity of the model and number of Earth system components

[2] The global impact of these urban heat islands has been extensively analyzed and assessed to ensure measurements of global temperature are not biased by local urban heat islands.
[3] Biogeochemistry refers to the biological-chemistry of the Earth system, such as the uptake of atmospheric carbon by land and ocean vegetation.

included, the horizontal and spatial resolution within the model, and the number of years of simulations the model can produce per day of computer time. Consequently, there is a hierarchy of model complexity, often based on the degree to which approximations are required for each model or component processes omitted.

Approximations in climate models represent aspects of the models that require parameter choices and "tuning." As a simple example, imagine a single cumulus cloud and how it has to be represented in a global climate model. The cloud may encompass only a few hundred meters in the vertical and horizontal extent, which is much finer resolution than can be run on today's coupled atmosphere and ocean climate models. This then means that in order to incorporate such clouds into the climate model, some approximations have to be made regarding the statistical properties of such clouds within say an area 100 or 1000 times larger than the cloud itself. This is referred to as model parameterization, and the process of selecting the most appropriate parameters to best simulate observed conditions is called model tuning. Similar methods are also required in today's state-of-the-science weather forecasting models.

An important difference between weather forecasting models and climate models is that weather models are initialized with a specific set of observations representing today's weather to precisely predict the weather "x" days or hours into the future. The initial starting conditions of the climate models, however, are not nearly as important. Climate models are used to simulate many years of "weather" into the future with the intent of understanding the difference in the collection of weather events at some point in the future, compared to some other time in the past (often the climate of the last 30 years or so). This comparison enables scientists to study the output of climate model simulations to understand the effect of various modifications of those aspects of the climate system that might cause the climate to change. A key challenge in climate modeling is to isolate and identify cause and effect – which requires knowledge about the changes and variations of the external forcings controlling climate, and a comprehensive understanding of climate feedbacks (such as a change in the earth's reflectivity because of a change sea ice or cloud amount) and natural climate variability.

Model simulations of climate over specified periods can be verified and validated against the observational record. Models that prove to describe climate variability and change well can be used as a tool to increase our understanding of the climate system. Once evaluated and validated, climate models can then be used for predictive purposes. Given specific forcing scenarios, climate models can provide viable projections of future climate. In fact, climate models have become the primary means to predict climate, although prediction is ultimately likely to be achieved through a variety of means, including the observed rate of global climate change.

How do we know the global air temperature is increasing?

There has now been a comprehensive analysis of the changes of temperatures near the surface and throughout much of the atmosphere in the April 2006 Climate Change Science Program Synthesis and Assessment Report 1.1. This report addressed the nagging issue of differences in the rate of warming between measurements derived near

the surface and those taken from the atmosphere. The surface air temperatures are derived from several different analyses teams using various combinations of ocean ships and buoys, land observations from weather reporting stations, and satellite data. Atmospheric data sets have been derived using satellites, weather balloons, and a combination of the two.

Considering all the latest satellite, balloon and surface records, the CCSP report concluded there is no significant discrepancy between the rates of global temperature change over the past several decades at the surface compared to changes higher in the atmosphere. The report does, however, acknowledge there are still uncertainties in the tropics, and this is primarily related to data from weather balloons. There is uncertainty as to whether scientists have been able to adequately adjust for known biases and errors in the data, especially in the tropics where many developing nations struggle to routinely launch weather balloons and process these measurements.

Globally, data indicate that rates of temperature change have been similar throughout the atmosphere since 1979 when satellite data were first available, and the rates of temperature change have been slightly greater in the atmosphere compared to the surface air temperature since 1958 (the time at which weather balloons had adequate spatial coverage for global calculations). The global surface temperature time series, shown in Figure 3, indicates warming on even longer time scales, with acceleration since 1976.

Instrumental temperature measurements are not our only evidence for increasing global temperatures. The observed increased melting of glaciers can be used to estimate the rate of temperature increase since the late 19th Century. Estimates of the near-surface temperature based on glacial melting are very similar to estimates based on instrumental temperature data. There has been a 15-20 percent reduction in Arctic sea ice since the 1970s, a 10 percent decrease in snow cover since the 1970s, and shortened periods of lake and river ice cover (about 2 weeks shorter since the 19th century). Also, ocean heat content has significantly increased over the past several decades (IPCC, 2001).

Why do we think humans are influencing the Earth's climate?

The scientific community has been actively working on detection and attribution of climate change as related to human activities since the 1980s. As described above, one set of tools often used to examine these issues are mathematical computer models of the climate. Outstanding issues in modeling include specifying forcing mechanisms (e.g., the causes of climate variability and change) within the climate system; properly dealing with complex feedback processes that affect carbon, energy, and water sources, sinks and transports; and improving simulations of regional weather, especially extreme events. Today's inadequate or incomplete measurements of the various forcing mechanisms, with the exception of well-mixed greenhouse gases, add uncertainty when trying to simulate past and present climate. Confidence in our ability to predict future climate depends on our ability to use climate models to attribute past and present climate change to specific causes.

Recent carbon dioxide emission trends are upward with increases between 0.5 and 1 percent per year over the past few decades. Concentrations of both reflective and nonreflective aerosols are also estimated to be increasing. Radiative forcings[4] from greenhouse gases dominate over the net cooling forcings from aerosols and the global temperature has exceeded the bounds of natural variability. This has been the case since about 1980. As an example of how models are used to detect human influence on the climate system Figure 4 shows that without including all the observed forcing mechanisms the models cannot replicate the observed global temperature changes. There are many other aspects of the climate system besides global surface temperatures that have been tested for human influences.

Today, there is convincing evidence from a variety of climate change detection and attribution studies pointing to human influences on climate. These include regional analyses of changes in temperature, the paleoclimatic[5] temperature record, three dimensional analysis of atmospheric temperature change, changes of free atmospheric temperature, changes in sea ice extent and other components of the cryosphere, changes in ocean heat content, and new studies on extreme weather and climate events. Thus, there is considerable confidence that the observed warming, especially the period since 1970s is mostly attributable to increases in greenhouse gases (IPCC, 2001; Karl et al., 2006; Stott et al., 2001; Stott et al., 2006; Tett et al., 2002; Hegerl et al., 2001; Gillet et al., 2002; Zhang et al., 2006; Allen, 2005; Zweirs and Zhang, 2003; Stone and Allen, 2005; Karoly and Wu, 2005; and many others).

Changes in Extremes in the United States

The U.S. Climate Change Science Program Synthesis and Assessment Report 3.3 will specifically address the issue of changes in extreme events, focusing on North America. This assessment will focus on a wide range of climate-related extreme events and promises to help clarify what we know and do not yet understand about these important events, as related to climate change. Here, three types of climate extremes are discussed as they are likely to be influenced by rising global temperatures. This includes changes the frequency and intensity of heavy and extreme precipitation events, droughts, and hurricanes.

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[4] Radiative forcing can be thought of as the change heat (expressed in Watts per square meter: Wm^{-2}) at the tropopause due to an internal change or a change in the external forcing of the climate system, such as, for example, a change in the concentration of carbon dioxide or the output of the Sun. The tropopause is the boundary between the troposphere and the stratosphere represented by a rather abrupt change from decreasing to increasing temperatures

[5] Climate during periods prior to the development of measuring instruments, including historic and geologic time, for which only proxy climate records are available. A proxy climate indicator is a local record that is interpreted, using physical and biophysical principles, to represent some combination of climate-related variations back in time. Climate-related data derived in this way are referred to as proxy data. Examples of proxies are: tree ring records, characteristics of corals, and various data derived from ice cores.

Increasing air temperature leads to increased water vapor in the atmosphere. By raising the air temperature, the capacity of the atmosphere to hold more water vapor is increased, which defines the upper bounds of the amount of precipitation that can occur during short term (~daily or less) extreme precipitation events. Surface moisture, if available (as it always is over the oceans), effectively acts as the "air conditioner" of the surface – as heat used for evaporation moistens the air rather than warming it. Therefore, another consequence of global heating of the lower troposphere is accelerated land-surface drying and more atmospheric water vapor (the dominant greenhouse gas). Satellite measurements now confirm a significant increase in atmospheric water vapor (Trenberth et al., 2005; Dai et al.,2005), consistent with theoretical expectations given the rate of observed atmospheric warming during the past several decades. Accelerated drying, without an increase in precipitation, increases the incidence and severity of droughts (Dai et al., 2004), whereas additional atmospheric water vapor increases the risk of heavy precipitation events (Trenberth et al., 2003). Increases in global temperature also increase sea surface temperatures, one of several important factors affecting the hurricane intensity.

NOAA's National Climatic Data Center calculates a Climate Extremes Index (CEI) over the United States that includes extremes related to all of these indicators including temperature, precipitation, drought and hurricanes. Although no index can claim to adequately capture all of the important changes in extremes, the changes and variations of the CEI as reflected in Figure 5 is illustrative of the varying decadal variability of climate extremes. Currently, the CEI is at record levels during the past decade or so, but not much higher than in previous decades, so there is no clear indication of a general increase in the aggregate set of extremes included in the CEI when viewed across much of the 20th Century.

Changes in Heavy and Extreme Precipitation

Basic theory, climate model simulations, and empirical evidence (Figure 6) confirm that warmer climates, owing to increased water vapor, lead to more intense precipitation events even when the total precipitation remains constant, and with prospects for even stronger events when precipitation amounts increase. Figure 7 depicts the aggregate land-surface world-wide changes in heavy precipitation events over the last half of the 20th century with an associated geographic depiction of where changes in heavy precipitation have occurred, with most areas showing increases. World-wide, an increase of a few percent in heavy precipitation events is evident since the middle of the 20th century, particularly in the middle and high latitudes. By the end of the 21st Century a conservative estimate of the projected increase in the amount of precipitation that would occur in one day (a one-in-twenty-year heaviest daily precipitation event) is between 10-20 percent (Zweirs and Zhang, 2005). This assumes carbon dioxide does not exceed 550 ppmv[6].

[6] Such a scenario is built on the storyline of relatively low population growth and with rapid changes in economic structures toward a service and information economy, with reductions in material intensity, and the introduction of clean and resource-efficient technologies.

The practical implications of addressing these changes are seen in NOAA's recent update of the Ohio River Basin's 100-year 24-hour precipitation return period. These data are used to help set engineering design standard related to excessive rainfall. Over the past several decades increases in the amount of precipitation occurring in the heaviest daily precipation events has been observed in many areas of central and eastern United States over the past several decades (Karl and Knight, 1998; Groisman et al., 2004; Groisman et al., 2005).

In many geographic regions increases in extreme precipitation is occurring, even when changes in total precipitation are relatively constant (Groisman et al., 2003 and 2005; Alpert, 2005).

Changes in Drought Severity and Frequency

Drought is a recurring feature of the climate system. In other words, we have had major droughts in the past, and expect to have major droughts in the future. At any given time, at least part of the U.S. is in drought, with percentages ranging from 5-80 percent of the total land area. U.S. droughts show pronounced multi-year to multi-decadal variability, but no convincing evidence for systematic long-term trends toward more or fewer events. Drought calculations have been made showing that over the U.S. the increase in temperatures that may have led to increased evaporation has been compensated by a general increase in precipitation over the past few decades (Dai et al., 2004) as there has been no general trend in drought intensity across the United States (Figure 8). Over the U.S. there are no clear patterns of precipitation increase that has emerged from climate model simulations as global temperatures increase, so the increase in precipitation over the past few decades may not persist and could reverse. Such a reversal, added to the continuing increase in temperatures, such as the recently observed record high January though June of 2006 (NOAA Press Release, July, 2006), could lead to greater drought severity and frequency, especially during periods of dry weather due to increases in evaporation.

For the continental U.S., the most extensive U.S. drought in the modern observational record occurred from 1933 to 1938. In July 1934, 80 percent of the U.S. was gripped by moderate or greater drought (Figure 8), and 63 percent was experiencing severe to extreme drought. During 1953-1957, severe drought covered up to 50 percent of the country. Paleoclimatic data (e.g. tree ring measurements) have been used to reconstruct drought patterns for the period prior to the modern instrumental record (Cook et al., 1999 and 2004). These reconstructions show that during most of the past two millennia the climate of the western U.S. has been more arid than at present. The recent intense Western drought from 1999 to 2004 that strongly affected the Colorado River basin was exceeded in severity as recently as the 19th century. Within the past millennium there have been severe droughts in both the western U.S. and Midwest that have lasted for multiple decades.

Long-term warming trends have also led to changes in the timing of snow melt and stream flows, especially in the West. This is resulting in earlier peak stream flows and diminished summer-time flows.

Drought is a recurring feature of the climate in the US and as temperatures increase this will lead to increased drying during periods of dry weather leading to more intense droughts.

Changes in Hurricane Intensity and Frequency

Tropical storms and particularly hurricanes, are an important issue of concern for the United States. The record-breaking hurricane season of 2005, and especially the havoc created by Katrina, raised public awareness of the dangers of hurricanes to new heights. Hurricanes respond to a number of environmental factors including ocean temperatures, atmospheric stability, El Niño, and other factors. One important question is whether hurricane activity has changed over the last 100 years. Since 1995, Atlantic hurricane activity has significantly increased, with more hurricanes, and more intense hurricanes, compared to the two previous decades and this is also reflected in those hurricanes striking the U.S. (Figure 9). However, earlier periods, such as the 1945 to 1970 period were nearly as active.

An important consideration in hurricane intensity is a trend toward warmer sea surface temperatures, particularly in the tropical Atlantic and Gulf of Mexico, indicating climate change may play some role in the increased hurricane intensity (Emanuel, 2005; Webster et al., 2005). Another factor is a slow cycle of natural fluctuations in atmospheric conditions and ocean temperatures in the North Atlantic referred to as the Atlantic Multi-decadal Oscillation (AMO). This AMO is currently in a warm ocean temperature phase.

What does the future hold for hurricane activity? In the near term, it is expected that favorable conditions for Atlantic hurricanes will persist for the next decade or so based on previous active periods. For the longer term, climate models project an increase in the intensity of strong hurricanes late in the 21st Century Knutson, (2006). Specifically, this translates to increases in wind speed and about a ½ category increase in intensity on the commonly used Saffir-Simpson Hurricane Intensity Scale as tropical sea surface temperatures increase by nearly 2°C. Given those conditions (stronger hurricanes and warmer tropical sea surface temperatures) climate models also predict an increase in storm rainfall rates of about 20 percent (Knutson 2006). However, it is unclear if the total number of hurricanes will change in future years (IPCC, 2001).

New analyses of precipitation rates for different strengths of landfalling Atlantic tropical cyclones (both hurricanes and tropical storms) over the southeastern United States have recently been completed. These analyses (Karl et al., 2004; Groisman et al, 2006) show that daily precipitation amounts increase with tropical cyclone strength, while hourly precipitation does not. This means that the more intense hurricanes have longer periods with heavy rainfall. The implications are relevant for local planning, if indeed tropical cyclone strength increases in the future.

Overall, the issue of hurricanes and climate change is an ongoing debate. The scientific community has varying viewpoints on the magnitude of influence of global climate change on hurricanes and how long the current active period will last. NOAA recognizes

the debate and continues to study hurricane development, intensity, activity, and modeling.

Conclusion

The state of the science continues to indicate that modern climate change is affected by human influences, primarily human-induced changes in atmospheric composition. These perturbations result mainly from emissions associated with energy use, but on local and regional scales, urbanization and land use changes are also important contributors to climate change. While there is still considerable uncertainty about the rates of change that can be expected, it is clear these changes will be increasingly manifested in important and tangible ways, such as changes in extremes of temperature and precipitation, decreases in seasonal and perennial snow and ice extent, sea level rise, and now there is accumulating evidence to suggest that there will be increases in hurricane intensity and related heavy and extreme precipitation. Furthermore, while there has been progress in monitoring and understanding the causes of climate change, there remain many scientific, technical, and institutional challenges to precisely planning for, adapting to, and mitigating the effects of climate change. The U.S. Climate Change Science Program is addressing the scientific dimensions of these challenges by facilitating the creation and application of knowledge of the Earth's global environment through research, observations, decision support, and communication. The program's vision is to improve the nation's ability to manage the risks and opportunities of change in the climate and related environmental systems. Within the next two years the program will produce a series of synthesis and assessment reports that describe the scientific state-of-the-art on a range of key issues, thereby providing further important contributions to the nation's discussions of climate change. As mentioned above, the first in the series (Climate Change Science Synthesis and Assessment Product 1.1) was released earlier this year on the topic of temperature trends, and has already made a valuable contribution to the national dialogue.

Thank you again, Mr. Chairman for allowing me the opportunity to help inform the Committee about climate change.

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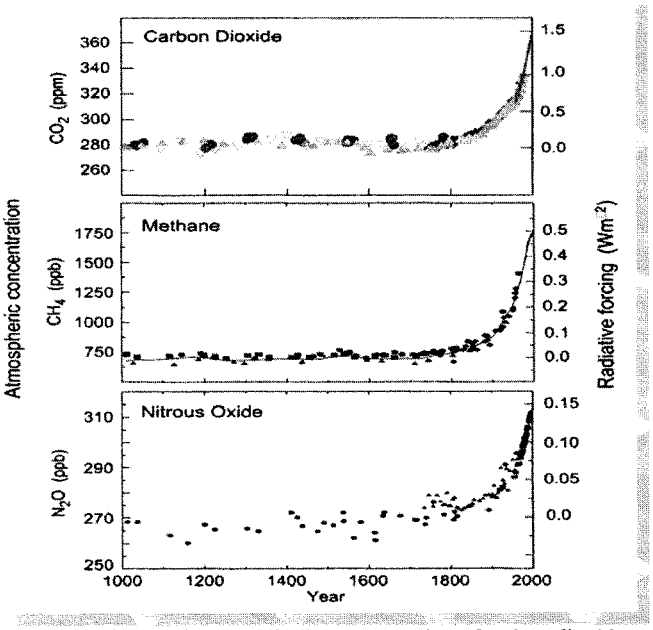

Figure 1: Changes in atmospheric concentration of carbon dioxide, methane, and nitrous oxide since 1000 A.D. (from IPCC, 2001).

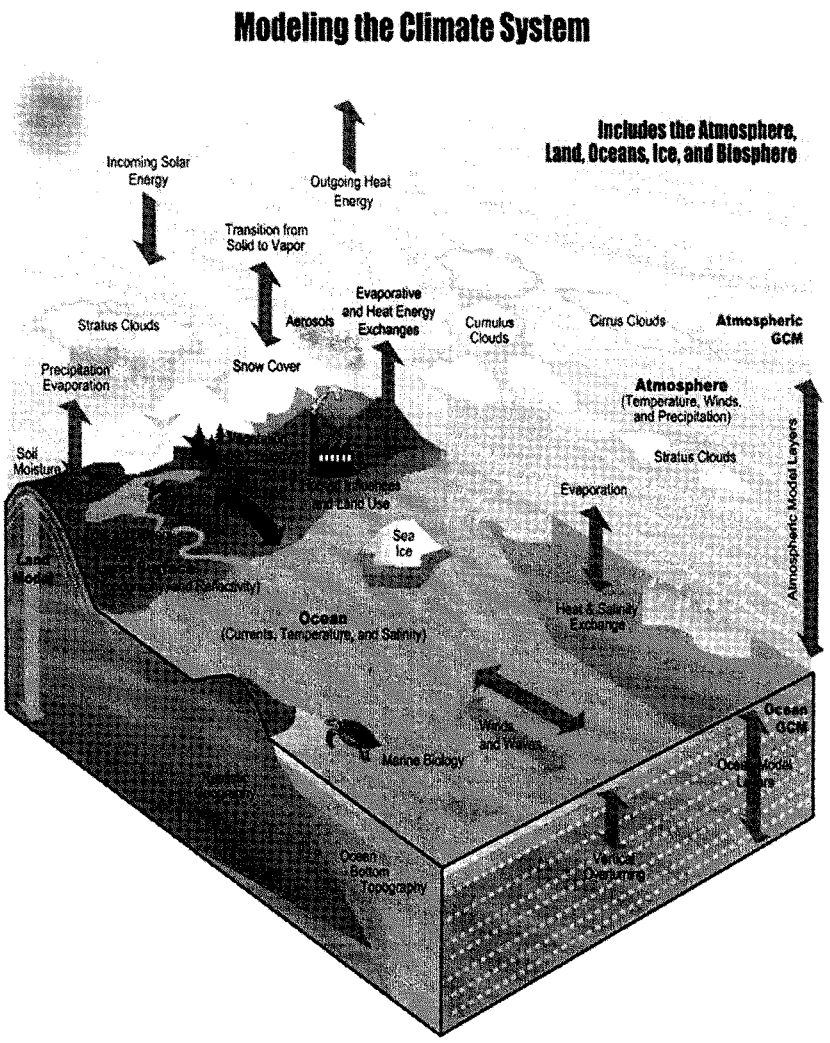

Figure 2. Components of the climate system and the interactions among them, including the human component. All these components have to be modeled as a coupled system that includes the oceans, atmosphere, land, cryosphere, and biosphere.

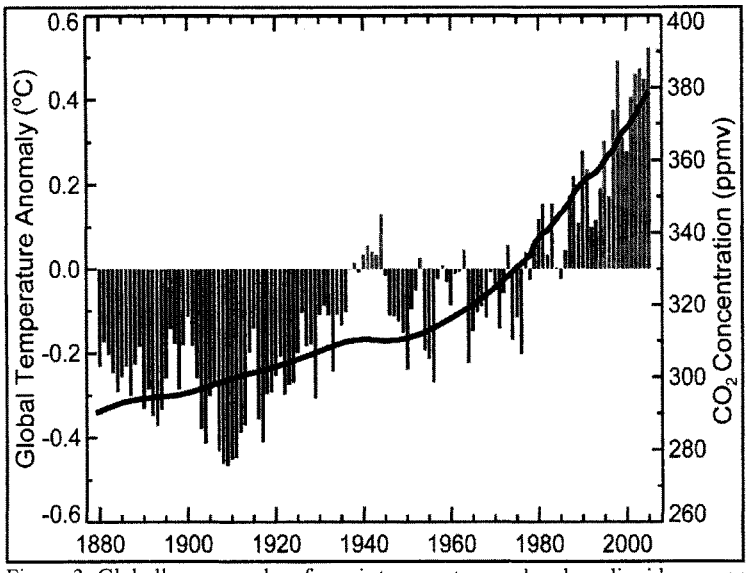

Figure 3: Globally averaged surface air temperature and carbon dioxide concentration (parts per million by volume) since 1880 (Updated from Karl and Trenberth, 2003).

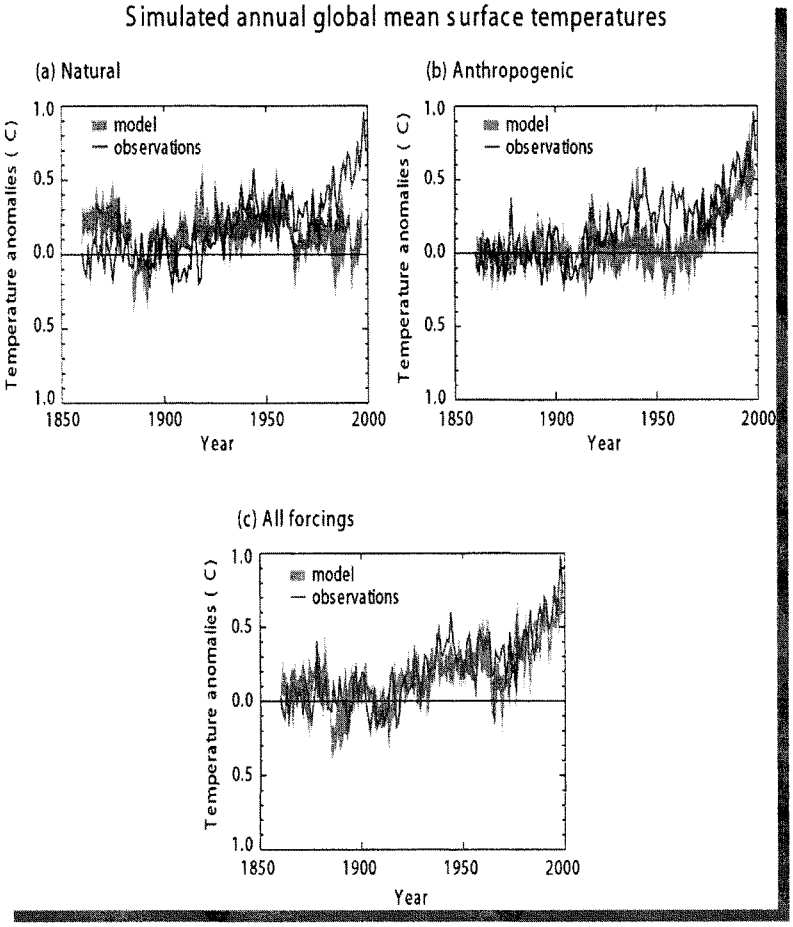

Figure 4: Climate model simulations of the global air temperature for the period 1860-2000. Figure 4a includes only natural forcing mechanisms such as volcanic eruptions and solar variability; 4b includes only anthropogenic greenhouse gas increases; and 4c includes both natural and anthropogenic forcing mechanisms (from IPCC 2001).

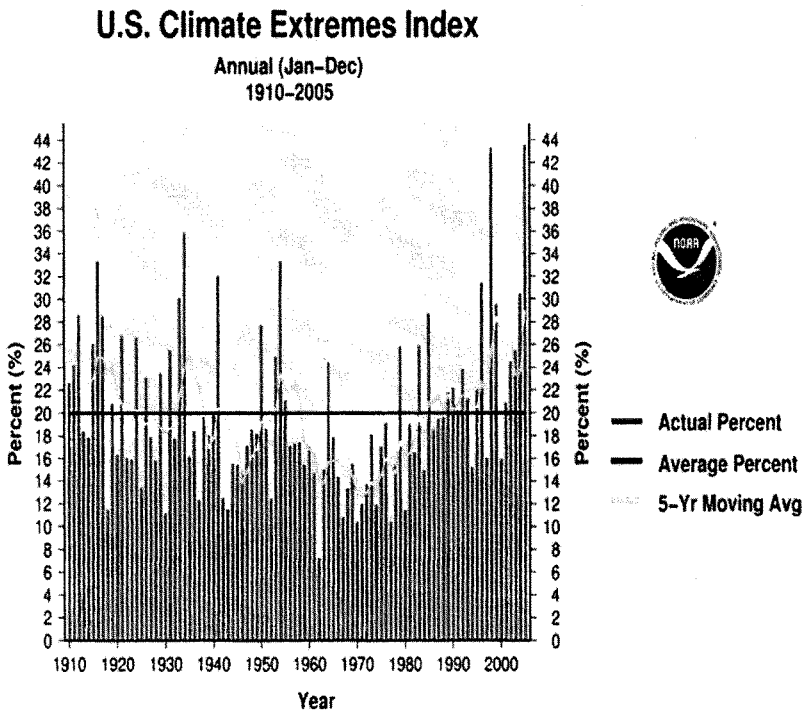

Figure 5: The U.S. Climate Extremes Index (CEI) is the average of the percent of U.S. land area experiencing extremes in temperatures, drought, precipitation, and tropical storms. More detailed information on the CEI is available at http://www.ncdc.noaa.gov/oa/climate/research/cei/cei.html.

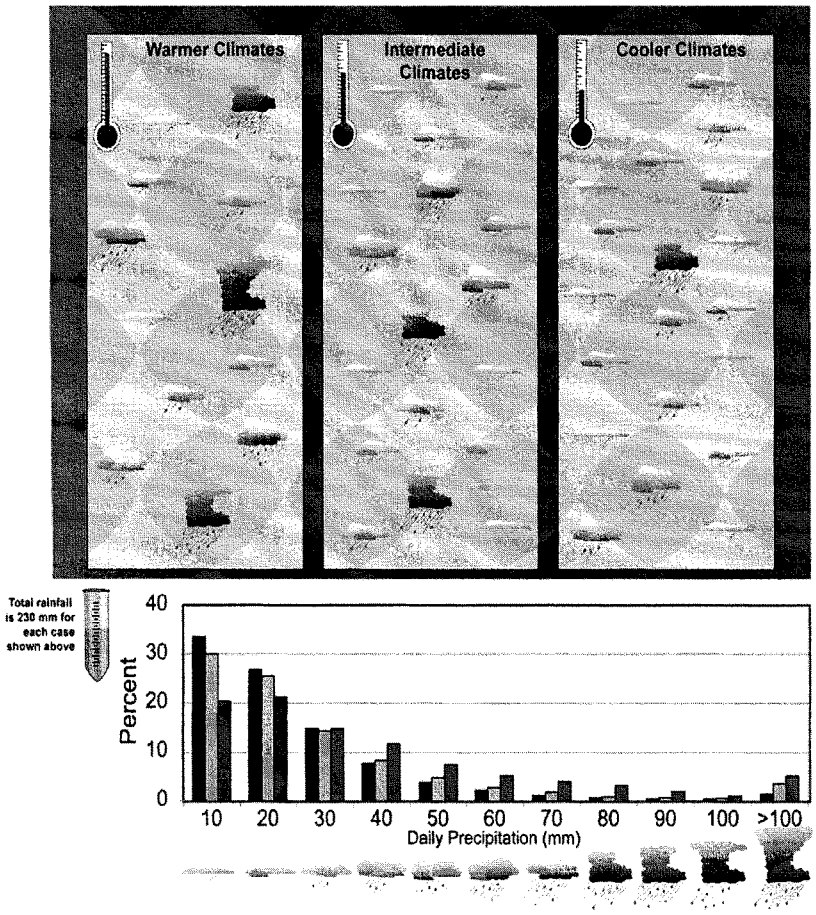

Figure 6: The diagram shows that warmer climates (red) have a higher percentage of total rainfall coming from heavy and very heavy events. The data are based on a worldwide distribution of observing stations, but each have the same seasonal mean precipitation amount of 230 (±5) mm. For cool climates (blue), there are more daily precipitation events than in warmer climates (Adapted from Karl and Trenberth, 2002). The various cloud and rain symbols reflect the various daily precipitation rates and have been categorized in the top panel of this figure to reflect the approximate proportion of the various precipitation rates for cool, moderate, and warm climates across the globe.

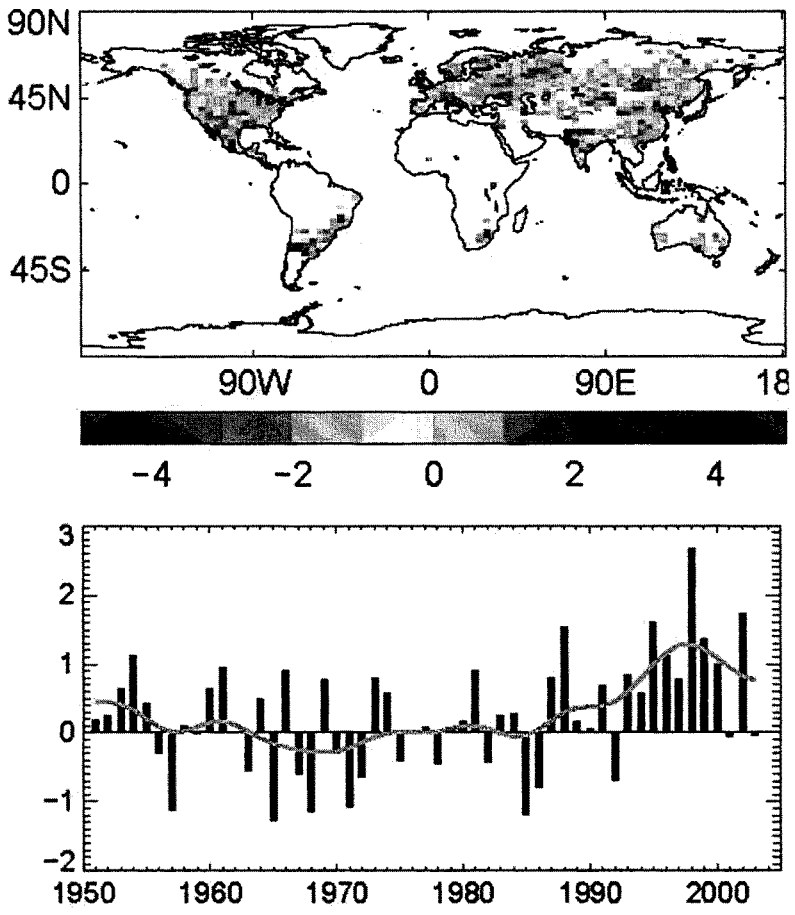

Figure 7: Changes in the contribution of heavy precipitation events to the annual total amount. The annual values are smoothed by the orange line to better represent decadal variability and change. Globally there has been a change of nearly two percent since the mid-20th century (from Alexander et al., 2006: Global observed changes in daily climate extremes of temperature and precipitation. *J. Geophys. Res.*, D05109, doi:10.1029/2005JD006290).

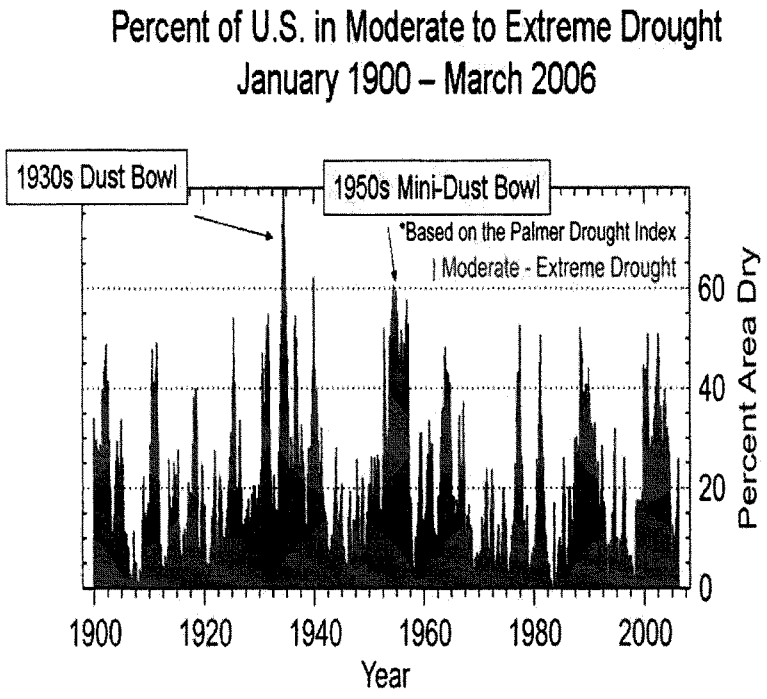

Figure 8: The percentage of the contiguous U.S. land area in moderate to severe drought (NOAA, National Climatic Data Center).

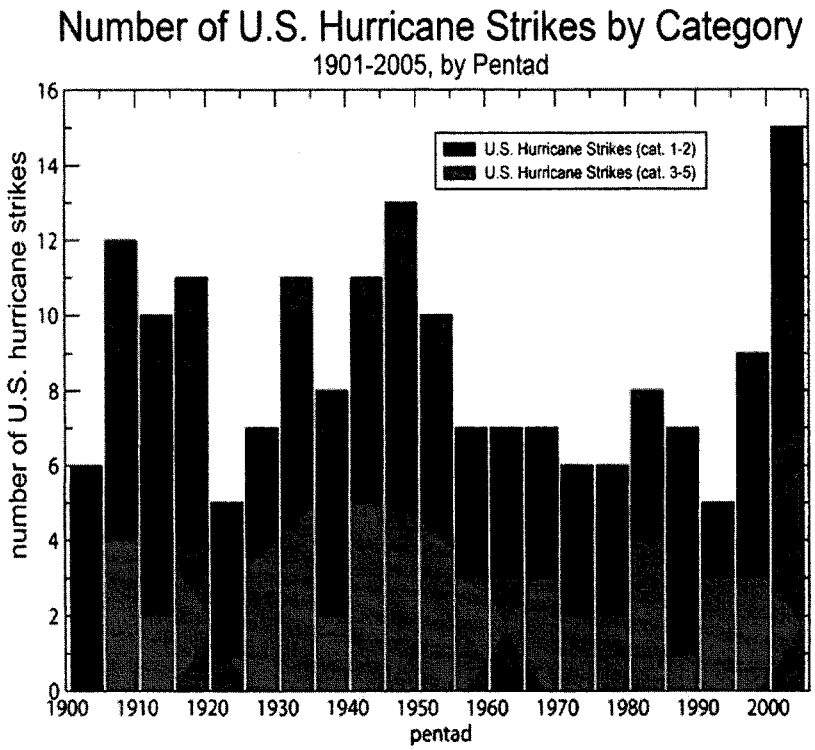

Figure 9: The number of hurricanes striking the U.S. summed by five year periods (e.g. 1901-1905, 1906-1910, etc.). The red bar is the number of major hurricanes (category 3-5) and blue bar is the number of weaker category 1 and 2 hurricanes per five year period (pentad). (NOAA, National Climatic Data Center)

Chairman TOM DAVIS. Thank you very much.

Just to try to sort through it all, let me just ask each of you—Mr. Connaughton, I will start with you—global warming is a fact; would you agree with that at this point?

Mr. CONNAUGHTON. Yes.

Chairman TOM DAVIS. And it is likely to continue over the next 50 years?

Mr. CONNAUGHTON. That is what the scientists tell us.

Chairman TOM DAVIS. Dr. Karl, would you agree?

Dr. KARL. Yes. We are already committed to, even if we stopped emitting all greenhouse gases, we are already committed to approximately another half to 1 degree rise in temperature because of the heat that has already been absorbed into the oceans and the resident time of existing atmospheric greenhouse gases.

Chairman TOM DAVIS. How much of this is naturally occurring in the cycle of Earth and how much of this is really man created?

Dr. KARL. We think most of it is due to man. There are natural effects such as volcanoes and El Ninos that do have contributions on global temperatures, but mostly the rise in temperature is attributed to human influences of the past 30 years.

Chairman TOM DAVIS. And as you look ahead 30, 50 years, without an aggressive policy what does this mean for the planet?

Dr. KARL. Well, in terms of some of the climate activities, we look toward increasing heavy and extreme precipitation events, more in the way of heat waves, reduce snow cover and sea ice, less in the way of cold waves, temperatures in the winter would warm up, rising sea levels expecting to continue, and probably at this point in time, when dry weather does occur on a global basis, the tendency will be for greater evaporation and potentially greater intensity of droughts, as well.

Chairman TOM DAVIS. Just in the natural occurring of the planet in our millions of years of existence, or whatever, we have had warmings and we have had it cooled and everything else, and that has changed dramatically the landscape, where water is, the kind of plants and animals that can survive. What is the degree of change that we are looking for at this point?

Dr. KARL. I think it is important to keep this in mind because if you look at the climate about 18,000 years ago, when we were in the middle of the last full glaciation, global temperatures were approximately—we don't have precise measurements—approximately 8 to 10 degrees colder than they are at the present time. Some of the scenarios for changes in atmospheric greenhouse composition run well into the end of this century and into the next century. Some of the scenarios approach changes of that magnitude, but within a short period of time, a period of 100, 150 years as opposed to a much longer time that it has taken for us to recover from the last full glaciation.

Chairman TOM DAVIS. So that is a very significant change?

Dr. KARL. Yes.

Chairman TOM DAVIS. And, Mr. Connaughton, you have talked about some of the things that the administration is doing on this and so on. I think it is important to note that there is a recognition on the part of the administration that not only is there global

warming, that we are contributors to that, but that we need to be very proactive. Do you agree with that?

Mr. CONNAUGHTON. It goes well beyond recognition. The scale and scope of what the United States is undertaking in terms of greenhouse gas mitigation is far beyond anything it has done before, and the scale of what we are doing as a Nation far exceeds what any other nation is accomplishing. But we also have the biggest burden and the biggest obligation. We are the largest emitter.

But we have promised, as well—I will give you an example. One of the most potent greenhouse gases, which is methane, is 20 times more potent than CO_2, but it also has a shorter atmospheric lifetime, so taking action on methane gives us an earlier benefit in terms of its forcing.

The United States has found a way profitably to get an absolute reduction in methane emissions, so that is something we have been able to go after aggressively through the 1990's, and we are carrying that forward, and what we are trying to do is take that approach international. So there are real opportunities with respect to some greenhouse gases to dramatically reverse them.

I will give you another one: PFCs, perfluorocarbons, which also contribute to ozone depletion. We are in the process, the United States, of effectively removing them from our economic system. The aluminum sector has done a really great job of really cutting their use of PFCs.

So we have some actions where we can really make some dramatic reductions and then there are others, such as CO_2 from fossil energy generation, that are going to require longer time horizons, so we need to work on both these really aggressive, dramatic cuts, and then these more gradual, phased-in cuts.

Chairman TOM DAVIS. But I think you have been critical of some of the treaty-based efforts for emissions reductions. Can you explain why this is true? I mean, many of the other people we are going to hear from today think the only way that the climate change can be effectively addressed is through international cooperation, particularly with the part of the world stepping on now and industrializing.

Mr. CONNAUGHTON. The two main components from an environmental perspective that have an economic dimension are the problems with the Kyoto protocol. The Kyoto protocol set reasonably achievable targets for some countries and set impossible to achieve targets for other countries. The United States falls into the category of the impossible to achieve. So we can't ratify a treaty if we don't have confidence that we can actually achieve its objectives. We can do a lot toward achieving those goals, but it was just a wrong deal.

The other problem is——

Chairman TOM DAVIS. Should we go back and at least try to get another deal, I mean, if that is not reasonable?

Mr. CONNAUGHTON. It is not should we, we already are embarked on that exercise on a massive scale. Hold that for 1 second, because the other problem is the global participation issue. If we were to even make halfway progress toward achieving Kyoto, one of the big outcomes of meeting that goal would have been a shift of our en-

ergy intensive manufacturing base to countries that don't have targets.

That is bad enough from a jobs and an economic perspective, but let's just worry about climate change. What we have effectively done is move our emissions produced in relatively efficient manufacturing to another country that does it much less efficiently, so you would likely get a net rise in greenhouse gases elsewhere. It is like squeezing the end of a balloon. It just fills out the other end.

So we have to be very careful about a well-intentioned aspiration creating an unintentional outcome that everybody can agree on. Simply moving our emissions to another country doesn't solve the problem. That is why we need to pull back into this realm of reasonably ambitious, and everybody is moving at about the same rate. That is what we are doing to the Asia Pacific partnership. We have six huge countries: the United States, Japan, South Korea, China, and India.

And then you have the G8 group that Tony Blair pulled together, which is the G8 countries along with India, China, Brazil, South Africa, and a few others. That is a pretty powerful group of countries that have realized that, regardless of these aspirational targets, how do we break it down into the several hundred pieces of action that have to occur either individually or jointly to make the greatest rate of progress.

Again, it is exciting what is going on, because we are finally talking about real programs of work, not rhetorical flourishes, not challenges to each other to accomplish things. We are actually breaking it down into how do we make biodiesel available worldwide with the same standard. How do we bring cellulosic ethanol to market in 2010 rather than 2020? These are the very tangible aspects of progress, and that is happening. That is what is exciting.

We have a renewable energy and energy efficiency partnership. Methane to markets has several dozen countries involved in it trying to do what we do well in the United States. We capture methane from landfills. In most of the rest of the world they don't. Imagine. That is profitable.

We capture methane from agricultural waste. In other parts of the world there is a huge capacity to capture that methane and make it a clean-burning, profitable energy source. And in the United States we don't leak natural gas in the environment from our oil and gas systems and we don't leak methane out of our coal mines any more. We capture it and convert it to energy.

All of those are profitable investments with existing technology that can dramatically cut greenhouse gases. You just have to roll up your sleeves and work with these other countries and help them understand this investment opportunity.

Chairman TOM DAVIS. My time is up.

Mr. Waxman.

Mr. WAXMAN. I thank you, Mr. Chairman.

Mr. Connaughton, you heard what Dr. Karl had to say on the state of the science on global warming. Is there anything he said that you disagree with?

Mr. CONNAUGHTON. No.

Mr. WAXMAN. I am sure you are familiar with the joint statement on global warming issued last year by the National Science

Academies of 11 countries, including the United States, Britain, Russia, China, and India. The academies asserted that climate change is real, there is now strong evidence that significant global warming is occurring, and it is likely that most of the warming in recent decades can be attributed to human activities. They also had a call to action saying the scientific understanding of climate change is now sufficiently clear to justify nations taking prompt action.

Does the administration disagree with the joint statement of the national academies, and do you agree that United States should be taking prompt action?

Mr. CONNAUGHTON. The U.S. National Academy of Sciences in 2001 was commissioned by President Bush to give a U.S. perspective on the climate science, and they released their report in June 2001, a report that the President issued in his June 2001 policy statement. The statement that was released by the joint academy last year is largely a nearly complete reflection of the report the President, himself, commissioned and relied on in 2001.

Mr. WAXMAN. So you agree? The administration's policy is to agree with this position?

Mr. CONNAUGHTON. And let me take it a step further. The joint——

Mr. WAXMAN. Well, the problem with taking it a step further is that I don't get a step further on my questions, so it would be easier if you could just answer yes or no.

Mr. CONNAUGHTON. Let me make clear, not only the President but the G8 leaders in the Gleaneagle's Plan of Action on Climate and Clean Development last year jointly received that report and agreed on the need for urgent action.

Mr. WAXMAN. OK. Now, in your testimony you tried very hard to make the case that the administration is doing something meaningful, and here is why I don't buy it: all of those programs, initiatives, partnerships, spending aims, all the things that you enthusiastically reported to us aim to get you to the President's global warming goal, but that goal actually allows U.S. emissions of global warming pollution to rise by 14 percent by 2012.

Talking about so-called intensity targets lets you obscure this basic fact, your plan is to let emissions go up by a lot. Are you trying to tell us that allowing U.S. emissions to rise by 14 percent in a decade is prompt action?

Mr. CONNAUGHTON. It is significantly better than the alternative path we were on, which is an even greater rise, Mr. Waxman. The challenge we face—we faced it with water pollution, we faced it with air pollution, and I could give you half a dozen other examples—is step one in any of these efforts to control a major environmental substance, step one is to slow the growth through reasonable investment. Step two, and air pollution is a good example, the efforts in the 1960's and the early 1970's put us on a path to slow the growth of harmful air pollutants. It was not until the 1980's——

Mr. WAXMAN. Mr. Connaughton.

Mr. CONNAUGHTON [continuing]. It was really not until the 1980's that we were able to stop the growth, and then now, as we sit here today——

Mr. WAXMAN. Mr. Connaughton, excuse me.

Mr. CONNAUGHTON. Mr. Waxman, let me get the point.

Mr. WAXMAN. No, no. You excuse me because it is my time to question you, not for you to give a monologue.

Mr. CONNAUGHTON. I am sorry. I thought you were looking for a complete answer, sir.

Mr. WAXMAN. Well, complete answers can take volumes, but I only have 5 minutes, because what you are saying is you are slowing the growth of emissions as to what they would otherwise be, but that is only by 3 percent. Your goal barely even slows the growth of emissions because emissions intensity improved at about the same rate from 1990 to 2000. These types of shell games just reinforce the point that the Bush administration has very little credibility on this issue.

I want to review the administration's actual record, not rhetoric, on global warming. When President Bush came into office, one of the first things he did was to backtrack on a campaign pledge he made to regulate global warming pollution from power plants. He declared that carbon dioxide is the greatest contributor to global warming, and then he said it isn't even a pollutant. He also renounced the Kyoto protocol. You have already responded to that.

The administration followed this with a tax package that promoted purchase of gas-guzzling Hummers and other highly inefficient vehicles and killed efforts to develop super efficient vehicles in the near term to the partnership for a new generation of vehicles. Then the administration went to a world summit on sustainable development and joined forces with Saudi Arabia in opposing targets and timeframes for increasing renewable energy worldwide.

And then the administration denied a petition to regulate greenhouse gases and is still in court defending that decision. The administration refused to raise efficiency standards for cars and opposed Senator McCain's modest legislation setting mandatory caps on global warming, pollution. The Cheney Energy Task Force, if anything, increased not decreased global warming pollution. And now the administration is trying to overturn efforts in California and 10 other States requiring motor vehicles to reduce their emission of greenhouse gases.

If this is a firm commitment to sensible action, we might be better off with no action from this administration.

Chairman TOM DAVIS. You can answer that if you would like, Mr. Connaughton.

Mr. CONNAUGHTON. Some of what you say is factually correct, contextually out of place, and some of it is a gross distortion. I will leave it at that, given the fact that Mr. Waxman doesn't want a long answer from me.

Chairman TOM DAVIS. Well, his time is up, but if you want to answer it you are welcome to. If not——

Mr. CONNAUGHTON. I have a long list. It is hard in my 5 minutes to respond to each of those allegations. I look forward to further conversations about it.

Mr. WAXMAN. I would certainly give him an opportunity to elaborate further because I have made some serious accusations.

Chairman TOM DAVIS. If you want to take a second, you are welcome to, and address a couple of the issues.

Mr. CONNAUGHTON. Sure. Let's start with CAFE, fuel economy standards. It was the national energy plan led by Vice President Cheney that made very clear, based on recommendations by the National Academy of Sciences, another report that we commissioned, the Bush administration commissioned, on the need to get on with improving fuel economy standards, but do it in a way that doesn't kill people.

CAFE is a 30 year old statute, well intentioned, proved to have a bad design. The car companies down-weighted cars and we had more traffic fatalities and thousands of new injuries. The Academy gave us good advice on how to improve fuel economy safely. The President called on Congress to lift the rider that had blocked us from doing fuel economy standards. Secretary Mineta, a strong Democrat, is the one that pushed for that, the Secretary of Transportation, and Congress lifted the rider.

We moved forward with the fastest schedule ever to set new fuel economy standards for light trucks and SUVs, including Hummers, for the first time, and we accomplished that goal, and we did it twice. We set it for 2005 to 2007 and we set a new set of standards for 2008 to 2011, and that had not been done in the generation prior.

At the same time, 5 years ago the President called on Congress to give us the authority to go after passenger cars. Congress still, 5 years later, has not given us that authority. We want it. We can make safe improvements in fuel economy in the passenger sector, too, just like we have done it for light trucks.

But we didn't stop there. The President called for nearly $1 billion in tax credits for the most fuel efficient vehicles. That was also in the national energy plan in 2001. We finally got that 4 years later in EPAC last year, supported in a bipartisan basis, which is fabulous.

But we didn't stop there. You said that we have opposed the new advances in vehicle technologies. That is flatly wrong. In the State of Union in 2003 the President put hydrogen powered vehicles on the world stage and has unleashed a massive new Federal investment, nearly $1.7 billion, the largest, I think, one of the largest single technology investments the Nation has committed to. And he has found a way to partner with dozens of countries internationally, not just to make this a U.S. initiative, which is what the partnership for a next generation vehicle was about, but with hydrogen we have made it a global initiative to create a global opportunity for this zero emission energy source.

But it didn't stop there. The President also pushed for tax credits to put more money back in consumers' pockets. The Republicans in Congress strongly endorsed that package, and if you look at the vehicle sales that followed those tax rebates for the purchase of newer, more efficient, higher performing cars, it was a great outcome from a piece of good economic policy.

So I will just give you that as one example. I could hit five of your others with the same set.

There is a popular mythology out there, sir, that we need to reconcile with this kind of a conversation, and there are lots of great things we can be doing in a sensible way, so let's just get on with it.

Chairman TOM DAVIS. Thank you very much.

Mr. Shays. We have three votes on, but I am going to go to another round, get some questions out of the way. We will come back afterwards.

Mr. SHAYS. Thank you. I am happy to have my opportunity to ask questions.

I feel like there was a Faustian agreement between the manufacturers and labor, manufacturers particularly representing, tending to be more Republican, laborers tending to be more Democratic, to not move forward with what just strikes me as obvious. We exempted minivans, SUVs, and trucks from the standard, but cars were under it.

There is no logic that they should be exempted, not under, and I would say to you, Mr. Connaughton, I get the sense that the administration has been passive on this issue, and therefore, given the record of the administration, it is going to be viewed as against it. So clarify the position for me, if you would.

Mr. CONNAUGHTON. Well, on fuel economy, again, we have to cut against what I call popular mythology and what actually occurred. The national energy plan of 2001 specifically had as a component the need to remove the barriers to setting new fuel economy standards, No. 1, and we called on Congress to do that. Secretary Mineta sent two letters, and we have statements of administration position related to various legislative efforts focused on implementing the National Academy of Science recommendations. That goes all the way back to 2001. I personally worked on that. I worked with Norm Mineta on that.

Mr. SHAYS. Let me just ask you if you could sort of shorten your answers a bit.

Mr. CONNAUGHTON. OK. And then following that we got the rider lifted on light trucks. On our own initiative we added large SUVs and Hummers, which were excluded. You are absolutely right. And we now have fuel economy standards governing those vehicles for the first time.

Mr. SHAYS. What are those standards?

Mr. CONNAUGHTON. I don't have the precise numbers. It is about a 15 percent improvement in the near term.

Mr. SHAYS. Let me just say to you that is where I have my problem. After September 11th I would have loved this administration to have said to the environmental community, the energy community, we are going to be energy independent, Manhattan project, whatever you want to call it, a race to the moon, and so I think you would agree, while you have done those things, it is not the kind of thing where he went out every day like he did on Social Security and say, you know, this is what I want.

Therefore, given that in the beginning of this administration it almost wanted the environmental community to dislike it so it could be favorable with some—and, unfortunately, you are faced on the environmental side, but, you know, you were put in a position. If the administration was viewed as being pro-environment, some Republicans thought that was bad. Now we are in the mess we are in. I think that is why the administration is in the mess it is in. A lot of the good steps it has taken it will not get credit for because of that.

I want to ask you, there were resolutions on Kyoto, and I am wondering if you could speak to any of them. There was one resolution I believe on July 25, 1997 to which the vote was 95 to zero. Are you familiar with that vote?

Mr. CONNAUGHTON. Yes, I am.

Mr. SHAYS. Would you explain what that vote was all about?

Mr. CONNAUGHTON. That was before the administration went off to cut the final deal on Kyoto, and the Senate, in a bipartisan basis, said, don't come back with a deal that has two problems. One, it is going to really impede economic growth, so don't come back with a deal that is going to cost us a lot of jobs. And don't come back with a deal that doesn't include the major emitters in the developing world.

The administration came back with that deal, a deal that was bad economically, shifting jobs overseas as I discussed, and a deal that didn't seriously engage the large developing country emitters.

The administration, to its credit, spent 4 years trying to fix it. They did not succeed even when they are in the lame duck——

Mr. SHAYS. You are talking about the previous administration?

Mr. CONNAUGHTON. The Clinton administration. Even when they were in the lame duck period when they could have saddled the Bush administration with a bad deal, they didn't. So, to their credit, they knew that they needed to fix those problems, the economic piece and the developing country piece, and it never happened.

Mr. SHAYS. OK. Let me just ask you, Dr. Karl, you are pretty emphatic. You leave no doubt global warming exists and mankind is the biggest contributor. That is your statement. I happen to believe it. Is the debate ended within the administration about this? Can we put that behind us, no longer have a debate coming from the administration? Or is this debate with some Senators, Republicans in the Senate? Is there a continued debate or is global warming for real and, in fact, primarily caused by humans?

Dr. KARL. I think there isn't much of a debate. I can speak probably more reliably in the scientific community about whether global warming is real and whether humans are having an impact on it. Where the debate in the science community currently is focused today is will the changes be at the higher end of sensitivity to atmospheric changes and greenhouse gases or at the lower end. That makes a big difference in what I indicated earlier.

Mr. SHAYS. Let me just say a concluding sentence. I think it is dramatic that this is definitively being said to this committee. If nothing else, just having you two make that statement is worth a lot, and I thank you both.

Chairman TOM DAVIS. Thank you very much.

Mr. Van Hollen, do you want to try to get your 5 minutes in?

Mr. VAN HOLLEN. Whatever you want to do.

Chairman TOM DAVIS. Mr. Van Hollen, let me see how many minutes are left.

I think with your indulgence—we have three votes, we will get at the end of one. We will be back in about 20 minutes.

Mr. RUPPERSBERGER. Mr. Chairman, I won't be able to come back. Can I provide questions to both Dr. Karl and Mr. Connaughton and have them respond to those questions?

Chairman TOM DAVIS. That would be fine. No problem at all. They have expressed a willingness to entertain and try to be as forthcoming as they can on these issues. Mr. Waxman and I are sending a number of questions up that we didn't have time to get today. They have agreed to answer.

Thank you very much. We will recess for about 20 minutes.

[Recess.]

Chairman TOM DAVIS. The committee will come back to order.

While I am waiting for Mr. Van Hollen, I just had a followup.

Dr. Karl, your models are not exact, right? You just take the variables and plug it in to the best of your ability, right?

Dr. KARL. Did you say models are not exact?

Chairman TOM DAVIS. Correct.

Dr. KARL. Yes.

Chairman TOM DAVIS. They are models.

Dr. KARL. Yes.

Chairman TOM DAVIS. I mean, you have variables, you plug them in, nobody understands what all the variables were together. To what percent do you think they are reliable? We look at this as the best data we can put together, and if you were given a reliability factor and you are looking ahead 10 years and what happened and how you projected it?

Dr. KARL. For the climate models looking ahead into the future——

Chairman TOM DAVIS. I know what our budget models are like here in Congress, so, I mean, I hope you are doing better than that.

Dr. KARL. Well, there are two things that cause them to be in error. One is whether or not the changes that we think might occur, whether they actually do in terms of changes, for example, in atmospheric composition, events that are unforeseen, volcanic emissions, so there are scenarios that are put in the models that are——

Chairman TOM DAVIS. May or may not occur?

Dr. KARL. May or may not occur. So that is one source of uncertainty. The other areas which would cause models to be less reliable have to do with what we discussed earlier as their ability to take a complex system, run it in a computer, and if you had all our understanding in one model you would not have a computer fast enough to run that model, so you have to make some assumptions and parameterizations, as the word is called.

Chairman TOM DAVIS. But the time line? I think you and Mr. Connaughton would agree the trend line is essentially correct? Mr. Connaughton, would you say that the trend line in their models is one that you would agree with?

Mr. CONNAUGHTON. The trend line is at an order of scale in which you could have relatively high confidence, as the scientists will tell you about, and we recently published a report on temperature change that was the first assessment product that the science panel put out.

But then as we get into these second order issues, that is when the very important interface between the scientific community, in terms of what they see physically, but also there is interface in the policy community and economic community in terms of what you see in human development, human effects. There is a lot of inter-

face between projections about that, and we are constantly building our levels of data into that and our levels of confidence.

When we talk about the nearly 2 billion to climate science, a big chunk of it is dedicated to reducing our uncertainties.

Chairman TOM DAVIS. And how confident are you and Dr. Karl? You agree with the basic trend, but he hasn't given me a percentage, and if you don't feel comfortable that is fine.

Mr. CONNAUGHTON. I am not qualified actually to express personal confidence, so I just take——

Chairman TOM DAVIS. Or unconfidence?

Mr. CONNAUGHTON. What we get from the scientific community as a policymaker is we get some—I call it we get a band width. They say here is one end of the scale, and here is at the other end of the scale, and here is our range of confidence. That is helpful for policymaking, just like a budget projection. We do that with weather. We do it with air pollution. We have different levels of capacity to have confidence in those projections, and climate is probably the most complex puzzle we are dealing with right now. So you need to accept it in that mode.

We know enough to commit this incredible program of work going forward and commit the level of taxpayer resources that we are putting in this. We know that much. And then we are constantly learning on how to adjust that.

Chairman TOM DAVIS. Thank you.

Mr. Van Hollen.

Mr. VAN HOLLEN. Thank you very much, Mr. Chairman. Thank you both for your testimony. Mr. Connaughton, let me also echo the statements of Mr. Shays with respect to congratulations on preserving many thousands of acres in the Pacific Ocean around the Hawaiian islands. I think that was an achievement.

As you know, we get a very short amount of time to ask these questions, so I am going to ask you, if you could, to keep your answers brief.

We heard the testimony this morning that you agreed with the scientific statement that Dr. Karl made. Would you agree it is important for our political leaders, given the urgency of this issue, to speak out clearly and let the American people know that this is a challenge and that the scientific debate on the issues we discussed this morning is behind us?

Mr. CONNAUGHTON. Yes, and it is also important to educate the public on where the science is going in terms of what we are trying to learn about the effects of climate change.

Mr. VAN HOLLEN. I want to just read a statement that President Bush gave on July 6th to People Magazine in response to a question about global climate change. He said, "I think we have a problem on global warming. I think there is a debate about whether it is caused by mankind or whether it is caused naturally, but it is a worthy debate."

My understanding is that your testimony this morning is that that debate is, in fact, over; that, in fact, global climate change is real; and I understood you to accept the conclusions of Dr. Karl that in recent times the majority of it is caused by human activity; is that right?

Mr. CONNAUGHTON. Yes, and I want to make sure you understand the context for where we are in our understanding of science from a policy perspective. There is a lot of agreement top line on warming, lot of agreement on human contribution to the problem. We begin to get into issues about the extent to which humans are a problem. We begin to get into issues of natural forces and human forces and the effects they cause. So there is still debate as we get into these lower level issues. At the top, a lot of agreement.

Mr. VAN HOLLEN. Let me just——

Mr. CONNAUGHTON. By the way, that is where the President is, too.

Mr. VAN HOLLEN. OK.

Mr. CONNAUGHTON. He has got a lot of agreement up top and he is taking the science as we get it.

Mr. VAN HOLLEN. The statement you both made this morning is the majority of the problem in recent times has been human contribution. The President's statement does not reflect that. This is an important issue for the American people, and if the top political leadership doesn't let the public know that we are in agreement on this issue I think it is a disservice to the people of the country. He said he has a debate about whether—a debate not how much, a debate about whether it is caused by mankind or whether it is caused naturally.

I don't have time to go into this any more, but that is the President's statement.

Mr. CONNAUGHTON. I need to clarify. The President has said much more than that, and, in fact, he said very strongly what I have said to you, so I do not want to leave this hearing with an impression that the President is somehow in a different position than what you are hearing from me today because that would not be correct.

Mr. VAN HOLLEN. All right. What I am worried about is the President's position as the last person who talked to him on this issue. I am sorry, but that is my statement, not yours, and I understand what you are saying. But this kind of statement in the most recent issue, one of the most recent, in People Magazine, which is read by millions of people, would give you the impression that hey, we really haven't reached a scientific consensus on what I understand we have reached a consensus on, based on the testimony you both gave this morning.

Mr. CONNAUGHTON. And I would disagree with that characterization.

Mr. VAN HOLLEN. OK. Thank you. I said it was mine.

In the 2002 energy bill—so now we have a consensus we have a problem. Now we have to figure out what we are going to do about it.

Now, in the 2002 energy bill Senator Brownback put a provision in that would have required large companies to disclose their greenhouse emissions. The administration, the Bush administration's statement or position on that bill opposed that provision, simply requiring them to report their emission levels. Can you explain why we would not want to know what they were?

Mr. CONNAUGHTON. We went back and forth on the appropriate mechanism for work with the industry. We didn't think a manda-

tory reporting system, per se, made a lot of sense, given the fact we already had a functioning program that had been working since 1992.

What the President wanted to do was improve and fix that program, which we have now done. Just this year we have completed all the protocols for actually state-of-the-art, industry-wide reporting on greenhouse gases. We then create a climate vision that got the major emitting sectors making specific greenhouse gas reduction commitments. They are not just saying what they are doing, but making commitments to reduce, and all of that infrastructure is now underway, so I think we are there.

Mr. VAN HOLLEN. Is it your testimony we now know the amount of greenhouse gases being emitted by American industry on a per-company basis?

Mr. CONNAUGHTON. Yes. We know it on a macro basis and we have good data sector by sector, and we are getting better data company by company, and that is what our new 1605(b) guidelines are going to incentivize.

Mr. VAN HOLLEN. Let me ask you, California, as you know, has set a law that set greenhouse gas emission standards for automobiles. Ten other States said that they are prepared to follow suit. The Governor of California I believe is a strong proponent of this bill. Can you tell me what the administration's position is on that?

Mr. CONNAUGHTON. To the extent the program is the equivalent of setting a fuel economy standard, the courts have made clear that is preempted by the CAFE law, which was enacted by a Democratic Congress and signed by President Jimmy Carter back in the 1970's, saying if we are going to have a fuel economy standard it needs to occur on a nationwide basis because of the huge market disruptions that would occur by doing in a State by State basis.

Mr. VAN HOLLEN. Let me ask you, would you adopt the California legal provisions as a national policy, you, the administration? What would your position be on doing that?

Mr. CONNAUGHTON. We do not support that as national policy; we support the CAFE program under the reform system that we have now implemented and that is enjoying broad support. And, by the way, we support fuel economy in the automobile fleet in all 50 States, not just in a handful of States.

Mr. VAN HOLLEN. If I could, Mr. Chairman, that is why I asked you. You said you objected to the California provision on some legal technicality, and the CAFE standard, so my question was: are you prepared to amend the national CAFE standard law and essentially put in place at the national level the California law? You would agree that would get better—that would improve our ability to reduce carbon dioxide emissions, would you not?

Mr. CONNAUGHTON. We don't need to adopt the California law as national law because we have a national law for setting fuel economy standards, and that is the corporate average fuel economy statute.

Mr. VAN HOLLEN. I understand that. Mr. Chairman, if I could just, I mean, obviously the people of California have decided that is not adequate to achieve the reductions they want, and they want to move ahead as a State. You say you are opposed to that because

it is superseded by CAFE, but you are unwilling to increase CAFE to get the same kind of emission reductions that the California law would provide for; is that right?

Mr. CONNAUGHTON. You are comparing apples and oranges. What we have done is set standards for the period through 2011. The California program goes well beyond that. We have made no decision as to what happens after 2011 because the CAFE statute requires an administrative process led by technical experts on product design and on economics to figure out the rate that makes the most sense, given those factors that Congress—again, on a bipartisan basis, including some Members who were around back then for part of the creation of that statute. We have a process for doing that.

California seeks to leap ahead and do it arbitrarily. We think it is much better to do it through a process that is based on the facts and the economic evidence and the technical evidence.

Mr. WAXMAN. Would the gentleman yield?

Mr. VAN HOLLEN. I would be happy to yield.

Mr. WAXMAN. As a Californian and as someone who was here to pass that law and the Clean Air Act, the whole premise of the Clean air Act was modeled on the fact that California had taken the lead on trying to reduce emissions that cause smog and other pollutants that cause health problems. Here California wants to take the lead on responding to this global warming climate change issue, and yet the Republican administration that at least rhetorically talks about local decisionmaking wants to keep the local State of California from going ahead of the Federal Government. I do believe that Mr. Van Hollen was correct when he characterized it as using a loophole that the industry has suggested is a basis for challenging it, rather than let the States do actions on its own.

Are you against any experimentation at the State level or do you think Washington knows best for everybody?

Mr. CONNAUGHTON. We actually strongly support work at the State level to the extent it is not preempted by Federal law. In this specific example there is probably a clear case of preemption, but also I would be concerned, Congressman, about——

Mr. WAXMAN. It is not a clear case of preemption. It is the preemption argument that the administration is making along with the industry to throw it out.

Mr. CONNAUGHTON. Actually, we already had the one round on the preemption argument with respect to the California zero emission vehicle mandate and the court threw that out. But I would also be cautious about using California as an example because California often has rhetoric that exceeds its results. California did lead early on in cutting air pollution, but as we sit here today California's air quality is the worst in the Nation and they have no prayer of meeting the current air quality standards. So I want to be careful when separating, again, well intentioned, you know, although, maybe unsupported objective with real programs designed to achieve reasonably ambitious outcomes that we have some confidence in attaining.

Chairman TOM DAVIS. This panel has got to leave. I promised 12:30. Let me give Mr. Kucinich a couple of questions. He is coming

in. Can you bear with that, Mr. Connaughton, and then we will move to the next panel.

Mr. KUCINICH. I thank the chairman. I thank the Chair for holding this hearing.

Mr. Connaughton, many European leaders are taking their cues from science which is unambiguous on one point: to stabilize the climate requires humanity worldwide cut emissions by 70 to 80 percent. As a result, Holland is now cutting emissions by 80 percent in 40 years. Mr. Blair has committed the U.K. to cutting by 60 percent in 50 years. Germany has obligated itself to cuts of 50 percent in 50 years.

Several months ago French President Chirac called on the entire industrial world to cut emissions 75 percent by 2050. How long would it take for the United States to reach a goal of emissions reductions of 75 percent below current levels with the administration's current policies?

Mr. CONNAUGHTON. You weren't here earlier, Congressman. I want to sort of differentiate between very good, solid aspirations for what we might achieve 50 years from now from sort of the hard-nosed what can we achieve in reasonable timeframes and have some confidence and success.

Mr. KUCINICH. Well, we breathe through hard noses.

Mr. CONNAUGHTON. Yes, we do. I do, as well. So when you ask, we are on track to significantly slowing the growth of emissions in the near term. I personally have high confidence that we will stop the growth of emissions, especially if we make real progress on getting nuclear power back into our energy mix and if we can find a way to commercialize the zero emission coal plants. Those are two big breakthroughs for which there are huge policy obstacles right now.

Mr. KUCINICH. It is kind of interesting you would say that, because the very notion of greenhouse gas intensity gives the administration cover to claim credit for reduction of greenhouse gases, and that simply isn't true. So-called greenhouse intensity or gas intensity would have gone down simply because of efficiency gains, alone. So I am going to ask you again: what levels of greenhouse gases do we need to achieve for our own well-being, and how quickly must we achieve them? I am asking you a second time.

Mr. CONNAUGHTON. Well, to take the first part of your question, it is clear that massive new investments in efficiency are actually helping us to dramatically slow the growth of greenhouse gas emissions, and it is resulting from billions and billions of dollars of private sector investment, aided by good Government policies—bipartisan Government policies, I would add.

In terms of what will it take until we stop and what will it take to get to the levels that you described, I can't give you an answer right now. There is not a basis for giving an answer.

Mr. KUCINICH. Thank you. But I think it is important to give that answer. I mean, we have other nations that are giving answers, and I think it is important if we are going to see the good faith of the administration on this issue of greenhouse gas reduction. Other nations are declaring targets, shouldn't we?

One section of the GAO report boasts of funnelling millions of dollars in subsidies for nuclear power, but using nuclear power to

effect any meaningful reduction in greenhouse gases would cost trillions of dollars. Renewable technologies, on the other hand, are much more cost effective to implement. Could you tell me and this committee why does the administration favor nuclear power over renewables, despite the poor economics of nuclear power?

Mr. CONNAUGHTON. We don't favor one or the other. We need a lot more of both. The cost profile on the renewable, many renewable sources right now are more expensive than their fossil counterparts, but they can be installed rapidly, so that is why you have seen States like Texas, huge investment in wind power, and that is fabulous. At the same time, nuclear power plants are really expensive to build but really cheap to operate, but they take longer to install. So you just have two very different economic platforms, which is why the policies directed at nuclear are different than the incentives directed at renewables.

But I would note, Congressman——

Mr. KUCINICH. Let me ask you——

Mr. CONNAUGHTON [continuing]. This Congress on a bipartisan basis——

Mr. KUCINICH. I want to note something. You are talking a cost/benefit analysis here.

Mr. CONNAUGHTON. No, I am not, sir.

Mr. KUCINICH. Well, I hope you are, because are you taking into account in your underlying assumptions the cost of nuclear waste, which is stored and never disposed of? Do you take that into account in terms of the cost of nuclear power, or do you write that off the books?

Mr. CONNAUGHTON. No. In terms of the total life cycle of cost we do take that into account.

Mr. KUCINICH. Storage?

Mr. CONNAUGHTON. Storage. But what we have moving forward right now, plank one occurred in the Energy Policy Act, but we are trying to get to a new regime on the waste management and storage issue that would dramatically cut the cost of both management and storage. That has not been factored in, but if we can make success there then the cost profile of nuclear becomes even better. And by the way, it is safer and more proliferation resistant, and that is really good.

Mr. KUCINICH. Do you take into account the nuclear proliferation aspects of national security when you are talking about promoting nuclear technologies as opposed to safe, renewable technology? Do you factor that cost?

Mr. CONNAUGHTON. The answer is yes. You can do it in a qualified way. As a matter of policy, Secretary Bodman, shortly after the State of the Union this year, launched the new global nuclear energy partnership which is directed specifically at the important issue of proliferation. I think the objectives of that program would be very consistent with some of the current concerns I have heard you voice in the past, Congressman, about nuclear power.

One other observation as to the other countries. While they all have—some of them have these long-term aspirational goals. You missed my earlier testimony. When you look at what they are actually doing, the rate of progress that they are making today, it is the case that the rate of progress in those key countries in Europe,

here, and Asia we are all making about the same near-term rate of progress.

By the way, that is a good thing because it is an improved rate of progress, but you still have to differentiate a 50 year articulated goal, you know, for which the current political actors will not be around to see achieved, from what they are actually doing as a matter of policies to produce specific results. The results are good, but we are all pulling in the same direction at about the same rate.

Mr. KUCINICH. Mr. Chairman, thank you.

Chairman TOM DAVIS. Thank you. And, Mr. Connaughton, thank you very much for your testimony and elaborating on the administration's plan.

Mr. CONNAUGHTON. Thank you.

Chairman TOM DAVIS. Dr. Karl, thank you. Did you want to add one thing?

Dr. KARL. Mr. Chairman, I would like to give you a little more direct answer to the question on reliability of climate models. I think they are reliable enough to be a very useful guide into the future, and we have improved them considerably in the last couple of decades.

Chairman TOM DAVIS. I do not think there is any disagreement from Mr. Connaughton either. I just tried to get a percent. It is tough, given all the variables. That is all I was trying to get. I wasn't trying to discredit you. We appreciate all the work that you are doing.

I will dismiss this panel and we will now recognize our second panel.

We will have Dr. Judith Curry, the Chair of the School of Earth and Atmospheric Sciences at Georgia Institute of Technology; Dr. John R. Christy, professor and director, Earth System Science Center at the University of Alabama in Huntsville; Dr. Roger Pielke, the Center for Science and Technology Policy Research at the University of Colorado at Boulder; and Dr. Jay Gulledge, senior research fellow for science and impacts at the Pew Center on Global Climate Change.

[Witnesses sworn.]

Chairman TOM DAVIS. Dr. Curry, we will start with you and we will move right on down. Your entire testimony is in the record, so what you say, you can supplement or highlight for the audience, the cameras, and the Members, but we are going to ask questions based on the total testimony.

You have a light in front of you. It turns green when you start, orange after 4 minutes, and red after 5. To the extent we can keep with that, we would appreciate it. Thank you.

Welcome to the committee, and thank you.

STATEMENTS OF JUDITH CURRY, CHAIR, SCHOOL OF EARTH AND ATMOSPHERIC SCIENCES, GEORGIA INSTITUTE OF TECHNOLOGY; JOHN R. CHRISTY, PROFESSOR AND DIRECTOR, EARTH SYSTEM SCIENCE CENTER, NSSTC, UNIVERSITY OF ALABAMA IN HUNTSVILLE; ROGER A. PIELKE, JR., CENTER FOR SCIENCE AND TECHNOLOGY POLICY RESEARCH, UNIVERSITY OF COLORADO AT BOULDER; JAY GULLEDGE, SENIOR RESEARCH FELLOW FOR SCIENCE & IMPACTS, PEW CENTER ON GLOBAL CLIMATE CHANGE

STATEMENT OF JUDITH CURRY

Dr. CURRY. Thank you.

I would like to thank the chairman, the ranking member, and the committee for the opportunity to present testimony today.

My name is Judith Curry, and I am the Chair of the School of Earth and Atmospheric Sciences at Georgia Institute of Technology, and I have been conducting climate research for the past 20 years. Most recently, I have been conducting research on the subject of hurricanes and global warming.

The prospect of increased hurricane activity on a warmer climate is an issue of substantial societal concern. In my written statement I have outlined in some detail the evidence for the impact of global warming on increased hurricane activity. In my testimony today I will focus on presenting the data, the documents that interpret the increase in hurricane activity. All of the data that I am presenting is publicly available from NOAA, and most of this information is already published in peer reviewed scientific journals.

[Slide presentation.]

Dr. CURRY. Let's begin by examining the historical data record of north Atlantic tropical cyclones back to 1851. This figure shows the numbers of named storms in blue, hurricanes in red, and category four and five hurricanes in green.

To highlight the decadal and longer-term variability, the data has been smoothed to eliminate the year to year variabilities such as that from El Nino.

Some cycles are apparent in data, but the most striking aspect is the particularly high level of activity since 1995. If you compare the statistics for the most recent decade with the previous decade of peak activity centered around 1950, it would seem that the current period has 50 percent more name storms, 50 percent more hurricanes, and 50 percent more category four and five storms than the previous peak period.

This figure shows the total named storms in blue overlain by the average tropical sea surface temperature in red. The period 1910 to 1920, with low storm activity, was associated with anomalously cool sea surface temperatures in the north Atlantic. The most recent period of elevated activity is associated with anomalously high sea surface temperatures. On average, an increase in temperature a half a degree centigrade, which is 1 degree fahrenheit, implies an additional five tropical storms per season.

Let's take a closer look at the cycles. A 70 year cycle referred to as the Atlantic multi-decadal oscillation, is evident from peaks around 1880 and 1950 and valleys around 1915 and 1985. Also evident is a smaller 20 year cycle.

Examination of the cyclic variations indicates that the next peak in the cycle is expected around 2020; hence, it appears that these cyclical variations cannot explain the high level of north Atlantic activity we have seen in the past decade, 50 percent higher than the previous peak in 1950.

What does this increase mean for the United States in terms of land-falling hurricanes? In this plot of the number of land-falling storms, the 70 and 20 year cycles are clearly seen. Recall the peak in the current 70 year cycle is expected around 2020. While we are presently 15 years from the peak in this current natural cycle, the number of land-falling storms in the past decade has already surpassed the previous peak period in the 1930's to 1950's.

If we cannot explain the recent elevated hurricane activity by natural cyclic variability, can we therefore assume the increase is caused by greenhouse warming? Prior to the 2005 hurricane season, Dr. Kevin Trenberth published commentary in Science raising the issue as to whether the recent increase in north Atlantic hurricane activity could be attributed to global warming.

I was skeptical of this idea at the time, since it did not seem reasonable to infer anything about the impact of global warming merely by examining data in the north Atlantic. Trenberth's paper motivated our group at Georgia Tech to examine the global hurricane data that was available from the satellite data base since 1970.

A paper published in Science last September showed that, while there has been no increase globally in the number of hurricanes since 1970, the proportion of category four and five hurricanes has doubled. These are the most intense hurricanes. This implies that the distribution of hurricane intensity has shifted toward more intense hurricanes.

The two dominant factors that determine hurricane intensity are the tropical sea surface temperature and vertical wind shear. The figure on the left shows the change in tropical sea surface temperatures for each of the regions where hurricanes formed. Since 1970, there has been an increase of 1 degree fahrenheit in each of these regions. By contrast, the figure on the right shows that there has been no trend in wind shear. Our research has shown that the global increase in category four and five hurricanes since 1970's is directly linked to the trend in tropical sea surface temperature.

What is causing the increase in global tropical sea surface temperatures? This tropical warming is consistent with a similar increase in global surface temperatures, which is shown by the black curve in the figure. The cause and attribution of surface temperature trends over the last century has been extensively studied, as summarized in numerous assessment reports using the results of climate model simulations, as described previously by Tom Karl.

The results from one such climate model from the National Center for Atmospheric Research are shown in this figure. The blue curve shows the response of the global surface temperature only from the natural forcing, solar, plus volcanoes. The red curve shows the response to natural forcing plus that caused by humans, including greenhouse gases. It has seen that since 1970's the global surface temperature trend in black cannot be reproduced in climate models without inclusion of greenhouse warming.

So what can we conclude at this point about hurricanes and global warming? This research that we publish is new. Numerous uncertainties remain in our understanding of how global warming is influencing hurricane activity; however, particularly in the north Atlantic, where warmer sea surface temperatures cause more intense hurricanes, as well as more numerous storms, global warming is expected to continue to elevate the risk from hurricanes.

[End of slide presentation.]

Dr. CURRY. Thank you.

[The prepared statement of Dr. Curry follows:]

Global Warming and Hurricanes

Judith A. Curry
Georgia Institute of Technology

Testimony presented to the Climate Change Hearing,
House Committee on Government Reform
20 July 2006

Global warming and skepticism

As a climate scientist, I have devoted 25 years to conducting research on a variety of topics with the goal of addressing uncertainties in the climate system so as to improve our understanding and our ability to simulate and predict the climate system using models. My research has focused on the impact of clouds on the earth's energy balance, the exchange of energy between the ocean and the atmosphere, the influence of aerosols on cloud and radiation characteristics, the thermodynamics of sea ice, and most recently the impact of warming sea surface temperatures on the characteristics of tropical cyclones.

Scientific researchers naturally focus their research on uncertainties, and scientific understanding progresses as new ideas are developed and tested. Skepticism and the competitive clash of ideas move knowledge forward. Constructive skepticism is a mainstay of the scientific method and it has a long and noble tradition in science. The history of my personal skepticism regarding anthropogenic greenhouse warming is described in the following paragraphs.

At the time of Dr. James Hansen's 1988 testimony that global warming was underway, I thought that there were too many uncertainties in both the observational record and the climate models to support such a conclusion. In short, I was skeptical. In the 1990's, my personal research program focused on climate feedbacks in the Arctic. A feedback is the response of nonlinear system (e.g., the coupled climate system) such that a change to the system will be enhanced (positive feedback) or diminished (negative feedback). Based upon observations and climate model simulations available in the early 1990's, climate models were predicting more warming in the Arctic than had been observed. A group of scientists including myself conducted a comprehensive research program in the Arctic Ocean that culminated in a major field expedition 1997-1998, the Surface Heat Budget of the Arctic Ocean (SHEBA; Uttal et al. 2001). SHEBA focused on documenting and understanding feedbacks among the atmosphere, sea ice and ocean towards addressing the discrepancies between observations and climate models. It was hypothesized that there must be negative feedbacks somewhere in the Arctic climate system that were acting to counter the greenhouse warming. However, a principal result of SHEBA was that we identified a number of feedbacks that were more strongly positive than previously believed, that were acting to amplify the greenhouse warming. As a result of SHEBA, and my increasing awareness of the impacts of the warming in the Arctic (see ACIA 2004), I became convinced that greenhouse warming was having a substantial impact in the Arctic. In the last decade, the observed warming in the Arctic has more than caught up with the warming simulated by climate models.

In addition to my own personal research experiences in the Arctic, a series of national and international assessments undertaken by the Intergovernmental Panel on Climate Change (IPCC), the U.S. National Academies, and the U.S. Climate Change Science have made it very difficult to

maintain a credible position of scientific skepticism regarding the influence of humans on global warming. The past year has seen striking resolutions to two controversies involving the data record of climate change that support anthropogenic greenhouse warming: the synthesis report on the surface temperature reconstructions over the past two millennia the (NAS, 2006) and the synthesis and assessment report on temperature trends in the lower atmosphere (CCSP, 2006). Further, the draft IPCC 4th Assessment Report presents climate model simulations that are far more sophisticated and accurate than were available in prior assessments, substantially increasing the credibility of such simulations and the associated projections. The cautious conclusions of the large body of scientists contributing to these assessment reports by evaluating a large body of published research are extremely important in providing a balanced overview of the state of knowledge in the scientific research community. Based upon these assessments, our understanding of how the climate system works, while incomplete, is more than sufficiently robust to afford a basis for rational action.

Of the likely impacts of anthropogenic greenhouse warming, the prospect of increased hurricane activity arguably has the greatest near-term socioeconomic impact. Prior to the 2005 North Atlantic hurricane season, Trenberth (2005) published commentary in *Science* raising the issue as to whether the increase in North Atlantic hurricane activity since 1995 could be attributed to global warming. I was skeptical of this idea at the time, since it did not seem reasonable to infer anything about the impact of global warming on hurricane activity merely by examining data in the North Atlantic. Trenberth's paper motivated a group at Georgia Tech (led by Peter Webster) to begin looking at global hurricane data. In August, Emanuel (2005) published a paper in *Nature* associating the increase in sea surface temperature (SST) with an increase in maximum hurricane potential intensity and the destructive capacity of hurricanes, focusing on hurricanes in the North Atlantic and North Pacific. Webster et al. (2005; hereafter WHCC) in an article in *Science* showed that since 1970 the total number of hurricanes has not increased globally, but the proportion of category 4 and 5 hurricanes had doubled, implying that the distribution of hurricane intensity has shifted towards more intense hurricanes.

The following paragraphs summarize the arguments and data that support the link between increased hurricane activity and global warming, including uncertainties in the data and its interpretation.

The data: detection of increased hurricane activity

Central to the argument that global warming is causing increased hurricane activity is analysis of the data. The most reliable data on tropical cyclones (which includes tropical storms and hurricanes) is in the North Atlantic. The HURDAT data prepared by the National Hurricane Center goes back to 1851. Prior to 1944, only surface-based data were available (e.g. landfalling storms and ship observations). Since 1944, aircraft reconnaissance flights have been made in nearly all of the North Atlantic tropical cyclones and hence the record since 1944 is most reliable (Owens and Landsea 2003). Since 1970, satellite observations have made observing and monitoring tropical cyclones even more accurate.

Figure 1 shows the time series in the North Atlantic of the numbers of named storms (tropical cyclones), hurricanes, and category 4 +5 hurricanes (NCAT45; NCAT45 is not shown prior to 1944 owing to concerns about data accuracy). To highlight the decadal and longer-term variability, the data has been smoothed (11 year running mean) to eliminate the year-to-year variability. A nominal 70-year cycle is evident from peaks ca. 1880 and 1950 and minima ca.

1915 and 1985. Also evident is a nominal 20-year cycle, with most pronounced peaks ca. 1934, 1954, and 1974. However, the most striking aspect of the time series is the overall increasing trend since about 1970 and the high level of activity since 1995.

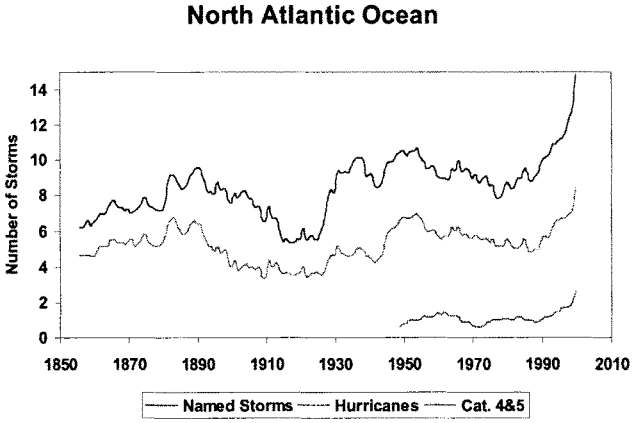

Figure 1: Number of total named storms, hurricanes and category 4-% storms since 1851, filtered by an 11-year running mean. Data are obtained from http://www.aoml.noaa.gov/hrd/hurdat/. Figure courtesy of J. Belanger.

Table 1 compares the statistics for the period 1995-2005 with the previous period of peak activity, 1945-1955. It is seen that current period has 50% more named storms, 50% more hurricanes, and 50% more category 4 +5 storms than the period ca. 1950. It is clear that the current period is not analogous to 1950's and 1960's, since we are just entering the active phase and already the level of activity is 50% greater than the activity in the previous period ca. 1950.

Table 1: Comparison of North Atlantic hurricane statistics for the periods 1945-1955 and 1995-2005 (data from http://www.aoml.noaa.gov/hrd/hurdat/). Curry et al. (2006)

	1945-1955	1995-2005
#Named storms	115	165
# Hurricanes	74	112
# Category 4+5	19	28

One key to understanding why we are seeing more tropical cyclones is to examine the length of the hurricane season (period between the first and last storm of the hurricane season). The official North Atlantic hurricane season is between June 1 and November 30. During the 2005 season, there were two tropical storms in December and January. Figure 2 shows the length of the hurricane season in the North Atlantic since 1851. Evidence of the 70-year and particularly the 20-year cycles is clearly seen. But the most striking aspect of the time series is the trend of increasing season length over the past century, averaging 4.8 days per decade or nearly 50 days over the past century. Most of this lengthening is occurring on the later end of the season.

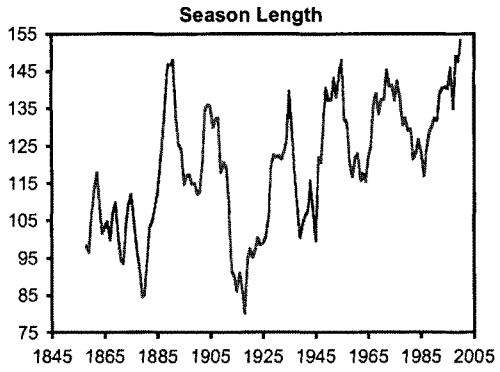

Figure 2: Length (in days) of the North Atlantic tropical cyclone season, filtered by an 11 year running mean. (data from http://www.aoml.noaa.gov/hrd/hurdat/). Figure courtesy of J. Gulledge.

While the data since 1944 are generally agreed to be reliable, what about the quality of data earlier in the record? Figure 3 shows the time series of total named storms and the average sea surface temperature (SST) in the main development region of the North Atlantic. Comparison of the two time series shows coherent variations of the number of storms and the SST for periods greater than 20 years. In particular, the period 1910-1920 with low storm activity is associated with anomalously cool sea surface temperatures. The coherence between the total number of tropical storms and the sea surface temperature on multidecadal time scales lends credence to the tropical storm data in the earlier part of the period, although the storm intensity in the earlier part of the record is arguably much less accurate.

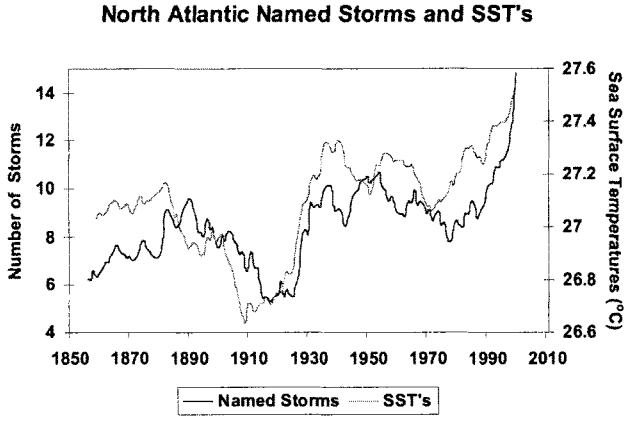

Figure 3: Number of total named storms in the North Atlantic and the average sea surface temperature in the main development region, filtered by an 11-year running mean. Data are obtained from http://www.aoml.noaa.gov/hrd/hurdat/. Figure courtesy of J. Belanger.

The most reliable data set in the early part of the record is the count of the number of storms that have made U.S. landfall (Figure 4). Strong evidence of the 20- and particularly the 70-year cycles are seen in these plots. Again, the activity during the past decade, particularly in terms of the total number of tropical storms, has surpassed the previous peak period in the 1930's – 1950's.

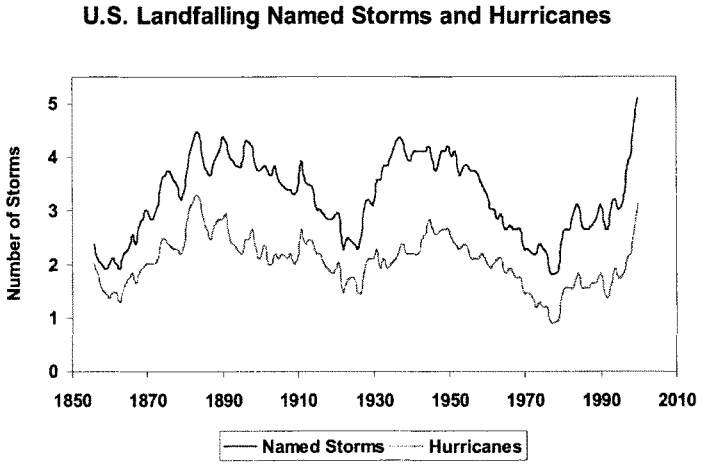

Figure 4: Number of total named tropical storms and hurricanes that have made U.S. landfall, filtered by an 11-year running mean. Data are obtained from http://www.aoml.noaa.gov/hrd/hurdat/. Figure courtesy of J. Belanger

While the data provides strong support for elevated hurricane activity in the North Atlantic that is significantly beyond what has been seen in the historical record, is there evidence of elevated hurricane activity in the other oceanic regions where hurricanes form? Webster et al. (2005) examined the global hurricane activity since 1970 (the advent of reliable satellite data). The most striking finding from this study is that while the total number of hurricanes has not increased globally, the number and percentage of category 4 + 5 hurricanes has nearly doubled since 1970 (Figure 5). While multidecadal oscillations are seen prominently each of the ocean basins, a clear trend in increasing number of NCAT45 hurricanes is seen in each region.

Skeptics have found our analysis unconvincing owing to suspected problems with the data. However, given the existing database and the lack of any rigorous uncertainty analysis of the data, the existing data cannot be used to reject our assertion that the number of category 4 and 5 hurricanes has increased substantially since 1970. There is an obvious need for an improved climate data record for global hurricane characteristics. Efforts are underway at the National Climatic Data Center and the University of Wisconsin to reprocess the satellite data, although it will be a considerable challenge to assemble the data prior to 1977. A consistent method of determining surface wind speed, combined with careful assessment of the satellite data integrity and sampling errors, are essential elements of a reanalysis.

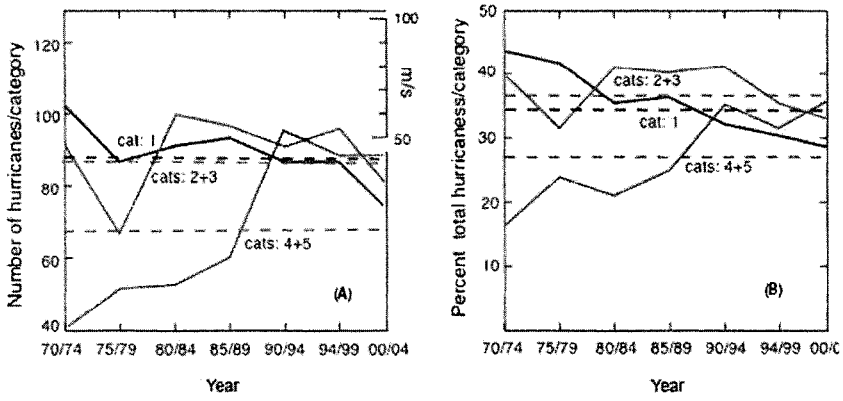

Figure 5: Intensity of global hurricanes according to the Saffir-Simpson scale (categories 1 to 5), in 5 year periods. (A) The total number of storms and (B) the percent of the total number of hurricanes in each category class. Webster et al. (2006).

Cause and attribution of the increased hurricane activity

The increase in global hurricane intensity since 1970 and the increase in the number of named storms in the North Atlantic since 1995 are associated directly with a global increase in tropical sea surface temperature (Emanuel 2005; Webster et al. 2005; Hoyos et al. 2006; Elsner et al. 2006). Figure 6 shows the variation of tropical sea surface temperature (SST) in each of the ocean regions where tropical cyclone storms form. It is seen that in each of these regions that the sea surface temperature has increased by approximately 0.5°C (or 1°F) since 1970. The causal link between SST and hurricane intensity was established over 50 years ago, when it was observed that tropical cyclones do not form unless the underlying SST exceeds 26.5°C and that warm sea surface temperatures are needed to supply the energy to support development of hurricane winds (e.g., Gray, 1968). The role of SST in determining hurricane intensity is generally understood and is supported by case studies of individual storms and by the theory of potential intensity (e.g. Emanuel 1987). Hoyos et al. (2006) have clarified the relationship between seasonally-averaged hurricane intensity and the seasonally-averaged tropical SST in individual ocean basins. By isolating the trend from the shorter modes of variability and applying a methodology based on information theory, Hoyos et al. found that the global increase in category 4 and 5 hurricanes for the period 1970-2004 is directly linked to the trends in SST.

Skeptics have argued that wind shear plays a predominant role in variations of hurricane intensity (e.g. Klotzbach 2006; Chan 2006). While the intensity of an individual storm may be determined by wind shear and even the intensity of storms in an entire season may be dominated by wind shear (e.g. in an El Nino year), there is no trend in wind shear since 1970 that can explain the global increase in hurricane intensity (Figure 7).

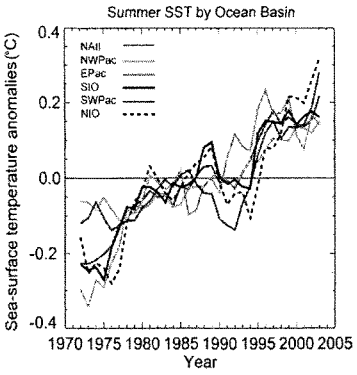

Figure 6. Evolution of the sea surface temperature anomalies relative to the 1970-2004 period for the North Atlantic, Western Pacific, East Pacific, South Indian Ocean, Southwest Pacific and North Indian Ocean Basins (Curry et al., 2006).

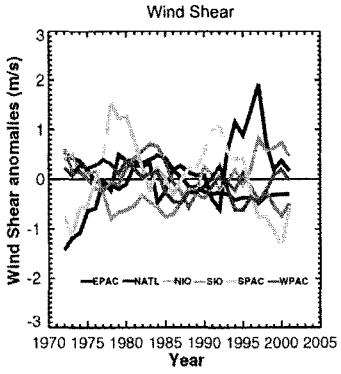

Figure 7. Evolution of the wind shear anomalies relative to the 1970-2004 period for the North Atlantic, Western Pacific, East Pacific, South Indian Ocean, Southwest Pacific and North Indian Ocean Basins (Hoyos et al., 2006).

A number of natural internal oscillations of the atmosphere/ocean system have a large impact on SST (e.g. El Nino, North Atlantic Oscillation). However, decadal-scale oscillations tend to be specific to each ocean basin and are often anti-correlated from one basin to another. The data show that the tropical SST increase is global in nature and occurs consistently in each of the ocean basins (Figure 6). This tropical warming is consistent with a similar increase in global surface temperatures (Figure 8). External forcing factors, such as volcanic eruptions and solar

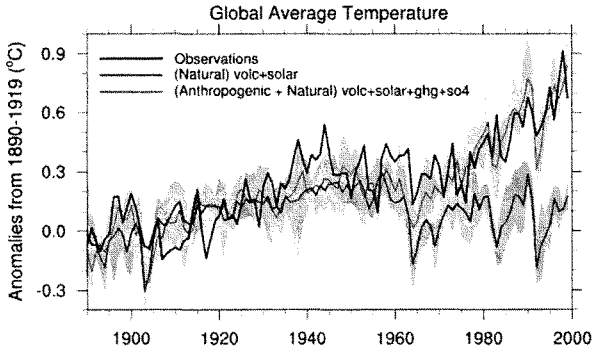

Figure 8. The four-member ensemble mean (red line) and ensemble member range (pink shading) for globally averaged surface air temperature anomalies for all forcing (volcano + solar + GHG + sulfate + ozone); the solid blue line is the ensemble mean and the light blue shading is the ensemble range for globally averaged temperature response to natural forcing (volcano + solar); the black line is the observations after Folland et al. (2001). Taken from Meehl et al. 2004.

variability, which are also natural causes, are known to produce global responses in surface temperature. The surface temperature trends over the last century has been extensively studied as summarized in the IPCC TAR (2001) and detailed in subsequent climate modeling studies (Figure 7; Meehl et al. 2004). The unanimous conclusion of these climate model simulations is that the global surface temperature trend since (including the trend in tropical SSTs) cannot be reproduced in climate models without inclusion of anthropogenic greenhouse gases. Knutson et al. (2006) specifically attributed the increase in global tropical sea surface temperatures to greenhouse warming.

In summary, the arguments for the hypothesis that

> Greenhouse warming is causing an increase in global hurricane intensity

have been presented as a causal chain:

> 1. *Frequency of the most intense hurricanes is increasing globally.*
> 2. *Average hurricane intensity increases with increasing tropical SST.*
> 3. *Global tropical SST is increasing as a result of greenhouse warming*

Skeptics argue that the increase in hurricane intensity reported by Emanuel (2005) and Webster et al. (2006) is greater than that expected from the theory of potential intensity and from climate model simulations (Knutson and Tuleya, 2004; Oouchi et al. 2006), by a factor of 2-4. Skeptics have used this inconsistency in two ways: first, to argue that the observed trend cannot be associated with greenhouse warming, because it does not agree with the model and theoretical results (Landsea, 2005); and second, to argue the model results are wrong, because they are not supported by the observations (Michaels et al, 2005). The appropriate way to interpret the finding that the model simulations show a slower increase of hurricane intensity than do the data is that the models may be underestimating the impact of global warming on hurricane intensity or there are additional mechanisms whereby SST indirectly influences hurricane intensity in ways that are not accounted for by theories of potential intensity or the climate models. Michaels et al. (2006) argue for a step-like, rather than continuous, influence of SST on tropical cyclone intensification.

Skeptics have argued that the causal chain linking hurricane intensity to an increase in tropical sea surface temperature caused by greenhouse warming should also hold for individual ocean basins (e.g. Chan 2006), and I concur with this. The North Atlantic hurricanes deserve special discussion in light of the relatively long historical record of hurricanes, and the repeated assertions from the National Hurricane Center that the recent elevated hurricane activity is associated with natural variability, particularly the Atlantic Multidecadal Oscillation (AMO). Figures 1-4 suggest that natural modes of multidecadal variability, notably the AMO (~70 year cycle), do have an influence on North Atlantic hurricane activity. However, recent examination of the data by Mann and Emanuel (2006) and Trenberth and Shea (2006) suggest that the impact

of the AMO on tropical sea surface temperature and hurricane activity has been overestimated owing to the convolution of the AMO with the global forcing (natural plus anthropogenic). Analyses that rely solely on SST to identify the AMO may have aliased the phase and amplitude of the AMO signal (Mann and Emanuel, 2006). The observations of Bryden et al. (2005) show that the North Atlantic thermohaline circulation has decreased during the period since 1950, suggesting that there is no rationale for supposing that the AMO has moved into an anomalously positive phase. And most compellingly, the strength of the tropical storm activity during the period 1995-2005 (which is at least a decade away from the expected peak of the current AMO cycle), is already 50% greater than the previous peak period ca. 1950 (Table 1).

What can we conclude from the above analysis? The evidence that greenhouse warming has caused an increase in tropical sea surface temperature is substantial. The link between sea surface temperature and hurricane intensity is well understood theoretically and is supported observationally. The causal chain linking the increase in global hurricane intensity to global warming cannot be invalidated by the available evidence. The primary issue is whether the magnitude of the observed increase in hurricane intensity is as large as that found by Webster et al. (2005), given concerns about the quality of the data. As previously stated, a reanalysis of the global hurricane data set is needed to create a robust and homogeneous climate data record. Current efforts to use very high resolution coupled climate models to examine the impact of global warming on hurricane characteristics will also shed new light on the subject once these models are capable of simulating realistic tropical cyclones.

While both groups of scientists (those that support the natural variability explanation and those that support the global warming contribution) agree that hurricane activity in the North Atlantic will remain elevated for some years, the implications for future projections of hurricane activity are quite different. Based upon the hypothesis of natural variability being the cause of the high hurricane activity in the North Atlantic since 1995, there have been several predictions of a forthcoming downturn in hurricane activity: Goldenberg et al. (2001) imply a downturn in 10-40 years; and Gray (2006) anticipates a downturn in 3-8 years associated with a global cooling. By contrast, based upon the historical data record in the North Atlantic, an increase of 0.5°C (1°F) in tropical sea surface temperature implies an additional 5 tropical storms per season (Figure 9), and hence global warming will result in an continued increase in the number of North Atlantic storms and hurricane intensity globally.

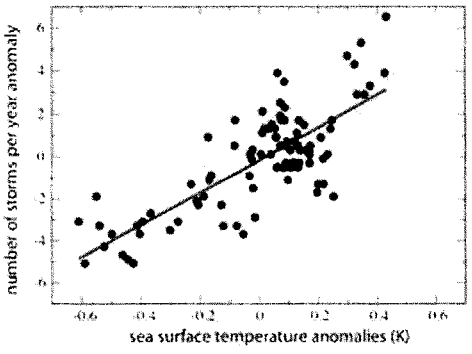

Figure 9: Relationship between the total number of North Atlantic tropical storms and hurricanes and the sea surface temperature, using data points that are 5-year running averages for the period 1910-2005. Figure courtesy of J. Gulledge.

It may take up to a decade for the observations to clarify the situation as to which explanation, natural variability or global warming, has better predictive ability. In the short term, evaluation of seasonal forecasts for the North Atlantic can provide some insights into the predictive capability of natural variability. Holland (2006) has conducted an assessment of statistical forecasts of North Atlantic tropical storm activity. Seasonal forecasts are based upon the statistics of North Atlantic tropical storms for the period since 1950. W. Gray commenced making seasonal forecasts in 1984. For the first decade (until 1994), Gray's forecasts performed well (Figure 10), with a bias error of -0.2 storms per season for the June forecasts and a root mean square error of 1.8. In the period since 1998, Gray's forecasts have performed much worse, with a notable low bias averaging -3.1 storms per season and a root mean square error of 5.2. NOAA's seasonal forecasts for the same period show little variation from Gray's forecasts. It is argued here that the persistent low bias in the seasonal forecasts since 1995 indicates that the elevated activity in this period cannot be explained solely by natural variability seen in the historical data record since 1950.

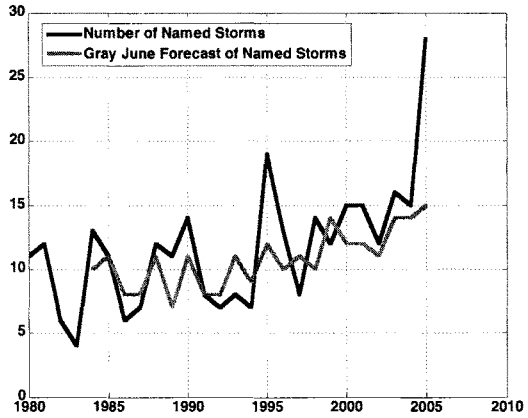

Figure 10: Evaluation of W. Gray's seasonal June forecasts for North Atlantic named storms. Figure courtesy of G. Holland.

Finally, I return to the general issue of skepticism about hurricanes and global warming. Skepticism about whether the global warming argument has been made convincingly is not the same as assuming that the converse (natural variability) must therefore be true. The arguments for natural variability are refuted by: the known range of natural variability in the existing database; and the absence of a convincing mechanism for natural variability that can explain the global increase in both oceanic temperatures and the frequency of intense hurricanes.

Mixing politics and science

Mixing politics and science is unavoidable on scientific topics of significant societal and policy relevance. However, this process, aided and abetted by the media, often politicizes the science and polarizes the scientific community in ways that are detrimental both to the scientific and

policy processes. While the scientific debate on the topic of hurricanes and global warming has been proceeding in the peer reviewed scientific journals (as summarized above), the public debate in the media and even in congressional testimony has unfortunately diverged from the scientific debate. As the scientific debate continues and uncertainties in this research are addressed, one would hope that the general message conveyed to the public and to policy makers is that a scientific debate is underway by respected research scientists on the subject of a link between global warming and hurricanes and that the research findings, if correct, imply an elevated risk for increased damage from future hurricanes as global warming proceeds. Instead, there have been substantial public efforts to ignore and/or discredit this research and even the scientists that have been conducting this research. This divergence of the public debate from the scientific debate has confused and misled the public and policy makers on this important issue.

After considerable reflection motivated by my personal experiences this past year with the media, the public, and policy makers as a result of publication of the Webster et al. paper, I have come to the following understanding of the complex interplay of issues that have contributed to this situation:

- The influence of global warming deniers, consisting of a small group of scientists plus others that are motivated to deny global warming owing to the implications associated with any policy to control greenhouse gas emissions
- The tendency of a large number of forecast meteorologists (including TV meteorologists) to deny global warming and in particular the possibility of a link between increasing hurricane intensity and global warming
- The public statements by NOAA administrators and National Weather Service scientists that neglect the published research and deny a link between hurricanes and global warming
- The role of certain elements of the media in promoting divisiveness among the scientists, polarizing the debate, and legitimizing disinformation

The issue that is arguably of greatest concern to research scientists is the public position taken by NOAA on the issue of hurricanes and global warming. Statements by NOAA administrators and selected scientists from the National Weather Service in Congressional testimony, press communications, and website material have categorically denied a connection between global warming and increased hurricane intensity. Most egregiously, on its web site http://www.magazine.noaa.gov/stories/mag184.htm NOAA states that there is a consensus of NOAA scientists on this issue, although public identification of a number of NOAA scientists that did not agree with this consensus opinion resulted in an addendum at the end of the online article to state that the agreement is among *some* NOAA researchers and forecasters. This information being disseminated by NOAA is misleading, incomplete and one-sided, and does not accurately reflect the state of knowledge as reflected in the published scientific literature. NOAA's statements, by default, are viewed by the public as the official federal position on hurricanes and global warming. Government leadership that is willing and able to engage in an appropriate representation of scientific research is essential for scientifically well-informed national planning and preparedness.

The adverse impacts of misleading information on the hurricanes and global warming issue were emphasized to me during a recent lecture tour through Florida. In our meeting with Governor Jeb

Bush on 31 May, Governor Bush voiced frustration over the disagreement between the National Hurricane Center and climate researchers and also the media furor that made it very difficult to assess the actual risk. Florida is extremely vulnerable to any increase in hurricane activity. During the past 10 years 48% of U.S. landfalling hurricanes have struck Florida, and during 2004 it has been estimated that 1 in 5 Florida homes were damaged by hurricanes striking Florida that year.

Given the important socioeconomic impacts and policy implications, the scientific controversies, and the divergence of the public from the scientific debate, an independent scientific assessment is needed on the topic of hurricanes and global warming. I hope that such an assessment would clarify the scientific debate, identify the uncertainties, and illuminate the fuzzy thinking that has entered into the public debate. The National Research Council Board on Atmospheric Science and the Climate Research Committee have prepared a proposal for such an assessment study, but the NRC has thus far been unable to identify funding for this study (Chris Elfring, NAS, personal communication).

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Chairman TOM DAVIS. Thank you very much, Dr. Curry.
Dr. Christy, thank you for being with us.

STATEMENT OF JOHN R. CHRISTY

Dr. CHRISTY. Thank you, Chairman Davis and Ranking Member Waxman and committee members, who evidently are not here. I am John Christy, professor of atmospheric science and director of the Earth System Science Center at the University of Alabama in Huntsville. I am also an Alabama State climatologist.

I recently served as the lead author of the Climate Change Science Program's Reporter [CCSP], on temperature trends, and was a panelist on the National Academy of Science's Report on Temperature Reconstructions for the Past 2,000 years.

I will be reporting today on research I have completed over the past 2 years that has just appeared or will be appearing shortly in publications. In one paper my research shows that in central California the changes in temperature indicate a pattern more closely related to land use changes rather than the effects anticipated by the greenhouse theory. Two other papers deal with atmospheric temperatures and indicate that the atmosphere is apparently warming at a more modest rate than projected by a greenhouse theory.

Earlier this year I and three co-authors published a paper on temperature trends in central California since 1910. This was actually a followup to work I did as a teenager growing up in San Joaquin Valley some 40 years ago when all I had was a pencil, graph paper, a slide rule, and a fascination for climate. This new work, though, was sponsored by the National Science Foundation.

What drew my attention to central California now was the apparent rapid rise in night time temperatures in the valley being warmer than any I remembered as a teenager. In my written testimony I described in more detail how that work was accomplished, but let me say here that there was a lot of manual digitization of paper records. We utilized literally 10 times the amount of data of any previous study in this region.

We discovered that, indeed, since 1910 the night time temperatures in the valley had warmed remarkably, about 6 degrees in summer and fall, while the daytime temperatures in the valley actually fell 3 degrees in those seasons. This night time warming is consistent with the effects of urbanization and massive growth in irrigation around the 18 stations we used. The cooling daytime temperatures are also consistent with irrigation.

But the real surprise was the temperature record of the 23 stations in the Sierra foothills and mountains. We found no change in temperature since 1910. Now, irrigation and urbanization have not affected the foothills and mountains to any large extent, but evidently nothing else had, either.

Those temperature observations did not match the output given by models which included greenhouse effects specifically downscaled for California. These models show that the Sierras should have warmed more rapidly than the valley.

While these results are provocative, we will, of course, await more analysis. That is the way science works. However, we performed four ways to check potential errors of these trends and

found that the night time warming in the valley was significant in all cases, but the changes in the Sierras were not. These results don't agree with the current greenhouse warming theory when applied to this region.

While the bottom line here is that models have shortcomings in reproducing the type of regional changes that apparently have occurred, this also implies that they would be ineffective at projecting future changes with confidence, especially as a test of the effectiveness of certain policies.

Now, there was considerable media attention given to the CCSP report about temperature trends at the surface and those in the lower atmosphere up to about 35,000 feet. Much of it, in my view, was misrepresented, they misrepresented the report, and in my written testimony I deal with some of those issues.

The basic question that CCSP addressed was whether actual temperature trends in the atmosphere were warming faster than the surface, because that is a feature of climate model projections. The number of observational data sets, or a number of observational data sets, indicate a slower rate of atmospheric warming than models project. My new research sponsored by the Department of Energy, Department of Transportation, and National Oceanic and Atmospheric Administration seeks to answer questions left open by the CCSP.

In these studies, I included new observational data sets and more formally assessed errors and uncertainties. In both papers we show that atmospheric trends indeed appear to be less positive than greenhouse theory projects, especially in the tropics, which represent fully one-third of the Earth.

Now what does this mean? That greenhouse gases are increasing in concentration is clearly true, and therefore they will have an impact on the radiation budget of the atmosphere. In our observational work we have not been able to show clear support for the way this effect is being depicted in the present set of climate models.

To policymakers my point is the following: we cannot reliably project the trajectory of the climate for large regions—United States, for example—it would be far more difficult to reliably predict the effects of a policy that altered by a tiny amount any greenhouse emissions. The evidence I presented here is consistent with that view.

Now, I feel I have some expertise not common to the average scientist that I believe is important to the whole discussion of climate change. In the 1970's I taught science and math in Africa as a missionary teacher, and I observed the energy system there. The energy source was wood chopped from the forest. The energy transmission system was the backs of women and girls. The energy use system was burning the wood in an open fire indoors for heat and light. The consequence of that energy system was deforestation and habitat loss, while for people it was poor respiratory and eye health.

The U.N. estimates 1.6 million women and children die each year from the effects of this indoor smoke. That is 1.6 million die each year now due to this primitive energy system. So the energy system will grow, as it should, to allow these people to experience the

advances in health and prosperity that we in this country enjoy. They are far more vulnerable to impacts of poverty and political strife than whatever the climate system might do.

I simply close with a plea: please remember the needs and aspirations of the poorest among us when policy is made.

Thank you very much.

[The prepared statement of Dr. Christy follows:]

House Committee on Government Reform

Written Testimony of John R. Christy, PhD
University of Alabama in Huntsville

20 July 2006

Chairman Davis, Ranking Member Waxman and committee members, I am John Christy, professor of Atmospheric Science and Director of the Earth System Science Center at the University of Alabama in Huntsville. I am also Alabama's State Climatologist. In addition I recently served as a convening Lead Author of the first Climate Change Science Program's (CCSP) report on temperature trends and was a Panelist on the National Academy of Science's report on temperature reconstructions for the past 2,000 years.

Summary

I will be reporting today on research that has just appeared or that will be published shortly. Many of the statements below will be framed in terminology of "consistent with" rather than "proof of". This is the way science works in the field of climate because we basically cannot give a 'final answer" which will stand the test of all time. Science evolves as new information is discovered, and that is particularly true for climate science.

In the following I will first describe how a carefully reconstructed time series of temperatures in the Central Valley of California indicate that changes since 1910 are more consistent with the impacts of land-use changes than the effects now expected from the enhanced greenhouse theory. Secondly, I will present results from two papers which examine our knowledge of atmospheric temperatures as they relate to the surface. The results point to a more modest atmospheric warming than anticipated from our current understanding of the enhanced greenhouse theory.

The meaning for policy makers is two-fold. First, it is apparent that we have little skill at reproducing and predicting changes on regional scales such the U.S. Secondly, it is therefore far more difficult to predict the effect of a particular policy aimed at altering current emissions of greenhouse gases by a tiny amount. In other words, we are unable with any confidence to predict climate outcomes from policy options, especially where our citizens live.

Central California Temperatures

Earlier this year I and 3 coauthors published a paper on temperature trends in Central California since 1910 (Christy et al. 2006a). This was actually a follow-on

of work I did as a teenager growing up in the San Joaquin Valley some 40 years ago when all I had was a pencil, graph paper, a slide rule and a fascination with climate. In this new work, sponsored by the National Science Foundation, we set out to collect all available information on surface temperatures in the Valley and nearby Sierra Nevada mountains and then develop a means to generate temperature trends with high levels of confidence.

What drew my attention to this problem was the apparent rapid rise in nighttime temperatures in the Valley, temperatures that appeared to be much above those I remember recording as a teenager. We produced a dataset with many observations never before utilized since we performed the manual digitization of those records. In addition, we examined all of the ancillary information to determine when stations experienced changes that could affect the overall trends. This involved reading and digitizing over 1600 pages of information about the stations and instruments. This has not been done before in California.

We then developed a method which takes into account the various events that affected each station, i.e. a move, a change of instruments, a change in procedure, etc. We discovered that on average, a station experienced about 6 events that could produce a change in the surface temperature. We combined the stations in the Valley to see what went on the last 100 years and did the same for the Sierras as a control experiment. Our work uses literally 10 times the amount of data of previous attempts at creating such temperature records.

We discovered that indeed the nighttime temperatures in the 18 Valley stations were warming rapidly, about 6°F in summer and fall, while the same daytime temperatures fell about 3°F. This is consistent with the effects of urbanization and the massive growth in irrigation around these thermometers.

The real surprise was the temperature record of the 23 stations in the Sierra foothills and mountains. Here, there was no change in temperature. Of course irrigation and urbanization have not affected the foothills and mountains to any large extent. Evidently, nothing else had influenced the temperatures either.

These results did not match the results given by models specifically downscaled for California where the Sierra's are shown to have warmed to a greater degree than the Valley (e.g. Snyder et al. 2002).

These results are provocative, but we performed four different means of determining the error characteristics of these trends and determined that the result that nighttime warming in the Valley was significant but that changes in the Sierras, either day or night, were not. Models suggest that the Sierra's are the place where clear impacts of greenhouse warming should be found, but the records we produced did not agree with that hypothesis. The bottom line here is that models can have serious shortcomings when reproducing the type of regional changes that apparently have occurred. This also implies that they

would be ineffective at projecting future changes with confidence, especially as a test of the effectiveness for specific policies. In other words it will be almost impossible to say that a specific policy will have a predictable or measurable impact on climate.

[Note: as a follow-up to Christy (2002) on Alabama temperature trends, we examined the output from 10 climate models. All showed a warming trend for 1900 to 2000. The observations revealed a cooling trend (common throughout the SE U.S. Again, evidence that model reconstructions of the past encounter great difficulty in being correct, and thus future projections should have low confidence attached to them.]

Atmospheric Temperature Trends

There was considerable media attention given to the CCSP report about temperature trends in the atmosphere, about 0 – 35,000 ft, versus those of the surface for period since 1979. The basic task of the CCSP was to look at the various datasets of atmospheric and surface temperature and draw conclusions about their relative trends. Several atmospheric datasets revealed trends less than or the same as the surface, which is at odds with greenhouse theory as projected in present-day climate models.

The key statement regarding GLOBAL trends in the report claimed, "This significant discrepancy no longer exists." It would have been more accurate in my view to have said, "The magnitude of these global discrepancies is not significant." This is a subtle but important difference because it acknowledges that discrepancies still exist but that the differences between the global surface and atmospheric trends are within the uncertainty bounds of our various measurements. In other words, rather than being a statement acknowledging the certainty of the measurements and models it should have been a statement claiming the uncertainty of our knowledge. I had proposed the second rendition, but was unsuccessful in seeing it implemented.

Be that as if may, the more interesting issue is found in the tropical region. Here we have significant discrepancies between surface and atmospheric trends for most datasets. The tropical region is not trivial, constituting 1/3 of the global area.

The report acknowledged this curiosity as an "open question" but came to a consensus statement that the reason for the discrepancy was (a) errors common to models (b) errors in most observational datasets or (c) a combination of the two. The report says that the authors "favored" the second reason, i.e. observational error. The word "favor" was used to allow a sense of a majority view, since I did not agree with that assessment. I preferred the third option, that models and observations have roughly the same amount of error.

I was fairly happy with choosing option c because I knew of the two papers that were going to appear this year based on research sponsored by the Dept. of Energy, the Dept. of Transportation and the National Oceanic and Atmospheric Administration (Christy and Norris 2006, Christy et al. 2006b). In these papers I dealt specifically with atmospheric trends and the information we have to assess errors and uncertainties. In both papers we show that atmospheric trends from our UAH datasets are most consistent with independent measurements than is the one dataset that showed enough atmospheric warming to allow the CCSP to make its statement about possible observational error.

In one paper, we examined eight upper air datasets in the tropics. All but one revealed much less cooling aloft than at the surface. And, in all cases, these seven differed from the one warming dataset in the same way, something that would be highly improbably by chance. This suggested that the one satellite dataset showing warming was likely affected by spurious jumps near the middle of the 1979-2004 period. The conclusion of the paper was that there is likely a significant difference between the surface and atmospheric trends, with the atmosphere being cooler. This is significant because all model simulations indicate the atmosphere should be warming faster than the surface if greenhouse influences are correctly included in climate models.

Science evolves. The information we create today may be superceded tomorrow, which always means we should be cautious of the certainty we often ascribe to our results. I wish I could report to you the preliminary results of our temperature work in East Africa that should be published next year, but we must still do all of the details that will enhance the confidence in those results.

What does this mean?

That greenhouse gases are increasing in concentration is clearly true and therefore they will have an impact on the radiation budget of the atmosphere. In our observational work we have not been able to show support for the way this effect is being depicted by the present set of climate models.

For policy makers my point is the following. We cannot reliably project the trajectory of the climate for large regions within the U.S. for example. It would be a far more difficult task to reliably predict the effects of a policy that altered a tiny amount the emissions which act to enhance the greenhouse effect. The evidence I've spoken here is consistent with that view. However, other reasons such as energy security may drive this issue to a different mix of energy sources.

I feel I have some expertise not common to the average scientist that I believe is important in this whole discussion of climate change which may be due to humans. In the 1970's I taught science and math in Kenya as a missionary teacher. I observed the energy system there. The energy source was the wood chopped from the forest. The energy transmission system was the backs of

women and girls. The energy use system was burning the wood in an open fire indoors for heat and light. The unintended consequences of that system were poor respiratory and eye health, and a degraded tropical habitat. The U.N. estimates 1.6 million women and children die each year from the effects of this indoor smoke.

Energy demand will grow, as it should, to allow these people to experience the advances in health and prosperity that we in the U.S. have. They are far more vulnerable to the impacts of poverty and political strife than climate changes. I simply close with a plea, please remember the needs and aspirations of the poorest among us when energy policy is made.

Thank you.

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Snyder, M.A., Bell, J. L., Sloan, L. C., Duffy, P. B., and Govindasamy, B., Climate responses to a doubling of atmospheric carbon dioxide for a climatically vulnerable region, Geophysical Research Letters, 29 (11), 10.1029/2001GL014431, 2002.

Chairman TOM DAVIS. Thank you very much.
Dr. Pielke.

STATEMENT OF ROGER A. PIELKE, JR.

Dr. PIELKE. Thank you, Chairman Davis, for the opportunity to offer testimony today. My name is Roger Pielke, Jr. I am a professor of environmental studies at the University of Colorado, where I studied the intersection of science and policy.

I would like to start by reading a quote by former Representative James Scheuer, 1992, who was speaking at a hearing not unlike this one. He was speaking to representatives of the Federal research community. He said, "How much longer do you think it will take before the Nation's climate researchers are able to hone down their conclusions to some very simple recommendations on tangible, specific action programs that are rational and sensible and cost effective for us to take, justified by what we already know?"

The main message of my testimony is that the questions about what actions on climate change make sense in the short term raised by Congressman Scheuer remain largely unanswered 16 years later. Until we better organize the climate science and technology enterprise to focus on policy options for the short term, the climate debate is likely to remain in its present gridlock.

I am going to quickly go through eight take-home points in my testimony that are spelled out in far more detail than I can present here.

No. 1, human-caused climate change is real and requires attention by policymakers to both mitigation and adaptation, but there is no quick fix. The issue will be with us for decades and longer. The IPCC has concluded that greenhouse gas emissions resulting from human activity are an important driver of changes in climate, and on this basis alone I am personally convinced that it makes sense to take action to limit greenhouse gas emissions. Of course, the answer to what action is not at all straightforward. It involves questions of on what time scales, at what cost, with what consequences, with what foregone opportunities, and what mix of adaptation and mitigation.

Two is a very important point: any conceivable emissions reductions policies, even if successful, cannot have a perceptible impact on the climate for many decades. The long lead time until mitigation could have a perceptible effect on the climate system seem to be well appreciated by many scientists and policy analysts, but seems less well appreciated in the public and political debate over climate change.

It is quite easy to postulate various alternative scenarios for future emissions, but at the same time it is similarly quite easy to discuss various scenarios for global poverty, democracy in Iraq, or the future state of the deficit. What matters for real world outcomes are not future scenarios but concrete, rational policy actions.

No. 3, the cost of action, whatever they may be, are born in the near term and the benefits are achieved in the distant future. Due to the properties of greenhouse gases in the atmosphere and their effects on the climate system, even if society takes immediate and drastic action on emissions there could be no scientifically valid ar-

gument that such actions will lead to a perceptibly better climate in coming decades.

The point of this analysis is not to throw up our hands and do nothing about mitigation, but the asymmetry in costs and benefits suggests that if meaningful action is to occur on mitigation we must think about different strategies, and in particular policy options that have more symmetry between the timing of costs and benefits.

I fully intend that this perspective be viewed as an alternative to the two-sided debate that has been caricatured as climate skeptics versus climate alarmists. Perhaps those holding this third position might be characterized as climate realists.

No. 4, many policies that result in a reduction in emissions also provide benefits in the short term that are unrelated to climate change. Examples of such short-term issues related to mitigation include addressing the cost of energy, the benefits of reducing reliance on fossil fuels from the middle east, the innovation and job-creating possibilities of alternative energy technologies, reducing particulate air pollution, increasing transportation efficiencies, and so on.

In coming decades, the only policies that can effectively be used to manage the immediate effects of climate variability and change will be adaptive. For example, even accepting a large role for human-caused influences on hurricane intensities, greenhouse gas mitigation offers little prospect for significantly reducing future hurricane damages.

No. 6, climate policy, particularly international climate policy under the Framework Convention on Climate Change has been structured so as to keep policy related to the long-term climate change distinct from policies related to shorter-term issues of energy policy and adaptation.

No. 7, following this political organization of international climate change policy, research agendas have emphasized the long term, meaning that relatively very little attention is paid to developing specific policy options or near-term technologies that might be put into place with both short-term and long-term benefits. The U.S. global change research program and its successors, the climate change science program, have never placed the needs of decision-makers at the center of their mission, focusing instead on advancing scientific understandings or reducing uncertainties.

Part of the explanation for the situation lies in the fact that the scientific community has benefited immensely from the current approach, and an emphasis on short-term policy and technological options would necessarily imply a different approach to climate science and technology policy priorities.

Another part of the explanation is that it is quite easy for policymakers to put the burden of solving the problem onto the scientific community, which also has the effect of using research policies as a substitute for other types of action. With political advocates on either side of the issue also looking to science as a leading element of their public relations and political lobbying campaigns, it should be no surprise that scientific and technological research on climate has focused on long-term issues over the generation of practical options for short-term considerations.

Eight, finally, the climate debate may have begun to slowly reflect these realities, but the research and development community has not yet focused much attention on developing policy and technological options that might be politically viable, cost effective, and practically feasible. I am convinced that as people begin to see the limited performance of existing approaches to emissions reductions and as the toll of climate-related disasters grow due to ever-increasing vulnerabilities, there will be a shift to a more short-term focused approach to climate mitigation and adaptation. However, given the institutional and political momentum which currently characterize the climate issue, there is a substantial risk that the issue will continue to display sound and fury, with most action being symbolic or simply ineffectual.

The question is whether we can organize our intellectual infrastructure to invent and bring forward policy and technological options that will satisfy both the short-term and long-term facets of this incredibly complex issue.

Through oversight of the climate change science program and the climate change technology program, Congress might motivate the evolution of these programs to focus more explicitly on the needs of decisionmakers.

Thank you.

[The prepared statement of Dr. Pielke follows:]

**STATEMENT TO THE
COMMITTEE ON GOVERNMENT REFORM
OF THE UNITED STATES HOUSE OF REPRESENTATIVES**

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20 July 2006

> *How much longer do you think it will take before [the nation's climate researchers] are able to hone [their] conclusions down to some very simple recommendations, on tangible, specific action programs that are rational and sensible and cost effective for us to take . . . justified by what we already know?*[1]
>
> *Representative James Scheuer (D-NY), 1992*
>
> *Clearly, it's time for some radical ideas about solving global warming. But where's the radical realism when we need it?*[2]
>
> *Katherine Ellison, 2006*

I thank the Chairman and the Committee for the opportunity to offer testimony this morning on "Climate Change: Understanding the Degree of the Problem."

My name is Roger Pielke, Jr. and I am a Professor of Environmental Studies at the University of Colorado where I also direct the CIRES Center for Science and Technology Policy Research.[3] My research focuses on the connections of science and decision making. I have been studying climate change science and policy for about 15 years. A short biography can be found at the end of my written testimony, including links to my publications. In my oral testimony I'd like to highlight eight "take home points," which are developed in greater detail in my written testimony and in the various peer-reviewed scientific papers cited therein.

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[1] House Committee on Science, Space, and Technology, 1992. Hearing on U.S. Global Change Research Program, May 5, Committee Report 102-148, at p. 88.

[2] Ellison, K. 2006. Turned off by global warming, *The New York Times*, Late Edition - Final, Section A, Page 13. http://select.nytimes.com/gst/abstract.html?res=F60B17FA385A0C738EDDAC0894DE404482

[3] CIRES is the Cooperative Institute for Research in Environmental Sciences, a joint institute of the University of Colorado and the National Oceanic and Atmospheric Administration. The Center that I direct has received research funding from a number of other federal research agencies, including NSF and NASA. As can be gleaned from the citations, much of the work presented here that I have been involved in has benefited from collaboration with Daniel Sarewitz of Arizona State University. The views presented here are my own.

Abstract: The main message of my testimony is that the questions about what actions on climate change make sense in the short –term raised in the italicized quotes above remain largely unanswered, and that until we better organize the climate science and technology enterprise to focus on policy options for the short term, the climate debate is likely to remain in its present gridlock. Policies that address climate change – both mitigation (focused on modulating future climate via greenhouse gas emissions) and adaptation (focused on managing the impacts of climate events by increasing resilience and reducing vulnerabilities) -- have both long-term and short-term effects. To date climate policy has focused primarily on the long-term, and so too has research supported to inform policy. As a consequence, too little attention is paid to policy options and technological alternatives that might make sense in the short-term. One reason for the oversight of the short-term is the intellectual gerrymandering of the climate change issue at the international level to focus extremely narrowly on greenhouses gases and their effects. Billions of dollars of public investments in climate science and technology might be reoriented to better serve the needs of decision makers grappling with climate change, which will be a policy issue for decades to come, by focusing on policies that make sense in the short term as well as long term.

Take Home Points

1. Human-caused climate change is real and requires attention by policy makers to both mitigation and adaptation – but there is no quick fix; the issue will be with us for decades and longer.
2. Any conceivable emissions reductions policies, even if successful, cannot have a perceptible impact on the climate for many decades.
3. Consequently, costs (whatever they may be) are borne in the near term and benefits related to influencing the climate system are achieved in the distant future.
4. However, many policies that result in a reduction in emissions also provide benefits in the short term unrelated to climate change.
5. Similarly adaptation policies can provide immediate benefits.
6. But climate policy, particularly international climate policy under the Framework Convention on Climate Change, has been structured to keep policy related to long-term climate change distinct from policies related to shorter-term issues of energy policy and adaptation.
7. Following the political organization of international climate change policy, research agendas have emphasized the long-term, meaning that relatively very little attention is paid to developing specific policy options or near-term technologies that might be put into place with both short-term and long-term benefits.
8. The climate debate may have begun to slowly reflect these realities, but the research and development community has not yet focused much attention on developing policy and technological options that might be politically viable, cost effective, and practically feasible.

Discussion of the 8 Take-Home Points

1. **Human-caused climate change is real and requires attention by policy makers to both mitigation and adaptation – but there is no quick fix; the issue will be with us for decades and longer.**

Nothing in this testimony should be interpreted as contradicting the assessment of climate change science provided by Working Group I of the Intergovernmental Panel on Climate Change (IPCC).[4] The IPCC has concluded that greenhouse gas emissions resulting from human activity are an important driver of changes in climate. And on this basis alone I am personally convinced that it makes sense to take action to limit greenhouse gas emissions. Of course, the answer to "what action?" is not at all straightforward. (e.g., on what timescales, at what costs, with what consequences, with what foregone opportunities? etc.) One of the important messages of the IPCC is that there is no quick fix to issues of climate change. In its most recent report the IPCC concluded, "Anthropogenic climate change will persist for many centuries."[5] More recent research has concluded that even under a hypothetical instantaneous curtailment of emissions, the world is committed to some degree of climate change into the future.

Note that throughout this testimony I use the phrase "climate change" as defined by the IPCC[6] to mean: "a statistically significant variation in either the mean state of the climate or in its variability, persisting for an extended period (typically decades or longer). Climate change may be due to natural internal processes or external forcings, or to persistent anthropogenic changes in the composition of the atmosphere or in land use."

The IPCC defines "climate variability" to mean: "variations in the mean state and other statistics (such as standard deviations, the occurrence of extremes, etc.) of the climate on all temporal and spatial scales beyond that of individual weather events. Variability may be due to natural internal processes within the climate system (internal variability), or to variations in natural or anthropogenic external forcing (external variability)."

Under the IPCC definitions both climate change and variability have human and non-human elements, and the human element goes beyond greenhouse gases to include other sources of human influences on the climate system (such as the effects of aerosols and land use changes). Clearly explicating these definitions are important because the Framework Convention on Climate Change uses a different and much narrower definition of climate change that is focused only on the marginal effects of greenhouse gas emissions on the climate system. The different definitions profoundly affect climate policy and the relationship of research and policy, which I discuss below under take-home point #7.

[4] http://www.ipcc.ch

[5] http://www.ipcc.ch/pub/spm22-01.pdf at p. 17

[6] http://www.grida.no/climate/ipcc_tar/wg1/518.htm

2. Any conceivable e missions reductions policies, even if successful, cannot have a perceptible impact on the climate for many decades.

At a Senate hearing on climate change science and economics held one year ago, James Hurrell of the U.S. National Center for Atmospheric Research, made a very important observation about the timescale of the benefits of mitigation policies for altering climate behavior: "it should be recognized that mitigation actions taken now mainly have benefits 50 years and beyond now."[7] And Science magazine reported earlier this year, "The wheels of global climate change are in motion, and there is little we can do to stop them, at least in the short-term"[8] The long lead time until mitigation could have a perceptible effect on the climate systems seems to have been well appreciated by scientists and policy analysts, but seems to be less well appreciated in public and political debate over climate policy.

Scientists sometimes tend to overshadow this important point by talking about "scenarios" for future emissions rather than actual policies that lead to particular outcomes. Such scenarios have an important role for shaping thinking and research on the range of possible futures. At the same time, it is quite easy to postulate various alternative scenarios for future emissions that lead to changes in global temperature in future decades discernibly different than business as usual. It is of course similarly quite easy to discuss various rosy "scenarios" for global poverty, democracy in Iraq, or the future state of the deficit. What matters for real-world outcomes are not future scenarios but concrete, practical policy actions that lead to desirable outcomes.

From this perspective, for all of the bluster about the Kyoto Protocol, its implementation is much more about symbolism and setting the stage for future policy action rather than any significant effect on the climate system. Economist William Nordhaus of Yale University wrote recently that "the Kyoto Protocol is widely seen as somewhere between troubled and terminal. . . Even if the current Protocol is extended, models indicate that it will have little impact on global temperature change. Unless there is a dramatic breakthrough or a new design, the Protocol threatens to be seen as a monument to institutional overreach."[9]

According to Oxford's Steve Rayner the focus on Kyoto has distracted attention from other possible approaches,

> Unfortunately, support for Kyoto has become a litmus test for determining those who take the threat of climate change seriously. Between Kyoto's supporters and those who scoff at the dangers of leaving greenhouse gas emissions unchecked, there has been a tiny minority of commentators and analysts convinced of the

[7] http://energy.senate.gov/public/index.cfm?FuseAction=Hearings.Testimony&Hearing_ID=1484&Witness_ID=4227

[8] http://www.aaas.org/news/releases/2005/0318scipak.shtml

[9] http://www.fpif.org/fpiftxt/3167

> urgency of the problem while remaining profoundly sceptical of the proposed solution. But their voices have largely gone unheard.[10]

Nordhaus would seem to agree on this point: "Nations are now beginning to consider the structure of climate-change policies for the period after 2008-2012. Some countries, states, cities, companies, and even universities are adopting their own climate-change policies. Are there in fact alternatives to the scheme of tradable emissions permit embodied in the Protocol? The fact is that alternative approaches have not had a serious hearing among natural scientists or among policymakers."

Experience indicates that even those countries expressing strong support for emissions reductions face difficulties achieving those reductions in practice. Tim Dyson from the London School of Economics has offered a sobering view of such "climate realism":

> ". . . in the last decade or so virtually all countries have continued to burn greater amounts of fossil fuel. This also applies to those that have arguably been most prominent in supporting the Kyoto process - notably Canada, Japan and those of the EU. Many of these countries are unlikely to meet their CO2 reduction targets agreed under the Kyoto treaty (which finally came into force in 2005). Thus comparing 1990 and 2002, it is estimated that Canada's emissions increased by 22 percent and Japan's by 13. While the CO2 emissions of the EU(15) remained roughly constant, this was mainly due to reductions in Germany and Britain - both of which gained fortuitously from a move away from coal towards natural gas (which emits less CO2 per unit of energy). Of the remaining countries in the EU(15), only Sweden - which relies heavily on hydro and nuclear - registered a fall in CO2 emissions. Of the 36 'Annex B' countries of the Kyoto treaty (i.e. the industrialized countries, including former eastern bloc nations), only 12 experienced declines in emissions: the three in the EU(15), plus nine former eastern bloc nations. If one excludes these, then CO2 emissions among the remaining 24 Annex B countries rose by 13 percent during 1990-2002 (Zittel and Treber 2003). Of course, the United States, the world's largest emitter of CO2, is not a signatory to the Kyoto treaty. And, to complete the list of predictable social reactions, the 'Kyoto process' has involved no shortage of rather bitter recrimination between representatives of the US and EU countries."[11]

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[10] Rayner, S. 2004. Memorandum to: The Environmental Audit Committee House of Commons The international challenge of Climate Change: UK leadership in the G8 and EU, 24 September, http://sciencepolicy.colorado.edu/prometheus/archives/EAC%20memo%20fin.doc

[11] Dyson, T. 2005 "On development, demography and climate change: The end of the world as we know it?" London School of Economics, Paper prepared for Session 952 of the XXVth Conference of the International Union for the Scientific Study of Population, Tours, 18-23 July, 2005. http://iussp2005.princeton.edu/download.aspx?submissionId=50222 Compare, In 1995, Pekka E. Kauppi wrote presciently in Science that the goal of the Framework Convention on Climate Change to prevent "dangerous interference" in the climate system was either "unattainable or irrelevant If [climate model] projections are right, the climate will change, there will be dangerous effects and the Convention objective will be unattainable" (in Science, **220**:1454).

The bottom line is that with respect to modulating the behavior of the climate system current greenhouse gas mitigation policies being (discussed or implemented) are more symbolic than substantive. A number of observers believe that focusing on such policies has limited the scope of discussions about alternative policies that might show greater substantive outcomes. Advocates for action have limited discussion of alternatives by asserting that, for all of their flaws current approaches are merely "first steps" and a discussion of options might diminish political momentum for action. Of course, opponents to action don't wish to discuss policy options in the first place. As discussed below, action on adaptation has been a victim of the institutionalization of climate policy, which shows a strong bias in favor of mitigation over adaptation. But even with a pace of emissions reductions that seems practically if not politically inconceivable today, such reductions would have little or no perceptible effect on the climate system for decades.

More than ever, we need new and creative policy options on climate change that make sense in the short term.

3. **Consequently, costs (whatever they may be) are borne in the near term and benefits are achieved in the distant future.**

The reality of the time-lag of costs to benefits illustrates the disingenuousness of using current climate events to justify mitigation action. Due to the properties of greenhouse gases in the atmosphere and their effects on the climate system, even if society takes immediate and drastic action on emissions, there can be no scientifically valid argument that such actions will lead to a perceptibly better climate in the coming decades. For the foreseeable future the most effective policy responses to climate-related impacts (e.g., such as hurricanes and other disasters or diseases such as malaria) will necessarily be adaptive.

The point of this analysis is not to throw up our hands and do nothing about mitigation. But the asymmetry in costs and benefits suggest that if meaningful action is to occur on mitigation we must think about different strategies, and in particular policy options that have more symmetry between the timing of costs and benefits.

I fully intend that this perspective be viewed as an alternative to the two-sided debate that has been caricatured as "climate skeptics" vs. "climate alarmists". Perhaps those holding this third position might be characterized as "climate realists."

4. **Many policies that result in a reduction in emissions also provide benefits in the short term unrelated to climate change.**

Observers of climate policy have long recognized that mitigation actions can provide benefits that go beyond their effects on the long-term behavior of the climate system. In 2001 the IPCC's Working Group III on Mitigation argued,

> "The effectiveness of climate change mitigation can be enhanced when climate policies are integrated with the nonclimate objectives of national and sectorial policy

> development and be turned into broad transition strategies to achieve the long-term social and technological changes required by both sustainable development and climate change mitigation. Just as climate policies can yield ancillary benefits that improve wellbeing, non-climate policies may produce climate benefits. It may be possible to significantly reduce greenhouse gas emissions by pursuing climate objectives through general socioeconomic policies."[12]

This conclusion has been backed up by empirical research of communities in the United States that are taking action to mitigate greenhouse gas emissions. Consider the following extended excerpt from a study of local initiatives on climate change by M. Betsill at Colorado State University.

> "The experience of CCP [Cities for Climate Protection (CCP) campaign sponsored by the International Council for Local Environmental Initiatives] communities indicates that global climate change is most likely to be reframed as a local issue when city officials recognise that actions to control GHG emissions also address other local concerns already on their agendas. Localisation requires the prior existence of a local hook on which to hang the issue of global climate change. Localising global climate change is an important first step in developing a municipal response to global warming; it helps generate political support for reducing local GHG emissions. However, not all communities are able to move from reframing to policy action. There are several institutional barriers that make it difficult for cities to develop and implement policies and programmes for mitigating climate change: the issue does not fit the way most city governments organise themselves; many city governments lack the administrative capacity to monitor their GHG emissions; and there are often budgetary constraints that make it difficult to invest in emissions reduction activities. Ultimately, motivating local action to mitigate global climate change calls for an indirect strategy, focused on the ways in which emissions-producing activities are embedded in broader community concerns (Rayner & Malone, 1997). The primary benefit of an indirect approach is that it avoids many of the political debates about climate change science that have plagued international efforts to address this issue (Sarewitz & Pielke, 2000). Several officials noted that it really does not matter whether global climate change science is credible. Since the emphasis is on how reducing GHG emissions can help the city address other (more pressing) problems, questions of the scientific basis for climate change rarely come up. When and if they do, city officials can easily reply that these are actions they should take anyway."[13]

When it comes to effective substantive action on mitigation, I would argue that the available research and experience shows quite clearly that progress is far more likely when such actions align a short-term focus with the longer-term concerns. In practice, this typically means focusing such actions on the short-term, with the longer-term

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[12] http://www.ipcc.ch/pub/wg3spm.pdf at p. 12

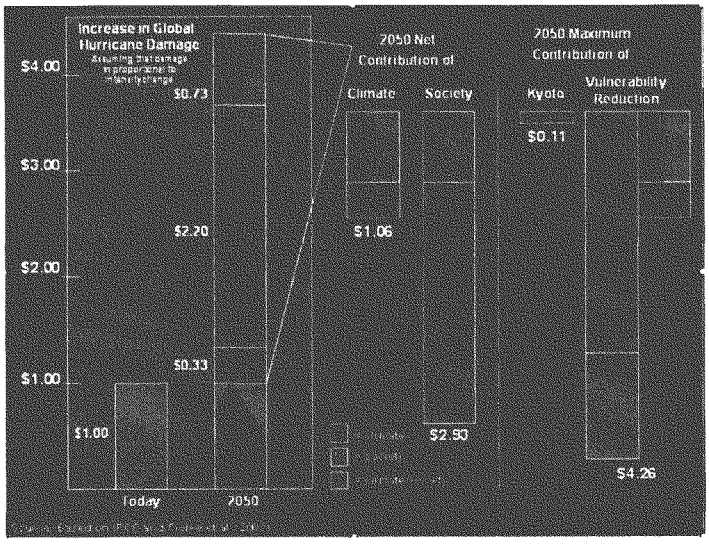
[13] Betsill, M. 2001. Mitigating Climate Change in US Cities: opportunities and obstacles, *Local Environment*, 6:393-406. http://www.colostate.edu/Depts/PoliSci/fac/mb/Local%20Environment.pdf

concerns taking a back seat. Examples of such short-term issues related to mitigation include the costs of energy, the benefits of reducing reliance on fossil fuels from the Middle East, the innovation and job-creating possibilities of alternative energy technologies, particulate air pollution, transportation efficiencies, and so on. This approach to climate change is contrary to the dominant approach (see point #6 below).

5. In coming decades the o nly policies that can effectively be used to manage the immediate effects of climate variability and change will be adaptive.

This conclusion results inescapably from the fact that any realistic greenhouse gas mitigation policies will have no perceptible impact on climate behavior for decades and longer (point #2 above). This conclusion is illustrated in the following figure, which comes from research that I am currently preparing for publication on the relative contributions of societal changes (e.g., population growth and development) and climate changes on future hurricane damages.[14]

The figure illustrates how $1.00 in global hurricane damage today will increase by 2050 under assumptions about changing hurricane intensity, societal development, and the relationship between increased hurricane intensity and damage.[15]



[14] Note that the more general term for hurricanes is "tropical cyclone."

[15] The figure assumes that by 2050 all hurricanes increase in intensity by 10% (based on Henderson-Sellars, A., H. Zhang, G. Berz, K. Emanuel, W. Gray, C. Landsea, G. Holland, J. Lighthill, S-L Shieh, P. Webster, and K. McGuffie, 1998: Tropical cyclones and global climate change: A post-IPCC assessment. *Bulletin of the American meteorological Society* **79**:19-38.), that population and wealth increase by a combined 1.1% per year (the lowest rate of increase used by the IPCC in its Special Report on Emissions Scenarios), and that hurricane damage increases are proportional to the increase in wind speed (which is an over-estimate).

The light blue box within the figure shows that for $1.00 in hurricane damage today (grey bar), by 2050 there will be an increase in damage of $0.33 due to the increased intensity of the storms (blue increment), $2.20 due to more exposed people and wealth in coastal locations (green increment), and $0.73 due to the cumulative effects of the increased intensity on the additional people and exposed property (green-blue increment). Adding these increments together ($1.00 + $0.33 + $2.20 + $0.73) results in a total damage in 2050 of $4.26 for every $1.00 today.

The middle two bars in the graph, labeled "Net Contribution of Climate [and] Society," summarize the total effects of changes in climate (increments with blue) of $1.06 and changes in society (increments with green) of $2.93. To get a sense of the relative potential for mitigation and adaptation to reduce the increasing damage requires several other assumptions. Here I have chosen to illustrate this analysis with the Kyoto Protocol because it will be familiar to most readers, but substituting other policies results in qualitatively similar results.

If we assume that greenhouse gas reductions have an instantaneous (i.e., contemporaneous with the reductions) and proportional (i.e., a 50% decrease in emissions decreases the projected increase in hurricane intensity by 50%) effect on hurricane intensity,[16] then full implementation of Kyoto (including U.S. participation) would roughly decrease projected greenhouse gas emissions under the "business-as-usual" scenario by about 10% by 2050.[17]

Under these assumptions the *maximum potential effectiveness* of Kyoto for reducing future global hurricane damage is $0.11 (that is, 10% of $1.06) and the maximum potential effectiveness of adaptation (i.e., reducing the vulnerability of people and property) is about 40 times greater, or $4.26.[18] While it would of course not be cost-effective to reduce damages 100% (e.g., by moving everyone away from the coast), this idealized exercise indicates that a 2.5% reduction in vulnerability leads to about the same effect on future damages as 100% success of Kyoto. These conclusions are qualitatively insensitive to the magnitude of the projected increase in hurricane intensity or population scenarios. Consider that if we instead assume that hurricane intensity increases by 40% the ratio of maximum potential effectiveness of adaptation to mitigation is about 14 to 1.[19]

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[16] Of course, the real climate system does not work this way, and the effects of mitigation on hurricane behavior remains poorly understood, but it is certainly less direct than the oversimplification offered here.

[17] I am assuming a 120 ppm increase in carbon dioxide (or equivalent) by 2050 under "business as usual", and that Kyoto would reduce this by 12 ppm, or 10%. The conclusions are not sensitive to these assumptions, feel free to substitute others if you would prefer, the qualitative results will not change.

[18] The maximum potential effectiveness of adaptation is equal to the total costs. If atmospheric concentrations of greenhouse gases could be instantly be held constant such that there would be no effect of human-caused climate change on hurricanes, then the maximum effectiveness of mitigation would in this case be $1.06. In reality this number is substantially smaller given the commitment to climate change and the time lag of emissions reductions effects on the climate system.

[19] This ratio remains constant under both the low or high SRES estimates for wealth and population.

To emphasize, this is not an argument against Kyoto specifically or mitigation of greenhouse gases generally. Instead, this simple analysis under the most favorable assumptions for mitigation indicates that in the short term (decades into the future) any realistically achievable mitigation policies can have at best only an imperceptible effect on global hurricane damage. The same conclusion holds for other extreme events, and I would hypothesize, for the vast majority of society-climate interactions. In fact, I am not aware of a single study that suggests that there will be significant short-term benefits of climate mitigation for climate impacts.

This reality explains why adaptation necessarily must be at the center of climate policy. It also helps to explain why mitigation policies in the short-term necessarily must be focused on their non-climate benefits.

6. But climate policy, particularly international climate policy under the Framework Convention on Climate Change, has been structured so as to keep policy related to long-term climate change distinct from policies related to shorter-term issues of energy policy and adaptation.

The climate issue suffers from a bizarre sort of intellectual gerrymandering that has little basis in science or policy. The Framework Convention on Climate Change (FCCC), focused on international policy, and the Intergovernmental Panel on Climate Change (IPCC), focused on scientific assessments in support of the FCCC, use different definitions of climate change. Understanding the effects of the two definitions on the politics of the climate issue helps one to understand the current international stalemate on climate policy, a stalemate that matters because climate change is real and actions are needed to improve energy policies and to reduce the vulnerability of people and ecosystems to climate effects.

Point #1 above explained that the IPCC's Working Group I has a very broad definition of climate change, that is, changes in the climate occurring for any reason.[20] By contrast, the FCCC is narrowly focused on climate change from greenhouse gas emissions. Taken literally, the focus of the FCCC would necessarily limit attention to the long-term consequences of climate change and only on the role of greenhouse gas emissions in driving those consequences. I have written that this focus creates a bias against adaptation, because it creates a cost/benefit calculus in which adaptation has only costs and no benefits.[21] The FCCC definition also encourages the waging of political battles through science as evidence for the detection and attribution of climate change (and whether it will exceed a threshold of "dangerous interference" in the climate system under FCCC Article 2) is a prerequisite for action under the FCCC.

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[20] By contrast the IPCC's Working Groups II and III often utilize the FCCC definition of climate change rather than the IPCC definition. See Pielke (2005) cited in the following footnote for discussion.

[21] The logic behind costs without benefits is that without the marginal influence of greenhouse gas caused climate change on the climate system, such adaptation would be, by definition, unnecessary. See Pielke, Jr., R.A., 2005. Misdefining "climate change": consequences for science and action, *Environmental Science & Policy*, **8**:548-561.
http://sciencepolicy.colorado.edu/admin/publication_files/resource-1841-2004.10.pdf

Numerous participants and analysts have recognized this fundamental flaw in the structure of the FCCC and have worked hard to overcome it by emphasizing the relationships of climate policy and sustainable development.[22] Some involved in the IPCC have also recognized the importance of integrating issues of climate change and sustainable development, and a chapter on the subject is to be included in the next assessment report in 2007.[23] Nonetheless, I remain skeptical that such efforts will do much to alter the narrow intellectual approach to the FCCC and reflected throughout the IPCC.[24]

The narrow focus of the FCCC helps to explain why we see so many supposedly scientific debates related to detection (of changes) and attribution (to human greenhouse gases), such as the ongoing battle over the infamous "hockey stick" graph. Given the emphasis placed on detection and attribution it is not too much of an exaggeration to observe that many proponents of action on emissions reductions want to characterize every climate event or trend as the result of human-caused climate change, whereas opponents of action on emissions reductions want to cast as much doubt as possible on such claims. We have seen a perfect example of this dynamic in public debate over hurricanes and climate change over the past few years as the science of hurricanes became almost instantaneously caught up in the politics of the global warming debate.

The effect of the intense politicization of climate change has been to preclude most reasoned discussion of innovative or new policy options on climate change. Most of the focus instead is on empty exhortations of support for "action" or claims of "too much uncertainty." Such expressions may be emotionally satisfying but do little to move the political debate forward in any meaningful way. Despite strong public support for action on climate change, the lack of meaningful alternatives in the public debate sets the stage for what T. Dyson has called a recipe for only marginal action:

> "The prospects for an enforceable international agreement to significantly reduce CO2 emissions are very poor. While it may be in the interest of the world as a whole to restrict the burning of fossil fuels, it is in the interest of individual countries to avoid making such changes. Moreover, the enormous complexities involved - many of them created and informed by matters of interest - will also hinder agreement. Doubtless there will be gains in energy use efficiency, shifts towards less carbon intensive fuels, and greater use of renewable energy sources (e.g. solar, wind and tidal power). But except for a massive shift towards nuclear - which has many serious problems attached, and would in any case take decades to bring about - there are limits to what such changes could possibly achieve in terms of CO2 reduction. Other technological ideas - like the development of the so-called 'hydrogen economy', or the extraction of CO2 from coal and its sequestration underground or at sea - are remote, even fanciful ideas as large scale and significant solutions to the problem. Indeed, such notions can themselves be the basis of avoidance inasmuch as they suggest that something is being done. Understandably, poor countries are unlikely to put great

[22] See, e.g., Klein, R.J.T., E.L.F. Schipper and S. Dessai, 2005: Integrating mitigation and adaptation into climate and development policy: three research questions. *Environmental Science & Policy*, **8**:579-588.
[23] See, e.g., http://www.ipcc.ch/am-sd.pdf
[24] As a practical matter, discourse on climate policy reinforces the intellectual gerrymandering through new concepts such as "mainstreaming" that preserve rather than move beyond the status quo.

> effort into constraining their CO2 emissions - especially in the face of massive discrepancies between them and the rich. In sum, for the foreseeable future the basic response to global warming will be one of avoidance and, at most, marginal change."[25]

A recent poll conducted by the National Journal of the perspectives of members of Congress on climate science and policy supports the importance of short-term policy issues as a focal point of policies to reduce greenhouse gas emissions.[26] The poll asked, "*Do you think it's been proven beyond a reasonable doubt that the Earth is warming because of man-made pollution?*" The replies are interesting with 98% of Democrats saying "Yes" and only 23% of Republicans saying "Yes."[27]

Even with the party divisions, a clear majority of members of both the House and Senate believe that global warming is real and caused by humans. If the poll numbers accurately reflect Congressional perspectives, then 55 members of the Senate and 251 members of the House believe that "it's been proven beyond a reasonable doubt that the Earth is warming because of man-made pollution." This seems to be inescapable evidence that there is exceedingly little value left in continuing to argue the science of this particular question. Clearly, there are other factors at play here beyond "skepticism" which shapes how decision makers act on climate change. Efforts to educate Congress on the reality of climate change are in my view completely wasted on a majority of the convinced

The poll asks a second question, "Which of these actions to reduce pollution could you possibly support?" and the answers included five options, Mandatory limits on carbon dioxide emissions, Increased spending on alternative fuels, Greater reliance on nuclear energy, Higher fuel-efficiency standards for automobiles, and a Higher gasoline tax. For each of these issues, except a gasoline tax, which is not favored by members of either party, there is far more agreement than was displayed on the question of science. And in each case there is evidence of enough support to suggest that agreement across parties might be found on particular policy options. The devil is of course always in the details, but what this poll shows is that debate on climate policy should be taking place in terms of policy options, and not science. There is ample evidence that there is room for compromise across partisan boundaries, without the need to turn Republicans into Democrats or vice versa.

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[25] Dyson, T. 2005 "On development, demography and climate change: The end of the world as we know it?" London School of Economics, Paper prepared for Session 952 of the XXVth Conference of the International Union for the Scientific Study of Population, Tours, 18-23 July, 2005. http://iussp2005.princeton.edu/download.aspx?submissionId=50222

[26] http://nationaljournal.com/

[27] Interestingly, as has been found in many areas, the views of members of Congress are more ideologically determined than those of their party membership among the general population. In opinion polls of the public asking a similar question, Democrats do not show such unanimity of opinion, and Republican views are not so consolidated. This may be a consequence of the effects of gerrymandering of Congressional districts which has often been pointed to as a key factor in a legislature far more ideological than the people who they actually represent.

The nation awaits politically creative policy options that can navigate the complicated set of interests of 535 members of Congress to start taking effective action on climate policy. All of the precursors for such action are in place, minus the politically creative options. Efforts to debate the science are simply misplaced in such a context. Die-hard partisans will no doubt come up with a range of excuses why they cannot compromise, and will gravitate back to the science as a comfortable home for maintaining the present debate. Such partisans typically point the finger of blame at their political opponents, though they should be looking in the mirror. The evidence from this poll suggests very strongly that such reactions are grounded more in a desire to maintain the present gridlock, rather than to move the issue of climate policy forward.

7. **Following the political organization of international climate change policy, research agendas have emphasized the long-term, meaning that relatively very little attention is paid to developing specific policy options or near-term technologies that might be put into place with both short-term and long-term benefits.**

In 1994 I argued that the U.S. Global Change Research Program was likely to produce good science, but would be unlikely to deliver "useful information" to policy makers as had been called for in the legislation that created the program. I wrote that instead of a long-term focus on large-scale climate change the USGCRP could "distill the practical significance of scientific information, and at the same time develop a wide range of action alternatives ...".[28] The USGCRP, and its successor the Climate Change Science Program, have never placed the needs of decision makers at the center of their mission, focusing instead on advancing scientific understandings. Part of the explanation for this situation lies in the fact that the scientific community has benefited immensely from the current approach, and an emphasis on short-term policy and technological options would necessarily imply a different approach to climate science and technology policy priorities.[29] Another part of the explanation is that it is quite easy for policymakers to put the burden of "solving" the climate problem onto the scientific community, which also has the effect of using research policies as substitute for other types of action. And with political advocates on either side of the issue also looking to science as a leading fixture of their public relations and political lobbying campaigns, it should be no surprise that scientific and technological research on climate has focused on long-term issues over the generation of practical options for short-term consideration.

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[28] Pielke Jr., R. A., 1994: Scientific Information and Global Change Policymaking. *Climatic Change*, **28**, 315-319. http://sciencepolicy.colorado.edu/admin/publication_files/1994.02.pdf
For an early evaluation of USGCRP, see: Pielke Jr., R. A., 1995: Usable Information for Policy: An Appraisal of the U.S. Global Change Research Program. *Policy Sciences*, **38**, 39-77. .
http://sciencepolicy.colorado.edu/admin/publication_files/resource-109-1995.07.pdf

[29] Pielke, Jr., R. A. and D. Sarewitz, 2003. Wanted: Scientific Leadership on Climate, *Issues in Science and Technology*, Winter, pp. 27-30. http://sciencepolicy.colorado.edu/admin/publication_files/2003.01.pdf

8. The climat e debate may have begun to slowly reflect these realities, but the research and development community has not yet focused much attention on developing policy and technological options that might be politically viable, cost effective, and practically feasible.

I am convinced that as people begin to see the limited performance of existing approaches to emissions reductions and as the toll of climate-related disasters grows dues to ever-increasing vulnerabilities that there will be a shift to a more short-term focused approach to climate mitigation and adaptation. However, given the institutional and political momentum which currently characterizes the climate issue, there is a substantial risk that the issue will continue to display sound and fury with most action being symbolic or simply ineffectual. The question is whether we can organize our intellectual infrastructure to invent and bring forward policy and technological options that will satisfy both the short-term and long-term facets of this incredibly complex issue. Through oversight of the Climate Change Science Program and Climate Change Technology Program, Congress might motivate the evolution of these programs to focus more explicitly on the needs of decision makers.

Short Biography

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Roger A. Pielke, Jr. has been on the faculty of the University of Colorado since 2001 and is a Professor in the Environmental Studies Program and a Fellow of the Cooperative Institute for Research in the Environmental Sciences (CIRES). At CIRES, Roger serves as the Director of the Center for Science and Technology Policy Research. Roger's current areas of interest include understanding disasters and climate change, the politicization of science, decision making under uncertainty, and policy education for scientists. In 2000, Roger received the Sigma Xi Distinguished Lectureship Award and in 2001, he received the Outstanding Graduate Advisor Award by students in the University of Colorado's Department of Political Science. Before joining the University of Colorado, from 1993-2001 Roger was a Scientist at the National Center for Atmospheric Research. Roger sits on the editorial boards of Policy Sciences, Bulletin of the American Meteorological Society, Environmental Science and Policy, Darwin, Water Resources Research, and Natural Hazards Review. He sits on various advisory committees, is author of numerous articles and essays, and is also author, co-author or co-editor of four books. He is also the author of a forthcoming book titled: **The Honest Broker: Making Sense of Science in Policy and Politics** to be published by Cambridge University Press in early 2007.

For more information see:

http://sciencepolicy.colorado.edu/about_us/meet_us/roger_pielke/

All of my publications referenced here can be found online at:
http://sciencepolicy.colorado.edu In particular see our NSF-sponsored research project titled Science Policy Assessment and Research on Climate:
http://sciencepolicy.colorado.edu/sparc/

Disclaimer: CIRES is the Cooperative Institute for Research in Environmental Sciences, a joint institute of the University of Colorado and the National Oceanic and Atmospheric Administration. The Center that I direct has received research funding from a number of other federal research agencies, including NSF and NASA. The views presented here are my own.

Chairman TOM DAVIS. Thank you very much.
Dr. Gulledge.

STATEMENT OF JAY GULLEDGE

Dr. GULLEDGE. Mr. Chairman and ranking member and members of the committee, I appreciate this opportunity.

I just want to clarify that while I am replacing Dr. Hansen on the panel, I am not representing him, and my testimony is my own.

Chairman TOM DAVIS. We appreciate your coming on short notice.

Dr. GULLEDGE. Thank you. I appreciate that.

[Slide presentation.]

Dr. GULLEDGE. I am senior research fellow for science and impacts at the Pew Center on Global Climate Change, as well as an Adjunct Assistant Professor at the University of Louisville, which houses my academic research program on carbon cycling.

Dr. Karl sat up here earlier and gave you some very affirmative questions and exhibited a lot of certainty about some things for the science, and I want to give you a sense for why the science in recent years has really become quite solid and scientists have become quite certain about the causes of climate change.

I would summarize the progress as under two broad categories: reductions of uncertainties and observed changes in the climate itself.

Dr. Karl showed you that the global surface temperature has, in fact, risen over the 20th century, and it has increased by about 1.4 degrees fahrenheit over this time.

We see the same pattern of warming in the Arctic, and we see that it is amplified there. The warming there has been on the order of 2 degrees or more. Currently, even though we had quite a warm period during the 20th century in the Arctic, we see that we have exceeded that significantly at this point.

We see the same kind of pattern for sea surface temperatures. This is just an example from the tropical Atlantic. Again, the current temperatures there have exceeded the warm period during the middle of the 20th century.

Not only are we the warmest time in this past century, a number of efforts have been made to document the temperature trends over the last thousand years. None of these attempts have been able to show that there has been a time that it was as warm in the past thousand years as we currently see.

Now, these next two slides are very fundamental to what I am trying to communicate here about reduced uncertainties. First, I show a picture here of Antarctica, but globally there has been an intensification of the water cycle of glaciers, both in mountains as well as polar ice in the north and in the south. Back in the 1980's it was predicted that you should see an intensification of the water cycle, which means more snowfall in the high elevations of glaciers and more melting at the low elevations of glaciers. This has not been confirmed globally. We see it in Greenland, we see it in Antarctica, and we see it in mountain glaciers around the world, including the tropics.

This was predicted more than two decades ago based on specifically how the greenhouse effect should drive changes in glaciers

around the world. More recently, this year it has also been documented that the atmosphere above Antarctica has warmed dramatically relative to the rest of the world, and we weren't sure about that before and now we actually have that confirmation.

This slide is also very important. Also recently, data on the heat content of the ocean over the last 50 years has been compiled, and we now see that the ocean has been gaining heat over the last 50 years, at least—that is where we start the record—and this is an immense amount of energy. You cannot get it from anywhere else in the climate system. It has to come from outside the climate system and it is consistent with what we call an external forcing. There are not many external forcings that we can think of. During this time, for instance, there has been no apparent increase in the intensity of the sun, but this is when the most increases occurred in greenhouse gases.

Now, when you have greenhouse forcing, most of the energy getting trapped goes first into the ocean, more than 80 percent of it, and it is here. This warming you see here is what we call the warming in the pipeline. This energy will equilibrate with the atmosphere later. There is about another 1 degree of warming trapped in here already. And we already see that the 1 degree of warming we have had in the past 50 years has already caused the immense continent of Antarctica to respond.

Now, the consequences are numerous. I am focusing on global changes here. Mountain glaciers around the world have reacted to these changes in climate, and here we have a reconstruction of glacier lengths related through a physical model, a mathematical physical model to surface temperature. These are glaciers from around the world. We see that in the 20th century it starts here in the little Ice Age and remains stable until 1850, and then glaciers begin to retreat. This accelerates dramatically in the 20th century, and glaciers respond to the small changes that we see, global changes that we see during the 20th century. So this tells us that, in fact, the climate is quite sensitive, even to the relatively small climate change that is already in the bag.

Next we see that the arctic ice, sea ice, has reached its lowest recorded extent in the year 2005.

Greenland, according to the latest measurements, which have some uncertainty, is apparently having a net loss of ice. First observations of Antarctica suggest the same. This was published just this year. The point of all of this is that we are seeing all these impacts globally.

Finally, the next slide shows that we have finally—one of the uncertainties was whether or not sea level rise was accelerating. You definitely should expect that. Over the last decade, the rate of sea level rise has been 70 percent faster, based on satellite measurements, than the average over the 20th century, which does suggest that there has been an acceleration. Time will tell whether that is a persistent effect. Right now the rate of sea level rise would give us 1 foot of additional sea level rise by 2100 without further acceleration.

To sum up, we have had reduced uncertainties. We now know that the warming is truly global, even over Antarctica, which was a big question. Warming has reached historic proportions. Glacier

water cycle intensification is occurring globally. The ocean is known to be gaining heat, and sea level rise appears to be accelerating.

Finally, the observed changes in the climate tell us that, in fact, the climate system globally is quite sensitive to these levels of changes, and so far the changes are small compared to what is projected for the future as a result of greenhouse gas forcing. We see global glacier loss accelerating. The Arctic Ocean may be heading for an ice free condition, according to recent research. The changes generally have been faster than expected, which tells us we have probably also underestimated the sensitivity of the climate system in the past. That is based on the warming we have had so far, and we know we have a similar amount of warming already in the pipeline.

[End of slide presentation.]

Dr. GULLEDGE. Thank you.

[The prepared statement of Dr. Gulledge follows:]

Testimony of Jay Gulledge, Ph.D., to the House Committee on Government Reform
July 20, 2006

Mr. Chairman, Ranking Member, Members of the Committee:

Thank you for this opportunity to speak to you today.

Although I am replacing Dr. James Hansen on this panel, I would like to clarify that I am not representing Dr. Hansen, and I am fully responsible for my testimony.

There has been landmark progress in the science of climate change since the publication of the last IPCC report in 2001 and even in just the past one or two years, as my testimony will show. I would characterize this progress as falling into two general categories: (1) greatly reduced uncertainties and (2) global changes in the climate, many of which were predicted years ago based on the anticipated effects of man-made greenhouse gases, are already being observed. The observed changes, especially changes in global ice cover, are occurring sooner and are more intense than had been expected, indicating that the climate is more sensitive to global warming than had been anticipated.

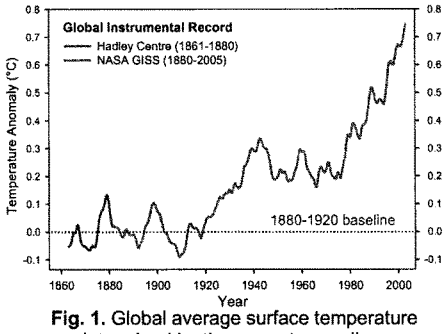


Fig. 1. Global average surface temperature as determined by thermometer readings.

Global Surface Temperature

From 1920 to the present, the earth's surface temperature has increased by 1.4 °F (Fig. 1). The sharpest rise occurred between 1975 and the present, when temperature rose steadily by about 1 °F. The same pattern of warming is apparent in sea-surface temperatures, as illustrated by the tropical North Atlantic (Fig. 2).

The same pattern of warming is also apparent in the Arctic region, which includes all surface area north of 66° North latitude (Fig. 2). Although the Arctic was relatively warm during the mid-twentieth century, it is clearly warmer today than at anytime in the past century. With an increase of 2 to 3 °F over the past century, the Arctic has warmed more than the global average. This amplification of warming over the high latitudes is a fundamental prediction of the enhanced greenhouse effect.

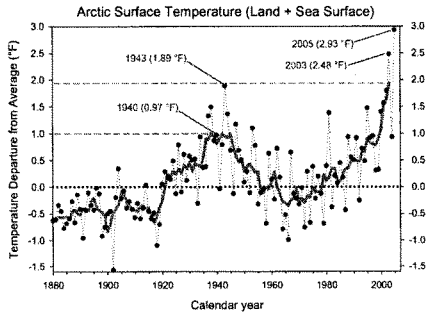


Fig. 2. Average surface temperature for the Arctic region (66° N to 90° N; (Ghcn 2006).

A long-standing uncertainty has been whether the Antarctic is also warming. In 2006, new long-term data were published based on weather-balloon data (Turner, Lachlan-Cope, Colwell et al. 2006). This is now the longest and most geographically comprehensive data set of direct temperature measurements for the Antarctic continent. The results show that the lower atmosphere above Antarctica cooled between the 1950s and 1975, and then increased sharply from 1975 to the present, similar to the global pattern shown in Fig. 1. Moreover, the Antarctic atmosphere has undergone the largest warming trend (1.2 °F per decade) of any spot on the entire globe (Fig. 3). There was also net warming on the ground.

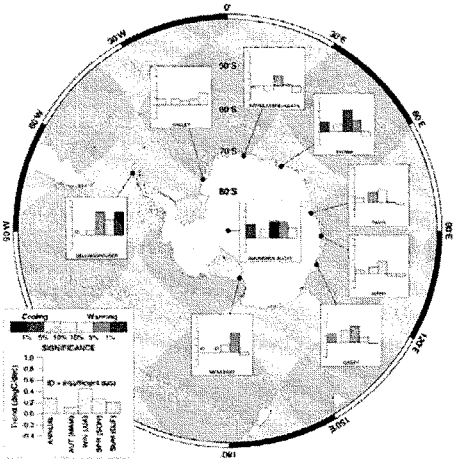


Fig. 3. Annual and seasonal warming in the Antarctic atmosphere over the past three decades (Turner et al. 2006).

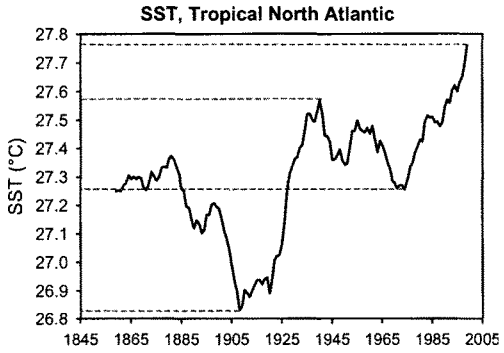


Fig. 4. Sea-surface temperature for 1860-2005 in the tropical North Atlantic Ocean (see (Webster et al. 2005)

Tropical sea-surface temperatures show a warming pattern similar to the global average and Arctic warming trends. Again, the present is considerably warmer than the mid-twentieth century warm period, as illustrated for the tropical North Atlantic (Fig. 4).

Not only is the current global temperature higher than at anytime in the past century, recent research on past global climate indicates that the late 20th century is warmer than at anytime in the past 1,000 years or more. One area of research that illustrates this finding is the reconstruction of past surface temperature from multiple proxies (ancient biological or geological structures that store information on the contemporary temperature at the time the structure was formed). Several reconstructions have been produced, none of which find evidence for any time in the past millennium when global surface temperatures approached those that have occurred since 1990 (National Research Council 2006); Fig. 5). Proxy reconstructions provide only one of several lines of evidence that support this conclusion.

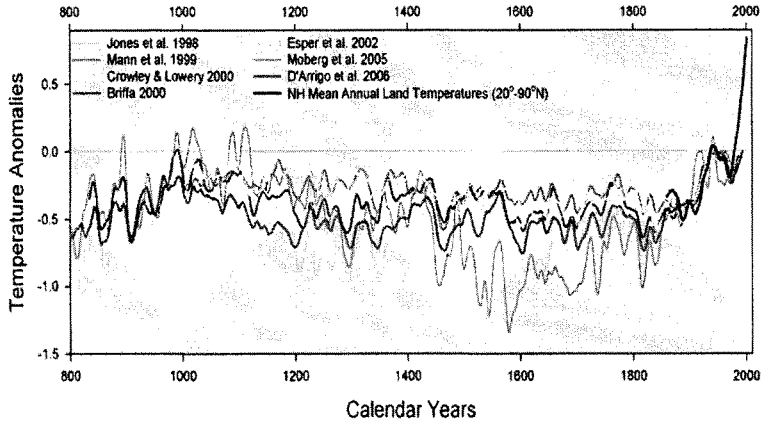


Fig. 5. Temperature of the past 1,200 years, based on paleoclimate proxies (D'arrigo et al. 2006).

The discussion above confirms that the observed pattern of global surface warming extends to the high latitudes in both the north and the south, and that the warming at high latitudes is larger than the warming at low latitudes, as predicted by the enhanced greenhouse theory. Moreover, the degree of warming since 1990 is of historic proportions, both for the twentieth century and the past millennium.

Ocean Heat Uptake

In 2005 a major breakthrough was made in understanding global warming when a large dataset was published showing that the global ocean had been absorbing more heat than it was releasing since at least 1955 (Fig. 6; Levitus, Antonov and Boyer 2005). Over this period, the heat content of the global ocean increased by an amount equivalent to 10,000 times the amount of energy produced for electricity in the U.S. in 2005. This amount of heat is far too large to have been transferred to the ocean from anywhere else within the climate system, and requires the accumulation of new energy from outside the earth system, such as from increased solar radiation or from the trapping of more outgoing infrared heat, as occurs from increased greenhouse gas concentrations in the atmosphere. The sun's intensity has not changed appreciably over the past 5 decades, but this period coincides with the most intense increase in man-made greenhouse gases.

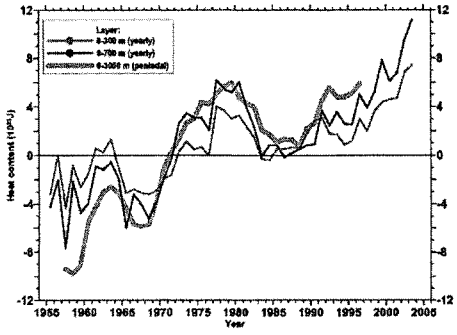


Fig. 6. Ocean heat uptake over the past 50 years. (Levitus et al. 2005)

Using the ocean heat content data described above, another recent study demonstrated that the enhanced greenhouse effect explains the ocean's heat gain over the past 5 decades (Barnett, Pierce, Achutarao et al. 2005). Observations show that the oceans have been warming from the surface downward, which indicates heat transfer from the atmosphere (red dots in Fig. 7). The vertical pattern of heat penetration with depth varies from ocean to ocean as a result of currents transporting heat from one ocean to another (Fig. 7a). Modeling of natural variability from solar and volcanic forcings did not produce temperature profiles that matched this fingerprint (Fig. 7a). However, the combined influence of anthropogenic greenhouse gases, natural forcings, and internal variability matched the unique fingerprint of heat penetration for each ocean (Fig. 7b). Of the three elements, anthropogenic greenhouse gases strongly dominated the overall forcing.

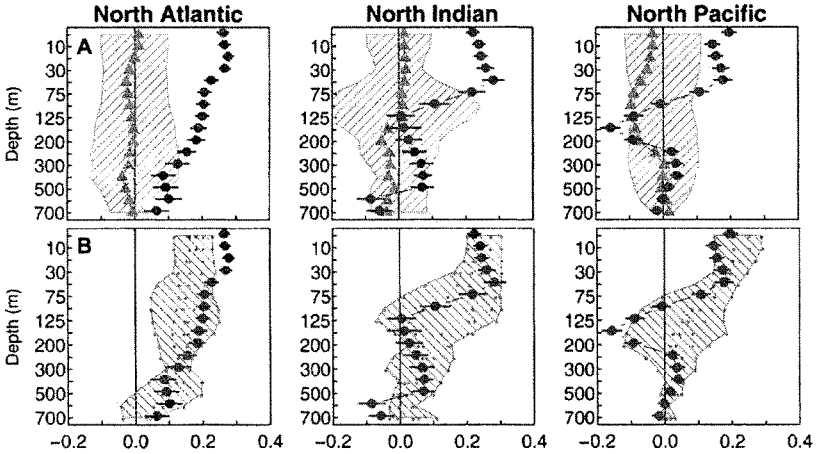


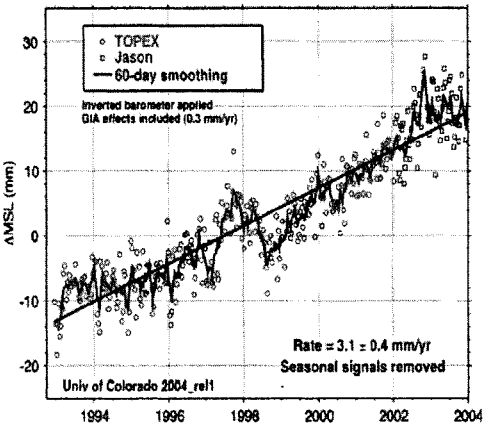
Fig. 7. Observed ocean heat content with (A) natural factors only and (B) natural + human factors. The results shown in Fig. 7B show that man-made greenhouse gases are responsible for warming the global ocean over the past 50 years (Barnett et al. 2005).

The ocean absorbs more than 80% of the heat that is initially trapped by greenhouse gases. This heat does not affect the atmosphere right away, but ocean temperature gradually equilibrates with the atmosphere. As a result, the new heat that is currently stored in the ocean will come back out over the next several decades, further warming the earth's surface. This warming, about 1 °F, is already with us and will occur later even if we were to stabilize greenhouse gas emissions today. Hence, we are already committed to an additional warming approximately equivalent to the warming that occurred during the late 20th century (Meehl et al. 2005).

Sea-level Rise

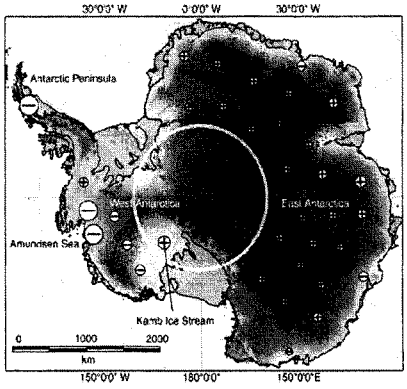
Based on tide-gauge records, the average rate of sea level rise (SLR) over the twentieth century was about 0.7 inches per decade (Houghton et al. 2001; Church and White 2006). Satellite altimeter measurements taken since 1993, by contrast, indicate that the rate of

SLR at the end of the twentieth century was about 1.2 inches per decade (Fig. 8; (Cazenave and Nerem 2004). This result alone indicates that the rate of SLR is higher now than it was earlier in the twentieth century and implies a minimum acceleration rate of 0.05 inches per decade. This exact estimate of acceleration over the twentieth century was obtained using a more sophisticated statistical method from reconstructed tide gauge records (Church and White 2006).



So it is now apparent that SLR has accelerated over the twentieth century. If the current rate of acceleration were to continue through the year 2100, global sea level would rise by about one foot during the twenty-first century, which is consistent with predictions of the IPCC Third Assessment Report (Houghton, Ding, Griggs et al. 2001; Church and White 2006). However, with continued global warming, it is reasonable to expect the rate of acceleration to continue to increase, leading to greater than one foot of sea level rise.

Fig. 8. Global sea level rise during 1993-2004 as measured by satellite-born altimeters (Cazenave and Nerem 2004). The measured rate is 70% higher than the average rate of sea level rise over the 20th century.



Glacier Water Cycle Intensification

Decades ago, glaciologists predicted that the enhanced greenhouse effect would cause the water cycle of glaciers to become intensified (Oerlemans 1982; Huybrechts et al. 1991). Glaciers gain ice by snowfall at high elevations and they lose ice by melting at low elevations. The amount of snowfall and melting have both increased in mountain glaciers from the tropics to the high latitudes (Dyurgerov 2003), as well as in the large polar ice sheets of Greenland (Johannessen et al. 2005) and Antarctica (Fig. 9; (Vaughan 2005).

Fig. 9. Antarctic glacier water cycle. Dark shading with (+) sign shows areas of ice thickening (increased snowfall) and light shading with (-) sign shows ice thinning (Vaughan 2005).

These new observations reduce uncertainty about the cause of global climate change because glaciers all around the globe are responding as originally predicted based on the

enhanced greenhouse theory; the response is no longer merely a prediction. Also, the observed change in the glacier water cycle reveals the sensitivity of the climate system to a relatively small amount of warming compared to what is projected for the future as a result of continued greenhouse gas emissions. It is safe to say that glaciologists have been surprised by how quickly and sensitively glaciers around the world, and especially the large polar ice sheets, have responded to late 20th century warming.

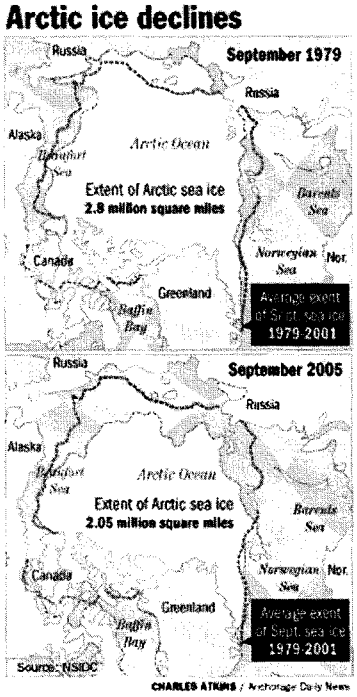


Fig. 10. Decline of Arctic sea ice extent from 1979-200. The magenta line shows the average extent for 1979-2001.

Glaciers began retreating around 1850 at the end of the Little Ice Age, but accelerated during the 20th century, followed by a short period of advance, then a rapid retreat in the late 20th century. By comparing this pattern to the global surface temperature in Fig. 1, it is clear that mountain glaciers are extremely sensitive to temperature changes on the order of those currently caused by human activities.

New Signs of Climate Sensitivity

Unfortunately, the global climate is already responding to global warming in a sensitive fashion, even though the amount of warming so far is relatively small compared to the projections of future warming. For instance, Arctic sea ice reached the lowest extent ever recorded in September of 2005 and is being lost at current rate of about 8% per year (Fig. 10). Some climatologists predict that the Arctic Ocean will be ice-free during the summer by the year 2100, a condition that has not existed for at least one million years (Overpeck et al. 2005).

Mountain glaciers from the tropics to the mid-latitudes are losing ice vary rapidly. The relationship between glacier retreat and surface temperature is so tight that it is a simple matter to infer global surface temperature from historic glacier length records, using a simply physical relationship (Oerlemans 2005). There was no change in glacier lengths during the Little Ice Age that lasted from about 1500 to about 1850 (Fig. 11).

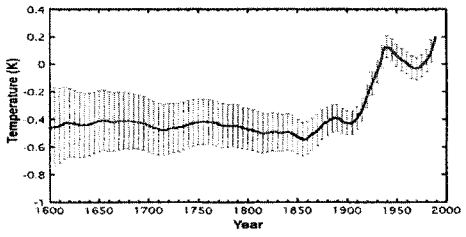


Fig. 11. Surface temperature reconstruction based on glacier length records determined by the physical relationship between change in glacier length and surface temperature (Oerlemans 2005).

The changes in glacier length reflected in Fig. 11 correspond to a relatively small amount of warming compared to projections for the future, and there is already another 1 °F of warming stored in the ocean, as explained above. Because billions of people around the world rely exclusively or primarily on mountain glaciers for their water supplies, the sensitivity of these glaciers to warming is of vital policy importance. Western Canada and the Western USA rely heavily on snow pack and glacier water. More critical is the sole reliance of a large population in South America that relies entirely on Andean glaciers for water (Bradley et al. 2006). Some of these glaciers are already gone, and others are perilously close to disintegrating. There is a similarly critical condition in Central Asia, where more than a billion people rely on glaciers for water. These regions are primarily economically underdeveloped and lack the financial resources to adapt to a dwindling water supply.

Mountain glaciers are relatively small and easy to melt compared to the enormous continental ice sheets covering Greenland in the north and Antarctica in the south. For this reason, glaciologists have been surprised in recent years to find these large ice sheets responding sensitively to global warming. The ice sheet covering the Greenland continent contains enough water to raise global sea level by more than 20 feet if completely melted. Until recent months, however, estimates of continental ice loss were biased low because they assumed that the rate of glacier flow was unchanging, and only accounted for mass loss through ice melt (Alley et al. 2005; Rignot and Kanagaratnam 2006). Glaciers are rivers of ice that flow slowly from the high-elevations of the continent to the low-lying coasts and into the sea. New satellite measurements indicate that the flow of Greenland's glaciers has accelerated dramatically over the past decade. Accounting for the combined effects of accelerating ice melt and flow rates, the most recent study of the Greenland ice mass estimated a net loss of ice twice as high as the previous IPCC estimate (Rignot and Kanagaratnam 2006).

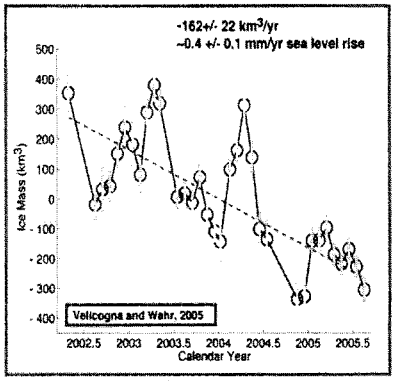


Fig. 12. Ice loss from the Antarctic ice sheet determined by gravity sensing satellites (Velicogna and Wahr 2006).

The largest ice sheet on earth covers Antarctica and stores enough water to raise global sea level by 230 feet. Although scientists do not think that anthropogenic climate change could cause a complete meltdown of Antarctica, a loss of just 10 percent of its ice would release more water than a total loss of the Greenland ice sheet. The Third Assessment Report of the Intergovernmental Panel on Climate Change (Houghton, Ding, Griggs et al. 2001) estimated that Antarctic ice was more or less in balance (no net ice gain or loss), but the report estimated that the Western Antarctic ice sheet (WAIS) was losing ice, while the larger Eastern Antarctic ice sheet (EAIS) was gaining ice at a rate that balanced the ice lost from the WAIS. The most recent

results paint a different picture. New gravity-sensing satellites, the first instruments to cover the entire Antarctic continent, indicate that the entire ice sheet is now in negative balance as a result of large losses of ice from the WAIS and no net changes in the EAIS (Velicogna and Wahr 2006). According to these measurements, Antarctica lost about 450 km^3 of ice—roughly the volume of Lake Erie—between 2003 and 2005. Like Greenland, much of the ice loss from the WAIS results from ice flow into the sea, which had been neglected in previous estimates of mass balance (Alley, Clark, Huybrechts et al. 2005; Velicogna and Wahr 2006).

Global ice cover is an important indicator of climate sensitivity. Not only are small mountain glaciers responding, but enormous continental polar ice sheets are also responding. The fact that changes have surprised glaciologists represents a lack of appreciation for how sensitive the climate system is to a relatively small amount of warming. Scientists are currently struggling to reassess the true sensitivity of the climate to the enhanced greenhouse effect, as it appears to have been underestimated.

Conclusions

Together, the recent observations described above have dramatically strengthened the scientific consensus that global climate change is underway and that on a global scale it is caused mostly by man-made greenhouse gases accumulating in the atmosphere. Direct observations of climate change also confirm that the climate system is more sensitive than scientists have previously assumed, as illustrated by the fact that the most recent IPCC report, published in 2001, did not project that the large polar ice sheets would be experiencing net ice loss as a result of the relatively small amount of warming that has occurred so far. Other new evidence also suggests that the amount of greenhouse gases required to warm the earth by a certain amount is smaller than previously thought. These are two critical aspects of climate sensitivity that appear to have been underestimated.

It is now clear from direct observations of climate changes currently underway that the amount of climate change to which we are already committed will have significant impacts on the climate system. Continued emissions of greenhouse gases will add further to these impacts.

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Chairman TOM DAVIS. Thank you very much.

Dr. Christy, Dr. Gulledge points to reduced uncertainties. Is that consistent with your new studies?

Dr. CHRISTY. Reduced sensitivities about what?

Chairman TOM DAVIS. Just generally the issues on climate change and the variables, accuracy of data.

Dr. CHRISTY. In our work we start looking at climate on the ground and in the air. We see continued uncertainties, that there are significant differences between model projections in these places I have shown. There are some other examples in there, too, in the regional scale aspects of climate.

The global average temperature, that is a different story, but remember that all climate modelers knew what the answer was ahead of time when they began reproducing the last 100 years or so.

Chairman TOM DAVIS. Dr. Curry, we are policymakers. We are not scientists. Mr. Waxman and I are lawyers. We do the best we can. But in the 1980's you called yourself a skeptic about global warming, but your research has now directed you away from that, but NOAA disagrees with some of your findings on hurricanes. Is there any way to reach a consensus on this to get everybody around and reach a consensus?

Dr. CURRY. The issue of hurricanes and global warming has received intense scrutiny for only about the past year, and that is sort of relatively new. Now, these things have to go back and forth. We have to survive challenges by skeptics, etc. I think the subject is rife for an assessment by a body such as the National Academy of Sciences to get an independent body of scientists who can assess the evidence, the data, the quality of the data, the published research that has been done, to make some sort of an assessment and recommendation for clarifying the uncertainties.

You know, too much of this debate is going on in the media and it has been polarized beyond anything that makes sense in terms of the actual science. I think we do need an assessment. The National Academy of Science Climate Research Committee and Board on Atmospheric and Science Research has proposed such an assessment. They have not yet identified funding. I encourage this committee to encourage such an assessment so we can at least sort out the evidence that we have so far and try to make sense of it.

Chairman TOM DAVIS. Dr. Pielke, in your testimony you stated that available research and experience shows quite clearly that progress is far more likely when actions align a short-term focus with the longer-term concerns. I wonder if you could kind of elaborate on that?

Dr. PIELKE. Yes. In my testimony I refer to some research that was done looking at some of the State and local initiatives related to climate change mitigation. The question was: what makes these successful? When do they work? When do they go beyond the statement of aspirations into actual progress on the ground? What those researchers found was that when those local government entities were able to line up—and this holds true for companies, as well—their short-term motivations, whether it is reducing the cost of energy, improving transportation efficiencies, reducing air pollution,

it is much easier for them to sell and put into place these policies that may be justified as long-term climate change policies.

Certainly for State and local communities, such as the one I live in in Boulder, any action that they take on energy policy is not going to materially affect the climate, so it could be a very hard sell to the citizens in those communities.

Similarly, if you look at the history of ozone depletion, ozone depletion gained traction as a political issue when substitutes were invented. Substitutes allowed companies like DuPont to realize economic benefits in the short term as they were dealing with a decade-old, very long-term problem.

But I think if you look at any issue beyond scientific issues, such as people saving for retirement, the Government gives tax breaks for people who put that money aside to try to reconcile short-term benefits with long-term benefits. It is just a common sense approach to public policy.

Chairman TOM DAVIS. OK. Dr. Christy, what precisely do you conclude scientifically from your finding that the location of warming is not what is predicted by the models? Does that mean that the increased greenhouse gas emissions are not going to alter the climate or that they are not going to alter it as much, or that the ways in which they would alter are very, very uncertain and unpredictable?

Dr. CHRISTY. From your description there, the latter two results are that the radiated forcing must increase because of this extra CO_2. There is really no way around that. There will be extra joules of energy stored in the climate system.

Chairman TOM DAVIS. There is agreement I think with everybody on that. That is not a fact in dispute. The question is then how is that going to be expressed?

Dr. CHRISTY. Right. The uncertainty is there, and I think the earlier panelists had mentioned them. In our data system—and we are doing boots-on-the-ground kind of climate work here—don't match up very clearly with the scenarios we see in the global climate models.

Chairman TOM DAVIS. But the excess CO_2, that is not a good thing over time? Could you say that?

Dr. CHRISTY. If you ask a corn plant it might think more CO_2 is great.

Chairman TOM DAVIS. If you live in North Dakota, maybe it is good?

Dr. CHRISTY. That, too.

Dr. GULLEDGE. Mr. Chairman, if I might add some perspective.

Chairman TOM DAVIS. Please.

Dr. GULLEDGE. The testimony that I gave is based almost entirely on research published in the last 2 years and it is purely observational. There is no modeling results there. It is all on-the-ground research. It is what is happening on the ground in Antarctica. The glacier cycle, water cycle is intensifying. The atmosphere above it is warming. These are things that the modelers did not know ahead of time.

Chairman TOM DAVIS. What does that mean? So the ocean rises 2 feet over 100 years. What does that do to me?

Dr. GULLEDGE. Well, it means, from my perspective as someone who is asking questions about the basic physics of the climate, it means that there is more energy being trapped in the climate system that is causing it to rise. Now, that is the nature of the testimony I am giving, is that it confirms our understanding that the climate is responding in a sensitive fashion to the energy that is being trapped into the system.

Chairman TOM DAVIS. Natural changes have gone on, though, for hundreds of thousands, for millions of years.

Dr. GULLEDGE. That is correct, and we are examining a variety of possible forcings. As I said, the heat absorption of the ocean tells us that this heat is coming from outside the Earth's system. This isn't a transfer of heat from one place to another within a climate. You have to look for an external forcing, and one that can be responsible for everything from the sea level rise to the intensification of the glacier water cycle on Antarctica.

Chairman TOM DAVIS. What is happening in Antarctica is really manmade, is what you are saying?

Dr. GULLEDGE. It clearly——

Chairman TOM DAVIS. Indirectly.

Dr. GULLEDGE [continuing]. Was predicted as the kind of response you would expect to see from greenhouse forcing, and it cannot be explained by something like changes in the sun. And it can be explained by the amount of greenhouse gases that we have added to the atmosphere.

Chairman TOM DAVIS. And the changes. What will occur is there will be new species developed and you will have species go extinct and water lines will change, but what does it mean 100 or 200 years from now.

Dr. GULLEDGE. You are asking about impacts?

Chairman TOM DAVIS. Yes.

Dr. GULLEDGE. It means the coastlines will be inundated. The coastal cities will have more of a storm surge. Right now we have coastal cities that care whether storm surge is plus or minus a foot.

Chairman TOM DAVIS. Let me ask Dr. Curry, do you agree with that, too, that we are seeing more storm surge today?

Dr. CURRY. Absolutely. There are some island nations that are on the verge of just being subsumed. A big chunk of Bangladesh sits about 2 feet above sea level. A big chunk of south Florida sits at 2 or 3 feet above sea level. We have seen from Katrina what happens when a big storm surge hits a city that is below sea level—not good things.

Chairman TOM DAVIS. And is there a consensus that the weather cycles of the last maybe decade, to some extent the warming of the water in the Caribbean having an effect?

Dr. CURRY. Yes.

Chairman TOM DAVIS. The previous panel seemed to indicate that.

Dr. CURRY. Yes. Observations clearly show the sea level rise.

Chairman TOM DAVIS. That is uncontroverted, in your opinion?

Dr. CURRY. Yes.

Chairman TOM DAVIS. How about you, Dr. Christy?

Dr. CHRISTY. Yes. The sea level has been rising for 18,000 years and should continue to rise because there is more ice to melt in the

system. About 130,000 years ago it was 18 feet higher as a result of that natural period. Someone mentioned about a foot per century. That is entirely reasonable and you don't even have to invoke greenhouse warming, but greenhouse warming might accelerate that a bit.

As a State climatologist I advise people on the coast, and I say, look, it is not the 1 inch per decade that is going to get you, it is the 20 feet that comes in 5 hours because of the storm surge. That is so much——

Chairman TOM DAVIS. You think the storm surges are worse today than they have probably been over the last——

Dr. CHRISTY. Not particularly. They are absolutely worse because we have more expensive things in the way that are just saying, come and hit me. You are going to see in the next century devastating hurricanes hit the Gulf Coast and the Atlantic Coast.

Chairman TOM DAVIS. How about the West Coast? Does Mr. Waxman get free?

Dr. CHRISTY. I think he is safe.

Chairman TOM DAVIS. He has got earthquakes to worry about.

Dr. CHRISTY. Watch out for earthquakes.

Chairman TOM DAVIS. Dr. Pielke.

Mr. WAXMAN. Just to say that statement that there be increases in hurricanes, and my question to you is why.

Dr. CHRISTY. I am sorry?

Mr. WAXMAN. Why?

Dr. CHRISTY. No, I didn't say an increase in hurricanes, I just said there will be an increase in hurricane damage because there is more stuff to damage.

Chairman TOM DAVIS. More stuff is built up.

Dr. CHRISTY. It is going to be devastating, and this fellow knows a lot about that.

Chairman TOM DAVIS. Dr. Pielke.

Dr. PIELKE. Yes. Earlier this spring in Germany I helped co-organize a workshop with Munich Reinsurance. The question we asked was: given this global trend of increasing disaster costs, which is going off the charts, can we attribute any part of that to human-caused climate change?

It turns out that the only consensus we could reach on that was that we could not at this time attribute that. Some people believed that it could be attributed, others not. What everyone agreed on, that at least 80 to 90 percent of the trend in the increasing damage could be attributed to more wealth, more population, more people along the coast.

The largest signal in the effects that we see like Katrina's and others from extreme events are the decisions that we make every day: where to build, how to build, at what value. That is driving the impacts much, much more than any of the changes in climate that might have been documented so far.

Chairman TOM DAVIS. OK. Mr. Waxman.

Mr. WAXMAN. Thank you, Mr. Chairman. I want to thank each of our witnesses for their presentations.

As the chairman said, we are not scientists, we are policymakers, and it turns out that both of us are lawyers. You are a lawyer are not you, Dr. Pielke?

Dr. PIELKE. No, I am trained as a political scientist.

Mr. WAXMAN. Political scientist, but you are not a climatologist?

Dr. PIELKE. No.

Mr. WAXMAN. OK. So what we have in the four of you is different views, and we try to figure out what those different views represent, but it is appropriate to hear different points of view. But there seems to be among scientists overall a pretty strong consensus. The chairman asked about it. Dr. Karl stated that the current debate in the science is no longer about whether humans are causing climate change but how sensitive the climate will be to a given amount of CO_2 in the future.

Dr. Gulledge, can you provide any more background in the state of that important scientific question?

Dr. GULLEDGE. Yes, about how sensitive the climate is to changes in forcing or amount of CO_2 or, for that matter, any kind of forcing that might change over time. This really is the $50 million question in climate science, and that is where the true scientific debate is going on in the science research at this time. And by debate, of course, I mean people do their research and then they compare their results and argue about them.

For a long time there was very little progress in understanding the sensitivity. The range kind of stayed the same for a long time. The bottom end is 1.4 degrees celsius, which is about 2½ degrees, up to about 6 degrees, with a mid range 2 to 4. Most of the modeling work comes out in that 2 to 4 range, meaning that for a doubling of CO_2 you would expect 2 to 4 degrees increase in surface temperature.

Recently there has been more progress——

Mr. WAXMAN. What does this debate mean to us as policymakers?

Dr. GULLEDGE. Well, the sensitivity of the climate is going to determine what the level of impacts is going to be.

Mr. WAXMAN. And does Dr. Christy have a different view, that he thinks the impact is going to be less?

Dr. GULLEDGE. I can't characterize his view on that.

Mr. WAXMAN. Is that accurate, Dr. Christy? Do you think it is going to be less of an impact?

Dr. CHRISTY. It will be on the low end.

Mr. WAXMAN. The low end?

Dr. CHRISTY. Yes.

Mr. WAXMAN. So, therefore, if we view it on the low end, there is less for us to do; if we view it as a higher-end problem, there is more for us to do? Is that an accurate statement for policymakers?

Dr. CHRISTY. Maybe if I would just characterize it simply this way: if the world uses 10 terawatts of energy right now and you wanted to have a 10 percent impact on that, you would need 1,000 nuclear power plants, 1 gigawatt. So if you want to add 10 percent impact on the emissions it would take 1,000 nuclear power plants.

Mr. WAXMAN. That is one way. The question is how much of a problem we have, therefore how much of a solution. Your views seem to be the problem is not as great.

Dr. Curry, Dr. Christy discussed a number of studies of his that downplay the risk of climate change and dismiss the capabilities of

climate models, and he seems to suggest that these studies undermine the arguments for taking prompt action to address global warming. Do you want to comment on that?

Dr. CURRY. Yes. Looking at one very small location or region to try to infer, climate models are not capable of resolving at the level of one city or one small region at this point, so the issue of one small region in California disagreeing with some inference about what—climate models talk about things on larger scales, continental, southeast United States, that kind of a scale it can talk about. It can't talk about at the county level or the sub-State level.

I mean, that is not what we are able to do, so I don't think that we can disprove climate model simulations by looking at temperature records in one location. That is basically what I would say. So I don't think that those kinds of studies refute climate model predictions in any way.

Mr. WAXMAN. Dr. Curry, in your written testimony you note that high-level NOAA officials and selected scientists from the National Weather Service have repeatedly categorically denied a connection between global warming and increased hurricane intensity, yet several peer-reviewed studies published in top science journals, including your own study, have found evidence of such a connection.

Have those studies been proven wrong in any way so as to provide a basis for the NOAA denials? And, if not, could you please discuss the implications of a Government science agency such as NOAA issuing such categorical denials while completely disregarding the most recent credible scientific evidence.

Dr. CURRY. The two papers that were published during last year's hurricane by Kerry Emanuel, and the one led by Peter Webster talking about the increase in hurricane intensity, these were two papers that were very provocative, landmark studies done by very reputable scientific groups. They generated an enormous amount of attention, and they have basically been categorically ignored by NOAA and their testimony. They have specifically said that it does not have to do with global warming.

It puzzles me because this seems to be driven by a few scientists in NOAA. I don't believe that if NOAA administrators had talked to scientists at the National Climatic Data Center or to scientists at the Geophysical Fluid Dynamics Laboratory, that they would have gotten that kind of assessment. So I don't know what was driving those kind of statements. Not to even mention that there was a debate underway to me seems irresponsible because the statements by NOAA are, by default, you know, the official Government position on this subject, and it is not consistent with the current published research and the scientific debate that is underway.

Mr. WAXMAN. Well, it would be good for us to hear from them and see what they say, challenge them on that point, see their reaction.

I see the red light is on.

Chairman TOM DAVIS. You can do a couple more questions.

Mr. WAXMAN. I can do a couple more questions? I guess the thing that is always perplexing to us when we hear about a scientific dispute is to figure out what that means in terms of how much time we have to do something.

Dr. Pielke, I remember the debate on the deterioration of the ozone layer. It came up in 1977. Believe it or not, I was here in 1977. I worked on the Clean Air Act revisions. I remember people coming in and saying the argument that chlorofluorocarbons is causing deterioration of the upper ozone layer, that is just not established, that is a theory but we shouldn't do anything about it.

By 1990 the Congress was looking at the Clean Air Act revisions again and we put in a very strong provision, stronger than the Montreal Protocol, because we felt that we ought to do something about the problem, even though it was a global one and Montreal Protocol hadn't been worked out, I don't believe. I guess we were still working on it, and the fact we were working on it pushed them to resolve it internationally.

If there is an issue and we decide we had better do something about it, do you think we ought to be stopped in the United States from doing something until everybody is doing it? Or do you think that we ought to show some leadership and then others will go along with us, particularly in the area of developing resources to combat pollution or emissions where we can be out front if we take the lead in it?

Dr. PIELKE. Let me say I am very familiar through my own research with your early efforts on climate change following ozone, and they are to be commended because there was some very forward thinking there. It seems to me that this debate that we just saw between scientists and talking about the science, it becomes irrelevant if we can come up with policies that make sense in the short term without having to have some specificity about the long-term costs and benefits of some global policy. So the United States should be in the lead. It should be participating internationally. Most importantly, it should be continually bringing new options to discuss.

Europe is having tremendous difficulty meeting their own targets. They need new options. The United States shouldn't stick its head in the sand. I agree with some of the critiques of the administration's position. They are simply using the wrong metric of success, and asking what are the effects of your policies on outcomes is the right question. But you can't beat something with nothing, and right now what I see is there is a lot of debate about let's take action, but not a lot of specificity about, all right, who is going to take what actions on what time scale at what cost.

Mr. WAXMAN. Do you think it would be helpful for the State of California, which is almost like an independent nation—10 percent of the automobiles, or at least 10 percent, are bought and sold in California—to have tighter emissions standards? It is not going to solve the problem for the planet, but it certainly does drive action by the Federal Government and internationally if they put out standards and the technology to accomplish those standards is developed, and hopefully that is going to be, I think, an economic boon to those who work on it in California.

Dr. PIELKE. Yes. I think the States are laboratories for experiments, and that the States should be allowed to see what they can do using a variety of different approaches the Federal Government can evaluate, and we need to evaluate at the same time what is working, what is not working. If it works and they work as adver-

tised, scale them up to the Federal level. If they don't, say, well, that is too bad. We will try something else. But that is part of introducing new options is allowing States and communities to experiment.

Mr. WAXMAN. Well, that is one of my debates with Mr. Connaughton, because it seems that the administration is telling the States, don't you go ahead of us, and then making sure that the Federal Government moves as slowly as possible, even though we already have some technology, and tell us basically to wait until way, way later until we get a silver bullet like hydrogen.

I appreciate your comments, all of you. Thank you, Mr. Chairman.

Chairman TOM DAVIS. Thank you very much.

Mr. Van Hollen.

Mr. VAN HOLLEN. Thank you, Mr. Chairman. I apologize. I had another meeting to go to, so I didn't have the benefit of all the oral testimony. I have had a chance to look at some of the written testimony.

If I could just start with you, Dr. Curry, I agree it sends confused signals when the head of the Weather Service, for example, doesn't even acknowledge this is a debate that is ongoing. There is no debate, is there, to the fact that surface water temperatures, for example, in the Gulf increased last summer, is there?

Dr. CURRY. In the scientific literature, no, but you will find certain scientists telling the media that it is not increasing.

Mr. VAN HOLLEN. That surface water was not higher during the last hurricane season?

Dr. CURRY. Yes. I participated in a debate where the person I was debating actually said that, scientific debate, so what gets published in the scientific literature versus what gets out there publicly is diverging. That is what I am trying to say.

Mr. VAN HOLLEN. Right.

Dr. CURRY. So the published scientific research agrees that sea surface temperature has increased since 1970.

Mr. VAN HOLLEN. All right. Is there agreement, even though skeptics, those that are trying to say something different than what the scientific consensus is, do they agree that if surface water temperatures are increasing that it would have the effect of increasing the intensity?

Dr. CURRY. Yes.

Mr. VAN HOLLEN. Everyone is agreed on that, but they are disputing that the underlying fact is so?

Dr. CURRY. Yes. People, the skeptics, may say, well, wind shear may counteract all that. Wind shear is really more important. Some people have said that, but, again, theory, models, and the data support the link with sea surface temperature increase.

Mr. VAN HOLLEN. All right. Is there a dispute on this panel as to the increase in sea surface temperature? No? OK.

I would like to ask you if I could, Dr. Christy, because, as I understand your testimony, you have raised certain uncertainties about the science, and obviously in every area there is a range of predictions, but, as I understand it, you were on the panel that drafted the American Geophysical Union's official statement on climate change in 2003; is that correct?

Dr. CHRISTY. That is correct, sir.

Mr. VAN HOLLEN. And did you agree with the findings of that panel?

Dr. CHRISTY. Yes.

Mr. VAN HOLLEN. You did? All right. Because, as I understand it, the statement acknowledges that the global climate is changing and human activities are contributing to that change. So you agree with that statement; is that right?

Dr. CHRISTY. Yes.

Mr. VAN HOLLEN. All right. And I understand that, according to the AGU, it is virtually certain that increasing greenhouse gas concentrations will cause global surface climate to be warmer. Do you have any reason to dispute that?

Dr. CHRISTY. No, and the reason that is stated exactly that way is there is no magnitude associated with that statement, and my famous quote that was all over the papers and NPR and so on was, here we are after changing deserts into farmland and forests into cities and throwing dust and soot and aerosols in the atmosphere and adding greenhouse gases, the climate just has to respond some way. It should change because of human activities.

Mr. VAN HOLLEN. So you have been on a number of panels, including the National Research Council, as well. Are there any findings or statements that have come out of those panels that you served on that you disagree with?

Dr. CHRISTY. That is a big question, and I had problems with some, yes.

Mr. VAN HOLLEN. OK. Did you have a dissenting opinion in any of those?

Dr. CHRISTY. In one case I said, please put a footnote in there that says John Christy takes this view on this particular issue, but the pressure was just so hard and placed upon me as sort of the only person on there, that there had to be a consensus, and so we went ahead with graying up one of the words.

Mr. VAN HOLLEN. You grayed one of the words. If I could just ask, on the surface temperature issue, because I just want to make sure, if you agree that there is an increase in the surface temperature, and I understood no one to sort of disagree with that scientific conclusion, would you agree that certainly one reason surface temperatures may be rising is a result of global climate change produced by human activity?

Dr. CHRISTY. The surface temperature has risen, and part of the cause of that is due to the enhanced greenhouses that humans have put into the atmosphere.

Mr. VAN HOLLEN. OK. And you also agree that increased surface water temperature leads to more intense hurricanes?

Dr. CHRISTY. I am not an expert on hurricanes.

Mr. VAN HOLLEN. All right. Fair enough.

Thank you, Mr. Chairman. I just have one question on the issue of short-term reductions that you mentioned. Have you put forward a set of sort of policy recommendations as to what short-term steps we can take?

Dr. PIELKE. I have some listed. They have gone by different names as no regrets options, or co-benefits, or ancillary benefits. It seems that we have the cart and the horse mixed up. We are trying

to look to reduce greenhouse gases and say, well, look at all these short-term benefits that come along with it. It seems to me turning it around and saying, well, let's do those things on technological innovation, energy efficiency, foreign policy, and hey, look, we get the greenhouse gas thing for free on the side. It seems that we have taken the most politically intractable part of this problem and put it at the center.

If anyone had the answer we wouldn't be sitting here today, so that is why I think that the wonderful resources of our technologists, our scientists, ought to be put to the test, not of the scientific questions about hurricanes and temperature, but give us some options, give us some things that you folks can turn into legislation, we can experiment with, and maybe has a real effect in the short term.

Mr. VAN HOLLEN. I certainly agree that we should be pursuing immediate options. I think one of the obstacles, frankly, to getting people to move forward on some more immediate options is the fact that some people continue to cloud the issue about whether there is any reason for us to be moving forward.

For example, let me ask you, the administration's budget this year actually cut the amount of funding for energy efficiency programs. There is some increase in some of the renewable energy programs, but wouldn't you agree that one of the areas we could get some very short-term gains in reducing greenhouse emissions is through greater efficiency standards, and that it is short-sighted to cut the budget for work in that area?

Dr. PIELKE. I would agree with that.

Mr. VAN HOLLEN. Thank you.

Thank you, Mr. Chairman.

Mr MARCHANT [presiding]. Thank you.

Dr. Pielke, as a former Hill staffer, you know how things work around here.

Dr. PIELKE. Well, I was an intern, so I got coffee and stuff, but yes.

Mr. MARCHANT. You at least know how people like their coffee. [Laughter.]

What unique message do you have for the Members and staffers to help them as they navigate the politics to arrive at appropriate responses to climate change?

Dr. PIELKE. I think one of the most instructive things for me is to take a look at hearings over time on this issue, and if you don't look at the date they look about the same over a decade, 15 years. The discussion is always on the science and trying to get some consensus on the science.

In my testimony I cite a poll done by the National Journal of Members of Congress, and it asked Members of Congress, some select group, what are your views on global climate change, and I don't have the exact numbers in front of me but something like 98 percent of Democrats thought it is a real serious issue and 23 percent of Republicans, a big partisan divide there.

But they asked a second set of questions: what sort of policies do you think make sense? They had to do with energy efficiency, CAFE standards sort of things. There was much greater agreement.

Scientists are going to be arguing about hurricanes and climate change 10 years from now. I think that is a safe prediction. I think the debate has to start moving on to a focus on options, and let's set aside the science. The science is plenty good enough and it has been for a long time for action to take place. Let's move the discussion. When we ask questions about hurricanes and climate change I would like to see a followup question: what can we do about it? What effect will energy policies have on hurricane behavior? How about adaptation? What can we do to make building codes stronger, land use policies?

Let's move from, do we know how many hurricanes are going to occur to, well, there are going to be a lot. There might be an awful lot or a terribly awful lot, but the policies that we are going to be dealing with are probably going to be the same in either case. So my recommendation is, as interesting as the science is, let's move beyond and focus everybody. Policymakers a lot of times set the agendas for the bully pulpit. Ask the policy questions, not the science questions.

Mr. MARCHANT. Dr. Christy, Dr. Curry said that you can't make an assessment based on a localized region, like in your studies. Would you like to comment on that?

Dr. CHRISTY. That is a correct statement, that one small region like that isn't something you would want to test your climate models on. What I did was I used lots of climate models on one region, went to another region, did the same thing that I mentioned in here but not in my oral testimony. The entire southeast is cooling over the past 120 years, and not one single climate model in every run we have ever checked has been able to reproduce that, not once out of 50 some odd.

But then I think the bigger one is that when you look at something the size of the tropics, that is one-third of the globe. That is not a trivial part. And so the carbon dioxide, the enhancement of its concentration will have an effect on the climate, and there are lots of reasons to not want to burn carbon for energy. It is quaint, if you think.

A hundred years from now they will look back and say how quaint it was that they burned carbon for energy back then. And so I am not sitting here saying let's not do anything about climate change, but as a climate scientist looking at so many data sets that we build ourselves we don't see the catastrophic direction of the climate system.

Mr. MARCHANT. Your experience in Africa led to your concerns about unintended consequences of our policy choices regarding mitigating climate change. How should policymakers look at those unintended consequences versus the pressure for action?

Dr. CHRISTY. Well, let me come to the State of Alabama. We have many poor people in my State. If the regulatory climate is to say let's increase taxes and drive energy prices high so that is a way to reduce CO_2, that will have a very bad effect on the poorest in my State, and I would be much against something like that. It will have no effect on the climate. We would never be able to measure the effect, in any case.

I really like a lot of the things Roger here has said about what kind of policy decisions that should be made are those that have

some effects that have many benefits, and I gave a little example about the thousand nuclear plants can make a 10 percent dent in the thing, but who wants to do that. I don't know.

So just remember there are poor people out there. Energy makes their lives healthier, it makes their lives longer, and to make energy less accessible to them is, in my view, not the right thing to do.

Mr. MARCHANT. So you are saying that the thousand nuclear plants could make a difference, if you just did them for ecological reasons, but what if they are done for economic reasons as well, that energy coming out of them is cheaper, as well?

Dr. CHRISTY. You know, I am not an energy expert, but I would say you are dealing then with other issues like energy security. If you had your own energy source, you wouldn't have to deal with all the things we see in the newspapers today. So there are a lot of reasons to develop other kinds of energy than what we use now, as long as we keep it affordable and accessible, because that is important for people's lives, and especially people I deal with in Alabama.

Mr. MARCHANT. And affordability and accessibility almost assures continued use and continued escalating use.

Dr. CHRISTY. Yes. I don't think anyone here would disagree with the statement that energy demand will rise.

Mr. MARCHANT. With cheaper.

Dr. CHRISTY. No matter what, regardless of price. It brings so many good benefits immediately to human life, health, and longevity that it, especially around the world in the Third World, energy use will rise.

Mr. MARCHANT. Mr. Shays.

Mr. SHAYS. I thank the gentleman.

I am so, so sorry I was not able to be here. I do know I don't do this often, but I know there is written testimony that I can review, and this will be testimony I will review.

My sense is that we basically, Dr. Curry, can listen to your skepticism at first and your conviction now that we do have a global warming problem, and that it is impacting the media, which sometimes likes to dramatize, that storms are being impacted because of global warming. Your nodding of the head is a yes, correct? It needs to be recorded.

Dr. CURRY. Yes.

Mr. SHAYS. And my sense to you, Dr. Christy, is that when you look at sea level temperatures and so on it is just an added confirmation that global warming is a factor, as well, correct?

Dr. CHRISTY. Yes, that human effects are causing a change in the radiation balance that leads to higher temperatures, yes.

Mr. SHAYS. When we put the two of you together, my sense with you, Dr. Pielke, is that you are looking at it from a policy standpoint and, you know, there are things that can be done in the short run, and so on; is that correct? Yes. And you, Dr. Gulledge, you look at the overall policy of how we deal with this issue?

Dr. GULLEDGE. I am sorry, I am not a policy analyst. I am a scientist.

Mr. SHAYS. Then your point, your primary point that you want me to hear? I am sorry that it is redundant.

Dr. GULLEDGE. My primary point is that I agree very much with Roger's statements that this is the wrong panel sitting here. There are not enough questions left about the science that we should actually be taking up your time, in my view.

Mr. SHAYS. In other words, case closed, answered?

Dr. GULLEDGE. Any differences you may have perceived about the science on this panel are actually quite minor and stem more from differences in perspective than understanding the science.

Mr. SHAYS. Right. And you speak from what background?

Dr. GULLEDGE. I am a scientist. I am an ecosystem ecologist. I study the carbon cycle.

Mr. SHAYS. Well, for you it may not be significant; for me, it is about time that we had people sit at a table and say what is the obvious. I get the sense from you, Dr. Pielke, that even if we did policies that were not addressing the problem that existed, it would still be a benefit to our world?

Dr. PIELKE. If we organize our approach to climate change in that manner. The way that the international approach is set up under the Framework Convention is it separates out the long-term climate policies from the sustainable development, energy efficiency, and so it separates those out, and so we don't talk about them at the same time.

Mr. SHAYS. So with this in mind, our first panel said global warming is real and it is being caused in significant measure by humanity, you all just adding voice to that as scientists, I would like you to tell me your biggest regret and, if you could get the President to do one thing, just one thing, what it would be.

But what is your biggest regret? I mean, for me a big regret would have been not having minivans, SUVs, trucks, and cars all getting the same mileage when we did it so people couldn't go off in that direction, or another one, that fuel was so cheap we didn't care about the wasting of energy. That would be a big regret, because I think, had we dealt with it differently, it would have had a huge impact today. We would be in a different place.

I would like each of you to tell me what your biggest regret is and what you would like to see happen. I will ask the chairman to give me a little latitude, since there are only two of us, just to pursue this. I will start with you.

Dr. GULLEDGE. Thank you. That is a very large question, and——

Mr. SHAYS. I am going to start with biggest regret, and then I am going to ask you to say the most significant thing we could and should do now.

Dr. GULLEDGE. OK. I am going to step back from my profession as a scientist and speak as a well-informed American citizen who has followed this issue for a long time. My biggest regret as an American is that the United States didn't take leadership in multilateral, international negotiations to deal with climate change two decades ago, and released its leadership role to other countries so that in the end we ended up with something that our Congress didn't like and our country wasn't engaged in developing, and now we are just being left behind and we do not have a leadership role on one of the biggest issues in the world. I feel terrible about that.

Mr. SHAYS. I am so happy I asked that question, because that one comment alone was worth coming here.

Dr. GULLEDGE. Now that is just my view as a citizen.

Dr. PIELKE. My view is fairly wonky. In 1990 when Congress was debating creating legislation to create the U.S. global change research program there was a parallel effort proposed at the time called MARS—Mitigation and Adaptation Response Strategies. It was envisioned at the time to be as large as the scientific research program, to focus on policy options. Through the mechanics of the congressional process it got axed, so we focused——

Mr. SHAYS. What was that called?

Dr. PIELKE. MARS, Mitigation and Adaptation Research strategies. I can send you some information.

Mr. SHAYS. And what year was that?

Dr. PIELKE. It was 1990. And so, instead of focusing on response strategies, the focus became on reducing uncertainties. Given that we missed that opportunity to focus on response strategies, it should come as no surprise that we are still talking about science over policy.

Mr. SHAYS. Thank you. These are really helpful.

Dr. CHRISTY. I suppose my biggest regret was that the investment in the observing system overall from space, as well as the surface, has lagged in terms of its ability to be precise and determine long-term changes with much less uncertainty.

Mr. SHAYS. From your standpoint, if we had better technology in space looking at the Earth——

Dr. CHRISTY. And around the Earth, as well.

Mr. SHAYS. Right.

Dr. CHRISTY. Yes, on the surface. And I suppose my one remark about the future would be——

Mr. SHAYS. No, not yet.

Dr. CHRISTY. OK. I am sorry.

Mr. SHAYS. I am asking the chairman to indulge me. I know we got another—I didn't see Mr. Waxman come back, so maybe he won't indulge me, but would you at least answer this question?

Dr. CURRY. OK. I would echo Jay Gulledge's comments. The fact that we don't have a plan at this point and that we are not in a leadership role is extremely unfortunate. As a scientist, I have avoided making any kind of specific policy recommendations for several reasons, so as to appear that I don't have an agenda, and that I am not personally qualified to evaluate all the technologies, the politics, and the economics, but——

Mr. SHAYS. I will yield back. I am sorry.

Dr. CURRY [continuing]. But the fact that we do not have a plan is very disturbing.

Mr. SHAYS. Do you mind if I just ask then this question?

Mr. WAXMAN. Fine with me.

Mr. SHAYS. Then just tell me the one thing each of you would like to see—I realize there is lots, but maybe it is the first thing or whatever, the one big thing that you would like to see happen. Yes, sir?

Dr. PIELKE. I would like to see increased congressional oversight of the climate change science program and climate change tech-

nology program going back to Public Law 101–606 that calls for those programs to provide policy options.

Mr. SHAYS. By oversight, you want to see more money put into it?

Dr. PIELKE. No. I want to see you bringing the leaders of those programs and the executive branch here and saying, what are the options that are resulting from this multi billion dollar investment?

Mr. SHAYS. OK.

Dr. PIELKE. You get a lot of good science. It is great science. But you are not getting many options.

Mr. SHAYS. OK. Thank you.

Dr. CHRISTY. I would just go along with the Hippocratic Oath: first, do no harm. Think of the poor people out there. If energy costs rise, that does specifically and directly affect them.

Mr. SHAYS. OK. The chairman is gaveling me, so the two of you will be on record. I thank the chairman.

Mr. MARCHANT. Thank you. We have some witnesses that need to catch some flights, so we are going to go to the third panel.

Mr. SHAYS. Fair enough.

Mr. WAXMAN. Mr. Chairman, as this group leaves I just want to comment that energy prices have doubled over the last 5 years and it wasn't because of our efforts to deal with global warming. Maybe the prices would have not risen so high if we had done something about energy efficiency, because that would have helped us in the area of climate change, as well.

Mr. SHAYS. Thank you.

Mr. MARCHANT. We will now recognize the third panel as they are coming up here. We will reconvene in about 3 minutes.

[Recess.]

Mr. MARCHANT. We are still missing one witness. Our first witness is Mr. Theodore Roosevelt, IV, chairman of strategies for the global environment, the Pew Center on Global Climate Change. Another of our witnesses present is Mr. Marshall Herskovitz, and he is a producer, director, and writer of television and film. And the other witness that we expect shortly is Mr. Andrew Ruben. He is vice president of corporate strategy and sustainability of the Wal-Mart Stores, Inc.

Welcome, gentlemen. It is customary for you to have a 5-minute opening statement and then we will have questions.

Welcome, Mr. Roosevelt.

It is our custom to swear the witnesses in, so if you will stand and raise your right hands.

[Witnesses sworn.]

Mr. MARCHANT. Thank you.

Mr. Roosevelt.

STATEMENTS OF THEODORE ROOSEVELT IV, CHAIRMAN, STRATEGIES FOR THE GLOBAL ENVIRONMENT/PEW CENTER ON GLOBAL CLIMATE CHANGE; ANDREW RUBEN, VICE PRESIDENT, CORPORATE STRATEGY AND SUSTAINABILITY, WAL-MART STORES, INC.; AND MARSHALL HERSKOVITZ, PRODUCER/DIRECTOR/WRITER, TELEVISION AND FILMS

STATEMENT OF THEODORE ROOSEVELT IV

Mr. ROOSEVELT. Thank you, Mr. Chairman. Thank you, Ranking Member Waxman and members of the committee. It is a pleasure to be here, to see old friends. I want to salute you and your committee for undertaking this hearing. I think it is extremely important.

As the chairman mentioned, I am the chair of global strategies, which is the umbrella organization for the Pew Center on Climate Change. I am also co-chair of the Alliance for Climate Protection and am on the board of the World Resource Institute.

Earlier you just heard, I think, some very good testimony from the panel on science, and also in the first panel. I am not going to dwell on this other than to say I believe that the science on this is compelling and shows clearly that human activities contribute to global climate change. Sometimes one hears the phrase, the science is not conclusive. I daresay all of us believe in Einstein's general theory of relativity, but I challenge certainly myself and probably most of you could you prove that theory conclusively. I couldn't even prove conclusively Newton's law of gravity, but when I take this bottle and bring it over to the edge and push it over I know that bottle would drop.

Prudence dictates that we take climate change seriously. A farmer who has got his crops and livestock in a barn knows the possibility of lightning hitting that barn is probably remote, but he will take out a policy of insurance because he knows if lightning does hit that barn he will be wiped out. We know the possibility of damage from global climate change is not remote, and the longer we delay addressing this issue the harder it will be for us to find solutions.

At the Pew Center a variety of companies sit on our Business Environmental Leadership Council. We call that the BELC. The oil and gas industry is represented by BP and Shell; transportation by Boeing and Toyota; utilities by PG&E, Duke Energy, and Entergy; high tech by IBM, Intel, HP; diversified manufacturing by General Electric and United Technologies. These are all companies that recognize climate change is real. They want to prepare themselves for a carbon-constrained future and they need time to make the necessary changes. They know that the risks of inaction outweigh the costs of action.

For example, Marsh, Inc., which just joined the BELC, said in a white paper, "Climate change is a significant global risk. Businesses, if they haven't already, must begin to account for it in their strategic and operational planning." Another leader in the insurance industry addressing climate change is Swiss Re, which is not a member of the BELC, but calculates that Katrina resulted in $45 billion of losses and $10 billion each from Rita and Wilma. Obviously, no one can blame damage from one hurricane on climate

change, but the evidence is pretty clear that, while the overall number of hurricanes may not increase, the number of category four and five hurricanes will, and with increased violence in hurricanes will come increased losses.

Some companies see attractive investment opportunities in meeting the need for renewable energy and increased energy efficiency. BP has created an alternative energy division, and they plan to invest up to about $8 billion over the next 10 years. General Electric, in its well-thought-out ecomagination initiative, plans to see revenues go to $10 billion over the next several years, which represents a doubling of where they currently are. Venture capitalists invested $1.4 billion in clean technology in 2005, up 43 percent from 2004. The carbon disclosure project started with 35 companies in 2003 accounting for about $4.5 trillion of assets. Today there are 155 institutions with combined assets of $21 trillion that have signed onto the carbon disclosure project.

Business, however, cannot do it alone. We need mandatory compliance structured in such a way as to take advantage of the tremendous power of markets and unleash the creativity of American companies and businesses to meet the challenges when required to do so. A relevant or perhaps great example of this is the extraordinary success of the 1990 amendment to the Clean Air Act. A key element in the success of that amendment was the cap in trading regime for sulfur dioxide and nitrous oxide. That cap in trading regime, which was put in in 1990, resulted by about 2003, 2004 in a reduction of about a third of these emissions, and they did so without, I believe, any legal suits as a result.

The elements for success in dealing with climate change will include greater conservation and efficiency in the use of energy and the use of new and better technologies. Significantly improving our energy efficiency will improve the competitive position of the United States, and in many instances will result in lower operating cost. Development of new technologies will open new markets for us overseas.

In conclusion, I would like to leave you with two thoughts. Global climate change is a serious issue and we cannot afford further delay in addressing it. Second, I have immense confidence in the power of this country to create effective policies to deal with climate change while maintaining economic growth as long as we can muster the political leadership to do so.

Thank you.

[The prepared statement of Mr. Roosevelt follows:]

Statement by

Theodore Roosevelt IV
Pew Center on Global Climate Change
July 20, 2006

regarding
Climate Change: Understanding the Degree of the Problem – and the Nature of its Solutions

submitted to
The Government Reform Committee
U.S. House of Representatives

Mr. Chairman and members of the committee, thank you for the opportunity to testify on climate change. My name is Theodore Roosevelt IV. I am the chairman of Strategies for the Global Environment, the umbrella organization of the Pew Center on Global Climate Change. I am also a co-chairman of the board of the Alliance for Climate Protection, and a member of the board of the World Resources Institute, though my statement today will primarily reflect the views of the Pew Center.

The Pew Center on Global Climate Change is a non-profit, non-partisan and independent organization dedicated to providing credible information, straight answers and innovative solutions in the effort to address global climate change.[1] In our eight years of existence, we have published almost seventy reports by experts in climate science, economics, policy and solutions, all of which have been peer-reviewed and reviewed as well by the companies with which we work.

Forty-one major companies sit on the Pew Center's Business Environmental Leadership Council, spanning a range of sectors, including oil and gas (BP, Shell), transportation (Boeing, Toyota), utilities (PG&E, Duke Energy, Entergy), high technology (IBM, Intel, HP), diversified manufacturing (GE, United Technologies), and chemicals (DuPont, Rohm and Haas). Collectively, the 41 companies represent two trillion dollars in market capitalization and three million employees. The members of the Council work with the Pew Center to educate the public on the risks, challenges and solutions to climate change.

[1] For more on the Pew Center, see www.pewclimate.org.

Mr. Chairman, global climate change is one of the most daunting challenges we have ever faced as a nation. I am not a scientist, but I respect science, and when the nation's premier science body, the National Academy of Sciences, speaks as clearly on an issue as it does on climate change, it is a good idea to listen. The National Academy of Sciences has said, in a statement signed last summer by the academies of ten other nations as well: "The scientific understanding of climate change is now sufficiently clear to justify nations taking prompt action. It is vital that all nations identify cost-effective steps that they can take now, to contribute to substantial and long-term reduction in net global greenhouse gas emissions."

What do we know about the impacts of climate change?

We know that hurricanes are becoming more intense, not just in the Atlantic, which gave us Katrina and Rita, but in all oceans where hurricanes occur. We know we are experiencing a worldwide loss of mountain glaciers, a trend that is accelerating and has major implications for water supply in this country and around the world. We know that sea level is rising at an accelarated rate. We know that ecosystems around the world are showing signs of responding to climate change, with strong scientific evidence indicating that climate change is promoting the spread of diseases to new areas. The bottom line is this: The earth is warming; the impacts—once only predictions—are now upon us and are likely to worsen; and human activity is largely to blame.

Because carbon dioxide and the other greenhouse gases stay in the atmosphere for so long – a century in the case of carbon dioxide – climate change is largely irreversible, at least in the time scales human society is used to dealing with. But that does not mean we should throw up our hands. Given the current projections, things could get bad. But if we do not act soon, they will get worse.

Beyond the environmental case, though, there is a strong business case for addressing climate change – and doing so in part through mandatory measures.

As I mentioned, the Pew Center works with a wide range of businesses. Each of the companies on our business council is acting voluntarily to reduce its greenhouse gas footprint. The voluntary actions have shown the companies there are cost effective – in some cases, cost saving – measures they can take to reduce greenhouse gas emissions. Thirty of the companies have targets for their voluntary actions, and 14 have already met their targets.

To give you some examples:

- Entergy last year met its first goal to stabilize CO_2 emissions at 2000 levels, and is now aiming for a 20 percent reduction in emissions by 2010.

- Weyerhaeuser will reduce its emissions 40 percent by 2020 through greater reliance on biomass to fuel its pulp and paper mills.

- SC Johnson reduced GHGs 18 percent since 2000, more than doubling initial 8 percent reduction goal, by vastly reducing reliance on fossil fuels and increasing use of alternative forms of energy, like landfill gas and wind.

Why are the companies doing this? In absence of serious climate policy in this country, why are they focused on this issue at all? Among other things, many in the business community realize that the risks of inaction outweigh the costs of action. For example, according to the reinsurance company, Swiss Re, there were $45 billion in total insured losses from Katrina, and $10 billion in insured losses from Rita and Wilma. While we can not say that any one hurricane is the result of climate change, there is strong evidence that we have and will be seeing more intense hurricanes, and these numbers illustrate the cost of that.

Perhaps because it is so exposed to the risks of climate change, the insurance industry has emerged as one of the strongest leaders in addressing the issue. For example:

- The National Association of Insurance Commissioners formed a task force this year to assess the impacts of climate change on the industry.

- Lloyd's of London published "Climate Change: Adapt or Bust," saying insurers must now take climate risks far more seriously.

- Marsh, Inc., which has just joined our business council, has committed to be a leading source of climate risk information and solutions. A Marsh white paper on corporate climate risk concluding that "Climate change is a significant global risk. Businesses – if they haven't already – must begin to account for it in their strategic and operational planning."

So businesses have a significant interest in climate action.

There is a limit, however, to how far even the bravest corporate leader can go voluntarily. If you expect mandatory climate policy to be enacted within the lifecycle of your capital investments – as most astute businesses managers do – voluntary action today could actually end up hurting you in competition with the laggards in your industry when the policy becomes mandatory.

More importantly, for investors and inventors to start working in earnest on the transformative technologies the world will need to keep growing the economy while shrinking our climate change footprint, they need the certainty that only mandatory policy can provide.

We have a tremendous track record in this country when it comes to meeting environmental challenges, even as we grow our economy. Of the many important lessons

we can draw from that experience, here is one especially to keep in mind: No major environmental problem has ever been solved in this country by voluntarism alone.

I have been discussing this in somewhat negative terms, but this is not just an issue in which we must manage risk, it is also an issue that yields business opportunities. That is one reason technology giants like GE, DuPont, United Technologies and the others on our council are working on this issue. The challenge of climate change, like other challenges we have met in the past, will create economic opportunities for U.S. industry. Eighty percent of our greenhouse gas emissions come from the burning of fossil fuels. Because of this, addressing climate change will involve, among other things, increasing the efficiency of our energy use. That increased efficiency will directly improve U.S. competitiveness, as well as increase our energy security by reducing reliance on foreign energy sources.

Furthermore, financiers are projecting significant growth in demand for renewable energy technologies and energy efficient products. Mandatory climate policy will spur U.S. leadership in environmental and energy technology innovation, assuring U.S. competitiveness in the booming global market for climate-friendly technology.

Again, a few examples:

- BP has created an Alternative Energy Division and may invest up to $8 billion in this venture over the next 10 years.

- The 2005 revenues of GE's *ecomagination* initiative are over $10 billion, up from $6.2 billion in 2004.

- Clean technology markets now represent annual global revenues greater than $150 billion.

- U.S. venture capitalists poured $1.4 billion in clean technology markets in 2005, up 43% from the year before.

- When the Carbon Disclosure Project was launched in 2003, 35 investors totaling $4.5 trillion in assets signed on. This year, 155 institutional investors with combined assets of $21 trillion signed on. Currently, more than 350 companies report their emissions and climate strategies through the CDP website.

There are also growing opportunities in the carbon trading market. Many of the companies on our business council have experience with the European Union's emissions trading system, and others participate in the Chicago Climate Exchange. In particular:

- Baxter International became first company to transfer greenhouse gas allowances from the European Union to the Chicago Climate Exchange, linking the two markets and setting an important precedent.

- PG&E has a Climate Protection Program that gives customers the opportunity to go "carbon neutral" by paying a small fee on utility bill to offset carbon emissions associated with electricity purchases.

How do we make this outstanding work the norm? In February, the Pew Center released the first comprehensive plan to reduce greenhouse gas emissions in the United States. Our Agenda for Climate Action outlines an ambitious yet practical approach, based on eight years of analysis and work with leading businesses and policymakers.

The Pew Center's Agenda outlines 15 specific recommendations in six overarching areas where the United States must take action. These six areas are: 1) science and technology; 2) market-based programs; 3) sectoral emissions; 4) energy production and use; 5) adaptation; and 6) international engagement. Let me say a word about a few of these.

First, we believe it is critically important to enact a mandatory cap and trade program that applies to large stationary sources – power-plants and major manufacturing facilities. Our work over the years has shown that market mechanisms such as emissions trading allow companies to reduce emissions in the cheapest, most efficient manner possible.

What a cap and trade system does is tell the market there is value in reducing emissions. It tells inventors and investors there is profit in creating and deploying climate-friendly technologies. It creates an essential pull for new technologies to enter the market. The push for those technologies comes from the funding of innovation, but we need both the push and the pull to achieve real and cost-effective results.

A cap-and-trade system by itself, however, and particularly at the level that would be politically practical, is not enough. This is why the Pew Center's Agenda also calls for sectoral approaches, such as transforming the much-maligned Corporate Average Fuel Efficiency (or CAFE) program. We recommend strengthening and converting the CAFE program to a set of tradable standards based on greenhouse gas emissions. If you are looking to protect the climate, focusing on emissions rather than fuel efficiency is the way to go. By creating a market for emissions reductions through trading, and at the same time supporting the development of low-emission vehicles and fuels (the push and pull approach)—you can reduce the cost of getting the job done.

Another critical issue is coal. We need to be realists here. Coal is responsible for 50 percent of our nation's electricity. It is cheap and it is plentiful and I believe it will continue to play a role in meeting U.S. and global energy needs for years to come. We need, therefore, to get very serious about reducing carbon dioxide emissions from coal-fired power plants. First, we need to build the very best, most efficient coal burning power plants possible to reduce emissions per kilowatt-hour of electricity. And then we have to prove that the carbon dioxide that still is emitted from these plants can be captured and stored in geological formations where it can be kept from entering the atmosphere for centuries or millennia.

We recommend an aggressive program of research, development and demonstration for these technologies. A few random demonstration projects done at a leisurely pace clearly are not enough. We need to build the most efficient plants and we need a concerted public-private effort to demonstrate that capture and sequestration can work, and then we have to insist that it be done.

Again, these are not the only issues that need to be addressed. Energy efficiency, renewable energy, carbon sequestration on agricultural and forest lands – all these are essential parts of the solution as well.

Finally, the Pew Center's Agenda, while primarily focused on domestic actions, also calls for greater U.S. participation in international negotiations on this issue. It is obvious now that there is no chance the United States will sign on to the Kyoto Protocol. Regardless, the fact remains that climate change is a global problem that demands a long-term global solution. We need to engage every country that is a major source of these emissions, not just the United States, but China and India as well. And we need to come up with ways to make the process fair and equitable for all involved.

In closing: climate change is a serious challenge and one we need to begin addressing now in a serious way, including through mandatory policy. Fortunately, there is every indication that if we design our policy right, we will be not just allowing, but helping, the economy to grow. I thank and commend you, Mr. Chairman, for holding this hearing. The Pew Center looks forward to working with the committee on the development of any future climate policy.

Mr. MARCHANT. Thank you.
Mr. Ruben.

STATEMENT OF ANDREW RUBEN

Mr. RUBEN. Mr. Chairman and Ranking Member Waxman and distinguished members of the committee, my name is Andrew Ruben. I am vice president of corporate strategy and sustainability for Wal-Mart Stores. On behalf of Wal-Mart Stores, we appreciate the opportunity to provide testimony on this important issue.

As our CEO, Lee Scott has said, business and the environment are not mutually exclusive. We are passionate about making Wal-Mart a more environmentally friendly company and believe that greenhouse gases can be cost-effectively reduced throughout the economy.

I have submitted in writing my testimony. I would like to summarize the testimony for you here.

Today I am prepared to share the various initiatives that Wal-Mart has undertaken and to highlight how our learnings with environmental sustainability make us a better business. As the largest retailer in the world, the largest private consumer of electricity in the United States, and the owner of one of the largest private truck fleets in the country, we recognize the effect we have on the environment.

We similarly recognize the opportunity we have for leadership. Last year, Lee Scott announced Wal-Mart would make sustainability a key part of the company's strategy and outlined three aspirational goals. Lee Scott talked about being supplied 100 percent by renewable energy, creating zero waste, and selling products to sustain our resources and the environment.

We also have more near-term goals. For example, we will reduce the solid waste in the back of our stores, clubs, and distribution centers 25 percent by 2008; our existing facilities will use 20 percent less energy within 6 years; and new facilities that are being built will use 25 to 35 percent less energy in the next 2 years.

We are already making progress toward these goals. For example, we have recently retrofitted our entire fleet with auxiliary power units. They are essentially more efficient diesel engines that allow, while the truck is idling, will allow auxiliary power for heating and cooling of the cab. That change, alone, saves 10 million gallons of diesel per year, avoids 100,000 metric tons of CO_2, and, by the way, saves our business $25.5 million in the avoidance of that fuel. It is a clear example about how these efforts make us a better business.

Another example where we can help our customers is compact fluorescent light bulbs. If the customers that go through our store in a given week simply buy one high-efficiency compact fluorescent light bulb, as opposed to today's traditional incandescent bulb, that will put $3 billion back into their pockets on electrical savings. It will equate to 100 million metric tons of CO_2, roughly five times Wal-Mart's global footprint, and, by the way, save a billion incandescent bulbs from the landfill.

Today less than 10 percent of the light sockets in the United States currently use these high-efficiency compact fluorescent

bulbs. You can start to see the immense potential we have in front of us.

We realized that we have similar opportunity to work with our suppliers. For example, we recently visited a factory, Dana Undies. If you are wondering, yes, Dana Undies does make underwear. We shared with them some of the learnings that we had from our stores. We talked to the CEO of the company and the plant manager. After making changes from that conversation to their lighting and their HVAC or heating and air conditioning systems, Dana Undies now sees a 60 percent reduction in their energy costs. It is better for us, it is better for our customers, it is better for the environment, and yes, it is also better for Dana Undies.

Some of the opportunities to create change are less obvious. For example, we recently removed 2 grams of weight from our private label of water that is on our shelves. That small change saved 5 million pounds of PET, virgin PET, from ever going into production every year. Our produce buyers are looking at more ways to buy locally grown produce, such as expanding a sourcing program for peaches from two locations in the United States to more than a dozen. That not only saves transportation; it also saves refrigeration, it saves packaging, while increasing the freshness of that product while it reaches the stores.

Finally, packaging on something as simple as laundry detergent, working with Unilever we introduced a product called, All Small and Mighty. It is essentially a concentrated laundry detergent. It is one-third the size of a traditional bottle. It saves packaging, transportation, and water. In fact, if all detergent that was made made similar changes, we would avoid thousands of deliveries to our stores and to stores across the United States.

While this is a business strategy, we are sharing everything we are doing. Simply stated, sharing these innovations and sharing these learnings allows greater scale and allows change to occur at a more rapid pace.

Two years ago I could not have imagined that we would have over 100 environmental NGO's, activists, and academics at our headquarters in Bentonville, AR. Two years ago I would have never believed that they would be coming to join 150 executives from some of our largest suppliers. Yet, last week, all together with our senior leadership, we brought these groups together and spent a day addressing business's potential role in climate change.

The members of this committee play an important role in what you are doing today in bringing this topic to bear and having this conversation. We appreciate the forum that you offer us and look forward to any ways that we can help provide insight into what has been going on at one business.

[The prepared statement of Mr. Ruben follows:]

WAL★MART®

WRITTEN TESTIMONY

ANDREW RUBEN
VICE PRESIDENT OF CORPORATE STRATEGY & SUSTAINABILITY
WAL-MART STORES, INC.
BENTONVILLE, ARKANSAS

"CLIMATE CHANGE: UNDERSTANDING THE DEGREE OF THE PROBLEM"

BEFORE THE UNITED STATES HOUSE OF REPRESENTATIVES
COMMITTEE ON GOVERNMENT REFORM

THURSDAY, JULY 20, 2006

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WRITTEN TESTIMONY OF ANDREW RUBEN

VICE PRESIDENT OF CORPORATE STRATEGY & SUSTAINABILITY

WAL-MART STORES, INC.

BEFORE THE UNITED STATES HOUSE OF REPRESENTATIVES

COMMITTEE ON GOVERNMENT REFORM

JULY 20, 2006

Chairman Davis, Ranking Member Waxman and distinguished members of the Committee:

Wal-Mart Stores, Inc. appreciates the opportunity to provide testimony on this important issue. We know that being an efficient and profitable business and being a good steward of the environment are goals that can work together. At Wal-Mart, from our CEO, H. Lee Scott Jr. and down, we are passionate about making Wal-Mart a more environmentally-friendly company and we believe that greenhouse gases can be cost-effectively reduced throughout the economy.

Today, we will discuss the various initiatives Wal-Mart has undertaken that highlight our commitment to sustainability. Our efforts include a number of initiatives to make Wal-Mart more environmentally-friendly. Further, these efforts have the added bonus of making us more efficient. We believe we can work together with suppliers, academics, NGO's, politicians and other business leaders to do the right thing.

Sustainability is not a one-time program for Wal-Mart. Environmentally-friendly efforts are now an integral part of the Wal-Mart culture. We are prepared to work with you to improve environmental sustainability within the United States and throughout the world.

Background

My name is Andrew Ruben. I am Vice President of Corporate Strategy & Sustainability for Wal-Mart Stores, Inc.'s worldwide operations. This position was established in the summer of 2005 as part of Wal-Mart's drive to incorporate social and environmental sustainability into its business strategies. My office is responsible for business sustainability initiatives worldwide.

I began my career with Wal-Mart in 2002 as Director of Corporate Strategy. I became Vice President of U.S. Strategies in 2003. In those roles, I gained familiarity across a wide range of Wal-Mart's businesses and markets. Before joining Wal-Mart, I was a consultant with Cap Gemini Ernst & Young's Strategy Practice, where I helped develop growth and planning strategies for dozens of Fortune 500 companies.

Based in Bentonville, Arkansas, Wal-Mart is the world's largest retailer. The company employs more than 1.8 million associates worldwide. Each week more than 176 million customers visit Wal-Mart stores worldwide, which we believe reflects the success of our commitment to providing Everyday Low Prices to our customers. Beyond operating stores,

clubs and distribution centers, Wal-Mart takes a proactive role in various issues impacting the communities within which it operates.

Overview

As the largest retail company in the world, the largest private consumer of electricity in the United States, and the owner of one of the largest private heavy-duty truck fleets in the country, we recognize our ability to significantly affect the environment. We know we can contribute while also providing leadership in ways to restore the life support systems of the earth. As such, Wal-Mart is particularly interested in the issue of climate change. We believe this restorative responsibility provides an opportunity to promote innovative business practices across our entire industry.

Last year, our President and CEO, H. Lee Scott, Jr., announced an initiative for Wal-Mart making sustainability a key part of its corporate mission. CEO Scott stated the following simple and straightforward environmental goals:

- To be supplied 100 percent by renewable energy.
- To create zero waste.
- To sell products that sustain our resources and environment.

Additionally, he has made it clear to us at Wal-Mart that human action contributes to global warming and that we at Wal-Mart must reduce greenhouse gases. He previously stated "I had embraced this idea that the world's climate is changing and that man played a part in that, and that Wal-Mart can play a part in reducing man's impact." Mr. Scott has also stated that, "We are looking at innovative ways to reduce our greenhouse gas emissions. This used to be controversial, but the science is in and it is overwhelming. Climate change doesn't cause hurricanes, but hot ocean water makes them more powerful. Climate change doesn't cause rainfall, but it can increase the frequency and severity of heavy flooding. Climate change doesn't cause droughts, but it makes droughts longer. We believe every company has a responsibility to reduce greenhouse gases as quickly as it can."

As a participant on behalf on Wal-Mart in the Senate Energy and Natural Resources Committee's conference on climate change this past April, I stated that Wal-Mart believes that the U.S. should provide strong leadership on climate change, with the help of companies like Wal-Mart, while serving the interests of U.S. consumers. As part of that testimony we made clear that Wal-Mart would accept a well-designed mandatory cap and trade system for greenhouse gases.

These statements and actions are proof that we at Wal-Mart believe sustainability may well be the most important initiative we undertake at Wal-Mart this decade, maybe even this century. It will have a huge impact on the way things are made, farmed, packaged, transported, displayed and sold worldwide. To this end, we have been taking and will continue to take steps to improve Wal-Mart's carbon footprint. Some of the actions we have taken and goals we have set include:

- We will eliminate 30 percent of the energy used by our stores. We have already taken steps to meet this goal by installing more efficient lighting and retrofitting refrigerators.

- New store prototypes in the works will use design and technology to be 30 percent more efficient than today's stores and in the longer term even 50 percent more efficient.
- We have set a corporate goal of eventually being fueled 100 percent by renewable energy.
- We will eliminate 25 percent of the solid waste from U.S. stores in the next three years as we approach our corporate goal of producing zero waste.
- We will increase the efficiency of our truck fleet by 25 percent over the next three years and we will double our efficiency within 10 years.
- We have cut the company's fuel use by 8 percent by implementing a new policy in our truck fleet. We have equipped 7,200 tractor trailer units with Auxiliary Power Units that will be used to power truck cabs during rest periods. This saves 10 million gallons of diesel fuel and prevents 100,000 metric tons of CO_2 from entering the atmosphere.
- We have had hybrid vehicles in our corporate fleet since June of 2003. In 2005, we increased our use of hybrid vehicles to 100, with plans to add at least 100 more per year to the 4,000 car fleet.
- Except in the North, we utilize white reflective roof membranes, resulting in a 10 percent lower cooling load.

The environmental advantages of Wal-Mart's actions come straight from our size. We are in thousands of communities around the United States and 15 other countries. We buy products from more than 60,000 suppliers in 70 countries. We sell anywhere from 35,000 to 100,000 product lines in each of our 6,000-plus stores and clubs. Our size enables us to help create markets for clean technologies that exist today, but do not yet have fully established markets. If Wal-Mart started using or selling those items all of a sudden, there would be enough scale that those would be viable alternatives.

Our size and scale means that even one small pro-environment change in our policies or our customers' habits has exponential impacts all over the world. This is best understood with a concrete example. By reducing the size of the cardboard packaging on just one line of our own-brand toys last summer, we saved over 5,000 trees and 1,300 barrels of oil that would have gone into making the packaging. We also reduced the amount of fuel needed to transport those products to our stores which generated a freight savings of more than $2.4 million a year.

The Challenge

What we are learning about our footprint on the environment is both concerning and inspiring. Despite our excellence in efficiency, commerce creates a lot of waste. Fortunately, we have identified many opportunities to transform our entire industry. While we are experimenting and innovating in many areas, we will not lose focus of our goals of maximizing energy effectiveness, reducing waste, and promoting environmentally preferable products.

At Wal-Mart, that which gets measured gets managed. Our teams are developing sets of common sense metrics that hold us accountable for the goals we are setting. We look forward to sharing what we learn with others so that we may all continue to work together towards preserving and improving our environment.

Already, we are sharing technology and encouraging innovations with our supplier partners to help them optimize their systems and reduce packaging. Together we are

discovering that these innovations help their bottom line. The advantages of sustainability are synergistic.

Wal-Mart's Sustainable Energy Initiatives in Detail

As significant consumers of energy worldwide, we are committed to doing our part. Through deep investments and efficiency innovations in our stores and trucking fleet, we plan to reduce our overall greenhouse gas emissions by 20 percent over the next eight years. We have implemented many programs and taken various steps to make our environmental goals a reality.

Environmentally-Friendly Products

Environmentally-friendly products reduce costs and expand options for customers. We believe all families should have affordable access to sustainable products, like organic fruits and vegetables, fresh seafood, clothes made from organic cotton, and forest and paper products that are safe for families and are produced, packaged and delivered to our stores in an environmentally-friendly way. Customers should not have to make trade-offs when they purchase products at our stores.

As outlined below, Wal-Mart offers many options to its customers that promote sustainability.

- Recently, SAM'S CLUB introduced a yoga outfit made of organic cotton. It sold 190,000 units at 290 clubs in 10 weeks. Customers snapped it up and, as a result of this and other environmentally friendly products we sell, Wal-Mart is now the largest purchaser of organic cotton in the world.

- In February 2006, Wal-Mart announced plans to, within the next three to five years, purchase all of its wild-caught fresh and frozen fish for the North American market from Marine Stewardship Council (MSC)-certified fisheries. The MSC is a non-profit organization dedicated to promoting solutions to the problem of over-fishing. Products from MSC-certified fisheries carry a distinctive blue eco-label letting customers know the fish they will serve their families was harvested in a sustainable way.

- In November of last year, Wal-Mart took a major step to ensure that the company's imported shrimp are farmed with environmental sustainability in mind. Wal-Mart partnered with the Global Aquaculture Alliance (GAA) and Aquaculture Certification Council, Inc. (ACC) to certify that all foreign shrimp suppliers adhere to Best Aquaculture Practices (BAP) standards.

- Additionally, we are working with various suppliers to educate and inform our customers through newspaper ads featuring new products that are good for the environment - like compact fluorescent light bulbs and cold water detergents.

Wal-Mart can provide access to sustainable products for every community, every family and every individual we serve, regardless of their station in life.

Using, Encouraging and Investing in Renewable Energy

Increasing our energy efficiency not only reduces dependency on oil and saves money, it reduces greenhouse gas emissions. As part of its desire to restore balance to climate systems, reduce greenhouse gas emissions and save money for our customers, Wal-Mart is committed to the following:

- Aggressively investing approximately $500 million annually in sustainable technologies and innovations.
- Reducing greenhouse gases at our existing stores, SAM'S CLUBs and Distribution Centers around the world by 20 percent over the next seven years.
- Aggressively pursuing regulatory and policy changes that will create incentives for utilities to invest in energy efficiency, to use low or no greenhouse gas sources of electricity, and to reduce barriers to integrating these sources into the power grid.
- Assisting in the design and support of a green company program in China, where Wal-Mart will show preference to those suppliers and their factories involved in such a program.
- Initiating a program here in the U.S. over the next 18 months that will show preference to suppliers who set their own goals and aggressively reduce their own emissions.

Reducing Waste

We intend to reach the point in the near future where there will be no dumpsters at our stores and no landfills with Wal-Mart throwaways. To do that, we must address packaging. We want to ensure that our goods come in the right size package and that the materials in that packaging are made from renewable or recyclable materials.

We are committed to:

- Reducing our solid waste from U.S. stores and clubs by 25 percent in the next three years.
- Working with suppliers to create less packaging overall, increase product packaging recycling and increase use of post-consumer material.
- Replacing some packaging of our private brands with alternatives that are more sustainable and recyclable within the next two years.

These solutions will build on the types of things we are already doing. For example, in November, we replaced our select produce packaging with corn-based (PLA) packaging on just four items - cut fruit, herbs, strawberries and Brussels sprouts. That change will save the equivalent of 800,000 gallons of gasoline and will prevent over 11 million pounds of greenhouse gas emissions from polluting our environment. We are currently testing PLA on everything from cake and donut boxes to bread bags and strawberry clam shells to deli trays and salad bowls.

In California, we recently announced the rollout of the Wal-Mart Kids Recycling Challenge, a private-public partnership that helps California elementary school students become responsible stewards of their environment while earning money for their schools. The Kids Recycling Challenge is the largest plastic bag recycling program of its kind ever undertaken in the state. Since its inception, more than 400 schools have participated, and have already recycled over 104 tons of plastic bags, earning more than $116,000 for their schools.

Further, we have implemented a new process in some of our stores that is helping us recycle plastic that we used to throw away. Having all of our stores participate in this program will save us $28 million per year. Finally, last year, Wal-Mart recycled 2.8 million tons of cardboard, 9,416 tons of plastic, 262 million aluminum cans, glass containers and plastic bottles and 49 million disposable cameras.

We believe that Wal-Mart can continue these kinds of efforts and significantly reduce the amount of waste going to landfills in our communities while reducing costs through increased recycling of the remaining material.

Land Preservation

In April 2005, Wal-Mart and the National Fish and Wildlife Foundation (NFWF) began the "Acres for America" partnership. The program preserves one acre of critical wildlife habitat for every acre Wal- Mart has developed and will develop for the next 10 years. To date, over 360,000 acres of wildlife habitat in Arizona, Arkansas, California, Idaho, Louisiana, Maine, Michigan and Oregon have been preserved.

History of Better Buildings

For more than a decade, Wal-Mart Stores has examined energy and environmental features in its buildings. Three stores in particular provided an initial examination as outlined below.

- Demonstration Store 1 in Lawrence, Kansas - Wood was chosen as the largest material source, since it could be reused or recycled. The store also has many energy-saving features, including a recycled asphalt parking lot.

- Demonstration Store 2 in Moore, Oklahoma - The energy and environmental "centerpiece" in this store is its futuristic heating, ventilation and air conditioning system that coordinates space conditioning and dehumidification, ventilation, indoor air quality, heat recovery and refrigeration with reduced energy use.

- Demonstration Store 3 in the City of Industry, California - In addition to utilizing all the best technologies from the above two demonstration stores, this store has three electric car-charging stations and 180 high-performance skylights.

Stores and Distribution Centers

As previously mentioned, our goal is to reduce greenhouse gases at our existing stores, clubs and distribution centers around the world by 20 percent over the next eight years and future stores will use 30 percent less energy and produce 30 percent fewer greenhouse gas

emissions than our 2005 design within the next three years. We believe these innovations will dramatically increase the value we bring to our products and communities.

Radically reducing the amount of electricity we use to run our business requires us to embrace change and think creatively about how we power our world. Our plan centers on retrofitting our existing stores with innovative power systems and building new stores with advanced energy effectiveness in mind.

As we have learned with our experimental stores, there is no one-size-fits-all solution. We are practicing with the energy systems of the future, such as high-performance light bulbs, wind power, solar energy, sky lighting, and even biofuel boilers. Further, we are working with top environmental groups and innovators to develop a set of measures that will hold us accountable for our goals. Once we have tested our innovations, we will share them with tens of thousands of vendors in our value chain, magnifying change on a global scale.

The Experimental/Applied Practice Stores

Wal-Mart has created two experimental or applied practice stores (one in McKinney, Texas and one in Aurora, Colorado) that highlight the way building owners, scientists, engineers, architects, contractors, and landscape designers can work together to create stores that save energy, conserve natural resources, and reduce pollution. These stores are living laboratories, testing experimental technologies and products.

Our foremost goal for the experimental stores was to focus on technologies and approaches that fit with our mission statement. Further, the goals for the experimental stores were to reduce the amount of energy and natural resources required to operate and maintain the stores, reduce the amount of raw materials needed to construct the facilities, and substitute, when appropriate, renewable materials. These goals served as the litmus test for every decision made about experimental technologies, products, and processes. Specifically, the experiments had to lead to a store design that improves the comfort of Wal-Mart associates, improves the ability to serve Wal-Mart customers, and reduces Wal-Mart's use of natural resources.

The McKinney Experimental/Applied Practice Store

Our Supercenter store in McKinney, Texas, uses revolutionary materials, technology, and processes to reduce the amounts of energy and natural resources required to operate the store. We are testing this store's sustainable practices with the intent to share them broadly, both internally and externally.

Not only does the Supercenter provide quality products and every day low prices, it has the potential to profoundly change the way the retail industry designs, constructs, and manages facilities as it relates to the environment. The store contains many of the best resource conservation and sustainable design technologies currently available to minimize the use of energy and natural resources.

The McKinney store experimented and continues to experiment with materials, technology, and processes, which include:

- Reducing the amounts of energy and natural resources required to operate and maintain the store;

- Reducing the amount of raw materials needed to construct the facility; and

- Substituting, when appropriate the amount of renewable materials used to construct and maintain the facility.

Wal-Mart wants to make the best use of renewable and alternate sources like wind and solar energy to generate electricity to supplement the power needs of the store. The store draws its energy first from on-site resources and systems, and then from conventional utility sources as a secondary service. For example, the waste cooking oil which had been used to fry chicken is recycled by mixing it with used automotive oil from the Tire and Lube Express to serve as fuel to heat the building. Additional steps we have taken in this store in support of our commitment to sustainability are outlined below.

- Climate Control - We are employing radical new ways to conserve energy from radiant floor heating to futuristic reflective paints.

- Internal Building Experiments - By reusing cooking and motor oil, we are saving enough energy to provide heat and hot water for an estimated 26 single family homes in McKinney for an entire year.

- Internal Lighting - By utilizing more efficient lighting sources, we will realize lighting savings near 300,000 kwh a year.

- Bioswale and Pervious Pavement - We utilize pervious pavement (which allows water to run through it) and bioswales are filtering our runoff water.

- Recycling - Recycling is about more than cans and bottles. We are learning about food waste, fly ash and volatile organic compounds, and looking into ways in which to use what we learn.

- Solar Energy - Solar panels on the store's façade are estimated to generate enough electricity to power up to 780 single-family homes for one day and reduce greenhouse emissions by 37,750 pounds per year.

- Water Conservation - Our rainwater harvesting and treatment system is expected to provide 95 percent of the water needed for irrigation on the site.

- Wind Turbine & Heat Island Effect - We have a new wind turbine and are experimenting with several types of shade structures for cooling cars and the parking lot surface.

Wal-Mart has contracted with the Oak Ridge National Laboratory to provide testing and analysis on store systems and materials, based on national scientific measurements and standards, for a period of three years. Sharing the results of the store's experiments with the rest of the retail and development industry could turn low-volume, rare technologies into industry standards. Wal-Mart hopes to learn new environmental conservation best management practices and benchmarks that will serve as future design standards in the retail industry when it comes to land development and building construction.

Our customers flocked to this store and the store manager is enjoying nearly 10 percent energy efficiency gains versus a "normal" Supercenter located a couple of miles down the road. While that is not enough to cover the cost of building the store, we are learning, and with our scale that will pay off as we introduce these technologies in new stores and clubs.

The Aurora Experimental/Applied Practice Store

Our Supercenter store in Aurora, Colorado is our second experimental/applied practice store. The store utilizes countless technologies and processes to minimize the use of energy and natural resources.

This store has been labeled "The World's Largest Recycling Project" in Colorado. More than 500 tons of material and concrete from Denver's Stapleton Airport's old runways were crushed up, recycled and used in the store's foundation. The used vegetable oil from the store's Deli and used motor oil from the store's Tire and Lube Express will be burned to help heat the store.

Overall, the store will test over 50 different experiments to help Wal-Mart evaluate technologies that will help us our sustainability goals. Some of the key experiments include solar and wind power, waste oil boilers, porous pavements, radiant floor heating that will help keep pedestrian areas clear of snow, and unique fabric duct air systems to heat and cool the building efficiently. There will even be a tall grass prairie on site and a place to welcome RV visitors.

Finally, Wal-Mart has contracted with the National Renewable Energy Lab (NREL) of Golden, Colorado to provide monitoring, testing, and analysis on store systems and materials, based on national scientific measurements and standards, for a period of three years.

New Prototype Stores

In an effort to continue improving our sustainability commitment, Wal-Mart is actively working on several new generation prototype stores that will be 15 to 20 percent more efficient than our already, very efficient, experimental/applied practice stores discussed above. These new prototype stores will be very different than the experimental/applied practice stores.

Specifically, Supercenter stores are under construction in Rockton, Illinois, Kansas City, Missouri and Highland Village, Texas. All three of these Supercenters are identified as "HE" or high efficiency projects. They represent Wal-Mart's first iteration towards a new, 30 percent higher efficiency prototype as outlined by our CEO, H. Lee Scott Jr. in an October 24th speech. This first iteration effort has a projected efficiency gain of 15 to 20 percent above Wal-Mart's baseline 2005 prototype efficiency, which is already about 9 percent more efficient than current energy codes require. These stores will open for business sometime between the fourth quarter of 2006 and the first quarter of 2007.

Our next iteration of the HE pilot prototypes is in development and scheduled for opening sometime between the third quarter of 2007 and the fourth quarter of 2007. In fact, plans for one Supercenter store in this iteration are ready to be sent out-to-bid. These pilot prototypes will increase efficiency by 20 to 25 percent. Finally, our third iteration of the HE

pilot prototypes, scheduled to open sometime in the fourth quarter of 2008, will increase efficiency by 30 percent or more.

Awards and Recognition

In June of this year, the Alliance to Save Energy (ASE) announced it will present its special Chairman's Award to Wal-Mart in September. The ASE, an organization created by Congress, promotes energy efficiency worldwide to achieve a healthier economy, a cleaner environment, and greater energy security.

As part of its Stars of Energy Efficiency Awards program, every year the ASE recognizes deserving companies and individuals for their outstanding commitment and contributions to energy efficiency. While the announcements were made in June, the awards will be presented at the ASE's annual black tie awards dinner on September 12, 2006 in Washington, DC.

This year Senator Mark Pryor (D-AK) will be presenting the Chairman's Award to Wal-Mart in recognition of Wal-Mart's commitment to energy efficiency and the environment and for its innovative corporate policy, strong leadership, and continued contribution to the cause of energy efficiency.

Additionally, Waste News, a leading news source about waste and environmental management, has named Wal-Mart the winner of the 2005 Waste News Environmental Award. According to Waste News editor Allan Gerlat, they chose Wal-Mart for this award because, in their judgment, it has made the most significant environmental progress of any business in 2005.

This is the first year Waste News has offered the Environmental Award. The Waste News editorial staff considered more than 50 nominations and some internally identified companies, before choosing Wal-Mart.

Waste News, a Crain Communications Inc. biweekly publication, is based in Akron, Ohio. It is the only industry newspaper that reports on all aspects of solid and hazardous waste management as well as air and water pollution, including businesses and organizations that generate waste and the recycling, disposal, collection, transportation and processing of waste.

Conclusion

When it comes to running an international business in ways that nourish and support the environment, we all have a lot to learn. However, everyday Wal-Mart is learning new ways to become a better steward of the environment and we believe that through consistent and applied practice, we will improve our abilities, get better at new skills, and increase the value we create for our customers and the world at large. While we believe we have achieved a significant amount in regards to improving and maintaining our environment, we know there is more to do. We are committed to doing our part. Wal-Mart wants to be a leader in corporate responsibility for the environment and our shareholders.

Mr. MARCHANT. Mr. Herskovitz.

STATEMENT OF MARSHALL HERSKOVITZ

Mr. HERSKOVITZ. Thank you, Mr. Chairman, Ranking Member Waxman, members of the committee for this chance to appear as you investigate the issue of global warming. My name is Marshall Herskovitz. I am a producer, writer, and director in Los Angeles. I have made such films as Legends of the Fall, Traffic, Last Samurai, and in television Thirty Something. I currently serve as president of the Producers Guild of America.

I have had a long involvement with environmental issues, but I believe the pressing urgency of global warming transcends any other, and I have been concerned for several years now, as a communicator, that no clear vision regarding this crisis is being communicated to the American people.

Now, in spite of our science panel today, I feel that a consensus is forming in the scientific community around the world, around the number of 80 percent. That is 80 percent of carbon emissions need to be cut. There is some disagreement as to whether that should be done in 50 years, 40 years, or 10 years, but some very, very, very intelligent scientists, including someone who was supposed to be here today, Dr. Hansen, and also the head of the Intergovernment Panel on Climate Change, have all said the real number is 10 years—80 percent carbon emission cuts in 10 years.

That is not even on the agenda of any legislative body anywhere in the world, and there is a reason for that, and that is because it seems like it is fundamentally impossible to achieve such a cut. It is not how business works. It is not how government works. Such precipitous action would seem to decimate any economy and dismantle the American way of life.

I, however, think these assumptions are totally incorrect, as I will try to show, as is another assumption that is rarely said out loud but is insidious, nonetheless, and that is the belief that we Americans have grown so spoiled and are so unwilling to face hardship that we will sacrifice our children's future for the sake of our own present comfort, which is why I am grateful to appear before this committee, because I am in the process of starting an organization whose purpose will be to overturn these assumptions and communicate what we believe is a greater truth about our national character.

We have actually been given a great opportunity at this moment in America, a challenge that is not only far from impossible but, in fact, has a blueprint for success that was laid down by our own parents and grandparents 65 years ago.

In December 1941 this Nation entered a total and unconditional struggle against the axis powers. Those words total and unconditional are very important. From that moment until August 1945, as we well know, every single man, woman, and child in the United States devoted themselves to the one goal of defeating our enemies. Every aspect of people's lives was affected: how they work, how they drove, how they ate, where they lived, not to mention the millions who were killed and injured in battle.

Let us also remember that within the first 3 months after Pearl Harbor every single automobile plant in the United States had

been shut down and retooled for making tanks. Not one automobile was manufactured in the United States between 1942 and 1946, and I have never read of anyone objecting. No price was too great if it meant protecting our freedom. But let's look exactly at what that price was. Again, I speak here of the economic cost, not the human cost, which obviously we still honor today.

When all those automobile plants were being retooled, Ford, Chrysler, and General Motors continued to be profitable. Ordinary citizens put up with 3 years of food and gas rationing and other privations, and the Federal Government ran up unprecedented deficits. The result was that America emerged from the war stronger and richer than it had ever been.

Similarly, the effort necessary to fight global warming does not in any way spell depression or deprivation for our country; rather—and this is the key point—it is our current lack of action, or what I fear will be our half action, that will inevitably lead to disaster.

A national commitment, a war against global warming would cause all sorts of discomforts and discomfitures, but would also stimulate new industries and new parts of the economy. Most of the technology needed to cut those emissions already exist. What we need is the national will and the willingness of our Federal Government to take the lead, which is why we are starting this organization, because, as we have discussed here today, that national will does not exist, and the American people are not generally aware of any plan that would make the kinds of cuts our scientists are calling for. And if they are not aware of it, how can they debate it?

The ideas are out there. We have heard some of them today: shifting industrial subsidies, trapping CO_2 before it leaves coal-fired smokestacks, plug in hybrids, cellulosic ethanol. There are hundreds of ideas, brilliant ideas, all of them useless unless the Federal Government either pays for them or indemnifies businesses against the extreme financial risks involved.

For the Federal Government to do that, it needs an unmistakable mandate from the people, which will be the agenda of this organization: to use the tools of modern marketing to put those ideas before the American people. We will create TV commercials, print ads, Web sites, editorials, events, daily sound bites for the news media, whatever is necessary to make people aware of the remarkable opportunity that lies ahead of us.

As you have heard, millions of Americans are already acting to solve this problem in their homes, in their businesses, in their local governments. The effort being expended without the Federal Government's real leadership is truly remarkable, but this crisis cannot be solved from the bottom up.

Since I am a storyteller I will postulate a slight adjustment of history. What if the Germans had been planning to invade the United States in 1942? Do you think we could have defeated them with ordinary citizens pulling pistols from under their beds, through local grocery stores barring their doors and windows? No.

The only way to defeat the Nazis was through the awesome power of the American industrial machine, through the tens of thousands of tanks and planes and guns, the liberty ships coming out of dry docks at the rate of one a week, the millions of people

working together for a common purpose, led by a Government that was willing to endure deficits of 23 percent of its GDP in order to make it happen.

We defeated the axis powers in less than 4 years. We put a man on the moon in 7. We can unleash that awesome power again and solve this problem in 10 years the same way we did it before: by a total, unconditional partnership between Government, business, and private citizens.

This is a moment of potential greatness for our Nation. We can reframe the device of discourse that has plagued us for years. Global warming is not the province of the right or the left; it is a bipartisan issue, a national security issue, a survival issue. I believe we must make these changes now, not in 30 years, if we want to stop the catastrophe from happening.

I thank you for your consideration, Mr. Chairman. Thank you for holding this hearing.

[The prepared statement of Mr. Herskovitz follows:]

STATEMENT ON GLOBAL WARMING

By
Marshall Herskovitz

Submitted to the
House of Representatives
Committee on Congressional Reform
July 20, 2006

My thanks to Chairman Davis, and the members of the committee, for this opportunity to appear before you as you investigate the vital issue of global warming. My name is Marshall Herskovitz – I'm a producer, writer, and director in Los Angeles, having made such films as "Legends of the Fall", "Traffic", and "The Last Samurai", and I am currently serving as president of the Producers Guild of America. My concern about climate change grows out of a long involvement in environmental issues, but I believe the pressing urgency of global warming transcends those other issues, and I have become worried, as a storyteller, as a communicator, that no clear vision regarding this crisis is being communicated to the American people.

You have heard different opinions today regarding the threat of global warming, but I believe the great majority of climate scientists say the threat is huge and immediate. I believe in fact there is a divide between the scientific world and the political world over this issue, and that our political will does not nearly match what our scientific community is saying. And what they're saying, frankly – the ones who aren't factoring political reality into their estimates – is that we have ten to fifteen years in which to cut 80% of carbon emissions in order to avert the worst effects of global warming.

And therein lies a problem, even for many in the environmental movement. The prospect of cutting emissions that deeply, in so short a time, seems fundamentally impossible. It's not how business works; it's not how government works. Such precipitous action would decimate our economy and dismantle the American way of life. I think these assumptions are totally incorrect, however, as is another assumption, rarely spoken aloud, that is all the more insidious for the influence it has over how many of us think: the belief that we Americans have grown so spoiled, and are so unwilling to face hardship, that we will sacrifice our children's future for the sake of our own present comfort.

Which is why I am so grateful to appear before this committee – because I am in the process of starting an organization whose purpose will be to overturn these assumptions, and communicate a greater truth about our national character. America has a historic challenge ahead of it, one that is not only far from impossible, but in fact has a blueprint for success laid down by our own parents and grandparents sixty-five years ago.

In December of 1941, this nation entered a total and unconditional struggle against the Axis powers. Those words – "total" and "unconditional" – are deeply important. From that moment until August of 1945, every single man, woman, and child in the United States devoted him-or-herself to the one goal of defeating our enemies. Every aspect of people's lives was affected – how they worked, how they drove, how they ate, how they clothed themselves, where they lived – not to mention the millions who were killed or injured in battle. Pertinent to our discussion, let us remember that within three months of Pearl Harbor, every single automobile plant in the United States was shut down and re-tooled for making tanks. Not one automobile was manufactured in the United States between 1942 and 1946, and I've never read of anyone objecting. In fact, no price was too great to protect our freedom. I do think many Americans today, three generations of a high standard of living past that time, would have a hard time imagining the efforts expended then.

But let's look at exactly what price was actually paid. When all those automobile plants were being re-tooled, Ford, Chrysler, and General Motors continued to be profitable. The federal government ran up unprecedented deficits in order to pay for the war effort, and ordinary citizens put up with three years of food- and gas-rationing and other privations – but the result was that America emerged from World War II stronger and richer than it had ever been. The effort and commitment necessary to fight global warming do not in any way spell depression or deprivation for our country. Rather – and this is the key point – it is our current lack of action, or our half action, that will inevitably lead to disaster. When much of New York City is inundated, vast stretches of our coastline including half of Florida are gone, when the great farms of the Midwest are barren desert, and half a billion people around the globe displaced, those are the conditions that will precipitate economic catastrophe.

A national commitment – a war – against global warming will cause all sorts of discomforts and discomfitures, but will also stimulate new industries and new parts of the economy. Most of the technology needed to cut those emissions already exists. What we need is the national will, and the willingness of our federal government to take the lead.

Which is why I am starting this organization. That national will does not exist. There is no plan currently before the American people to make the kinds of cuts our scientists are calling for. So this organization will have two agendas. First:

> To articulate a comprehensive plan or plans for how America can cut 80% of carbon emissions in ten to fifteen years.

Better policy analysts than I have been working on this problem, and there are all sorts of promising answers: shifting of subsidies and tax incentives for the oil, gas, and automotive industries toward renewable energy and more efficient vehicles; trapping carbon dioxide before it leaves the power companies' smokestacks; retro-fitting existing cars with electric motors so they can switch off during idling; cellulose ethanol; planting 500 million trees in sunbelt cities – the ideas go on and on. What they have in common is that either the federal government must pay for them, or at least indemnify businesses against the enormous financial risks involved. And for the federal government to do that, it needs an unmistakable mandate from the people. Which leads to the organization's second and more important agenda:

> To use the tools of modern marketing to put those plans before the American people.

We will create the TV commercials, print ads, websites, editorials, events, daily sound-bites for the news media – whatever is necessary to make people aware, not just of the extent of this emergency, but of the remarkable challenge and opportunity that lies ahead of us.

Millions of Americans are acting now to solve this problem, in their homes, in their businesses, in their local governments. The energy already being expended is remarkable. But we must understand that this crisis cannot be solved from the bottom up. Since I'm a storyteller, I'll postulate a slight adjustment of history: what if the Germans had been planning to invade the United States in 1942? Do you think we could have defeated them with ordinary citizens pulling pistols

from under their beds? Through local grocery stores barring their doors and windows? The only way to defeat the Nazis was through the awesome power of the American industrial machine, through the tens of thousands of tanks and planes and guns, the Liberty ships coming out of dry-docks at the rate of one a week, the millions of people working together for a common purpose, led by a government that was willing to endure deficits of 23% of its GDP in order to make it happen. We defeated the Axis powers in less than four years. We put a man on the moon in seven. We can unleash that awesome power again and solve this problem in ten years, the same way we did it before – by a total, unconditional partnership between government, business, and private citizens.

This is a moment of potential greatness for our nation. We can reframe the divisive political discourse that has characterized our society for years. Global warming is not the province of the Right or the Left; it is a bi-partisan issue, a national security issue, a survival issue. And survival is no single party's territory.

In conclusion, I know there a many, including our president, who believe that global warming is real, but that we don't know if it is caused by human activity. Let's assume for a moment that's correct, or assume it's too late to stop it anyway – and project ourselves thirty years into a future where seas are rising, the mid-west is drying out, and whole populations are on the move. The truth is, for our society and economy to survive under those circumstances, we will have had to make the same changes in energy use we're talking about here. What if a war makes foreign oil unobtainable? What about the enormous task of re-locating millions of people, finding them housing and jobs, feeding them, clothing them? Only by taking fossil fuels out of the equation, by drastically reducing our energy needs, can we imagine coping with such a situation. Imagine for a moment putting your family in the car and fleeing hurricane Katrina. You have half a tank of gas and there is no fuel available anywhere. Would you rather be able to drive a hundred miles on that half tank, or four hundred? That is a perfect microcosm for where our nation might be headed.

We must make these changes now, not in fifty years, if we want to stop this terrible catastrophe from happening; and if we can't stop it from happening, these same changes will be a key to our survival.

Thank you for your consideration, and thank you for holding this hearing.

Statement by

Theodore Roosevelt IV
Pew Center on Global Climate Change
July 20, 2006

regarding
Climate Change: Understanding the Degree of the Problem – and the Nature of its Solutions

submitted to
The Government Reform Committee
U.S. House of Representatives

Mr. Chairman and members of the committee, thank you for the opportunity to testify on climate change. My name is Theodore Roosevelt IV. I am the chairman of Strategies for the Global Environment, the umbrella organization of the Pew Center on Global Climate Change. I am also a co-chairman of the board of the Alliance for Climate Protection, and a member of the board of the World Resources Institute, though my statement today will primarily reflect the views of the Pew Center.

The Pew Center on Global Climate Change is a non-profit, non-partisan and independent organization dedicated to providing credible information, straight answers and innovative solutions in the effort to address global climate change.[1] In our eight years of existence, we have published almost seventy reports by experts in climate science, economics, policy and solutions, all of which have been peer-reviewed and reviewed as well by the companies with which we work.

Forty-one major companies sit on the Pew Center's Business Environmental Leadership Council, spanning a range of sectors, including oil and gas (BP, Shell), transportation (Boeing, Toyota), utilities (PG&E, Duke Energy, Entergy), high technology (IBM, Intel, HP), diversified manufacturing (GE, United Technologies), and chemicals (DuPont, Rohm and Haas). Collectively, the 41 companies represent two trillion dollars in market capitalization and three million employees. The members of the Council work with the Pew Center to educate the public on the risks, challenges and solutions to climate change.

[1] For more on the Pew Center, see www.pewclimate.org.

Mr. Chairman, global climate change is one of the most daunting challenges we have ever faced as a nation. I am not a scientist, but I respect science, and when the nation's premier science body, the National Academy of Sciences, speaks as clearly on an issue as it does on climate change, it is a good idea to listen. The National Academy of Sciences has said, in a statement signed last summer by the academies of ten other nations as well: "The scientific understanding of climate change is now sufficiently clear to justify nations taking prompt action. It is vital that all nations identify cost-effective steps that they can take now, to contribute to substantial and long-term reduction in net global greenhouse gas emissions."

What do we know about the impacts of climate change?

We know that hurricanes are becoming more intense, not just in the Atlantic, which gave us Katrina and Rita, but in all oceans where hurricanes occur. We know we are experiencing a worldwide loss of mountain glaciers, a trend that is accelerating and has major implications for water supply in this country and around the world. We know that sea level is rising at an accelarated rate. We know that ecosystems around the world are showing signs of responding to climate change, with strong scientific evidence indicating that climate change is promoting the spread of diseases to new areas. The bottom line is this: The earth is warming; the impacts—once only predictions—are now upon us and are likely to worsen; and human activity is largely to blame.

Because carbon dioxide and the other greenhouse gases stay in the atmosphere for so long – a century in the case of carbon dioxide – climate change is largely irreversible, at least in the time scales human society is used to dealing with. But that does not mean we should throw up our hands. Given the current projections, things could get bad. But if we do not act soon, they will get worse.

Beyond the environmental case, though, there is a strong business case for addressing climate change – and doing so in part through mandatory measures.

As I mentioned, the Pew Center works with a wide range of businesses. Each of the companies on our business council is acting voluntarily to reduce its greenhouse gas footprint. The voluntary actions have shown the companies there are cost effective – in some cases, cost saving – measures they can take to reduce greenhouse gas emissions. Thirty of the companies have targets for their voluntary actions, and 14 have already met their targets.

To give you some examples:

- Entergy last year met its first goal to stabilize CO_2 emissions at 2000 levels, and is now aiming for a 20 percent reduction in emissions by 2010.

- Weyerhaeuser will reduce its emissions 40 percent by 2020 through greater reliance on biomass to fuel its pulp and paper mills.

- SC Johnson reduced GHGs 18 percent since 2000, more than doubling initial 8 percent reduction goal, by vastly reducing reliance on fossil fuels and increasing use of alternative forms of energy, like landfill gas and wind.

Why are the companies doing this? In absence of serious climate policy in this country, why are they focused on this issue at all? Among other things, many in the business community realize that the risks of inaction outweigh the costs of action. For example, according to the reinsurance company, Swiss Re, there were $45 billion in total insured losses from Katrina, and $10 billion in insured losses from Rita and Wilma. While we can not say that any one hurricane is the result of climate change, there is strong evidence that we have and will be seeing more intense hurricanes, and these numbers illustrate the cost of that.

Perhaps because it is so exposed to the risks of climate change, the insurance industry has emerged as one of the strongest leaders in addressing the issue. For example:

- The National Association of Insurance Commissioners formed a task force this year to assess the impacts of climate change on the industry.

- Lloyd's of London published "Climate Change: Adapt or Bust," saying insurers must now take climate risks far more seriously.

- Marsh, Inc., which has just joined our business council, has committed to be a leading source of climate risk information and solutions. A Marsh white paper on corporate climate risk concluding that "Climate change is a significant global risk. Businesses – if they haven't already – must begin to account for it in their strategic and operational planning."

So businesses have a significant interest in climate action.

There is a limit, however, to how far even the bravest corporate leader can go voluntarily. If you expect mandatory climate policy to be enacted within the lifecycle of your capital investments – as most astute businesses managers do – voluntary action today could actually end up hurting you in competition with the laggards in your industry when the policy becomes mandatory.

More importantly, for investors and inventors to start working in earnest on the transformative technologies the world will need to keep growing the economy while shrinking our climate change footprint, they need the certainty that only mandatory policy can provide.

We have a tremendous track record in this country when it comes to meeting environmental challenges, even as we grow our economy. Of the many important lessons

we can draw from that experience, here is one especially to keep in mind: No major environmental problem has ever been solved in this country by voluntarism alone.

I have been discussing this in somewhat negative terms, but this is not just an issue in which we must manage risk, it is also an issue that yields business opportunities. That is one reason technology giants like GE, DuPont, United Technologies and the others on our council are working on this issue. The challenge of climate change, like other challenges we have met in the past, will create economic opportunities for U.S. industry. Eighty percent of our greenhouse gas emissions come from the burning of fossil fuels. Because of this, addressing climate change will involve, among other things, increasing the efficiency of our energy use. That increased efficiency will directly improve U.S. competitiveness, as well as increase our energy security by reducing reliance on foreign energy sources.

Furthermore, financiers are projecting significant growth in demand for renewable energy technologies and energy efficient products. Mandatory climate policy will spur U.S. leadership in environmental and energy technology innovation, assuring U.S. competitiveness in the booming global market for climate-friendly technology.

Again, a few examples:

- BP has created an Alternative Energy Division and may invest up to $8 billion in this venture over the next 10 years.

- The 2005 revenues of GE's *ecomagination* initiative are over $10 billion, up from $6.2 billion in 2004.

- Clean technology markets now represent annual global revenues greater than $150 billion.

- U.S. venture capitalists poured $1.4 billion in clean technology markets in 2005, up 43% from the year before.

- When the Carbon Disclosure Project was launched in 2003, 35 investors totaling $4.5 trillion in assets signed on. This year, 155 institutional investors with combined assets of $21 trillion signed on. Currently, more than 350 companies report their emissions and climate strategies through the CDP website.

There are also growing opportunities in the carbon trading market. Many of the companies on our business council have experience with the European Union's emissions trading system, and others participate in the Chicago Climate Exchange. In particular:

- Baxter International became first company to transfer greenhouse gas allowances from the European Union to the Chicago Climate Exchange, linking the two markets and setting an important precedent.

- PG&E has a Climate Protection Program that gives customers the opportunity to go "carbon neutral" by paying a small fee on utility bill to offset carbon emissions associated with electricity purchases.

How do we make this outstanding work the norm? In February, the Pew Center released the first comprehensive plan to reduce greenhouse gas emissions in the United States. Our Agenda for Climate Action outlines an ambitious yet practical approach, based on eight years of analysis and work with leading businesses and policymakers.

The Pew Center's Agenda outlines 15 specific recommendations in six overarching areas where the United States must take action. These six areas are: 1) science and technology; 2) market-based programs; 3) sectoral emissions; 4) energy production and use; 5) adaptation; and 6) international engagement. Let me say a word about a few of these.

First, we believe it is critically important to enact a mandatory cap and trade program that applies to large stationary sources – power-plants and major manufacturing facilities. Our work over the years has shown that market mechanisms such as emissions trading allow companies to reduce emissions in the cheapest, most efficient manner possible.

What a cap and trade system does is tell the market there is value in reducing emissions. It tells inventors and investors there is profit in creating and deploying climate-friendly technologies. It creates an essential pull for new technologies to enter the market. The push for those technologies comes from the funding of innovation, but we need both the push and the pull to achieve real and cost-effective results.

A cap-and-trade system by itself, however, and particularly at the level that would be politically practical, is not enough. This is why the Pew Center's Agenda also calls for sectoral approaches, such as transforming the much-maligned Corporate Average Fuel Efficiency (or CAFE) program. We recommend strengthening and converting the CAFE program to a set of tradable standards based on greenhouse gas emissions. If you are looking to protect the climate, focusing on emissions rather than fuel efficiency is the way to go. By creating a market for emissions reductions through trading, and at the same time supporting the development of low-emission vehicles and fuels (the push and pull approach)—you can reduce the cost of getting the job done.

Another critical issue is coal. We need to be realists here. Coal is responsible for 50 percent of our nation's electricity. It is cheap and it is plentiful and I believe it will continue to play a role in meeting U.S. and global energy needs for years to come. We need, therefore, to get very serious about reducing carbon dioxide emissions from coal-fired power plants. First, we need to build the very best, most efficient coal burning power plants possible to reduce emissions per kilowatt-hour of electricity. And then we have to prove that the carbon dioxide that still is emitted from these plants can be captured and stored in geological formations where it can be kept from entering the atmosphere for centuries or millennia.

We recommend an aggressive program of research, development and demonstration for these technologies. A few random demonstration projects done at a leisurely pace clearly are not enough. We need to build the most efficient plants and we need a concerted public-private effort to demonstrate that capture and sequestration can work, and then we have to insist that it be done.

Again, these are not the only issues that need to be addressed. Energy efficiency, renewable energy, carbon sequestration on agricultural and forest lands – all these are essential parts of the solution as well.

Finally, the Pew Center's Agenda, while primarily focused on domestic actions, also calls for greater U.S. participation in international negotiations on this issue. It is obvious now that there is no chance the United States will sign on to the Kyoto Protocol. Regardless, the fact remains that climate change is a global problem that demands a long-term global solution. We need to engage every country that is a major source of these emissions, not just the United States, but China and India as well. And we need to come up with ways to make the process fair and equitable for all involved.

In closing: climate change is a serious challenge and one we need to begin addressing now in a serious way, including through mandatory policy. Fortunately, there is every indication that if we design our policy right, we will be not just allowing, but helping, the economy to grow. I thank and commend you, Mr. Chairman, for holding this hearing. The Pew Center looks forward to working with the committee on the development of any future climate policy.

Mr. MARCHANT. Thank you, Mr. Herskovitz.

Do you believe that Americans are ready to make sacrifices that you are calling for?

Mr. HERSKOVITZ. I think Americans are ready to put an enormous amount of effort into what I am calling for. I think when we use the term sacrifice, we are already misconstruing what will take place if we commit ourselves to this war. I think that what needs to be done is mostly at an industrial level, mostly at a business level.

But right now we are asking corporations and industries to take on a responsibility that their shareholders will not allow them to do. The Federal Government has to be the instigator of these situations. If you tell the car companies, oh, you have to make a car that gets 50 to 60 or 70 miles to the gallon, which, by the way, technologically they can do, they are going to say to you, how do we know we can sell it?

The answer is the Federal Government has to mandate it. It has to mandate whatever business situation will allow that corporation to succeed under those circumstances. That is what took place in World War II, and I believe that is what needs to take place now.

Mr. MARCHANT. You talk about the Federal Government. Do you think it is necessary for the Federal Government to make the laws? What responsibilities would you place on local government, States, cities, counties?

Mr. HERSKOVITZ. Well, a remarkable number of cities and States are already doing that, but I think, as with so many things in our country, the resources locally are finally limited. It is finally only the Federal Government that can create the huge programs that are necessary in order to make this work.

What we are seeing now and what I have seen in the last few months as I have learned about this is just a remarkable upswelling of energy at the local level, but this problem cannot be solved at the local level. What we will find is if the Federal Government enables this, sets up these programs, you will see, just as in World War II, this incredible energy move in to fill up all of the opportunities that the Federal Government is going to create.

The energy is there. Look at these businesses. Look at Wal-Mart. They don't have to be doing this. There is a way in which many, many people in this country are ahead of where the Government is.

Mr. MARCHANT. Mr. Ruben, is Wal-Mart taking this new environmentally friendly policy to all of its operations, international as well?

Mr. RUBEN. Yes.

Mr. MARCHANT. And what kind of success are you having outside of the United States?

Mr. RUBEN. Well, the key to even the progress so far is that it lives inside the business. So what I mean by that is this is not a select group of people who sit on the side of the business talking about what we can do for the environment; it is about the way decisionmakers operate in the business, to have a broader view of unintended consequences and what takes place. So in every market—let me speak first from a market perspective and then from a centralized company perspective.

In every market people are identifying new opportunities to save energy, to save resources, to supply better products. On a centralized perspective, some of our learnings are coming in a global way. For example, solar technology, we are learning quite a bit from Central America, given the number of days of sunlight and the cost of energy. So both from a market perspective as well as a company perspective we are seeing opportunities being a global company.

Mr. MARCHANT. Thank you.

Chairman TOM DAVIS [presiding]. Mr. Roosevelt, I apologize for not being here, but you mentioned the difficulties companies face in implementing voluntary environmentally friendly policies, while at the same time running the risk of falling behind in their industry. Given this conundrum, do you see any opportunities for the Federal Government to further spur voluntary action in the corporate world?

Mr. ROOSEVELT. I think voluntary action has worked. We have seen leadership. Well-run companies are doing the right thing. But you need mandatory compliance; otherwise, you are going to have a problem with the free rider. There will be too many companies who will say, let's earn short-term profits and we will not take the long-term decisions that we need to make ourselves both stronger as a nation and both stronger in our industry.

Perhaps the best example of that—and I don't want to pick on Detroit. We don't want to see an industrialized ghetto in Detroit, but 5 years and 10 years ago, if you were deciding you wanted to buy stock in an automotive company would you have bought Ford or General Motors or Toyota? It was pretty clear one company had a better idea of the changes that were occurring in the environment, the business environment, and were taking appropriate steps to become more competitive. We overprotected our companies.

Chairman TOM DAVIS. Well, we did, in fact. I know that Mr. Waxman and myself and Mr. Shays, we favored higher CAFE standards. Had they complied with that, they would have been ahead of the curve.

Mr. ROOSEVELT. Absolutely right.

Chairman TOM DAVIS. And they resisted it, they didn't, and now they are paying a price for it. That is one time where the Government knew better than the marketplace. One of the few times, but it did.

Mr. ROOSEVELT. One of the rules, I think, of business—and in my daytime job I am an investment banker—good industries generally reinvent themselves at frequent intervals. Not-so-good industries tend to think that the old way of doing it will survive forever. If you go back and look at the catalytic converter, which is a good example, Detroit resisted that. They said, it is going to cost us $1,000, and the only cars we will be able to produce in the United States will be subcompacts.

I don't see many subcompacts out on the highways today. And you know what a catalytic converter costs; $100. They were off by a factor of 10.

Chairman TOM DAVIS. Thank you.

Mr. Waxman?

Mr. WAXMAN. Thank you, Mr. Chairman.

Mr. Herskovitz, thank you for being here. You are one of my constituents and obviously a leading producer involved with films. I looked at your list of successful films for television and movies. You do know how to communicate, and I am pleased that you are going to be involved in organizing a group that will put pressure on the U.S. Government to show the kind of leadership for our country and for the world in dealing with this very serious, the most serious environmental problem we have.

Mr. HERSKOVITZ. Thank you.

Mr. WAXMAN. I feel that a lot of our policies need to be communicated two different ways. You are going to communicate more from a grassroots activist organization to get us to try to lead on this issue, but then the Government has to lead, as well, and business has to lead, and a lot of that is going to involve trying to communicate to people why they should buy a more fuel efficient product, why they should buy a more fuel efficient motor vehicle, why we are all in this together to try to accomplish the goal of protecting ourselves and the planet from the dire consequences of global warming.

Do you think that as you organize this group that you might be available to give some suggestions to policymakers and the leaders of this country on how best to communicate to people around the Nation that we need to do things that we can do? For example, I offered an amendment to the energy bill, and I said the bill was primarily to produce more energy, drill here, drill there, here is some money, billions here, billions there to the oil, coal, nuclear industries.

But I suggested the President could simply call on the American people in a lot of ways to be more efficient in their use of fuel by not taking wasteful trips, to try to be mindful of things they could do now. I hope you will keep that in mind as you develop your policies to help us so we can call on you as established communicators to get people to understand what is going on.

Mr. HERSKOVITZ. Certainly. Always willing to help in any way. I think there has been a big mistake, by the way, in judgment. It is odd, really. Most people I talk to about this problem make some basic assumption that the American people are stupid. They always say to me, well, you are going to need something like Pearl Harbor. You are going to need some great event to show people that there is a problem.

You know, I think we are capable in this country of understanding that there is a problem. The problem has been the communication of what this issue is. It has been completely muddled. It has been completely mired in controversy and people have not known what to think. As soon as our leaders start saying the same thing, I think people are perfectly capable of understanding that there is an emergency, even though it is only manifested by a glacier that is melting 2,000 miles away.

Mr. WAXMAN. The President of the United States is always credited with having an enormous bully pulpit, but when the President of the United States is represented by Mr. Connaughton who was here earlier talking enthusiastically about all that they are doing, which I think is far short of what needs to be done, the President's quotes that Congressman Van Hollen held up, where there is a de-

bate going on about the science, that was not a clarion call for anything or anybody to do anything.

Mr. Ruben, Wal-Mart is taking a leadership role in all of this. Do you think that what you are doing voluntarily ought to be mandated on people, either through a market system that would be brought into being by caps on emissions or some kind of fuel efficiency standards that would be mandated for new products?

Mr. RUBEN. There are some things that we see that we think policy action does make sense, and there are a vast number that we think the competitive forces actually accelerate to go beyond there. As an example of that, the compact fluorescent light bulb that I talked about, and I mentioned it was less than 10 percent of the sockets that could be using this bulb, and you had mentioned sacrifice. It is not a sacrifice to get someone to buy a bulb that saves them every month. As a company that sells items to people, it is not a sacrifice for us to sell these bulbs that allow people more spending money in the economy.

There are a host of things that can be done right now to increase that number of 10 percent. At a certain point that bulb right now costs about $2 compared to $0.20 for the incandescent bulb. There is a certain percentage of the population that will be able to make that choice. It is a very good return on your money. Within 2 months you will get that money back.

Mr. WAXMAN. That is very well put and I thank you very much, but I see the yellow light is on. I will ask Mr. Roosevelt a question.

I assume from your testimony you think mandatory controls with a cap in trade would give the market incentives so that you wouldn't find a business out there realizing their competitors may not be doing what they need to do, and therefore they don't want to spend the money to reduce emissions, either. Is that a fair statement?

Mr. ROOSEVELT. Yes. You have captured very succinctly what I believe. The beauty about cap in trade is it gives businesses the alternative of when they want to make a capital expenditure. Let's say for whatever reasons the business says, I want to make this capital expenditure, but I want to do it 5 years from now. They have the opportunity to go off and buy and meet their emissions requirements, but then 5 years from now they can make the capital expenditure, and maybe they will do so well that they will become a net seller of carbon credits. So cap in trade is a very flexible way of working.

It is a little ironic that this is an idea that was invented by the United States. The Europeans didn't like it. Somehow they thought this was a trojan horse that wasn't going to work. Guess who is now leading in cap and trade. It is the Europeans.

You did mention, if I can just take another second—and I see the red light is on—you mentioned the bully pulpit, and that sort of runs in the family maybe a little bit. One of the things that I think——

Mr. WAXMAN. The bully or the pulpit?

Mr. ROOSEVELT. Perhaps both. One of the things that I think will accrue to the United States if we take a constructive role in global leadership on climate change is that we will start to regain some of the moral ground that we have lost. If nations around the world

see that we are doing the right thing in global climate change, whether it be a Bangladesh, whether it be some of the Pacific isles, whether it be some of the poor countries that are being affected adversely and will be affected sooner by global climate change, we will regain moral ground and we need that to carry out other political initiatives.

Mr. WAXMAN. Thank you. I want to thank all three of our panelists. I think you have been superb.

Chairman TOM DAVIS. Thank you very much.

Mr. Shays.

Mr. SHAYS. Thank you, Mr. Chairman. I know time is running out, but I am happy to take a chance on missing votes so I will be happy to chair it if you need to leave.

Chairman TOM DAVIS. After about 2 minutes I am going to turn the gavel over to you.

Mr. SHAYS. Thank you.

Chairman TOM DAVIS. You can finish up.

Mr. SHAYS. Just very quickly I want to say to you, Mr. Ruben, your company is controversial at times because it is so large. I wish it had better relations with some of the lowest of your paid employees, and I want to say that, but I also think you enable Americans throughout the world, throughout this United States, to buy things at a lower price, and it is in some ways a transfer of resources to those who don't have resources.

But I want to say thank you for doing what you are doing. Let me ask you, given you are so big, are you letting others know how you are doing this or are you trying to beat your competitors by letting them continue to do what they are doing? Are you sharing this information with others and trying to help others?

Mr. RUBEN. We are absolutely sharing. In fact, one of two experimental stores that we have open on the ground is in McKinney, TX. I was there this past week. The store manager there has become a part time tour guide. He has had just about every retail competitor that we have through that store. Every time a competitor comes through that store and sees something they might be able to adopt in their own practices, allows more people to participate in the technology, allows the scale of that technology to go up, the price of that technology to come down, creates jobs through innovation, and is simply a good thing.

Mr. SHAYS [presiding]. I am going to ask the other two witnesses to just describe this. What do they think is going to happen in the next 3 to 4 years in public policy. I mean, I am starting to feel that Americans are getting it, that whether it is hurricanes or whatever, you know, they have finally bought in and are not influenced by politicians who said global warming is not real. I am sure that some people who said global warming is not real will deny they ever said it.

But what do you think is going to happen in the next 2 or 3 years? Do you think the public is going to have significant perception? And do you think people like Al Gore, who said this in the late 1980's, are going to gain ascendancy as someone to listen to again on this issue?

Mr. HERSKOVITZ. I think there is going to be increasing and frightening evidence that will convince more and more people that

we have to act very quickly. I think the trajectory of urgency is going to go up very soon, and so I think public policy is going to have to keep trying to catch up with what will really be public opinion that this is a truly urgent problem.

Mr. SHAYS. And I just want to say I have always believed, and you said it, you reached me in this comment. I think you tell the American people the truth and they will have you do the right thing. But when you have debates about whether someone earned three Purple Hearts or whether someone fulfilled their national service, and that was the major debate in the Presidential race, you don't educate people very much.

What do you think is going to happen, Mr. Roosevelt?

Mr. ROOSEVELT. I believe firmly that the American people are now understanding it. They are looking for leadership. They want to see well-thought-out leadership.

If I may go back to Mr. Herskovitz' analogy around World War II, arguably the greatest mistake we made in World War II was not recognizing what was looming on the horizon and didn't get ourselves prepared for it. We see this now on the horizon and we see some very bright people, whether it be in the scientific community—I clearly salute Al Gore for an incredible movie. If anybody in this room hasn't seen it, please go see it.

But we all need to take personal responsibility for this and try to change our personal carbon footprint. The American people, the theme that has run through all three of us this morning is we believe that this country is ready. People will make the kind of sacrifices that are necessary. Just help us unleash the creativity that exists in this country.

Mr. SHAYS. Well, I think we will end with that note. I had thought it would happen 5 or 6 years sooner, but I believe it is going to happen and I think you all have contributed to that and I thank you very much.

I don't have a gavel to hit. Would you just hit the gavel?

A. BROOKE BENNETT. We are adjourned. Thank you.

[Whereupon, at 2:30 p.m., the committee was adjourned.]

[The prepared statements of Hon. Elijah E. Cummings and Hon. Dennis J. Kucinich and additional information submitted for the hearing record follow:]

U.S. House of Representatives
109th Congress

Opening Statement

Representative Elijah E. Cummings, D-Maryland

Full Committee Hearing:
"Climate Change: Understanding the Degree of the Problem"
Committee on Government Reform

July 20, 2006

Mr. Chairman,

Thank you for holding this vitally important hearing to examine the impact of global warming.

I can tell you that in urban communities like the one I represent in Baltimore, the impact has been great. A study conducted by researchers at Harvard University and the American Public Health Association finds that America's cities are blanketed with smog and climate-changing carbon dioxide, leading to an epidemic of asthma and other illnesses.

Hardest hit by the epidemic are preschool-aged children, whose rate of asthma rose by 160 percent between 1980 and 1994, the report says.

These kids are so young they are still learning to spell their names, and they cannot breathe because of the pollutants we have put in the air. Tragically, they are not the youngest victims.

In a comparison of 86 cities in the U.S., infants who lived in a highly-polluted city during their first two months of life had a higher mortality rate than infants living in the city with the cleanest air.

Talk about impact.

We can talk about impact in other terms too, because global warming impacts some communities more than others.

In 2002, 71 percent of African Americans lived in counties that violated federal air pollution standards, compared with 58 percent of whites.

Want to know what the impact of that disparity has been? Asthma attacks in 2002 sent African Americans to the emergency room at three times the rate of whites, and the asthma-related death rate for African Americans was nearly twice that of whites.

But that's not all. A recent study of the 15 largest U.S. cities found that global warming would increase heat-related deaths by at least 90 percent. Most African Americans live in inner cities, which tend to be about 10 degrees warmer than surrounding areas.

We have heard time and again the accusation that people who are sounding the alarm on global warming are bunch of reactionaries, making baseless claims. That is a dangerous line of reasoning.

The threat of global warming is here and it is real.

The Intergovernmental Panel on Climate Change, the U.S. National Academy of Sciences, the National Research Council and the national academies of sciences of eleven countries all agree when it comes to the impact global warming has made on this planet.

But I need no further evidence than what I see happening in my own backyard in Baltimore. Little kids can't breathe, babies are dying, and African Americans are getting sick in the communities where we live.

The time is past due for Congress to lead the charge in the fight against global warming.

I look forward to the testimonies of today's witnesses and yield back the balance of my time.

Statement of Rep. Dennis J. Kucinich
U.S. House of Representatives
Government Reform Committee
2154 Rayburn HOB

Hearing on "Climate Change: Understanding the Degree of the Problem"

July 20, 2006

Thank you Mr. Chairman for calling this important hearing on Climate Change, the first such substantive hearing in the House in recent memory. If we are to successfully deal with global warming, it cannot be a partisan issue. It will require our full attention and an inestimable share of our resources, which requires united leadership. This hearing, therefore, is a major step in the right direction. However, I was disappointed to hear the Administration's testimony today which is decidedly partisan. Indeed it continues to try to put a happy face on bad policies and take credit for work it has not done.

A good place to start is the Administration's claim to have reduced greenhouse gas "intensity" during its tenure. Efficiency gains make the "intensity" go down anyway. Moreover, this deceptive rhetorical device diverts attention from its failure to set a goal for greenhouse gas emissions reductions that is consistent with that which is justified by the current science. California has done so, calling for an 80% reduction. Holland is now cutting emissions by 80% in 40 years. Tony Blair has committed the UK to cutting by 60% in 50 years. Germany has obligated itself to cuts of 50% in 50 years. Several months ago, French President Chirac called on the entire industrial world to cut emissions 75% by 2050.

In fact, this is only one of the instances in which this Administration has thumbed its nose at the international community. There is not only an unwillingness to move forward with substantive action on global warming, there is active resistance, and in fact, bullying of other countries. The Administration started by walking away from the Kyoto protocol. I was in Johannesburg for the World Summit on Sustainable Development in 2002. Nothing of significance from the US. I went to Buenos Aires for the Conference of the Parties in 2004. Nothing of significance from the US. In Montreal, Harlan Watson walked out of negotiations in what was perceived in international media as a tantrum when the Administration didn't get its way. There was an agreement in the G8 that the US re-engage on the issue. It did not happen.

Instead, we see not only rhetorical red herrings, but we see Enron accounting techniques being used to create the illusion that something is being done. The GAO released a report in August 2005 called *Climate Change; Federal Reports on Climate Change Funding Should be Clearer and More Complete.* This report listed suspect activities

claimed by the OMB as spending on global warming, including such efforts as the "Andean Counterdrug Initiative."

Making matters worse, the Administration advocates for dealing with global warming by advocating for nuclear power. Nuclear power has been shown to be greenhouse gas intensive, it is far less cost effective than renewables, far less polluting than renewables, and facilitates further proliferation of nuclear weapons materials. We are trading our addiction to oil and all the problems that go with it, for nuclear power and a whole new set of equally pernicious problems that go with it, when common sense alternatives are readily available or within our reach.

In the meantime, it is becoming increasingly clear that the effects of global warming are already being felt. The United Nations has declared that at least 5 million cases of illness and more than 150,000 deaths every year are attributable to global warming. The 2003 European heat wave killed over 20,000 people. The ten hottest years on record have occurred in the last 15 years. Two consecutive record breaking hurricane seasons.

Exactly how bad does it have to get?

Deposition on the absence of a basis for claims of alarming climate change

Richard S. Lindzen
Alfred P. Sloan Professor of Atmospheric Science
Massachusetts Institute of Technology

July 19, 2006

Summary

For about twenty years we have been told that the catastrophic consequences of global warming are about to descend and that all scientists agree. Periodically, it is acknowledged that some disagreement existed but that now all scientists do indeed agree. Notwithstanding the constant repetition of the cataclysmic claims, these claims are intrinsically weak on many counts. While there are indeed aspects of climate concerning which there is a measure of widespread agreement, this testimony questions whether any association of these limited aspects with cataclysmic claims is meaningful. The deposition emphasizes the following points:

1. While there is widespread agreement that the global mean temperature has gone up (rather irregularly) on the order of half a degree Centigrade over the past century, that atmospheric carbon dioxide has also increased (rather regularly) over this same period, and that carbon dioxide as a minor greenhouse substance (compared to the major substances, water vapor and clouds) should contribute to warming, further agreement is largely spurious.

2. The claim that man has been identified as a major contributor to warming is based on a curve fitting exercise that would be an embarrassment in freshman physics.

3. The observed warming is on the order of a quarter of what current models say we should have seen. Thus, even if it were the case that man caused the observed warming, it would still be evidence that the models upon which alarm is based are grossly exaggerating the impact of anthropogenic greenhouse substances. There is increasing evidence that we know why this exaggeration is occurring.

4. Once one gets beyond the relatively trivial issue of global mean temperature, whatever consensus exists is generally likely to be in opposition to the alarmist vision. Here is where one sees some of the most glaring differences even between the text and the Policymakers Summary of the IPCC reports.

5. There is a remarkable amount of confusion over the relation between emissions of carbon dioxide, carbon dioxide levels in the atmosphere, and the impact of anthropogenic greenhouse substances on climate. The last item has already reached a level that corresponds to three quarters of what would accompany a doubling of atmospheric carbon dioxide. No proposed policy would discernibly alter this.

In brief, the case for alarming global warming is not a plausible case where there are a few remaining doubts. Rather it is an implausible case which is defended on the basis of uncertainty which makes it difficult to rigorously prove that the alarmism is impossible. Regardless, the problem, whether possible or not, is not, with known technology, amenable to mitigation. The association of this issue with energy policy is more a matter of pure energy policy than a matter of avoiding environmental damage. Obscuring this relieves proponents of energy policies of the need to rationally defend their position, while spurious claims of consensus relieve all concerned of the need to understand the science. The situation invites incoherence for both the science and for energy policy.

Please accept my apologies for being unable to attend these hearings. The present deposition describes my position on this matter.

One of the most peculiar aspects of the so-called global warming debate has been the immense variety of often unrelated claims that have been subsumed under the single heading of global warming. Without the least attempt to disentangle these claims, the concept of consensus is introduced despite the fact that such a notion is intrinsically foreign to science. Science, after all, is not a source of authority based on votes, but rather a very effective mode of inquiry based on skepticism. Despite claims of consensus, I know of no attempts to actually poll scientists – even within the narrow confines of the Intergovernmental Panel on Climate Change (IPCC). Nevertheless, in a society that is, in large measure, ignorant and afraid of science, the concept of consensus serves to conveniently dispose of the need to understand the science. Yielding to this temptation, however, guaranties incoherent policy and encourages politicized science. A couple of years ago, Tony Blair offered a brief example of what many politicians believe the scientific consensus to be: "The overwhelming view of experts is that climate change, to a greater or lesser extent, is man-made, and, without action, will get worse." It is hard to tell if the sloppiness of Mr. Blair's language was intentional or not, but the phrase 'greater or lesser' leaves unbounded space for ambiguity, and the phrase 'worse' used without a useful reference is meaningless. In what sense is our present climate worse than it was during the Little Ice Age of the 15th through 18th Centuries or for that matter, the major glaciation of the last Ice Age itself? In what sense is the current hurricane season worse than those of the 1930's and 40's? And, of course, what do such things as the breaking off of icebergs, fluctuations in hurricanes, slow rises in sea level, etc. have to do with the very modest 1 degree F increase in global mean temperature over the past century? In point of fact, there is little known connection though there is ample controversy. Vice President Gore's recent movie attempts to gloss over this while claiming absolute scientific support. That such claims are unjustified became evident in Gore's recent interview with George Stephanopoulos where he acknowledged that he had gone against the scientific judgment that large abrupt sea level rises are unlikely (presumably in order to achieve greater cinematic impact). Quite frankly, I think one should always be worried when politicians attempt to frighten rather than inform the public.

In the remainder of this deposition, I would like to review the few things concerning which there is widespread agreement within the climate science community. We will see that the implication here is that observed warming has, in fact, been much less than was predicted by existing climate models. I will then show how this has been disguised by various claims that are largely irrelevant, and how the arguments over these claims have been twisted into claims of support for alarmism.

Here are the few points concerning which there is widespread agreement. I won't suggest that there is no controversy over details, but there are few that would fundamentally disagree with the following.

1. The global mean surface temperature is always changing. Over the past 60 years, it has both decreased and increased. For the past century, it has probably increased by about 0.6 degrees Centigrade (C). That is to say, we have had some global mean warming.

2. CO_2 is a greenhouse gas and its increase should contribute to warming. It is, in fact, increasing, and a doubling would increase the greenhouse effect (mainly due to water vapor and clouds) by about 2%.

3. There is good evidence that man has been responsible for the recent increase in CO_2, though climate itself (as well as other natural phenomena) can also cause changes in CO_2.

I will refer to this as the *basic agreement*. Various bodies have been unable to resist making claims that items 1 and 2 are causally connected. This is referred to as the attribution question. I will show that attribution is by no means widely accepted or even plausible. However, as we will see, the alleged attribution, itself, also provides little or no support for alarm. The reason why the *basic agreement* (even when supplemented by the claim of attribution) does not support alarm hinges on other points of widespread agreement, which are rarely alluded to.

4. In terms of climate forcing, we are already three-quarters of the way to a doubling of CO_2. The main reasons for this are 1) CO_2 is not the only anthropogenic greenhouse gas – others like methane also contribute; and 2) the impact of CO_2 is nonlinear in the sense that each added unit contributes less than its predecessor.

5. A doubling of CO_2 should lead (if the major greenhouse substances, water vapor and clouds remain fixed), on the basis of straightforward physics, to a globally averaged warming of about 1C. The current anthropogenic forcing should lead to a warming of about 0.76C, which is already more than has been observed, but is nonetheless much less than current climate models predict

This brings us, finally, to the issue of climate models. Essential to alarm is the fact that most current climate models predict a response to a doubling of CO_2 of about 4C. The reason for this is that in these models, the most important greenhouse substances, water vapor and clouds, act in such a way as to greatly amplify the response to anthropogenic

greenhouse gases alone (ie, they act as what are called large positive feedbacks). However, as all assessments of the Intergovernmental Panel on Climate Change (IPCC) have stated (at least in the text – though not in the Summaries for Policymakers), the models simply fail to get clouds and water vapor right. We know this because in official model intercomparisons, all models fail miserably to replicate observed distributions of cloud cover. Thus, the model predictions are critically dependent on features that we know must be wrong.

If we nonetheless assume that these model predictions are correct (after all stopped watches are right twice a day), then man's greenhouse emissions have accounted for about 3-6 times the observed warming over the past century with some unknown processes canceling the difference. This is distinctly less compelling than the statement that characterized the IPCC Second Assessment and served as the smoking gun for the Kyoto agreement: *The balance of evidence suggests a discernible human influence on global climate.* This is simply a short restatement of the *basic agreement* with the addition of a small measure of attribution. While one could question the use of the word 'discernible,' *there is no question that human influence should exist, albeit at a level that may be so small as to actually be indiscernible.* As we have already noted, however, even if all the change in global mean temperature over the past century were due to man, it would still imply low and relatively unimportant influence compared to the predictions of models.

Another example of the use of the *basic agreement* to promote alarm consists in the opening lines of the executive summary of the U.S. National Research Council (NRC) 2001 report: *Climate Change Science: An Analysis of Some Key Questions.* This hurried report was prepared at the specific request of the White House. The brief but carefully drafted report of 15 pages was preceded by a totally unnecessary 10 page executive summary. The opening lines were appended at the last moment without committee approval. Here they are:

Greenhouse gases are accumulating in Earth's atmosphere as a result of human activities, causing surface air temperatures and subsurface ocean temperatures to rise. Temperatures are, in fact, rising.

The changes observed over the last several decades are likely mostly due to human activities, but we cannot rule out that some significant part of these changes is also a reflection of natural variability.

To be sure, this statement is leaning over backwards to encourage the alarmists. Nevertheless, the two sentences in the first claim serve to distinguish observed temperature change from human causality. The presence of the word 'likely' in the second statement is grossly exaggerated, but still indicates the lack of certainty, while the fact that we have not emerged from the level of natural variability is, in fact, mentioned albeit obliquely. What, as usual, goes unmentioned is that the observed changes are much smaller than expected.

The response was typical and restricted to the opening lines. CNN's Michelle Mitchell characteristically declared that the report represented "a unanimous decision that global warming is real, is getting worse, and is due to man. There is no wiggle room." Mitchell's response has, in fact, become the standard take on the NRC report. Hopefully, you can now approach such nonsensical claims with greater discernment.

We next turn to the question of how model based alarm has been 'justified' despite the fact that the observed warming over the past century is much less than was anticipated by the models. As usual, the argument involves obscuring this fact. The argument also ignores the fact that the climate is capable of unforced internal variability. That is to say, the climate can vary without any external forcing at all. El Niño is an example but there are many others. Reference to any temperature history of the earth shows fluctuations that are not connected to any known forcing, and these fluctuations amount to as much as half a degree Centigrade. The most common defense is based on studies from the UK's Hadley Centre, and appears in Chapter 12 of the IPCC's Third Scientific Assessment. In these studies, we are shown 3 diagrams. In the first, we are shown an observed temperature record (without error bars), and the results of four model runs with so-called natural forcing for the period 1860-2000. There is a small spread in the model runs (which presumably displays model uncertainty – it most assuredly does not represent internal variability). In any event, the models look roughly like the observations until the last 30 years. We are then shown a second diagram where the observed curve is reproduced, and the four models are run with anthropogenic forcing. Here we see rough agreement over the last 30 years, and poorer agreement in the earlier period. Finally, we are shown the observations and the model runs with both natural and anthropogenic forcing, and, voila, there is rough agreement over the whole record. It should be noted that the models used had a relatively low sensitivity to a doubling of CO_2 of about 2.5C. In order to know what to make of this exercise, one must know exactly what was done. The natural forcing consisted in volcanoes and solar variability. Prior to the Pinatubo eruption in 1991, the radiative impact of volcanoes was not well measured, and estimates vary by about a factor of 3. Solar forcing is essentially unknown. Thus, natural forcing is, in essence, adjustable. Anthropogenic forcing includes not only anthropogenic greenhouse gases, but also aerosols that act to cancel warming (*in the Hadley Centre results, aerosols and other factors cancelled two thirds of the greenhouse forcing*). Unfortunately, the properties of aerosols are largely unknown. This was remarked upon in a recent paper in *Science*, wherein it was noted that the uncertainty was so great that estimating aerosol properties by tuning them to optimize agreement between models and observations (referred to as an inverse method) was probably as good as any other method, but that the use of such estimates to then test the models constituted a circular procedure. In the present instance, therefore, aerosols constitute simply another adjustable parameter. However, the choice of models with relatively low sensitivity, allowed adjustments that were not so extreme. What we have is essentially an exercise in curve fitting. I suppose that the implication is that it is possible that the model is correct, but the likelihood that all the adjustments are what actually occur is rather small. The authors of Chapter 12 of the IPCC Third Scientific Assessment provided the following the draft statement for the Policymakers Summary: *From the body of evidence since IPCC (1996), we conclude that there has been a discernible human influence on global*

climate. Studies are beginning to separate the contributions to observed climate change attributable to individual external influences, both anthropogenic and natural. This work suggests that anthropogenic greenhouse gases are a substantial contributor to the observed warming, especially over the past 30 years. However, the accuracy of these estimates continues to be limited by uncertainties in estimates of internal variability, natural and anthropogenic forcing, and the climate response to external forcing. This statement is not too bad – especially the last sentence. To be sure, the model dependence of the results is not emphasized, but the statement is vastly more honest than what the Policymakers Summary ultimately presented: *In the light of new evidence and taking into account the remaining uncertainties, most of the observed warming over the last 50 years is likely to have been due to the increase in greenhouse gas concentrations.* In truth, nothing of the sort can be concluded. The methodology, by omitting any true treatment of internal variability, misses a crucial point. One can represent the presence of internal variability simply by plotting an horizontal line with the average value of the temperature for the period 1850-2000, and broadening this line to have a thickness of about 0.4C to represent the random internal variability of climate (in nature if not in the models). One can then plot the observations with a thickness of about 0.3C (corresponding to an observational uncertainty of about +/- 0.15C). The two appropriately broadened lines will now overlap almost everywhere (a certain percentage of non-overlap is statistically expected) leaving no evident need for forcing at all.

Thus, the impact of man remains indiscernible simply because the signal is too small compared to the natural noise. Claims that the current temperatures are 'record breaking' or 'unprecedented', however questionable or misleading, simply serve to obscure the fact that the observed warming is too small compared to what models suggest. Even the fact that the oceans' heat capacity leads to a delay in the response of the surface does not alter this conclusion. Indeed, such a delay was included in the above example.

We still have not really addressed the interesting question of how modest warming has come to be associated with alarm. Here we must leave the realm where fudging and obfuscation are the major tools to a realm of almost pure fantasy. A simple example will illustrate the situation.

According to any textbook on dynamic meteorology, one may reasonably conclude that in a warmer world, extratropical storminess and weather variability will actually decrease. The reasoning is as follows. Judging by historical climate change, changes are greater in high latitudes than in the tropics. Thus, in a warmer world, we would expect that the temperature difference between high and low latitudes would diminish. However, it is precisely this difference that gives rise to extratropical large scale weather disturbances. Moreover, when in Boston on a winter day we experience unusual warmth, it is because the wind it blowing from the south. Similarly, when we experience unusual cold, it is generally because the wind is blowing from the north. The possible extent of these extremes is, not surprisingly, determined by how warm low latitudes are and how cold high latitudes are. Given that we expect that high latitudes will warm much more than low latitudes in a warmer climate, the difference is expected to diminish, leading to less variance. Nevertheless, we are told by advocates and the media that exactly the

opposite is the case, and that, moreover, the models predict this (which, to their credit, they do not) and that the *trivial agreement* discussed earlier signifies scientific agreement on this matter as well. Clearly more storms and greater extremes are regarded as more alarming than the opposite. Thus, the opposite of our current understanding is invoked in order to promote public concern. *The crucial point here is that once the principle of consensus is accepted, agreement on anything is taken to infer agreement on everything advocates wish to claim.*

Again, scientists are not entirely blameless in this matter. Sir John Houghton (the first editor of the IPCC scientific assessments) made the casual claim that a warmer world would have more evaporation and the latent heat (the heat released when evaporated water vapor condenses into rain) would provide more energy for disturbances. This claim is based on a number of obvious mistakes (though the claim continues to be repeated by those who don't know better). For starters, extratropical storms are not primarily forced by the latent heat released in convection. However, even in the tropics, where latent heat plays a major role, the forcing of disturbances depends not on the evaporation, but on the evaporation scaled by the specific humidity at the surface. It turns out that this is almost invariant with temperature unless the relative humidity decreases in a warmer world. Incidentally, this would suggest that the feedbacks that cause models to display high climate sensitivity are incorrect. The particularly important issue of whether warming will impact hurricanes, is a matter of debate. As the IPCC has noted, there is no empirical evidence for such an impact. Some state of the art modeling suggests a negative impact, while there are theoretical arguments that suggest a positive impact on hurricane intensity. This is all of significant intellectual interest and a typical feature of fields like hurricane research where few questions have been resolved, but it is not the material out of which to legitimately build alarm. In point of fact, few objective arguments have been made, which is one reason that one relies on opinions.

As we have seen, a crucial part of creating alarm is 'spin.' We have already seen how this worked with the 2001 NRC response to the President's request. Two more recent reports present similar examples. In *Review of the U.S. Climate Change Science Program's Synthesis and Assessment Product on Temperature Trends in the Lower Atmosphere*, the tropospheric temperature trend over the last 30 years or so was reexamined because earlier studies had suggested that neither radiosonde (balloon) nor satellite microwave data showed the warming of a few tenths of a degree Centigrade that characterizes the global mean surface data. The popular public interpretation of this result was that the surface warming was not real, but the more serious issue was that greenhouse warming in models was characterized by warming that was greater in the troposphere than at the surface. As is usual in science, the failure to display this feature would eliminate the possibility that the warming was due to added greenhouse gases, but the presence of tropospheric warming would by no means establish such a cause. Moreover, nothing in the study would alter the fact that the observed surface warming was much too small relative to what models suggested. This therefore became a good example of bad science driven by public misunderstanding. However, the story gets worse. In data analyses and in observations, there are inevitably errors. The saving grace in science is that these errors are generally random. In the present case, the pressure to

'reconcile' atmospheric and surface data has led to an emphasis on only those errors that bring atmospheric trends closer to surface trends. Unless the original atmospheric data analyses were profoundly biased, this, in turn, means that the current analyses have actually introduced a bias. Despite such efforts, the report still fails to bring the atmospheric trends into agreement with model predictions, and when the observations focus on the tropics, the disagreement is as great as it was before. Nonetheless, this report was touted as supporting the claim that warming was due to man. What was the basis for this interpretation? Presumably, the fact that it was possible, in some peculiar sense, to reduce the discrepancy between observations and model results was interpreted to mean that the impossibility of the model results being correct had been reduced, and that, therefore, the study 'supported' the anthropogenic origin of the warming.

A similar example is presented in the NRC report *Surface Temperature Reconstructions for the Last 2,000 Years*. Here, the NRC investigated the much contested claim that the warming of the past century was unprecedented in the past 1000 and even 2000 years. Note that such a claim still does not deal with the fact that the warming over the past century has been much less than expected on the basis of current models. Nonetheless, the 'unprecedented' nature of the warming was taken to mean that something ominous was occurring. So what did the report conclude? Briefly, it suggested somewhat trivially, that the evidence that the earth is warmer now than it was in 1600, at the peak of what is known as The Little Ice Age, is good; however, attempts to go back further are too uncertain to be meaningful. The report gratuitously adds that given our almost total ignorance, it is possible that the present temperatures are warmer than they have been for the past 1000 years, and this was interpreted by some in the media as constituting 'support' for the proposition that man has caused recent warming. Once again, 'support' emerges from a bizarre blend of ignorance (more politely referred to as 'uncertainty') with non-sequitors.

So where does all this leave us?

First, I would emphasize that the basic agreement frequently described as representing scientific unanimity concerning global warming is entirely consistent with there being virtually no particularly serious problem at all. Indeed, the observations most simply suggest that the sensitivity of the real climate is much less than found in models whose sensitivity depends on processes which are clearly misrepresented (through both ignorance and computational limitations). Attempts to assess climate sensitivity by direct observation of cloud processes, and other means, which avoid dependence on models, support the conclusion that the sensitivity is low. More precisely, what is known points to the conclusion that a doubling of CO2 would lead to about 0.5C warming, and a quadrupling (should it ever occur) to about 1C. Neither would constitute a particular societal challenge. Nor would such (or even greater) warming be associated with more storminess, greater extremes, etc.

Second, a significant part of the scientific community appears committed to the maintenance of the notion that alarm may be warranted. Alarm is felt to be essential to

the maintenance of funding. The argument is no longer over whether the models are correct (they are not), but rather whether their results are at all possible. Alas, it is difficult to prove something is impossible.

As you can see, the global warming issue parts company with normative science at a pretty early stage. A very good indicator of this disconnect is the fact that there is widespread and even rigorous scientific agreement that complete adherence to the Kyoto Agreement would have no discernible impact on climate. This clearly is of no importance to the thousands of negotiators, diplomats, regulators, general purpose bureaucrats and advocates attached to this issue. For them as for many well meaning citizens, the important thing is to do something. In an obvious way, this is a reversion to the primitive practice of sacrifice to propitiate angry gods.

At the heart of this issue there is one last matter: namely, the misuse of language. George Orwell wrote that language "becomes ugly and inaccurate because our thoughts are foolish, but the slovenliness of our language makes it easier for us to have foolish thoughts." There can be little doubt that the language used to convey alarm has been sloppy at best. Unfortunately, much of the sloppiness seems to be intentional. The difficulties of discourse in the absence of a shared vocabulary are, I fear, rather evident. Unfortunately, the obvious politicization of climate science has made the correction of these problems particularly difficult.

August 14, 2006

Mr. James L. Connaughton
Chairman
Council on Environmental Quality
722 Jackson Place, NW
Washington, DC 20503

Dear Chairman Connaughton:

This letter is being sent in follow-up to the July 20, 2006 hearing of the Committee on Government Reform, entitled "Climate Change: Understanding the Degree of the Problem." Enclosed with this letter are questions for the record that I'm submitting.

I look forward to receiving your response to these questions by August 29, 2006. Please send your response by mail to the minority staff in B-350A Rayburn House Office Building and to the majority staff in 2157 Rayburn House Office Building and by fax to the minority staff at (202) 225-8185. If you have any questions, please call my staff contact, Alexandra Teitz at (202) 225-5420. Thank you for your attention to this request.

Sincerely,

Henry A. Waxman

Henry A. Waxman
Ranking Minority Member

Enclosure

cc: The Honorable Tom Davis

Questions for the Hearing Record for Mr. Connaughton, CEQ
Government Reform Committee Hearing July 20, 2006
from Rep. Henry A. Waxman

1. In your testimony, you repeatedly claimed that the Bush Administration is making "meaningful progress toward addressing" the issue of global warming. In fact, you claimed that: "[t]he scale and scope of what the U.S. is undertaking in terms of greenhouse gas mitigation is far beyond anything it has done before, and the scale of what we are doing as a nation far exceeds what any other nation is accomplishing."

You praised the President's voluntary national goal to reduce the greenhouse gas intensity of the economy by 18 percent over 10 years, from 2002 to 2012, and referred to this as an "ambitious" goal. Yet in the decade from 1990 to 2000, U.S. greenhouse gas intensity decreased by 17.4 percent, while total U.S. emissions of greenhouse gases grew by 14 percent. Under the Administration's goal, total U.S. emissions of greenhouse gases will again increase by 14 percent from 2002 to 2012.

a. Please explain how it is "ambitious" and "far beyond anything [the United States] has ever done before" to maintain roughly the same rate of increase in the quantity of greenhouse gas emissions and roughly the same rate of improvement in the greenhouse gas intensity of the economy as over the previous decade?

b. According to a chart included in your testimony, from 2000 to 2004, U.S. greenhouse gas emissions *increased* by 1.3%, while Germany and the United Kingdom *reduced* their emissions by 0.7% and 0.6% respectively. Please explain how this increase in U.S. emissions "far exceeds what any other nation is accomplishing" in terms of greenhouse gas mitigation?

2. On January 27, 2006, I wrote to Dr. Paula Dobriansky, the Under Secretary for Democracy and Global Affairs at the State Department, requesting the Administration to provide quantified analytical support for its claims that President Bush's climate change policies have slowed the growth in U.S. greenhouse gas emissions since 2000. Dr. Dobriansky's response failed to provide the requested information, which suggests that the Administration lacks analytical support for its claims.

In your testimony, you reiterated the claim that the Bush Administration's policies are slowing the growth in greenhouse gas emissions. Once again, I request the Administration to provide the analytical data that would support this claim. Specifically, please identify the quantity of emissions *that have already been avoided*, relative to projected business-as-usual emissions, that are directly attributable to either of the following:

a. new climate change policies and programs adopted by President Bush; or

b. expansions of existing climate change policies and programs implemented by President Bush (excluding the continuation of policies and programs implemented by President Clinton or prior administrations).

Please identify the quantity of emissions avoided by each new or expanded portion of a policy or program and provide the analytical basis for the assertion.

3. Your testimony also highlighted many of the Administration's initiatives, but generally without indicating what quantity of emissions reductions they have actually produced, if any, five years into President Bush's tenure. Please indicate the quantity of emissions reductions that (a) have already been achieved since 2001, and (b) will be achieved by 2012, under each of these initiatives cited in your testimony:

a. Climate Vision
b. Climate Leaders
c. Changes to the fuel economy standards (in estimating this quantity, please exclude emissions reductions attributable to higher gas prices, and please account for the increased emissions allowed by the Administration's regulatory extension of the loophole in the fuel economy standards for dual-fueled vehicles)
d. USDA's targeted incentives for greenhouse gas sequestration
e. Hydrogen Fuel Initiative
f. Energy Policy Act of 2005 (in calculating the net effect of this legislation on greenhouse gas emissions, please account for the increased emissions allowed by the legislative extension of the loophole in the fuel economy standards for dual-fueled vehicles)
g. Advanced Energy Initiative
h. Global Nuclear Energy Partnership
i. Climate Change Technology Program
j. Surface Transportation Programs
k. Carbon Sequestration
l. Asia-Pacific Partnership
m. International Partnership for the Hydrogen Economy
n. Carbon Sequestration Leadership Forum
o. Generation IV International Forum
p. Future Gen
q. International Thermonuclear Experimental Reactor
r. Clean Energy Initiative launched at the WSSD
s. Bilateral Activities

4. Your testimony claimed that as of the end of this year, the Administration will have spent a total of $29 billion on climate science, technology, international assistance and incentive programs. You also claimed that "[f]or fiscal year 2007, the President has asked for an additional $6.5 billion for climate-related activities." An August 2005 report by GAO found, however, that it is unclear how much additional funding has actually been devoted to climate change activities under this Administration because OMB has changed the reporting formats and spending categories, limiting the comparability of funding data over time.

a. GAO pointed out that from 1993 to 2001, OMB distinguished between programs that directly related to climate change and for which climate change is a primary purpose, versus

those programs that serve another primary purpose but support climate change goals. Beginning in 2002, however, OMB dropped that distinction. Some of the programs listed in your testimony appear to have primary goals that are unrelated to climate, with very minor, if any, future climate benefits. For example, according to GAO, the Clinton Administration did not consider nuclear programs to be part of its activities related to climate change, while the Bush Administration does count nuclear programs as climate change spending. Please provide the Administration's criteria for determining whether a program relates to climate. Why did the Bush Administration drop the distinction between programs that are directly and indirectly related to climate change?

b. Of the $6.5 billion that you claimed that the President requested for climate-related activities in FY2007, it appears that $1.6 billion is actually estimated revenue losses due to tax provisions that, according to the Administration, "may reduce greenhouse gases."[1] These tax provisions had already been adopted into law, so although the revenue losses are included in the President's budget, your testimony suggested that the President's climate-related funding request for FY 2007 was 25% higher than it was in fact. Why did you make this claim?

c. In its most recent report to Congress on climate change spending, OMB counts as "climate change expenditures" energy tax provisions that may reduce greenhouse gases. Of course, many other tax provisions have the indirect effect of increasing greenhouse gas emissions. For example, the Administration proposed to sharply increase the amount of the price of a vehicle that can be expensed under section 179 of the Internal Revenue Code, which provides tax incentives for purchases of the heaviest and least efficient vehicles (those over 6,000 pounds gross vehicle weight). On May 28, 2003, the President signed legislation to increase the amount that can be expensed for the heaviest vehicles from $25,000 to $100,000 (Congress has subsequently limited this to some degree).[2] Similarly, the Energy Policy Act provided substantial tax incentives to encourage oil drilling. Has the Administration made any attempt to identify the numerous provisions in the tax code that encourage increased energy use and greenhouse gas emissions? If not, why not? If so, please identify each of those tax provisions and indicate the associated revenue losses.

d. It is unclear what many of the categories of climate-related spending identified by the Administration in its April 2006 report to Congress, *Federal Climate Change Expenditures,* actually cover. Please identify the specific activities conducted under each of the following broad categories of spending and explain how each of the specific activities addresses climate change. For any activities that directly avoid or reduce emissions of greenhouse gases, please identify the quantities avoided or reduced:

i. Department of Defense, Research, Development, Test and Evaluation, Army
ii. Department of Defense, Research, Development, Test and Evaluation, Navy
iii. Department of Defense, Research, Development, Test and Evaluation, Air Force
iv. Department of Defense, Research, Development, Test and Evaluation, Defense-wide, DARPA

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[1] OMB, *Federal Climate Change Expenditures Report to Congress* (April 2006).
[2] P.L. 108-27.

v. Department of Defense, Research, Development, Test and Evaluation, Defense-wide, Office of the Secretary of Defense
vi. Energy Supply and Conservation – Electricity Transmission and Distribution
vii. Energy Supply and Conservation – Nuclear
viii. Fossil Energy R&D – Efficiency and Sequestration
ix. Science – Fusion, Sequestration, and Hydrogen (please indicate the funding amounts allocated to each of these three activities)

5. During the hearing, Congressman Waxman highlighted a series of Bush Administration actions that seem contrary to seriously addressing global climate change. You responded, "[s]ome of what you say is factually correct, contextually out of place, and some of it is a gross distortion. . . . It is hard in my five minutes to respond to each of those allegations." The questions below address whether or not it is factually correct that the Administration has taken each of the actions highlighted by Congressman Waxman. In addition to responding to each question as posed, please provide any additional context that the Administration believes shows that the actions discussed are not, in fact, indications of the Administration's failure to address global warming.

a. Does the President's so-called "intensity reduction goal" allow an increase in actual greenhouse gas emissions? Did emissions intensity relative to GDP improve between 1990 and 2000 at roughly the same rate as it would improve between 2002 and 2012 under the Administration's goal?

b. When President Bush first came into office, did he backtrack on a campaign pledge he had made to regulate carbon dioxide from power plants?

c. Did President Bush renounce the Kyoto protocol?

d. Did the Bush Administration support a tax package that, among other things, significantly increased the tax advantages of purchasing vehicles with a gross vehicle weight above 6,000 pounds, such as gas-guzzling Hummers?

e. Did the Bush Administration eliminate the Partnership for a New Generation of Vehicles, which aimed to increase motor vehicle efficiency over the near term?

f. At the World Summit on Sustainable Development in Johannesburg in 2001, did the Bush Administration and Saudi Arabia oppose targets and time frames for increasing renewable energy worldwide?

g. Did the Bush Administration deny a petition to regulate greenhouse gases and is the Administration still in court defending that decision?

h. On May 3, 2006, Secretary of Transportation Norman Y. Mineta testified that the Administration currently has the legal authority to raise fuel efficiency standards for passenger automobiles. On June 28, 2006, 62 Members of Congress wrote to the President urging him to

use that authority. Has the Bush Administration refused to exercise its existing authority to raise fuel efficiency standards for passenger automobiles?

i. Did the Bush Administration oppose the legislation introduced by Senators McCain and Lieberman setting mandatory caps on greenhouse gas emissions?

j. Has the Bush Administration issued a final rule opining that federal law preempts state efforts to reduce emissions of carbon dioxide from motor vehicles?

6. President Bush is quoted in *People Magazine* on July 6, 2006, as saying, "I think we have a problem on global warming. I think there is a debate about whether it is caused by mankind or whether it is caused naturally, but it is a worthy debate."

If there is little or no human contribution to global warming, it is unlikely that we can do anything about it. Conversely, if most of the warming in recent decades is due to human activities, as the world's leading national academies have stated, we have the option of changing those activities to reduce our contribution and the resulting warming. By indicating that it is an open question whether global warming is caused by humans or nature, the President has publicly undermined the case for action on global warming.

a. Did President Bush misstate the Administration's position on the science of global climate change when he indicated his belief that there is a debate as to "whether" global warming is caused by mankind?

b. If the President does not, in fact, believe that it is an open question whether or not global warming is being caused by humans, is the President going to announce a new public position? If the President does, in fact, believe that it is an open question whether or not global warming is being caused by humans, were your statements at the hearing regarding the President's and the Administration's position on the science of global warming inaccurate?

7. In response to a question from Congressman Van Hollen, you stated that the Administration opposed a requirement for large companies to disclose their greenhouse gas emissions. You explained, "[w]e didn't think a mandatory reporting system, per se, made a lot of sense, given the fact we already had a functioning program that had been working since 1992." You then referenced recent changes to that program, known as the 1605(b) program. You continued, "[w]e then create a climate vision that got the major emitting sectors making specific greenhouse gas reduction commitments. They are not just saying what they are doing, but making commitments to reduce, and all of that infrastructure is now underway, so I think we are there."

a. Does the Administration agree that knowing the quantities of greenhouse gas emissions released by each large company would benefit development of responses to global warming, as well as provide valuable information to the public? If not, why not?

b. Does the Administration assert that the data provided by companies on a voluntary basis under the 1605(b) program and the Climate Vision program provides an accurate inventory of the emissions of greenhouse gases from each large company in the United States? If not, why does the Administration believe that the existing voluntary programs are an adequate substitute for a mandatory program?

c. What percentage of annual U.S. emissions of greenhouse gases from stationary sources are reported annually under either the 1605(b) program or the Climate Vision program?

d. With respect to the Climate Vision program, GAO recently reported that as of November 2005, only 5 of the 15 trade groups participating in Climate Vision had reported data on their greenhouse gas emissions. GAO also noted that according to DOE, Climate Vision participants account for over 40% of U.S. greenhouse gas emissions. GAO further found that DOE has no deadline for groups to submit their emissions reports and does not even have a system for tracking program participants' actions, including completing work plans, reporting, and the other steps identified in the work plans.

As the trade groups in Climate Vision emit less than half of total U.S. greenhouse gas emissions, only a small proportion of those groups have reported their emissions under the Climate Vision program, and DOE has no deadline for reporting emissions and no system for even tracking whether the groups and companies are reporting their emissions, why does the Administration believe such a program is an adequate substitute for a comprehensive, mandatory emissions reporting program?

e. Mr. Van Hollen asked: "[i]s it your testimony we now know the amount of greenhouse gases being emitted by American industry on a per-company basis? You replied: "Yes. We know it on a macro basis and we have got good data sector-by-sector, and we are getting better data company-by-company, and that is what our new 1605(b) guidelines are going to incentivize."

Please provide an inventory of the greenhouse emissions emitted by each large American company for the most recent year for which the Administration has data. If the Administration does not have this information, please explain the basis for your statement.

8. On January 31, 2006, in the State of the Union address, President Bush stated that "we have a serious problem: America is addicted to oil, which is often imported from unstable parts of the world."[3] The President stated that technological breakthroughs in hybrid cars, electric cars, hydrogen fuel cell cars, and cellulosic ethanol would allow the United States "to replace more than 75 percent of our oil imports from the Middle East by 2025."[4] The President said that his plan would allow the nation to "move beyond a petroleum-based economy, and make our

[3] President George W. Bush, State of the Union Address (Jan. 31, 2006) (online at http://www.whitehouse.gov/news/releases/2006/01/20060131-10.html).

[4] *Id.*

dependence on Middle Eastern oil a thing of the past."[5] The Administration has dubbed this plan the Advanced Energy Initiative.

In addition to national security benefits, moving beyond a petroleum-based economy would have dramatic benefits for addressing global warming. On February 16, 2006, Representatives Henry Waxman, Marcy Kaptur, and Jim Davis wrote to the White House Council of Economic Advisors, inquiring why the 2006 *Economic Report of the President*, together with the *Annual Report of the Council of Economic Advisers* (CEA Report), do not reflect the Advanced Energy Initiative. The Council of Economic Advisors has never responded to this inquiry, and therefore I request your assistance with the following questions.

a. President Bush states in the *Economic Report of the President* that the *Annual Report of the Council of Economic Advisers* discusses the energy plan announced in the State of the Union.[6] However, while the CEA Report does describe many policy proposals supported by the Administration, it does not appear to reflect the President's State of the Union energy plan. The CEA Report acknowledges support for several energy policies, including the following:

- "The Administration supports greater access to oil and natural gas resources in Federal waters off shore states that support such development and supports opening a small portion of the Arctic National Wildlife Refuge (ANWR) in Alaska."
- "The Administration supports greater access to natural gas and oil resources in Federal waters off shore of states that support such development."
- "The Administration is supporting the development of various technologies that will improve power plant efficiency."
- "The Administration is also supporting further development of renewable sources of electricity, such as wind, solar energy, and biomass (e.g., wood and agricultural crops)"
- "the Administration is supporting the development of nuclear power"[7]

But the report fails to mention the President's initiative to "move beyond a petroleum-based economy, and make our dependence on Middle Eastern oil a thing of the past," and it does not explain how this vision can be made into reality. For example, there is no discussion of key elements of the State of the Union Address, including hybrid technology, electric cars, or fuel cells. Plug-in hybrids are not mentioned. Additionally, while the report states that the Administration supports development of biomass, there is no mention of how the President's State of the Union goal of making ethanol from wood chips and switch grass "practical and competitive within six years" will be achieved.

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[5] *Id.*

[6] Economic Report of the President together with the Annual Report of the Council of Economic Advisers (Feb. 2006) (online at http://www.whitehouse.gov/cea/erp06.pdf).

[7] *Id.*

Please explain why some stated energy goals of the Administration (i.e., drilling in the Arctic National Wildlife Refuge) were included in the CEA Report, and other stated energy goals (i.e., making ethanol from wood chips and switch grass "practical and competitive within six years") were not.

b. With regard to conservation and efficiency, the CEA Report states: "Increased scarcity and rising prices over time will encourage conservation."[8] However, increased scarcity and rising prices is hardly a policy prescription for aiding American families struggling under increasing energy bills. Overall, the report seems to lack any policies for short- to mid-term solutions, stating, "[i]n the long run, households and businesses respond to higher fuel prices by cutting consumption, purchasing products that are more efficient, and switching to alternative energy sources."[9] Please explain why the CEA Report does not provide policies for short- to mid-term solutions. Please explain the Administration's approach to assisting American families with energy bills in the short- to mid-term.

c. After the President's State of the Union address, the press reported that Energy Secretary Samuel Bodman and the director of the President's National Economic Council, Alan Hubbard, stated that the President "didn't mean it literally."[10] The press also reported that Energy Secretary Bodman stated the energy goal "was purely an example."[11] The CEA report further buttresses these concerns about the Administration's commitment to the State of the Union energy proposals. Please provide an explanation of how we are to interpret this report, and whether the American people should dismiss the Advanced Energy Initiative, as apparently the Council of Economic Advisers has done.

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[8] *Id.*

[9] *Id.*

[10] *Administration backs off Bush's vow to reduce Mideast oil imports*, Knight Ridder Newspapers (Feb. 1, 2006) (online at http://www.realcities.com/mld/krwashington/news/nation/13767738.htm?source=rss&channel=krwashington_nation).

[11] *Id.*

Deposition on the absence of a basis for claims of alarming climate change

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Summary

For about twenty years we have been told that the catastrophic consequences of global warming are about to descend and that all scientists agree. Periodically, it is acknowledged that some disagreement existed but that now all scientists do indeed agree. Notwithstanding the constant repetition of the cataclysmic claims, these claims are intrinsically weak on many counts. While there are indeed aspects of climate concerning which there is a measure of widespread agreement, this testimony questions whether any association of these limited aspects with cataclysmic claims is meaningful. The deposition emphasizes the following points:

1. While there is widespread agreement that the global mean temperature has gone up (rather irregularly) on the order of half a degree Centigrade over the past century, that atmospheric carbon dioxide has also increased (rather regularly) over this same period, and that carbon dioxide as a minor greenhouse substance (compared to the major substances, water vapor and clouds) should contribute to warming, further agreement is largely spurious.

2. The claim that man has been identified as a major contributor to warming is based on a curve fitting exercise that would be an embarrassment in freshman physics.

3. The observed warming is on the order of a quarter of what current models say we should have seen. Thus, even if it were the case that man caused the observed warming, it would still be evidence that the models upon which alarm is based are grossly exaggerating the impact of anthropogenic greenhouse substances. There is increasing evidence that we know why this exaggeration is occurring.

4. Once one gets beyond the relatively trivial issue of global mean temperature, whatever consensus exists is generally likely to be in opposition to the alarmist vision. Here is where one sees some of the most glaring differences even between the text and the Policymakers Summary of the IPCC reports.

5. There is a remarkable amount of confusion over the relation between emissions of carbon dioxide, carbon dioxide levels in the atmosphere, and the impact of anthropogenic greenhouse substances on climate. The last item has already reached a level that corresponds to three quarters of what would accompany a doubling of atmospheric carbon dioxide. No proposed policy would discernibly alter this.

In brief, the case for alarming global warming is not a plausible case where there are a few remaining doubts. Rather it is an implausible case which is defended on the basis of uncertainty which makes it difficult to rigorously prove that the alarmism is impossible. Regardless, the problem, whether possible or not, is not, with known technology, amenable to mitigation. The association of this issue with energy policy is more a matter of pure energy policy than a matter of avoiding environmental damage. Obscuring this relieves proponents of energy policies of the need to rationally defend their position, while spurious claims of consensus relieve all concerned of the need to understand the science. The situation invites incoherence for both the science and for energy policy.

Please accept my apologies for being unable to attend these hearings. The present deposition describes my position on this matter.

One of the most peculiar aspects of the so-called global warming debate has been the immense variety of often unrelated claims that have been subsumed under the single heading of global warming. Without the least attempt to disentangle these claims, the concept of consensus is introduced despite the fact that such a notion is intrinsically foreign to science. Science, after all, is not a source of authority based on votes, but rather a very effective mode of inquiry based on skepticism. Despite claims of consensus, I know of no attempts to actually poll scientists – even within the narrow confines of the Intergovernmental Panel on Climate Change (IPCC). Nevertheless, in a society that is, in large measure, ignorant and afraid of science, the concept of consensus serves to conveniently dispose of the need to understand the science. Yielding to this temptation, however, guaranties incoherent policy and encourages politicized science. A couple of years ago, Tony Blair offered a brief example of what many politicians believe the scientific consensus to be: "The overwhelming view of experts is that climate change, to a greater or lesser extent, is man-made, and, without action, will get worse." It is hard to tell if the sloppiness of Mr. Blair's language was intentional or not, but the phrase 'greater or lesser' leaves unbounded space for ambiguity, and the phrase 'worse' used without a useful reference is meaningless. In what sense is our present climate worse than it was during the Little Ice Age of the 15th through 18th Centuries or for that matter, the major glaciation of the last Ice Age itself? In what sense is the current hurricane season worse than those of the 1930's and 40's? And, of course, what do such things as the breaking off of icebergs, fluctuations in hurricanes, slow rises in sea level, etc. have to do with the very modest 1 degree F increase in global mean temperature over the past century? In point of fact, there is little known connection though there is ample controversy. Vice President Gore's recent movie attempts to gloss over this while claiming absolute scientific support. That such claims are unjustified became evident in Gore's recent interview with George Stephanopoulos where he acknowledged that he had gone against the scientific judgment that large abrupt sea level rises are unlikely (presumably in order to achieve greater cinematic impact). Quite frankly, I think one should always be worried when politicians attempt to frighten rather than inform the public.

In the remainder of this deposition, I would like to review the few things concerning which there is widespread agreement within the climate science community. We will see that the implication here is that observed warming has, in fact, been much less than was predicted by existing climate models. I will then show how this has been disguised by various claims that are largely irrelevant, and how the arguments over these claims have been twisted into claims of support for alarmism.

Here are the few points concerning which there is widespread agreement. I won't suggest that there is no controversy over details, but there are few that would fundamentally disagree with the following.

1. The global mean surface temperature is always changing. Over the past 60 years, it has both decreased and increased. For the past century, it has probably increased by about 0.6 degrees Centigrade (C). That is to say, we have had some global mean warming.

2. CO_2 is a greenhouse gas and its increase should contribute to warming. It is, in fact, increasing, and a doubling would increase the greenhouse effect (mainly due to water vapor and clouds) by about 2%.

3. There is good evidence that man has been responsible for the recent increase in CO_2, though climate itself (as well as other natural phenomena) can also cause changes in CO_2.

I will refer to this as the *basic agreement*. Various bodies have been unable to resist making claims that items 1 and 2 are causally connected. This is referred to as the attribution question. I will show that attribution is by no means widely accepted or even plausible. However, as we will see, the alleged attribution, itself, also provides little or no support for alarm. The reason why the *basic agreement* (even when supplemented by the claim of attribution) does not support alarm hinges on other points of widespread agreement, which are rarely alluded to.

4. In terms of climate forcing, we are already three-quarters of the way to a doubling of CO_2. The main reasons for this are 1) CO_2 is not the only anthropogenic greenhouse gas – others like methane also contribute; and 2) the impact of CO_2 is nonlinear in the sense that each added unit contributes less than its predecessor.

5. A doubling of CO_2 should lead (if the major greenhouse substances, water vapor and clouds remain fixed), on the basis of straightforward physics, to a globally averaged warming of about 1C. The current anthropogenic forcing should lead to a warming of about 0.76C, which is already more than has been observed, but is nonetheless much less than current climate models predict

This brings us, finally, to the issue of climate models. Essential to alarm is the fact that most current climate models predict a response to a doubling of CO_2 of about 4C. The reason for this is that in these models, the most important greenhouse substances, water vapor and clouds, act in such a way as to greatly amplify the response to anthropogenic

greenhouse gases alone (ie, they act as what are called large positive feedbacks). However, as all assessments of the Intergovernmental Panel on Climate Change (IPCC) have stated (at least in the text – though not in the Summaries for Policymakers), the models simply fail to get clouds and water vapor right. We know this because in official model intercomparisons, all models fail miserably to replicate observed distributions of cloud cover. Thus, the model predictions are critically dependent on features that we know must be wrong.

If we nonetheless assume that these model predictions are correct (after all stopped watches are right twice a day), then man's greenhouse emissions have accounted for about 3-6 times the observed warming over the past century with some unknown processes canceling the difference. This is distinctly less compelling than the statement that characterized the IPCC Second Assessment and served as the smoking gun for the Kyoto agreement: *The balance of evidence suggests a discernible human influence on global climate.* This is simply a short restatement of the *basic agreement* with the addition of a small measure of attribution. While one could question the use of the word 'discernible,' *there is no question that human influence should exist, albeit at a level that may be so small as to actually be indiscernible.* As we have already noted, however, even if all the change in global mean temperature over the past century were due to man, it would still imply low and relatively unimportant influence compared to the predictions of models.

Another example of the use of the *basic agreement* to promote alarm consists in the opening lines of the executive summary of the U.S. National Research Council (NRC) 2001 report: *Climate Change Science: An Analysis of Some Key Questions.* This hurried report was prepared at the specific request of the White House. The brief but carefully drafted report of 15 pages was preceded by a totally unnecessary 10 page executive summary. The opening lines were appended at the last moment without committee approval. Here they are:

Greenhouse gases are accumulating in Earth's atmosphere as a result of human activities, causing surface air temperatures and subsurface ocean temperatures to rise. Temperatures are, in fact, rising.

The changes observed over the last several decades are likely mostly due to human activities, but we cannot rule out that some significant part of these changes is also a reflection of natural variability.

To be sure, this statement is leaning over backwards to encourage the alarmists. Nevertheless, the two sentences in the first claim serve to distinguish observed temperature change from human causality. The presence of the word 'likely' in the second statement is grossly exaggerated, but still indicates the lack of certainty, while the fact that we have not emerged from the level of natural variability is, in fact, mentioned albeit obliquely. What, as usual, goes unmentioned is that the observed changes are much smaller than expected.

The response was typical and restricted to the opening lines. CNN's Michelle Mitchell characteristically declared that the report represented "a unanimous decision that global warming is real, is getting worse, and is due to man. There is no wiggle room." Mitchell's response has, in fact, become the standard take on the NRC report. Hopefully, you can now approach such nonsensical claims with greater discernment.

We next turn to the question of how model based alarm has been 'justified' despite the fact that the observed warming over the past century is much less than was anticipated by the models. As usual, the argument involves obscuring this fact. The argument also ignores the fact that the climate is capable of unforced internal variability. That is to say, the climate can vary without any external forcing at all. El Niño is an example but there are many others. Reference to any temperature history of the earth shows fluctuations that are not connected to any known forcing, and these fluctuations amount to as much as half a degree Centigrade. The most common defense is based on studies from the UK's Hadley Centre, and appears in Chapter 12 of the IPCC's Third Scientific Assessment. In these studies, we are shown 3 diagrams. In the first, we are shown an observed temperature record (without error bars), and the results of four model runs with so-called natural forcing for the period 1860-2000. There is a small spread in the model runs (which presumably displays model uncertainty – it most assuredly does not represent internal variability). In any event, the models look roughly like the observations until the last 30 years. We are then shown a second diagram where the observed curve is reproduced, and the four models are run with anthropogenic forcing. Here we see rough agreement over the last 30 years, and poorer agreement in the earlier period. Finally, we are shown the observations and the model runs with both natural and anthropogenic forcing, and, voila, there is rough agreement over the whole record. It should be noted that the models used had a relatively low sensitivity to a doubling of CO_2 of about 2.5C. In order to know what to make of this exercise, one must know exactly what was done. The natural forcing consisted in volcanoes and solar variability. Prior to the Pinatubo eruption in 1991, the radiative impact of volcanoes was not well measured, and estimates vary by about a factor of 3. Solar forcing is essentially unknown. Thus, natural forcing is, in essence, adjustable. Anthropogenic forcing includes not only anthropogenic greenhouse gases, but also aerosols that act to cancel warming (*in the Hadley Centre results, aerosols and other factors cancelled two thirds of the greenhouse forcing*). Unfortunately, the properties of aerosols are largely unknown. This was remarked upon in a recent paper in *Science*, wherein it was noted that the uncertainty was so great that estimating aerosol properties by tuning them to optimize agreement between models and observations (referred to as an inverse method) was probably as good as any other method, but that the use of such estimates to then test the models constituted a circular procedure. In the present instance, therefore, aerosols constitute simply another adjustable parameter. However, the choice of models with relatively low sensitivity, allowed adjustments that were not so extreme. What we have is essentially an exercise in curve fitting. I suppose that the implication is that it is possible that the model is correct, but the likelihood that all the adjustments are what actually occur is rather small. The authors of Chapter 12 of the IPCC Third Scientific Assessment provided the following the draft statement for the Policymakers Summary: *From the body of evidence since IPCC (1996), we conclude that there has been a discernible human influence on global*

climate. Studies are beginning to separate the contributions to observed climate change attributable to individual external influences, both anthropogenic and natural. This work suggests that anthropogenic greenhouse gases are a substantial contributor to the observed warming, especially over the past 30 years. However, the accuracy of these estimates continues to be limited by uncertainties in estimates of internal variability, natural and anthropogenic forcing, and the climate response to external forcing. This statement is not too bad – especially the last sentence. To be sure, the model dependence of the results is not emphasized, but the statement is vastly more honest than what the Policymakers Summary ultimately presented: *In the light of new evidence and taking into account the remaining uncertainties, most of the observed warming over the last 50 years is likely to have been due to the increase in greenhouse gas concentrations.* In truth, nothing of the sort can be concluded. The methodology, by omitting any true treatment of internal variability, misses a crucial point. One can represent the presence of internal variability simply by plotting an horizontal line with the average value of the temperature for the period 1850-2000, and broadening this line to have a thickness of about 0.4C to represent the random internal variability of climate (in nature if not in the models). One can then plot the observations with a thickness of about 0.3C (corresponding to an observational uncertainty of about +/- 0.15C). The two appropriately broadened lines will now overlap almost everywhere (a certain percentage of non-overlap is statistically expected) leaving no evident need for forcing at all.

Thus, the impact of man remains indiscernible simply because the signal is too small compared to the natural noise. Claims that the current temperatures are 'record breaking' or 'unprecedented', however questionable or misleading, simply serve to obscure the fact that the observed warming is too small compared to what models suggest. Even the fact that the oceans' heat capacity leads to a delay in the response of the surface does not alter this conclusion. Indeed, such a delay was included in the above example.

We still have not really addressed the interesting question of how modest warming has come to be associated with alarm. Here we must leave the realm where fudging and obfuscation are the major tools to a realm of almost pure fantasy. A simple example will illustrate the situation.

According to any textbook on dynamic meteorology, one may reasonably conclude that in a warmer world, extratropical storminess and weather variability will actually decrease. The reasoning is as follows. Judging by historical climate change, changes are greater in high latitudes than in the tropics. Thus, in a warmer world, we would expect that the temperature difference between high and low latitudes would diminish. However, it is precisely this difference that gives rise to extratropical large scale weather disturbances. Moreover, when in Boston on a winter day we experience unusual warmth, it is because the wind it blowing from the south. Similarly, when we experience unusual cold, it is generally because the wind is blowing from the north. The possible extent of these extremes is, not surprisingly, determined by how warm low latitudes are and how cold high latitudes are. Given that we expect that high latitudes will warm much more than low latitudes in a warmer climate, the difference is expected to diminish, leading to less variance. Nevertheless, we are told by advocates and the media that exactly the

'reconcile' atmospheric and surface data has led to an emphasis on only those errors that bring atmospheric trends closer to surface trends. Unless the original atmospheric data analyses were profoundly biased, this, in turn, means that the current analyses have actually introduced a bias. Despite such efforts, the report still fails to bring the atmospheric trends into agreement with model predictions, and when the observations focus on the tropics, the disagreement is as great as it was before. Nonetheless, this report was touted as supporting the claim that warming was due to man. What was the basis for this interpretation? Presumably, the fact that it was possible, in some peculiar sense, to reduce the discrepancy between observations and model results was interpreted to mean that the impossibility of the model results being correct had been reduced, and that, therefore, the study 'supported' the anthropogenic origin of the warming.

A similar example is presented in the NRC report *Surface Temperature Reconstructions for the Last 2,000 Years*. Here, the NRC investigated the much contested claim that the warming of the past century was unprecedented in the past 1000 and even 2000 years. Note that such a claim still does not deal with the fact that the warming over the past century has been much less than expected on the basis of current models. Nonetheless, the 'unprecedented' nature of the warming was taken to mean that something ominous was occurring. So what did the report conclude? Briefly, it suggested somewhat trivially, that the evidence that the earth is warmer now than it was in 1600, at the peak of what is known as The Little Ice Age, is good; however, attempts to go back further are too uncertain to be meaningful. The report gratuitously adds that given our almost total ignorance, it is possible that the present temperatures are warmer than they have been for the past 1000 years, and this was interpreted by some in the media as constituting 'support' for the proposition that man has caused recent warming. Once again, 'support' emerges from a bizarre blend of ignorance (more politely referred to as 'uncertainty') with non-sequitors.

So where does all this leave us?

First, I would emphasize that the basic agreement frequently described as representing scientific unanimity concerning global warming is entirely consistent with there being virtually no particularly serious problem at all. Indeed, the observations most simply suggest that the sensitivity of the real climate is much less than found in models whose sensitivity depends on processes which are clearly misrepresented (through both ignorance and computational limitations). Attempts to assess climate sensitivity by direct observation of cloud processes, and other means, which avoid dependence on models, support the conclusion that the sensitivity is low. More precisely, what is known points to the conclusion that a doubling of CO2 would lead to about 0.5C warming, and a quadrupling (should it ever occur) to about 1C. Neither would constitute a particular societal challenge. Nor would such (or even greater) warming be associated with more storminess, greater extremes, etc.

Second, a significant part of the scientific community appears committed to the maintenance of the notion that alarm may be warranted. Alarm is felt to be essential to

the maintenance of funding. The argument is no longer over whether the models are correct (they are not), but rather whether their results are at all possible. Alas, it is difficult to prove something is impossible.

As you can see, the global warming issue parts company with normative science at a pretty early stage. A very good indicator of this disconnect is the fact that there is widespread and even rigorous scientific agreement that complete adherence to the Kyoto Agreement would have no discernible impact on climate. This clearly is of no importance to the thousands of negotiators, diplomats, regulators, general purpose bureaucrats and advocates attached to this issue. For them as for many well meaning citizens, the important thing is to do something. In an obvious way, this is a reversion to the primitive practice of sacrifice to propitiate angry gods.

At the heart of this issue there is one last matter: namely, the misuse of language. George Orwell wrote that language "becomes ugly and inaccurate because our thoughts are foolish, but the slovenliness of our language makes it easier for us to have foolish thoughts." There can be little doubt that the language used to convey alarm has been sloppy at best. Unfortunately, much of the sloppiness seems to be intentional. The difficulties of discourse in the absence of a shared vocabulary are, I fear, rather evident. Unfortunately, the obvious politicization of climate science has made the correction of these problems particularly difficult.