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REVIEW OF THE UNITED STATES' CLIMATE POLICY, THE $5 BILLION BUDGET REQUEST FOR CLIMATE-RELATED SCIENCE AND TECHNOLOGY IN FISCAL YEAR 2006

HEARING

BEFORE THE

SUBCOMMITTEE ON GLOBAL CLIMATE CHANGE AND IMPACTS

OF THE

COMMITTEE ON COMMERCE, SCIENCE, AND TRANSPORTATION
UNITED STATES SENATE

ONE HUNDRED NINTH CONGRESS

FIRST SESSION

JULY 20, 2005

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FIRST SESSION

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REVIEW OF THE UNITED STATES' CLIMATE POLICY, THE $5 BILLION BUDGET REQUEST FOR CLIMATE–RELATED SCIENCE AND TECHNOLOGY IN FISCAL YEAR 2006

WEDNESDAY, JULY 20, 2005

U.S. SENATE,
SUBCOMMITTEE ON GLOBAL CLIMATE CHANGE AND IMPACTS,
COMMITTEE ON COMMERCE, SCIENCE, AND TRANSPORTATION,
Washington, DC.

The Subcommittee met, pursuant to notice, at 10:30 a.m. in room SR–253, Russell Senate Office Building, Hon. David Vitter, Chairman of the Subcommittee, presiding.

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

Senator VITTER. Good morning, I'm very excited to hold this first hearing of the Subcommittee on Global Climate Change and Impacts. This hearing will focus on our national climate strategy with particular focus on two things: first, the Administration's Fiscal Year 2006 budget request for climate-related science and technology programs; and second, how our climate policy may be effected by the recent G8 Summit in Scotland, and other international climate forums later this year. I'm really not sure whose idea it was to give a freshman a gavel, but I like the idea, it's the first time I've actually been able to sit up here, at least when other people were in the room.

[Laughter.]

Senator VITTER. So, it's great to be here to chair this. Seriously, though, it's a very important topic, and I expect the Subcommittee to spend a lot of time on this topic in Congress, this is only the first in a series of hearings that I plan to pursue on the issue. As you know, the Commerce Committee has very broad jurisdiction in regard to climate change, we intend to exert our full authority over that issue, the Science Program, the Technology Program, the agencies that will be responding to the changes caused by climatic variability; therefore, all of you should get comfortable here, because I know we're going to be delving into this issue very seriously.

As the President recently confirmed at the G8 Summit in Scotland, the United States has spent over $20 billion in climate-related science and technology programs, clearly much more than any other nation. In addition to half a billion dollars in tax incentives, the President has also requested an additional $5 billion for

these programs in Fiscal Year 2006 alone. It's a tremendous amount of money, and I'm very interested to learn of our witnesses' plans for 2006, how this relates to our larger policies on climate change, and our role in the international community. My top priority here is ensuring that our taxpayers are getting their money's worth, there are a lot of things any of us could decide to do with $5 billion, and I hope you are, and will continue to provide tangible results for our country and the world.

In addition, the Senate recently passed comprehensive energy legislation which is now in conference. This is critical, and overdue, to our national energy policy and includes a number of the important policy changes that reflect the advances in our science and technological base, and I think it's a really good step forward for our country.

Finally, many people have used some of the temperature trends and climate changes and their potential effects as something that our children and grandchildren will have to deal with, however, some of those changes we're experiencing, for instance, in Alaskan villages today, really cannot wait that long. I'm certain Chairman Stevens will pay particular attention to this as the Committee conducts its work this Congress, and if I know what's good for me, this Subcommittee will have particular focus on that, probably with field hearings on that as well. That is one of the very specific and concrete, and important, impacts that the name of this Subcommittee directly refers to, because it is about climate change and impacts.

Being from Louisiana, I would be remiss if I didn't mention another very important, specific impact that we will also touch on this Congress, and that is coastal erosion in Louisiana. In Louisiana we lose up to 35 square miles a year due to coastal erosion, that is a football field of land every 38 minutes. Recent reports by NOAA and USGS show that these same areas are also sinking through subsidence faster than anywhere else in the world. Some areas of coastal Louisiana have dropped over 20 inches in the past decade, almost two feet, and so we're experiencing the practical effects of sea level rise in Louisiana, and we're going to need to address these problems as well.

Before we move on to the Ranking Member's statement, I would like to quickly acknowledge that Dr. Mahoney announced his retirement yesterday. Dr. Mahoney is the Assistant Secretary of Commerce, and Director of our Climate Science Program. Doctor, I know you're not leaving right away, but I want to thank you for your service, standing up for a science program involving 13 different agencies is an extraordinary task, and I know you and your family have been through a lot lately, so thank you for all of that service. We certainly wish you and your family the best in all of your future endeavors.

Dr. MAHONEY. Thank you, Mr. Chairman.

Senator VITTER. Absolutely, and with that, let me turn it over to Senator Lautenberg, the Ranking Member.

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

Senator LAUTENBERG. Thanks Mr. Chairman, this is a kind of a new experience for each of us, neither one of us are new to the Congress, but this is a Committee just identified in this last year, and so we have an important task. I look forward to working with Senator Vitter, and I hope that we will get ourselves going in a way that identifies the seriousness of some of the problems that we have seen, and that Dr. Mahoney—we're sorry to see you leaving—but we look forward to hearing anything that you've got to say, even after you've left.

So, Mr. Chairman, thanks for convening the hearing, I look forward to working with you on this issue. Climate change, or global warming, is one of the most daunting challenges affecting our future, and I'm concerned that we're not treating it with the urgency that it deserves. Now, if one found out that their house was on fire, they would immediately call the fire department. They wouldn't wait until all the neighbors agreed about how long the fire had been burning, or about how much damage it would do. You would, immediately, when you see it and feel it, you would call the firemen to put it out. Well, that's my feeling about global warming, we know that the Earth is getting hotter, the four warmest years ever recorded were in 1998, 2002, 2003, and 2004, and judging by recent temperature levels around here, it looks like we're headed for an unenviable new record. The 10 hottest years we've experienced have all occurred since 1987, that grouping tells you something. The last 55 years, the volume of ice in the Arctic Ocean has been reduced by 45 percent, and the Chairman mentioned what kind of loss they've had of land in the area around Louisiana.

As this ice has melted, sea levels have risen around the world, and in New Jersey, the sea rose about 17 inches in the last century. Now, we also know that burning fossil fuel produces carbon dioxide and methane, and they are the two most important gases that intensify the Earth's natural greenhouse effect, and these are the facts: the National Academy of Sciences recently released a joint statement with the Science Academies of ten other nations. They declared that scientific evidence of global warming is solid enough to warrant mandatory reduction of greenhouse gases. It's the strongest statement yet from the National Academy of Sciences, and it represents the overwhelming consensus of the world scientific community. It's time for action. The United States must provide the leadership. We have the leadership position that dominates so much of the world, and we have a responsibility to accept that leadership and put it into place. With only 4 percent of the world's population, we produce 25 percent of all greenhouse gases, and if we fail to act, how can we expect other countries to pick up their share of the burden? Most of us realize the seriousness of the issue, and that is why we're spending $5 billion a year on climate science and climate technologies. Our Subcommittee is responsible for seeing that these studies are delivered in a timely manner and that they are free of political spin.

Now, unfortunately, we've seen both, spinning and delays. We had a White House official, Mr. Cooney by name, a man with no scientific background, editing reports on global warming, and now

he's gone back to work for the oil industry where he was before. A national climate assessment from the Administration was due to Congress a year ago, but we still haven't seen it, and there is evidently no plan to produce it. And to those who say there's nothing we can do about global warming, I would point to my home state, New Jersey, has an aggressive program for reducing greenhouse gases, major state utilities have established data registries to track emissions, and to those who say, "It costs too much," I ask, what is the cost of doing nothing? What would be the economic impact if the State of Florida is under water, or if the sea rises another two feet along New Jersey's 125 miles of shore, as it is projected to do by the end of this century if we fail to take action. Left unchecked, global warming will ravage our environment and our economy, and it is not the legacy that I as a grandfather want to leave for my 10 grandchildren. They are my most precious assets, and I think I owe it to them to at least give them a chance to breathe clean air, to be able to drink water that's not contaminated, and to live in a world in which we don't have natural changes that bring us nothing but problems.

There's one more indisputable fact about global warming, that we can't do anything in the short-term to reverse it. So, it means long-term planning, long-term investment. Carbon dioxide is a long-lived gas, and once it's released into our atmosphere, it pretty much stays there. We can't reverse global warming, we can only slow it down by reducing greenhouse gas emissions. Every day that we fail to act is lost forever.

Now, I took the time a couple of years ago to go down to Antarctica to visit the South Pole, and to see what the National Science Foundation was doing there, and you could almost hear the pain that the ice structure was feeling. The groaning at night, and no nights at that time, barely any that were going through the reaction. And then to see these huge chunks of ice floating off into the ocean, and where we had 70 percent of the world's fresh water stored in that ice, that's rapidly disappearing.

And in Australia, kids have to wear full bathing suits before they're allowed to go out on the beach because of the threat of skin cancer, because of the global warming and the hole in the ozone layers, so Mr. Chairman, we've got a lot to do, and I thank you for giving us the opportunity to begin our work on such an important issue.

Senator VITTER. Thank you, Senator, and now we'll move to our distinguished panel.

We have the Honorable James Richard Mahoney, Assistant Secretary for Oceans and Atmosphere, and also Director of the Climate Science Program in the U.S. Department of Commerce; Dr. David Conover, Principal Deputy Assistant Secretary, Office of Policy and International Affairs; Director, U.S. Climate Change Technology Program, in the U.S. Department of Energy; Mr. Daniel Reifsnyder, Director of the Office of Global Change in the U.S. Department of State; and, Dr. Ralph J. Cicerone, President of the National Academy of Sciences. Thank you all for being here today and participating in our hearing, and we will start with Dr. Mahoney.

STATEMENT OF HON. JAMES R. MAHONEY, PH.D., ASSISTANT SECRETARY OF COMMERCE FOR OCEANS AND ATMOSPHERE; DEPUTY ADMINISTRATOR, NATIONAL OCEANIC AND ATMOSPHERIC ADMINISTRATION (NOAA)

Dr. MAHONEY. Thank you, Mr. Chairman, and thank you to Senator Lautenberg, also. I'm pleased to be here today, since you graciously mentioned my health challenges and my just-announced plan to retire, I want to note for the record, as I begin my statement, that I am doing that on the basis that I will stay in my post through the time when my successor is confirmed and ready to begin, so I understand—and my supervisors do, too—that that may be months, it may be the end of the year, or beyond. So, I wanted to be clear for the record that I don't view today to be a statement, and then I'm leaving, unfortunately because I had been very much looking forward to working through this term of the President, it is the responsible thing for me to step down because of the health challenges I've had, but I don't intend to be off-the-scene right away. And I look forward to dialoguing with you, and responding to some of the very serious questions and challenges, including some that have been brought to our attention quite recently, so I would just note that for the record in the beginning.

I'll get along with my statement, I'm obviously very pleased to appear here today, and I want to start by noting that President Bush certainly recognizes climate change to be a very important issue for us to address, and in fact, the same metric that you cited—while there are many others—the fact that the President has, among other things, requested a budget this year, as in prior years, of more than $5 billion, represents his commitment to understanding the depth of the problem, and taking action, so I want to note that at the beginning of my statement.

I also want to note the statement that he made at the event, the evening before the G8 session began recently. He said, specifically, "We note that the surface of the earth is warmer and that an increase in greenhouse gases caused by humans is contributing to the problem." And I note, of course, that the research that we're doing, and the technology development we're doing is aimed at directly addressing those matters.

So, I want to begin with that, and then I'll move along with the rest of my statement here. In mid-2001, and then again in February of 2002, the President set out a new program for strengthening the approach to the research and technology development that this government is following, and he created both the U.S. Climate Change Science Program, and the related Climate Change Technology Program, both building on the work that had been done over the decade before, at that time. He furthered these commitments with the many discussions he had at the G8 meeting, and we've seen the outcome of that just recently.

The Climate Change Science Program, as the Chairman indicated, integrates the work of 13 Federal agencies, addressing the climate change issue. I will focus on that, my colleague, of course, David Conover will address the technology side directly, although I think we're most ready to answer collaborative questions as they may arise.

While I note the budget number is approximately $2 billion, with one more digit accuracy, the request this year for the 13 agencies combined is about $1.8, or even more accurately, $1.83 billion. So, for those to whom another $170 million is a difference, it is not quite two billion, it's a little bit less, but it's in the range of the request in recent years.

Briefly describing, giving the initiative that this subcommittee is now taking, what we have done with the Program, we began with the President's initiatives, and actually, they were pretty much coterminous with my swearing into my post in early 2002, as well. We began with an inventory of the research programs that the Federal agencies were conducting at that time, to set out to refresh, and re-prioritize, and re-budget, that kind of inventory of programs has been continued annually, since then and in the process of trying to increase the prioritization, and make sure that we don't get in the pattern of "same old, same old" where we repeat the work from the year before and we have set a mark specifically. While much work needs to continue because it relates to long-term trends and analyses, but we have set a mark in our prioritization and budgeting, aimed specifically at assuring that even at a level budget environment that we are, in fact, pursuing initiatives, which means, automatically, that we're also letting fall off the bottom of that distribution some things in order to keep our budgets level in that period.

I want to note in background that just 2 years ago this month, almost this day, 3 days from now, we released a massive strategic plan for our climate science program work that had been developed over the better part of the year before with massive public input, massive input by the science community. We had a workshop which was attended by about 1,300 climate scientists from around the world to discuss and debate the draft of that plan. We engaged the National Academy of Sciences, from whose President you will hear shortly here, to review not only our draft, but we specifically engaged them to review the draft and make comments, and stay on board to review the final version that resulted from all of the earlier comments, their own included. I note for the record, it's in my statement, to say briefly, the Academy heavily praised the plan for balance, I also note that they raised many cautions, and they raised many issues that needed special attention. But if I could quote just one sentence from their report, it was that "the revised strategic plan, having in mind the changes that have been made, is much improved over the first draft, and now includes the elements of management framework that can permit it to effectively guide research on climate and associated global change over the next decades."

I'll quickly go on to note, we produce an annual report on *Our Changing Planet,* and I want to say in the work we're trying to do to develop our scientific information in a form to deliver for the decision process, we have taken a three-step framework.

The first step is to develop very detailed synthesis and assessment products aimed at getting us the best current view on the state-of-science, and the state-of-relevant-science in the areas we're concerned with. This is especially important because there's so much that adds in quickly in our science, that if we don't really

challenge ourselves and get the best approach with good peer review on this, we're really stuck. So, we're doing that, we're working on adaptive management for planning for climate change, this means addressing questions of drought, fire suppression, agriculture, coastal development and so forth, and that's all a big part of this, and at the end of the day, we're dealing with the questions of the use of our rapidly expanding climate modeling capability to address the policy questions about what is the U.S. role, and what are the world roles in dealing with the climate change.

Let me just note for the record, too, that when we look at our science advancement, we tend to look in three areas. First, detection—how well do we know what is really changing in the climate, since the climate record is, in any case, a noisy record, and the key issue is how well can we segregate real change from the normal variability.

Second, attribution—how well can we segregate between natural variability and human influences, because that is core to the issue of our ability to make plans to mitigate those human influences over time.

Third is projection—if we have all of that, how good are our models and how well can we project going forward, so let me just mention that. I know my time is about up, I want to just mention a couple of last things. I have in my statement extensive information about the NOAA climate program. Within the overall Administration program, NOAA is a mission agency which, at its core, is responsible, we are responsible for developing scientific data and using it for weather forecasting, fisheries management, many other purposes, and you will see extensive information about that in my statement, including dealing with El Niño conditions, western drought conditions, working closely with the Western Governors Association, and many other things, including some important international efforts which, for reasons of time I won't mention further.

I'll close with just a note on our budget request, and I'll be delighted to talk about this more in response to questions as may be appropriate. First of all, speaking about NOAA, we request right around $240 million as our part of the climate program, and for NOAA's specific activities in Fiscal Year 2006 request, I'll mention for the CCSP Program, remember, I already mentioned $1.83 billion, and there are some important segregations between long-term satellite-based observations and other science work and that, if it's appropriate, we can get to in the questions with all of that.

Thank you for allowing me to give you this overview, and I'm delighted to work with you and your colleagues, thank you.

[The prepared statement of Dr. Mahoney follows:]

PREPARED STATEMENT OF HON. JAMES R. MAHONEY, PH.D., ASSISTANT SECRETARY OF COMMERCE FOR OCEANS AND ATMOSPHERE; DEPUTY ADMINISTRATOR, NATIONAL OCEANIC AND ATMOSPHERIC ADMINISTRATION (NOAA)

Good morning, Senator Vitter, Senator Lautenberg, and members of the Subcommittee. I am James R. Mahoney, Assistant Secretary of Commerce and Deputy Administrator of the National Oceanic and Atmospheric Administration (NOAA). I am also appearing today in my capacity as Director of the Federal interagency Climate Change Science Program (CCSP). I am very pleased to have this opportunity

to describe the progress of the Administration's climate science program as well as the NOAA Climate Program and its contribution to CCSP.

U.S. Climate Change Science Program

President George W. Bush recognizes climate change to be an important issue for the United States to address. On May 11, 2001, the Administration commissioned the National Academies [1]—National Research Council (NRC) to examine the state of our knowledge and understanding of climate change science. Based on the resulting NRC report, and the Administration's ongoing climate science planning activity, President Bush created a new cabinet-level management committee (the Committee on Climate Change Science and Technology Integration) in February 2002, to supervise the approximately $5 billion annual investment in climate change science and technology. The President's direction resulted in the creation of the U.S. Climate Change Science Program (CCSP), combining the existing U.S. Global Change Research Program (USGCRP) and the Climate Change Research Initiative (CCRI), as well as the creation of the Climate Change Technology Program (CCTP). President Bush furthered these efforts at the recent G8 Summit in Scotland, where the U.S. committed to grow economies, aid development, and improve the environment through technological innovation to achieve the combined goals of addressing climate change, reducing harmful air pollution and improving energy security.

The Climate Change Science Program integrates Federal research on global change and climate change, as sponsored by thirteen Federal agencies (the National Science Foundation (NSF), the Department of Commerce, the Department of Energy (DOE), the Environmental Protection Agency (EPA), the National Aeronautics and Space Administration (NASA), the Department of State, the Department of the Interior (DOI), the Department of Agriculture (DOA), Health and Human Services (HHS), the Department of Transportation (DOT), the Department of Defense (DoD), U.S. Agency for International Development (USAID), and the Smithsonian Institution), and with liaisons in the Office of Science and Technology Policy, the Council on Environmental Quality, the National Economic Council, and the Office of Management and Budget.

We know that the surface of the Earth is warmer, and that an increase in greenhouse gases caused by humans is contributing to the problem. Research conducted through CCSP is deepening our understanding of the interplay of natural and human-caused forces. CCSP is charged with investigating natural and human-induced changes in the Earth's global environmental system; monitoring important climate parameters; predicting global change; and providing a sound scientific basis for national and international decisionmaking.

Since CCSP was created, the program has successfully integrated a wide range of research, climate science priorities, and budgets of the thirteen CCSP agencies. With an approximately $2 billion annual expenditure, CCSP has taken 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 decisionmakers, resource managers, the science community, the media, and the general public. We have identified several methods to address these challenges. I briefly describe the steps we have already taken, the scientific advances we have achieved, and our future directions.

Inventory of Research Programs: A comprehensive inter-agency inventory of climate and global change research programs was initiated in May 2002, and has been updated annually since then. This essential stocktaking exercise (the first conducted in several years) enhanced coordination, efficiency, and effectiveness of the entire research effort. All CCSP agencies participated in this inventory.

CCSP Strategic Plan: In July 2003, CCSP released its *Strategic Plan for the U.S. Climate Change Science Program,* the first comprehensive update of a national plan for climate and global change research since the original U.S. Global Change Research Program strategy was issued at the inception of the program in 1990.

We took several steps to ensure that the Plan received extensive public input and scientific review. The Administration released a CCSP *Discussion Draft Strategic Plan* for public review in November 2002. The *Discussion Draft* outlined a comprehensive, collaborative approach for developing a deeper understanding of climate change and its potential impacts. It was guided by the priority information needs identified by scientists and stakeholders, both nationally and internationally.

External comments, obtained through several mechanisms, played an important role in revising the draft plan. First, CCSP held a workshop, in December 2002, that was attended by 1,300 scientists and other participants, including individuals from 47 states and 36 nations. This workshop was designed to facilitate extensive discus-

[1] Formerly known as the National Academy of Sciences.

sion and comments on the draft plan. In addition, written comments on the *Discussion Draft* were submitted during a public review period, and amounted to nearly 900 pages of input. Last, CCSP commissioned a special committee of the NRC to review the plan. The NRC conveyed its comments and recommendations on the *Discussion Draft* in a February 2003 report.

After consideration of the extensive external input and internal inter-agency review process, the (revised) *Strategic Plan for the U.S. Climate Change Science Program* was released in July 2003. In February 2004, the NRC review committee issued a second public report, *Implementing Climate and Global Change Research: A Review of the Final U.S. Climate Change Science Program Strategic Plan.* This NRC report expressed the committee's conclusions on the content, objectivity, quality, and comprehensiveness of the updated *Strategic Plan,* on the process used to produce the Plan, and on the proposed process for developing subsequent findings to be reported by the CCSP. The following quote is taken from the Executive Summary of the 2004 NRC report:

> "*The Strategic Plan for the U.S. Climate Change Science Program* articulates a guiding vision, is appropriately ambitious, and is broad in scope. It encompasses activities related to areas of long-standing importance, together with new or enhanced cross-disciplinary efforts. It appropriately plans for close integration with the complementary Climate Change Technology Program. The CCSP has responded constructively to the National Academies review and other community input in revising the strategic plan. In fact, the approaches taken by the CCSP to receive and respond to comments from a large and broad group of scientists and stakeholders, including a two-stage independent review of the plan, set a high standard for government research programs. As a result, the revised strategic plan is much improved over its November 2002 draft, and now includes the elements of a strategic management framework that could permit it to effectively guide research on climate and associated global changes over the next decades. Advancing science on all fronts identified by the program will be of vital importance to the Nation."

We have frequently noted that the CCSP *Strategic Plan* is a living document and we look forward to continued dialogue with Congress, the NRC, the scientific community, and the public throughout the implementation of the Plan, as the science evolves and priorities change over time.

Annual Program Report, *Our Changing Planet:* *Our Changing Planet* is an annual report of the CCSP. This program report is issued as a Supplement to the President's Fiscal Year budgets and submitted to Congress pursuant to a requirement of the 1990 Global Change Research Act. The document is intended to provide summaries and related budget data of ongoing CCSP-supported climate change work.

CCSP Assessment Information to Support Decisionmaking: The CCSP Strategic Plan identified three broad types of deliverables to be produced in support of enhanced policy development and decisionmaking by national and regional government officials, resource managers, planners, and the scientific community.

> (1) *Synthesis and Assessment Products:* Twenty-one Synthesis and Assessment Products are identified in the Strategic Plan. These reports are designed to address a full range of scientific questions and evaluate options for responses that are of greatest relevance to decision and policymakers and planners. These products are intended to provide the best possible state of scientific information, developed by a diverse group of climate experts, for the decision community. In response to an April 14, 2005 Government Accountability Office (GAO) report, Congressional inquiries, and our own internal assessment, on July 15 we presented to this committee, and other interested Members, a revision of the schedule and scope of the Synthesis and Assessment Products. We look forward to further dialogue with you on these important issues.
>
> (2) *Adaptive management and planning for resources and infrastructure:* "Adaptive management decisions" are operational decisions, principally for managing infrastructure (*e.g.,* waste water treatment systems), natural and managed resources (*e.g.,* water supply, agriculture), and societal response mechanisms (*e.g.,* health alerts). They typically occur within existing frameworks (*e.g.,* legal, institutional, economic), usually recurring on annual or shorter time scales. "Planning" focuses on these and additional sectors (*e.g.,* urban or regional planning), typically involving development of infrastructure and institutions with long lifetimes (several decades or more), and with decision processes over long timescales (years to decades). CCSP research results, data products, forecasts, and model results are already being applied to adaptive management

and planning in a number of regional and sectoral case studies. Specific examples include climate observations and projections for crop management, water quality management, and urban planning, as well as integrated products illustrating snowpack, precipitation, streamflow, and the potential for drought conditions.

(3) *Support for policymaking:* As described in the Strategic Plan, CCSP is focusing on two objectives in the area of support for policymakers: (1) developing scientific syntheses and analytical frameworks to support integrated evaluations, and (2) initially conducting a limited number of case studies with evaluation of the lessons learned, to guide future analyses. Integrated analysis of climate change is essential for bringing together research from many contributing disciplines and applying it to gain comparative insight into policy-related questions. Full integration of information including research on human activities, greenhouse gas and aerosol emissions, land-use and land-cover change, cycling of carbon and other nutrients, climatic responses, and impacts on people, the economy, and resources is necessary for analyses of many important questions about the potential economic and environmental implications of changing greenhouse gas concentrations and various technology portfolios. Specific examples of this type of work under CCSP include the DOE Integrated Assessment of Climate Change Research Program that sponsors research to develop comprehensive benefit/cost models for use in assessing the implications of potential climate change policies. NOAA, EPA, and NSF sponsor additional studies to improve aspects of such models, and to allow for the application of the models to address particular questions.

Scientific Advancements: CCSP has supported a highly integrated array of Earth system observations as well as a broad set of new scientific information. A large bibliography of new peer-reviewed scientific studies reflecting the advances in climate change detection, attribution, and projection, described below, will be reported in the upcoming edition of *Our Changing Planet,* and these studies will be reflected in the relevant CCSP Synthesis and Assessment Products.

Detection: CCSP-sponsored observational and scientific studies have more completely characterized the nature of observed increase in surface temperatures, and have significantly advanced our understanding of observed variability in ocean salinity and heat content. CCSP research has also investigated changes in the global distributions of snowfall and snowpack, and natural fluctuations in ocean circulation that influence the transport of heat and energy around the globe.

Building on the CCSP observations and monitoring strategy identified in its Strategic Plan, the U.S. Government has taken several steps toward establishing a comprehensive, coordinated, and sustained Earth observation system since hosting the inaugural Earth Observation Summit in June 2003. CCSP agencies have provided leadership, definition, and support for the Earth Observation meetings, and are closely integrating the U.S. observation and data management programs with the international programs launched by this effort. At the most recent meeting, the Earth Observation Summit III in Brussels, a ten-year Implementation Plan for the Global Earth Observation System of Systems (GEOSS) was adopted, and the 60-member intergovernmental Group on Earth Observations was established to begin implementation of the 2-, 6-, and 10-year targets identified in the plan. The U.S. contribution to GEOSS is the Integrated Earth Observation System (IEOS). In April 2005, the U.S. Government Committee on Environment and Natural Resources (CENR) released the *Strategic Plan for the U.S. Integrated Earth Observation System* that addresses the policy, technical, fiscal, and societal benefit components of this integrated system, and established the U.S. Group on Earth Observation (USGEO), a subcommittee of the National Science and Technology Council Committee on Environment and Natural Resources.

Attribution: CCSP research also works to establish and understand the most likely causes for climate change, with special emphasis on distinguishing between natural variability and human-induced effects. Recent advances in attribution research include the use of additional variables in climate models (*e.g.,* salinity, runoff, and regional-scale attribution) to obtain more insight on the origin of the climate signals and trends, as well as expansion of climate models to include improved representation of aerosols (airborne fine particles) and variability in solar energy output. These climate models, which have been produced for CCSP, include improved representations of physical processes and increased resolution to effort to enhance our climate modeling capabilities.

Projection: Through climate projections, CCSP attempts to present scientifically justifiable illustrations of the future climate and its potential impacts upon key elements of the Earth system. We are working in conjunction with the Climate Change

Technology Program (CCTP) to update greenhouse gas emissions scenarios that incorporate improved socio-economic data and consider expanded use of emerging technological options. These scenarios are being used with a new generation of climate models to develop improved climate projections for consideration by decisionmakers.

Expanded CCSP/NRC Advisory Contract: CCSP has recently expanded its contract with the NRC to incorporate important new elements of NRC advice to the program. The enhanced NRC advisory assignment involves three areas:

(1) Overall NRC advice on the CCSP research program on a continuing basis over the next 3 years, involving an NRC committee with wide areas of expertise;

(2) A comparative evaluation of relevant previous climate change assessments conducted around the world, to provide background information for the assessments being prepared by CCSP in compliance with the GCRA; and

(3) Designated support from two existing committees of the NRC that are well positioned to support CCSP with expertise in areas central to CCSP's core responsibilities, the Climate Research Committee and the Committee on the Human Dimensions of Global Change.

The Administration has endorsed the scope of the expanded contract to ensure that CCSP receives independent and credible scientific advice, as CCSP continues to implement its Strategic Plan.

Climate Change Science Program Workshop: *Climate Science in Support of Decisionmaking:* CCSP will hold a public workshop November 14–16, 2005, in Arlington, VA. The CCSP Workshop will address the capability of climate science to inform decision-making and will serve as a forum to address the progress and future plans regarding CCSP's three decision-support deliverables as described above. The Workshop will provide an opportunity for scientists and user communities to discuss needs and future application of scientific information on climate variability and change, as well as discussion on expected outcomes of CCSP's research and assessment activities that are necessary for sound resource management, adaptive planning and policy.

NOAA Climate Program

NOAA is responsible for developing and making accessible climate information products and services for near-term issues such as drought management and long-term issues such as potential effects of climate change on managed and natural ecosystems. As a mission agency, NOAA has a direct responsibility to provide climate information, products, and services that enable us to understand and respond to changing climate conditions.

The NOAA Climate Program goals are aligned with the CCSP goals outlined in the CCSP Strategic Plan. Climate is one of NOAA's four mission goals; it is designed to produce two outcomes. First, a predictive understanding of the global climate system on time scales of weeks to decades with quantified uncertainties sufficient for making informed and reasoned decisions; and second, a climate-literate public effectively incorporating NOAA's climate products into their plans and decisions. These outcomes are achieved through the following programs that are described in our Fiscal Year 2006 Budget:

- **The Climate and Global Change (CGC)** program goal is to establish a national information service based on reliable assessments and quantitative predictions of changing global climate in partnership with the university community. CGC will help NOAA provide high-quality predictions and assessments to the public and private sectors, other Federal and state agencies, and the international community. The near-term objective is to provide reliable predictions of global climate changes, both natural and human-induced, and their associated human effects on time scales ranging from seasons to that of a century or more. The Climate and Global Change Program is an important part of CCSP. Activities include atmospheric composition, carbon cycle, physical climate research, analysis of the climate record, climate predictions on time scales of seasonal, interannual, and decadal, and regional integrated sciences and assessments.
- **The Climate Observations and Services (COS)** program supports the development of the information and insights needed to help reduce impacts to the Nation from climate variations and change. We do this by monitoring the Earth's climate system, delivering data, developing predictions and impact assessments, and continuing performance-enhancing research. This is an integrated, multi-line organization activity within NOAA and involves the Office of

Oceanic and Atmospheric Research; National Environmental Satellite, Data, and Information Service; and the National Weather Service. The program involves an important transition of research observing and data systems into operational systems and products. NOAA activities supporting the Climate Change Research Initiative (CCRI) are also administered under the Climate Observations and Services program. Activities under this program include atmospheric and ocean observations, data assimilation and data management, transition of the Tropical Atmospheric Ocean (TAO) buoy array from research to operations, and assessments of climate change and variability (i.e., Stratospheric Ozone, Intergovernmental Panel on Climate Change, and CCSP Synthesis and Assessment Products). NOAA is leading the production of seven of the 21 CCSP Synthesis and Assessment Products called for in the CCSP Strategic Plan, and is contributing to eleven others.

- **The Arctic Research Program (ARP)** is coordinated with other U.S. Government agencies through the Study of Environmental Arctic Change (SEARCH) program. The specific role of the ARP is long-term climate observations and analysis of Arctic climate data. ARP continues to focus on key aspects of the Arctic climate system. The information provided will improve forecasts of temperature, precipitation, and storms across Alaska and the mainland United States. This information will also support improvements in forecasting and planning for energy needs, growth seasons, hazardous storm seasons and water resources, as well as provide for better management of Alaskan and Arctic resources.
- **Partnership Programs** cover a wide range of activities with a multitude of external research partners. These partnerships extend to other parts of NOAA; other Federal, state, and local government entities; international government programs; universities; and industry.

Recent Highlights of the NOAA Climate Program

NOAA is Detecting and Forecasting El Niño Conditions: NOAA's Tropical Atmosphere Ocean (TAO) array provided the observational backbone for detecting and forecasting evolving El Niño conditions in 2004. TAO array buoys, along with complementary buoys maintained by Japan in the western Pacific, are used to track the evolution of subsurface ocean warming that typically precedes the full-blown development of El Niño. In 2004, the buoys detected a weakening of the trade winds and warming surface ocean temperatures. These data, which are available to operational weather forecasting centers and climate researchers around the world, led to NOAA's recent declaration of a weak El Niño currently forming in the tropical Pacific.

NOAA Leads Implementation of a National Integrated Drought Information System (NIDIS): In a letter to the President on August 30, 2004, the Western Governor's Association recommended a team led by NOAA begin implementation of the National Integrated Drought Information System (NIDIS). NOAA is coordinating with stakeholders, states, and Federal agencies to implement NIDIS. NIDIS goals include fostering and supporting research, creating an early drought warning system, providing interactive delivery systems, providing a framework for interacting with and educating decisionmakers and the public, and developing an understanding of the impacts and data needs at the local level.

NOAA Implemented International Climate/Air Quality Field Study: NOAA is helping to lead and implement a multi-agency air quality and climate study performed under the auspices of the International Consortium for Atmospheric Research on Transport and Transformation (ICARTT), which was initiated in New England in Summer of 2004 (New England Air Quality—Intercontinental Transport and Chemical Transformation Study). Colleagues from five nations are engaged in the endeavor, which extended from the western U.S. to continental Europe. This research is addressing significant information gaps and delivering sound science that will improve the understanding of the long-distance transport processes that influence the air pollution levels that impact the population centers such as the New England region.

NOAA Contributes to Increased Understanding of Regional Weather and Climate Patterns: NOAA successfully completed the North American Monsoon Experiment (NAME) 2004 field campaign in collaboration with other U.S., Mexican and Central American agencies and academic institutions. NAME 2004, provided an unprecedented collection of detailed atmospheric, oceanic, and land-surface observations in the core region of the North American Monsoon over northwest Mexico, southwest U.S., and adjacent oceanic regions. It documented the evolution of the monsoon convection and precipitation, and helped to outline the key physical proc-

esses that must be parameterized for improved simulations and predictions with climate models.

NOAA Implements an Operational Critical Climate Forecast System: In August 2004, a global ocean and atmosphere coupled Climate Forecast System (CFS) became operational at the National Centers for Environmental Prediction of the National Weather Service. The Climate Forecast System is a fully coupled model representing the interactions between the Earth's oceans and atmosphere. These interactions are critical for determining climate on seasonal time scales. This implementation is a recent example of a successful transition of research into operations through long-term, ongoing collaborative efforts by NOAA scientists, other Federal Agencies (NASA, NSF), and the university research community.

NOAA Supports Development of Urban Climate Planning Website: NOAA has supported the development of the Climate Change Information Resource for the New York Metropolitan Area (CCIR–NY), a website (*http://ccir.ciesin.columbia.edu/nyc*) that includes information tools developed for decision-makers and those interested in planning for climate in an urban environment. Users of CCIR–NY include city, municipal, and county planners; natural resource managers; transportation managers; water managers; waste managers; educators and citizens. In addition to providing basic information about climate in the NYC area, the website serves as a forum for users to share expertise and information related to climate change and variability in the NY metropolitan area. The website is serving as an international model for the development of similar web tools in Tokyo and London.

NOAA Contributes to Operational Seasonal Wildland Fire Outlooks: In Fiscal Year 2003, NOAA helped to support the first operational annual nationwide fire assessment workshop, bringing together climatologists, predictive service meteorologists, fire analysts, and wildland fire managers from state and Federal agencies across 11 geographic area coordination centers. The result was to begin production of climate-informed, regional- and national-scale seasonal fire potential outlooks for the United States. A sustained commitment from NOAA and the Department of Commerce has resulted in the development of innovative methods for combining scientific expertise with regional and local knowledge to produce unique, stakeholder-driven decision support products. Through the National Interagency Fire Center, it is now possible for managers to access interactive geographic and national-level fire outlook maps over daily to seasonal timeframes. As NOAA expands its vision of providing operational climate services, this approach will serve as a model for additional climate applications, such as drought outlooks, air-quality predictions, improved land-use planning, and crop-yield forecasts.

NOAA Deploys Ocean Climate Observing Systems: NOAA is working with international partners to establish and maintain a sustained Global Ocean Observing System (GOOS, a program of the International Oceanographic Commission) necessary for long-term monitoring of the climate system and improved climate projections. NOAA provides a major U.S. contribution to the global component of the U.S. Integrated Ocean Observing System (IOOS), integral to the U.S. Integrated Earth Observing System (IEOS) and the Global Earth Observation System of Systems (GEOSS). NOAA's contribution to the observing system consists of various buoy networks, profiling floats (Argo), tide gauges, surface drifting buoys, tropical moored buoys, ocean reference stations) and ship observations (ships of opportunity, routine oceanographic surveys, air-sea flux studies). GOOS will be 51 percent complete by the end of Fiscal Year 2005.

NOAA Advances Seasonal-to-Interannual Prediction Capabilities: Due to our advanced observing systems (TOGA/TAO and satellites) as well as over 10 years of research and operational innovation, NOAA has recently developed the capability to make skillful U.S. winter forecasts associated with strong El Niño or La Niña conditions. We also have improved the accuracy of our forecasts of the level of Atlantic and Gulf seasonal hurricane activity. Major challenges remain for warm season prediction, especially of precipitation, as well as cold season prediction in the absence of a strong El Niño or La Niña. To meet these challenges, we are expanding observations to the Indian Ocean with international partners; developing predictions of the southwest monsoon over North America; and transferring information to resource managers to prepare for extreme weather events, fisheries impacts, and management of water resources.

NOAA Provides Weather and Climate Products to the FEWS Network: The International Weather and Climate Monitoring Project at NOAA's Climate Prediction Center is an extension of an earlier USAID Famine Early Warning System (FEWS) program that originally covered only Sub-Sahelian Africa. The project has now grown to encompass all of Africa, Afghanistan, Central America, and the Caribbean, the Mekong River Basin, and much of southern Asia. Work is underway to create a global weather and climate monitoring program to address any inter-

national region where humanitarian support is needed. The goal of the program is to provide weather and climate related information to users within USAID as well as international partner organizations, such that a greater level of humanitarian assistance may be offered. The goal is only accomplished through constant interaction with our partner groups such as the USGS, NASA, USAID, private-sector contractors, and local African organizations. A more thorough and accurate analysis of conditions is possible via these collaborations.

NOAA Supports RANET: The RAdio and InterNET for the Communication of Hydro-Meteorological Information for Rural Development (RANET) program is an international collaboration with based funding from USAID and NOAA to make weather and seasonal information available to remote populations in developing countries in Africa, Asia, and the Pacific. To achieve its mission, the program works to improve the basic communication and dissemination capacities of National Hydro-Meteorological Services (NHMSs) and related national agencies. The RANET program addresses its core objectives by applying technologies that can bridge and extend existing dissemination networks, by providing technical training, developing and using unique applications of technology, and nurturing an overall community-based dialogue on issues related to weather and the environment. As a testament to RANET's sustainable design, several of the recipient national meteorological services have dedicated personnel and resources to their own RANET efforts. In keeping with recent language from the G8 action plan on climate and energy, RANET exemplifies strategies that seek to further scientific capacity in pursuit of larger social, environmental, and economic objectives in ways that are truly consistent with local and regional realities.

NOAA Climate Program Budget for Fiscal Year 2006

The NOAA Climate Program is requesting $239.9 million in Fiscal Year 2006, reflecting a net increase of $19.6M over the Fiscal Year 2006 base level. This increase includes $10.6M for the high priority Climate Change Research Initiative (CCRI); $7.4M to reactivate activities requested under Climate Observations and Services (COS) in the Fiscal Year 2005 President's Budget; and $1.6M to restore funding requested in Fiscal Year 2005 for other ongoing climate activities.

This increase responds to the long-term observational requirements of climate predictions and assessments. Funding to reactivate COS activities will ensure continuation of climate observing networks, such as the highly regarded Climate Reference Network (CRN) and NOAA's Baseline Observatories. NOAA will be able to ensure critical monitoring of long-term trends in important climate variables and to improve forecasting capabilities and applications development over timescales from weeks to seasons.

These programs serve as a foundation for NOAA's participation in CCSP by funding important research and key observations and thereby reducing uncertainties in climate change science. These increases also support the objective in the Department of Commerce Strategic Plan to "Advance understanding and predict changes in the Earth's environment to meet America's economic, social, and environmental needs." In addition, these increases will support the research and production of CCSP Synthesis and Assessment Products.

NOAA will continue building and maintaining a global ocean observing system; initiate a new five-year effort to better understand how aerosols influence climate by their interaction with clouds; expand the Tropical Atmospheric Ocean (TAO) buoy array into the Indian Ocean; conduct new studies to better explain the causes for observed climate variability and change; and continue expanding and refining regional integrated research and outreach.

Thank you, Mr. Chairman and Members of the Committee. I look forward to the opportunity to respond to any questions you may have.

Senator VITTER. Thank you, Doctor, now Mr. Conover.

STATEMENT OF DAVID W. CONOVER, PRINCIPAL DEPUTY ASSISTANT SECRETARY, OFFICE OF POLICY AND INTERNATIONAL AFFAIRS; DIRECTOR, U.S. CLIMATE CHANGE TECHNOLOGY PROGRAM, DEPARTMENT OF ENERGY

Mr. CONOVER. Thank you, Mr. Chairman, good morning, and good morning, Senator Lautenberg, it's nice to see you again. Thank you for the opportunity to appear before you today to discuss climate change activities at the Department of Energy. My name is Dave Conover, and I'm Principal Deputy Assistant Sec-

retary in the Department's Office of Policy and International Affairs. I also serve as the Director of the Climate Change Technology Program, known as CCTP.

The essence of my testimony today is that the Department of Energy has a number of important climate change initiatives underway that support the Administration's comprehensive and strategic approach to climate change.

First, a little background. In February 2002, President Bush reaffirmed his Administration's commitment to the U.N. Framework Convention on Climate Change, and its central goal—stabilization of greenhouse gas concentrations in the atmosphere, at a level that prevents dangerous interference with the climate system. The Bush Administration believes that the most effective way to meet this challenge is through an agenda that promotes economic growth, provides energy security, reduces pollution, and mitigates greenhouse gas emissions.

Although climate change is a complex and long-term challenge, the Bush Administration recognizes that there are cost-effective steps we can take now. In 2002, President Bush set an ambitious national goal, to reduce the greenhouse gas intensity in the U.S. economy by 18 percent by 2012. To meet this goal, the Administration has developed an array of policy measures, including financial incentives and voluntary programs. Among these are DOE's Climate VISION Program, and the Voluntary Greenhouse Gas Reporting System known as the 1605(b) program. Climate VISION is the Presidential public/private partnership launched by the Department in February 2003, to contribute to the President's goal of reducing greenhouse gas emissions intensity. Business associations representing 14 energy-intensive industry sectors accounting for about 40 percent of U.S. gas emissions, and the business roundtable participate in this program.

The 1605(b) Program is a voluntary system for companies to record their progress in reducing greenhouse gas emissions. We will be issuing new guidelines this fall to meet the President's 2002 directive that the 1605(b) Program be revised to enhance the accuracy, reliability, and verifiability of the data reported through the system.

Data for 2003 and 2004, suggest we were ahead of schedule in meeting the President's intensity goal, further detail on that is in my written statement. The Administration is also laying a strong technological foundation to develop realistic and cost-effective mitigation options to meet climate and other objectives. The U.S. Climate Change Technology Program, or CCTP, was created to coordinate and prioritize the Federal Government's nearly $3 billion annual investment in climate-related technology research.

Later this week, Energy Secretary Sam Bodman will release the CCTP *Vision and Framework for a Strategic Plan.* This document lays out the guiding principles for investment and climate-related technology and research, development, demonstration, and deployment. This investment includes expanded and realigned activities, as well as new initiatives in strategic technology areas, such as the President's Hydrogen Fuel Initiative; and the FreedomCAR Program; carbon sequestration; FutureGen, the coal-fired, zero emissions power project; next generation nuclear energy and fusion. In

addition to our domestic R&D work, the Administration believes well-designed multilateral collaborations can accelerate development in commercialization of new technologies.

The International Partnership for the Hydrogen Economy, the Carbon Sequestration Leadership Forum, Generation for International Nuclear Forum—all U.S. initiatives provide vehicles for international collaboration to advance these technologies. In addition, the U.S. participates in ITER, a proposed multilateral collaborative project, to design and demonstrate a fusion energy production system.

Our most recent multilateral initiative led by EPA was launched in November 2004. The Methane to Markets Partnership focuses on the recovery of methane from landfills, underground coal mines, natural gas, and oil systems, for use as a clean energy source. The Department also participates in 14 climate partnerships with key countries and regional organizations that, together with the United States, account for almost 80 percent of global greenhouse gas emissions.

The U.S. launched the Clean Energy Initiative, and joined the Renewable Energy and Energy Efficiency partnership in order to assist developing countries to reduce poverty and increase their economic growth and environmental quality by modernizing their energy production and use, but with cleaner, more efficient technologies,

As you can see, the Bush Administration has developed a comprehensive strategy on climate change that is informed by science, emphasizes innovation and technological solutions, and promotes international collaboration to support the U.N. framework convention objective. DOE is proud to be a major contributor to this strategy.

Thank you for your attention, and I would be pleased to answer any questions that you have.

[The prepared statement of Mr. Conover follows:]

PREPARED STATEMENT OF DAVID W. CONOVER, PRINCIPAL DEPUTY ASSISTANT SECRETARY, OFFICE OF POLICY AND INTERNATIONAL AFFAIRS; DIRECTOR, U.S. CLIMATE CHANGE TECHNOLOGY, DEPARTMENT OF ENERGY

Mr. Chairman and Members of the Committee, thank you for the opportunity to appear before you today to discuss climate change activities at the Department of Energy (DOE).

As a signatory to the United Nations Framework Convention on Climate Change (UNFCCC), the United States shares with many countries its ultimate objective: stabilization of greenhouse gas concentrations in the atmosphere at a level that prevents dangerous interference with the climate system. In February 2002, President Bush reaffirmed his Administration's commitment to this central goal of the Framework Convention.

The Bush Administration believes that the most effective way to meet this challenge is to focus not solely on greenhouse gas emissions, but rather on a broader agenda that promotes economic growth, provides energy security, reduces pollution, *and* mitigates greenhouse gas emissions. Many of the DOE programs I will discuss today advance these goals.

Addressing global climate change will require a sustained, long-term commitment by all nations over many generations. To this end, the President has established a robust and flexible climate change policy that harnesses the power of markets and technological innovation, uses the best available science, maintains economic growth, and encourages global participation. Major elements of this approach include:

- implementing near-term policies and measures to slow the growth in greenhouse gas emissions;
- advancing climate change science;
- accelerating technology development; and
- promoting international collaboration.

Near-Term Policies and Measures

Although climate change is a complex and long-term challenge, the Bush Administration recognizes that there are cost-effective steps we can take now. In 2002, President Bush set an ambitious national goal to reduce the greenhouse gas intensity of the U.S. economy—i.e., emissions per unit of economic output—by 18 percent by 2012, which represents about a 28 percent increase in the rate of improvement projected by the Energy Information Administration (EIA) over this period.

A hallmark of the intensity approach is flexibility, an especially important consideration when confronted with the many uncertainties surrounding climate change. These uncertainties suggest that a measured response is required that concentrates first on slowing emissions growth before trying to stop and eventually reverse it. Unlike the Kyoto Protocol approach, a greenhouse gas emissions intensity goal can encourage reductions without risking economic consequences that could jeopardize our ability to invest in long-run scientific and technological solutions.

In 2002, the Administration estimated that its 18 percent intensity improvement goal will reduce cumulative emissions of carbon by more than 1,833 million metric tons of carbon dioxide by 2012. Recent EIA projections suggest that achieving the 18 percent goal will reduce carbon emissions by 366 million metric tons of carbon dioxide in 2012 alone.

To this end, the Administration has developed an array of policy measures, including financial incentives and voluntary programs. Among these are DOE's Climate VISION program and the Voluntary Reporting of Greenhouse Gases Program authorized under subsection 1605(b) the Energy Policy Act of 1992 and commonly known as the "1605(b)" program.

- *Climate VISION:* In setting the 18 percent decade goal, President Bush issued a challenge to the private sector to do its part. The President's call resonated with business, and in February 2003, the Federal Government and industry organizations representing thousands of companies from 12 energy-intensive economic sectors (since expanded to 14) and The Business Roundtable joined in a voluntary partnership known as Climate VISION (Voluntary Innovative Sector Initiatives: Opportunities Now). These Climate VISION partners, which include some of the largest companies in America, represent a broad range of industry sectors—oil and gas, electricity generation, coal and mineral production and mining, manufacturing (automobiles, cement, iron and steel, magnesium, aluminum, chemicals, and semiconductors), railroads, and forestry products—accounting for about 40 to 45 percent of total U.S. greenhouse gas emissions. Four Federal agencies participate in the program: DOE (lead), Department of Agriculture, Department of Transportation, and Environmental Protection Agency.

  Climate VISION is unique in that it focuses on economic sectors, not specific companies, with each industry association making a commitment on behalf of its members to reduce greenhouse gas emissions intensity. The program works with its partners in four areas: (1) measuring and monitoring; (2) finding cost-effective solutions to reduce energy use and GHG emissions; (3) helping to direct industry's energy efficiency R&D investments; and (4) exploring cross-sector efficiency gains to reduce emissions.

  The Climate VISION program also is exploring risk-based incentives for early commercial uses of advanced energy technologies to tip private investment decisions and speed the market penetration of new technologies and systems. It is looking at several areas where this approach could be applied, including residential and commercial buildings, coal gasification, nuclear energy, and biorefining. Climate VISION and DOE's Building America program, for example, have been working with three states—California, Texas, and New York—on pilot projects aimed at using a transaction chain approach to transform housing markets to increase the penetration of energy efficient homes. The lessons learned in these pilots could help inform policies to move the housing market toward greater energy efficiency.

  The Climate VISION website—*www.climatevision.gov*—is an excellent source of information about the program and the voluntary activities undertaken by industry to reduce emissions intensity.

- *"1605(b)" Voluntary Greenhouse Gas Registry:* The 1605(b) program is a voluntary system administered by EIA (*http://www.eia.doe.gov/oiaf/1605/frntvrgg.html*) that provides a vehicle for companies to record progress in reducing greenhouse gas emissions. Currently, about 220 companies file annual reports. In February 2002, President Bush directed that the 1605(b) program be revised to enhance the "accuracy, reliability, and verifiability" of the data reported to the system.

  Based on this guidance, DOE's Policy Office has been working with an interagency group to improve the system. We issued draft revised General Guidelines in November 2003, and subsequently held a public workshop to discuss the proposed guidelines and to receive comments.

  Interim Final General Guidelines and a Notice of Availability for the Draft Technical Guidelines were published in the *Federal Register* of March 24, 2005, for public comment. The Department of Energy hosted a public workshop April 26–27, 2005, to discuss the guidelines and to receive public comment. The agenda for this workshop, the presentation slides used during the workshop, a list of participants, and a full transcript of the plenary sessions are now available on DOE's website. On May 5, 2005, the Departments of Agriculture and Energy held a workshop on the agricultural and forestry elements of the guidelines. On June 30, 2005, EIA issued a *Federal Register* notice soliciting public comment on draft reporting forms and instructions based on the Interim Final General Guidelines and Draft Technical Guidelines. It is DOE's intention that final guidelines be issued this fall.

Other key Administration programs, like the Environmental Protection Agency's Climate Leaders and SmartWay Transport Partnership, also work in voluntary partnership with industry to reduce emissions. Further, the Department of Agriculture is using its conservation programs to provide an incentive for actions that increase carbon sequestration. DOE is pursuing many energy supply technologies with comparatively low or zero carbon dioxide emissions profiles, such as solar, wind, bioenergy, and combined heat and power. And the Bush Administration also has increased fuel economy standards for new light trucks and sport utility vehicles by 1.5 miles per gallon over the next three model years. A new round of standards is being prepared for proposal later this summer.

These and other initiatives may be contributing to greenhouse gas emission intensity reductions that we have seen already. The President's 18 percent ten-year goal represents an average annual rate of about 2.0 percent (compounded). According to Energy Information Administration's (EIA) *Emissions of Greenhouse Gases in the United States 2003* report, the energy-related greenhouse gas intensity was 2.3 percent lower in 2003 than in 2002, and a recent EIA estimate suggests a further improvement in carbon dioxide emissions intensity of 2.6 percent in 2004. Overall, then, the Nation appears to be ahead of schedule in meeting the President's goal.

Accelerating Climate Change Technology Development

While acting to slow the pace of greenhouse gas emissions intensity in the near term, the Administration is laying a strong technological foundation to develop realistic mitigation options to meet energy security and climate change objectives.

The Bush Administration is moving ahead on advanced technology options that have the potential to substantially reduce, avoid, or sequester future greenhouse gas emissions. Over 80 percent of current anthropogenic greenhouse gas emissions are energy related, and although projections vary considerably, a tripling of global energy demand by 2100 is not unimaginable. Therefore, to provide the energy necessary for continued economic growth while we reduce greenhouse gas emissions, we may have to develop and deploy cost-effective technologies that alter the way we produce and use energy.

The Climate Change Technology Program (CCTP), which I direct, was created to coordinate and prioritize the Federal Government's nearly $3 billion annual investment in climate-related technology research, development, demonstration, and deployment (RDD&D). Using various analytical tools, CCTP is assessing different technology options and their potential contributions to reducing greenhouse gas emissions. Given the tremendous capital investment in existing energy systems, the desired transformation of our global energy system may take decades or more to implement fully. A robust RDD&D effort can make advanced technologies available sooner rather than later and can accelerate modernization of capital stock at lower cost and with greater flexibility.

Later this week, Energy Secretary Bodman, who chairs the President's Cabinet Committee on Climate Change Science and Technology Integration, will release the CCTP Vision and Framework for our forthcoming draft Strategic Plan. CCTP's stra-

tegic vision has six complementary goals: (i) reducing emissions from energy use and infrastructure; (ii) reducing emissions from energy supply; (iii) capturing and sequestering CO_2; (iv) reducing emissions of other greenhouse gases; (v) measuring and monitoring emissions; and (vi) bolstering the contributions of basic science. The larger Strategic Plan will be published for public comment later this summer.

The Administration continues strong investment in many strategic technology areas.

- *Energy Efficiency and Renewable Energy:* Energy efficiency is the single largest investment area under CCTP and it provides tremendous short-term potential to reduce energy use and greenhouse gas emissions. Renewable energy includes a range of different technologies that can play an important role in reducing greenhouse gas emissions. The United States invests considerable resources in wind, solar photovoltaics, geothermal, and biomass technologies. Many of these technologies have made considerable progress in price competitiveness, but there remain opportunities to reduce manufacturing, operating, and maintenance costs of many of these technologies. Annually the Administration invests about $1.2 billion for these activities.
- *Hydrogen:* President Bush launched his Hydrogen Fuel Initiative in his 2003 State of the Union Address. The goal is to work closely with the private sector to accelerate our transition to a hydrogen economy, on both the technology of hydrogen fuel cells and a fueling infrastructure. The President's Hydrogen Fuel Initiative and the FreedomCAR Partnership launched in 2002, will provide $1.7 billion through 2008 to develop hydrogen-powered fuel cells, hydrogen production and infrastructure technologies, and advanced automotive technologies, with the goal of commercializing fuel-cell vehicles by 2020.
- *Carbon Sequestration:* Carbon capture and sequestration is a central element of CCTP's strategy because for the foreseeable future, fossil fuels will continue to be the world's most reliable and lowest-cost form of energy. A realistic approach is to find ways to capture and store the carbon dioxide produced when these fuels are used. DOE's core Carbon Sequestration Program emphasizes technologies that capture carbon dioxide from large point sources and store it in geologic formations. In 2003, DOE launched a nationwide network of seven Regional Carbon Sequestration Partnerships, involving State agencies, universities, and the private sector, to determine the best approaches for sequestration in each geographic region represented and to examine regulatory and infrastructure needs. On June 9 of this year, Secretary Bodman announced a major expansion of the Regional Partnerships program
- *Coal-Fired, Near-Zero-Emissions Power Generation:* The United States has vast reserves of coal, and about half of its electricity is generated from this fuel. Advanced coal-based power and fuels, therefore, is an area of special interest from both an energy security and climate change perspective. The Coal Research Initiative (CRI) consists of research, development, and demonstration of coal-related technologies that will improve coal's competitiveness in future energy supply markets. The Clean Coal Power Initiative (CCPI), within the CRI, is a cost-shared program between the government and industry to demonstrate emerging technologies in coal-based power generation and to accelerate their commercialization. A major initiative under CCPI is the FutureGen project, a 10-year, $1 billion government-industry effort to design, build, and operate the world's first near-zero atmospheric emissions coal-fired power plant. This project, which cuts across many CCTP strategic areas, will incorporate the latest technologies in carbon sequestration, oxygen and hydrogen separation membranes, turbines, fuel cells, and coal-to-hydrogen gasification. Through the CRI, clean coal can remain part of a diverse, secure energy portfolio well into the future.
- *Nuclear Fission:* Concerns over resource availability, energy security, and air quality as well as climate change suggest a larger role for nuclear power as an energy supply choice. While current generations of nuclear energy systems are adequate in many markets today, new construction of advanced light-water reactors in the near term and of even more advanced systems in the longer term can broaden opportunities for nuclear energy, both in industrialized and developing countries. The Nuclear Power 2010 program is working with industry to demonstrate the Nuclear Regulatory Commission's new licensing process, while the Generation IV Nuclear Energy Systems Initiative is investigating the more advanced reactor and fuel cycle systems that represent a significant leap in economic performance, safety, and proliferation-resistance. One promising system being developed under the Nuclear Hydrogen Initiative would pair very-high-temperature reactor technology with advanced hydrogen production capabilities

that could produce both electricity and hydrogen on a scale to meet transportation needs. Complementing these programs is the Advanced Fuel Cycle Initiative, which is developing advanced, proliferation resistant nuclear fuel technologies that can improve the fuel cycle, reduce costs, and increase the safety of handling nuclear wastes.

- *Fusion:* Fusion energy is a potential major new source of energy that, if successfully developed, could be used to produce electricity and possibly hydrogen. Fusion has features that make it is an attractive option from both an environmental and safety perspective. However, the technical hurdles of fusion energy are very high, and with a commercialization objective of 2050, its impact would not be felt until the second half of the century, if at all. Nevertheless, the promise of fusion energy is simply too great to ignore.

Advances in these and other technology areas in the CCTP portfolio could put us on a path to ensuring access to clean, affordable energy supplies while dramatically reducing the greenhouse gas profile of our economy over the long term. Moreover, the deployment of cleaner energy technologies in developing economies like China and India can make a huge difference in altering the future global energy picture.

Innovative International Partnerships

The Administration believes that well-designed multilateral collaborations focused on achieving practical results can accelerate development and commercialization of new technologies. Under President Bush's leadership, the United States has brought together key nations to tackle jointly some tough energy challenges. These multilateral collaborations mirror the main strategic thrusts of our domestic technology research programs, and they address a number of complementary energy concerns, such as energy security, climate change, and environmental stewardship. Another characteristic of each is that they include as partners Kyoto countries, non-Kyoto countries, industrialized countries, developing countries, and countries with economies in transition.

- *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, and in November 2003, representatives from 16 governments gathered in Washington to launch IPHE.[1] IPHE provides a vehicle to organize, coordinate, and leverage multi-national 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. Through IPHE, the U.S. has assisted Brazil and China in developing hydrogen roadmaps.
- *Carbon Sequestration Leadership Forum (CSLF):* CSLF is a U.S.-launched initiative that was established formally at a ministerial meeting held in Washington, D.C., in June 2003.[2] CSLF is a multilateral initiative that provides a framework for international collaboration on sequestration technologies. The Forum's main focus is assisting the development 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 and other interested nations are invited to participate in the FutureGen clean coal project.
- *Generation IV International Forum (GIF):* In 2002, nine countries and Euratom joined together with the United States to charter GIF, a multilateral collaboration to fulfill the objective of the Generation IV Nuclear Energy Systems Initiative.[3] GIF's goal is to develop the fourth generation of advanced, economical, safe, and proliferation-resistant nuclear systems that can be adopted commercially no later than 2030. A technology roadmap developed by the GIF and the

[1] 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.

[2] CSLF member governments include the United States, Australia, Brazil, Canada, China, Colombia, Denmark, European Commission, France, Germany, India, Italy, Japan, Mexico, Norway, Russia, South Africa, and the United Kingdom.

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

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.

- *ITER:* In January 2003, President Bush announced that the United States was joining the negotiations for the construction and operation of the international fusion experiment known as ITER.[4] If successful, this multi-billion-dollar research project will advance progress toward producing clean, renewable, commercially-available fusion energy by the middle of the century. It was recently agreed that the experimental reactor will be sited in Cadarache, France.
- *Methane to Markets Partnership:* In November of last year, the United States and representatives from 13 countries[5] launched the Methane to Markets Partnership, which is led on the U.S. side by EPA. This Partnership is an international initiative that focuses on advancing cost-effective, near-term methane recovery and use as a clean energy source to enhance economic growth, promote energy security, improve the environment, and reduce greenhouse gases. Initially, the Partnership will target three major methane sources: landfills, underground coal mines, and natural gas and oil systems.
- *Regional and 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.[6] These partnerships encompass over 400 individual activities, and 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 policy approaches to reducing greenhouse gas emissions.

Market Development for Commercialization of New Technologies

Adoption and transfer of modern energy technologies is capital and information intensive, and can only be accomplished as part of a broader effort to improve governance, regulation, and management of service providers in developing countries. 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 address climate change over the long term. 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.

Therefore, an important objective of U.S. participation in many of its international collaborations is to mobilize private sector investment by promoting 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, renewable, and infrastructure projects.

- *Clean Energy Initiative:* At the World Summit on Sustainable Development (WSSD), the United States launched a "Clean Energy Initiative" consisting 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, both led by EPA; and Efficient Energy for Sustainable Development (EESD), led by DOE. The mission of this initiative 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 modernizing energy services.

  DOE's EESD aims to improve the productivity and efficiency of energy systems, while reducing pollution and waste, saving money, and improving reliability through less energy intensive products, more energy efficient processes and production modernization. In furtherance of the U.S. Clean Energy Initiative, DOE

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[4] ITER member countries include the United States, China, European Union, Japan, Russia, and the Republic of Korea.

[5] Founding Methane to Markets member governments include the United States, Argentina, Australia, Brazil, China, Colombia, India, Italy, Japan, Mexico, Nigeria, Russian Federation, Ukraine, and the United Kingdom

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

submitted and obtained approval from Asia-Pacific Economic Cooperation forum Energy Ministers a plan to implement an agenda for financing energy efficiency and renewable energy projects within the region.

- *Renewable Energy and Energy Efficiency Partnership:* Formed at the World Summit on Sustainable Development in Johannesburg, South Africa, in August 2002, the Renewable Energy and Energy Efficiency Partnership (REEEP) seeks to accelerate and expand the global market for renewable energy and energy-efficiency technologies. As the world's largest producer and consumer of renewable energy, and with more renewable energy generation capacity than Germany, Denmark, Sweden, France, Italy, and the United Kingdom combined, the United States is one of 17 countries who are partners in REEEP. The United States also actively participated in the Renewables 2004 conference sponsored by the German Government in June 2004, and submitted five action items intended to provide specific technology plans and cost targets for renewable energy technologies using solar, biomass, wind, and geothermal resources.

Closing Remarks

The Bush Administration has developed a comprehensive strategy on climate change that is informed by science, emphasizes innovation and technological solutions, and promotes international collaboration to support the UNFCCC objective.

Further, the Administration remains committed to the UNFCCC and to the mutual goals of economic growth and energy security. The President has an ambitious near-term goal to reduce the greenhouse gas emission intensity of the U.S. economy, and is taking many actions to help meet that goal. We are also investing billions of dollars on advancing climate science and accelerating the development of advanced technologies—such as hydrogen, carbon sequestration, advanced nuclear power, and fusion energy—that have the potential to transform energy systems. And we are fully engaged internationally and lead major multilateral and bilateral climate change science and technology initiatives, and will continue to cooperate with all nations.

Although the scientific and technology challenges are considerable, the President remains committed to leading the way on climate change at home and around the world.

Senator VITTER. Thank you, Mr. Conover, we want to welcome Chairman Stevens, Mr. Chairman, thank you for being here. Now we'll go to Mr. Reifsnyder.

STATEMENT OF DANIEL A. REIFSNYDER, DIRECTOR, OFFICE OF GLOBAL CHANGE, BUREAU OF OCEANS AND INTERNATIONAL ENVIRONMENTAL AND SCIENTIFIC AFFAIRS, DEPARTMENT OF STATE

Mr. REIFSNYDER. Thank you, Mr. Chairman.

Mr. Chairman and Members of the Subcommittee, I'm pleased to have this opportunity to appear before you today to discuss the outcome with respect to climate change of the recent G8 Summit in Scotland, international meetings occurring later this year, and a brief overview of our bilateral and multilateral climate change agreements.

With your permission, I have a longer statement I would like to submit for the record regarding the G8 Summit outcomes. Two key documents, the Leader's Statement on Climate Change, Clean Energy and Sustainable Development, and the Gleneagles Plan of Action supporting the strategies set forth by the President were produced. The G8 leaders affirmed that, and I quote, "We face serious and linked challenges in tackling climate change, promoting clean energy and achieving sustainable development globally."

The G8 leaders agreed that the Gleneagles Program of Action, a broad-based practical program of over 50 activities to address climate change, to secure clean and affordable sources of energy, and to promote sustainable development over the coming decades. The

Gleneagles Program of Action calls for taking forward actions in six areas, including transforming the way we use energy, powering a cleaner future, promoting research and development, financing the transition to cleaner energy, managing the impact of climate change, and tackling illegal logging.

Turning to future international meetings as part of the implementation of Gleneagles—G8 leaders agreed to take forward a dialogue on climate change, clean energy, and sustainable development, inviting other interested countries with significant energy needs to join them. We understand that the United Kingdom plans to host a meeting in London on November 1 to this end, I have no additional details on this meeting at the moment, but we anticipate that it will focus on the specific elements of the *Gleneagles Plan of Action,* and seek to build on them.

The conference of the parties to the United Nations Framework Convention on Climate Change will hold its 11th session in Montreal from November 28 to December 9, 2005. As the Kyoto Protocol entered into force on February 16 of this year, the Montreal meeting will also be the first meeting of the parties under that instrument. We intend to carry forward our message, as we have in the last two COPs, and anticipate that it will have increased resonance as a result of the positive G8 outcomes. At those previous COPs, we have highlighted all that the United States is doing with respect to science and technology, and with respect to our domestic actions and international partnerships related to climate change.

Turning to our multilateral and bilateral initiatives, since June of 2001, the United States has launched 14 bilateral or regional partnerships to address climate change, and encompassing over 400 collaborative activities with developing and developed countries. These partnerships have, at their core, the principle that successful climate change policy must serve a larger purpose of fostering prosperity and well-being for citizens around the globe.

In recent years, the United States has launched a number of multilateral initiatives that address both near-term and longer-term issues related to climate change, science and technology, as well as near-term efforts to increase energy supplies, while reducing greenhouse gas emissions.

Mr. Chairman, inasmuch as Mr. Conover mentioned, some of these specific initiatives, the only one I would like also to mention here is the Earth Observation Summit that was held in Washington, D.C., in July 2003, to develop a comprehensive, coordinated and sustained Earth Observation System of Systems. That effort is well underway, as the newly formed group on observations seeks to meet the multiple targets in its 10-year implementation plan. But over 60 countries and 30 international organizations are now participating in this effort, and an International Secretariat has been established in Geneva, at the invitation of the World Meteorological Organization.

Mr. Chairman, I hope that my testimony this morning conveys the sense of the vast extent to which the United States is working internationally with multiple partners to reduce greenhouse gas intensity and promote energy-efficient technologies, while also placing primary importance on supporting economic growth and prosperity. We see economic growth and addressing the climate change

problem and energy security as integrally related. Thank you for this opportunity to testify before the Subcommittee on behalf of the Department of State. I would be pleased to answer any questions.

[The prepared statement of Mr. Reifsnyder follows:]

PREPARED STATEMENT OF DANIEL A. REIFSNYDER, DIRECTOR, OFFICE OF GLOBAL CHANGE, BUREAU OF OCEANS AND INTERNATIONAL ENVIRONMENTAL AND SCIENTIFIC AFFAIRS, DEPARTMENT OF STATE

Mr. Chairman and Members of the Subcommittee, I am Dan Reifsnyder, Director of the Office of Global Change in the Bureau of Oceans and International Environmental and Scientific Affairs at the Department of State. I am very pleased to have this opportunity to appear before you today to discuss the outcome of the recent G8 Summit in Gleneagles, Scotland, and upcoming international climate forums in London and Montreal. I will also provide an overview of our bilateral climate agreements and our multilateral initiatives, as requested by Chairman Vitter.

G8 Outcomes

The G8 Meeting produced two key documents: (1) the *Leaders' Statement on Climate Change, Clean Energy and Sustainable Development,* and (2) the *Gleneagles Plan of Action.* Both proved highly successful for the United States in that they support the strategy set forth by the President. Specifically, the Leaders noted that:

> "We face serious and linked challenges in tackling climate change, promoting clean energy and achieving sustainable development globally."

In other words, addressing the climate challenge is inextricably linked to our efforts to promote clean energy and to achieve sustainable development. As President Bush said in his speech at the Freer Gallery on June 30, 2005:

> ". . . Overcoming extreme poverty goes hand-in-hand with improving the environment. Stagnant economies are one of the greatest environmental threats in our world. People who lack food and shelter, and sanitation cannot be expected to preserve the environment at the expense of their own survival. Poor societies cannot afford to invest in cleaner, more efficient technologies. Indira Gandhi spoke of poverty and need as the greatest polluters. The long-term answer to environmental challenges is the rapid, sustained economic progress of poor nations."
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> The G8 Leaders also affirmed that:
>
> "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."
>
> They said that:
>
> "Tackling climate change and promoting clean technologies, while pursuing energy security and sustainable development, will require a global concerted effort over a sustained period."

Therefore, G8 Leaders agreed to the Gleneagles Program of Action, a broad-based, practical program of over fifty activities that will promote efforts to address climate change, to secure clean and affordable sources of energy, and to promote sustainable development over the coming decades.

The Gleneagles Program of Action calls for taking forward over fifty specific actions in six key areas:

> "(1) Transforming the way we use energy," including in buildings, appliances, surface transport, aviation and industry;
>
> "(2) Powering a cleaner future," with specific reference to cleaner fossil fuels, renewable energy and electricity grids;
>
> "(3) Promoting research and development";
>
> "(4) Financing the transition to cleaner energy";
>
> "(5) Managing the impact of climate change," including with respect to monitoring and data interpretation and risk management; and
>
> "(6) Tackling illegal logging."

The *Gleneagles Program of Action* puts forward one of the most practical work programs in this area agreed to date by international partners. By focusing on areas that can achieve both near—and long—term benefits in multiple areas, it represents a promising effort that can engage developing countries, which have long indicated

they are not prepared to accept negotiated international targets on greenhouse gas emissions.

We are also pleased that four of the multilateral initiatives launched by the United States are specifically endorsed in these G8 documents, including the:

(1) Carbon Sequestration Leadership Forum (CSLF)

(2) International Partnership for the Hydrogen Economy (IPHE)

(3) Methane to Markets Partnership (M2M) and

(4) Group on Earth Observations (GEO)

I will describe each of these with more specificity a bit later.

G8 London Meeting

As part of the implementation of Gleneagles, G8 leaders agreed to take forward a Dialogue on Climate Change, Clean Energy and Sustainable Development, inviting other interested countries with significant energy needs to join them. They specifically committed to:

"(a) address the strategic challenge of transforming our energy systems to create a more secure and sustainable future;

(b) monitor implementation of the commitments made in the Gleneagles Plan of Action and explore how to build on this progress; and

(c) share best practice between participating governments.

We understand that the United Kingdom plans to host a meeting in London on November 1 to take forward the Dialogue on Climate Change, Clean Energy and Sustainable Development. I have no additional details on this meeting at the moment, but we anticipate that it will focus on the specific elements of the Gleneagles Plan of Action and seek to build on them.

Montreal Meeting of the U.N. Framework Convention on Climate Change (UNFCCC)

The Conference of the Parties (COP) to the United Nations Framework Convention on Climate Change will hold its 11th Session in Montreal from November 28 to December 9, 2005. Under Secretary of State for Global Affairs Paula J. Dobriansky will head the U.S. delegation to this meeting. As the Kyoto Protocol entered into force on February 16 of this year, the Montreal meeting will also be the first "meeting of the Parties (MOP)" under that instrument.

While the COP and the MOP will take separate decisions, reflecting the different legal instruments involved and the different membership in these two bodies, there will be a joint "High Level Segment" from December 7–9. It is likely that statements of ministers and other heads of delegation will take up a good portion of the time, rather than the more interactive and successful roundtables that characterized the High Level Segments of COP–9 in Milan and COP–10 in Buenos Aires. In addition, there will be a heavy workload under the MOP as the Parties to that instrument seek to adopt the "Marrakech Accords" and other decisions to begin implementing the Kyoto Protocol.

We intend to carry forward our message, as we have in the last two COPs, and anticipate that it will have increased resonance as a result of the positive G8 outcomes. At those previous COPs, we have highlighted all that the United States is doing with respect to science and technology, and with respect to our domestic actions and international partnerships related to climate change.

Bilateral Climate Partnerships

Since June 2001, the United States has launched 14 bilateral or regional partnerships to address climate change, encompassing over 400 collaborative activities with developing countries, such as Brazil, Central American countries as a group (including Costa Rica, El Salvador, Guatemala, Honduras, Nicaragua, and Panama), China, India, South Korea, Mexico, and South Africa. Bilateral initiatives with partners in the developed world include those with Australia, Canada, the European Commission, Italy, Japan, New Zealand, and the Russian Federation. These partnerships have at their core the principle that successful climate change policy must serve a larger purpose of fostering prosperity and well-being for citizens around the globe. These partnerships have resulted in joint projects on climate change science, clean and advanced energy technologies, carbon capture, storage and sequestration, and policy approaches to greenhouse gas emissions.

Global Environment Facility

Another example of international cooperation is the Global Environment Facility (GEF), the financial mechanism under the UNFCCC. The United States is one of

the largest contributors to the GEF. President Bush's Fiscal Year 2006 budget includes a $107.5 million request for the GEF. The GEF focuses on innovative and generally small scale projects and funds only the incremental costs involved in producing global environmental benefits. Our commitment will fund technology transfer and capacity building in developing countries. The GEF has committed about $5.4 billion to date, leveraging over $17 billion from other sources, including the private sector, international development banks and organizations, governments, NGO's, and bilateral agencies. The GEF has designed and initiated nearly 1,600 investment and capacity building projects that are now being implemented by developing countries with the help of ten agencies, including the U.N. Development Program and the International Fund for Agricultural Development. It has also provided nearly 5,000 small grants directly to NGO's and community groups in over 70 countries.

Multilateral Initiatives

In recent years, the United States has launched a number of multilateral initiatives that address both near-term and longer-term issues related to climate change science and technology as well as near term efforts to increase energy supplies while reducing greenhouse gas emissions.

Carbon Sequestration Leadership Forum

The Department of State worked with the Department of Energy to launch the Carbon Sequestration Leadership Forum (CSLF) in June 2003. The CSLF, which now includes 17 countries and the European Commission, focuses on the development of improved, cost-effective technologies for the separation, capture, transport, and long-term storage of carbon dioxide in geological formations. Brazil, China, Colombia, India, Mexico, and South Africa participate in this cooperative framework along with numerous partners in the developed world.

International Partnership for the Hydrogen Economy

The Department of State also worked closely with the Department of Energy to launch the International Partnership for the Hydrogen Economy in November 2003 at a ministerial meeting in Washington, D.C. With 17 members, the IPHE provides a forum in which to organize and coordinate multinational research, development, and deployment of programs to advance the transition to a global hydrogen economy. Among developing countries, partners include Brazil, China, and India. IPHE partners are working together in such areas as hydrogen production and infrastructure, hydrogen storage, and codes and standards. The partnership addresses interests in both stationary and mobile sources of hydrogen as well as fuel cells and seeks to foster implementation of large-scale, long term public-private cooperation to advance research, development, demonstration, and commercial use of these technologies. Our goal is to make fuel cell vehicles commercially available by 2020, in line with the President's commitments with respect to both Freedom Fuels and FreedomCAR.

Methane to Markets Partnership

The Department of State worked closely with the Environmental Protection Agency, the Department of Energy, and the U.S. Agency for International Development to launch the Methane to Markets partnership at a ministerial meeting in Washington, D.C., in November 2004. The Partnership is designed to help promote energy security and reduce greenhouse gas emissions through cost-effective, near-term recovery and use of methane. Through this partnership, the United States and 15 other countries, including Argentina, Australia, Brazil, Canada, China, Colombia, India, Italy, Japan, Mexico, Nigeria, Russia, South Korea, Ukraine, and the United Kingdom, target methane from oil and gas activities, in coal beds and from landfills. By facilitating international cooperation, the Partnership has the potential to recover up to 500 billion cubic feet of methane annually by 2015, leading to the development of new and cleaner energy sources that stimulate economic growth and improve the environment. President Bush has pledged to commit up to $53 million to the Partnership over the next 5 years.

Group on Earth Observations

The United States held an Earth Observations Summit in Washington, D.C. in July 2003 to launch a multilateral effort to establish an intergovernmental, comprehensive, coordinated, and sustained Earth observation system. Continuous monitoring of the state of the Earth will improve our understanding of and ability to predict dynamic Earth processes and will provide timely, high-quality, long-term, global information as a basis for sound decisionmaking about climate change as well as for several other areas of societal benefit.

Through two succeeding ministerial meetings (in Tokyo in April 2004 and in Brussels in February 2005) a 10-year Implementation Plan for the Global Earth Observation System of Systems (GEOSS) was adopted, and the intergovernmental Group on Earth Observations was established to begin implementation of the 2-, 6-, and 10-year targets identified in the plan. Over 60 countries and 30 international organizations are now participating in this effort, and an international secretariat has been established in Geneva at the invitation of the World Meteorological Organization.

The United States Group on Earth Observations (USGEO), a subcommittee of the National Science and Technology Council Committee on Environment and Natural Resources coordinates the development of the Integrated Earth Observation System (IEOS) which is the U.S. contribution to GEOSS. GEOSS and IEOS will facilitate the sharing and applied usage of global, regional, and local data from satellites, ocean buoys, weather stations and other surface and airborne Earth observing instruments.

GEN–IV International Forum

We are improving the reliability of nuclear power, which is already an important greenhouse gas emissions-free energy source in many parts of the world. In 2001, the Department of Energy launched the Generation IV International Forum (GEN–IV), in which ten nations and Euratom are working together on the next generation of nuclear power that will be safer, more affordable, and more proliferation-resistant. These advanced nuclear technologies will help provide a clean, stable, and abundant source of energy while reducing the global demand for fossil fuels. We are working closely with the Department of Energy on this initiative.

ITER

The United States has rejoined an effort to build an experimental fusion energy reactor. ITER's members include China, the European Union, Japan, the Russian Federation, and South Korea. Fusion holds enormous promise as a potential source of clean, unlimited energy and is another component in the suite of technologies that comprise our long-term vision of developing and deploying transformational energy technologies as the key to energy security and reduction of GHG emissions. With the recent agreement to site the $5 billion experimental reactor in Cadarache, France, we look forward to continued progress in this endeavor.

Tropical Forest Conservation

Many of our international activities also help to promote the biological sequestration of carbon dioxide, an important tool for addressing climate change that can have benefits both for conservation and climate change. The Tropical Forest Conservation Act (TFCA) offers eligible developing countries opportunities to reduce concessional debt owed to the United States while generating local currency funds to support programs to conserve tropical forests. Since 1998, the United States has concluded nine TFCA agreements with eight countries that will generate more than $95 million for tropical forest conservation over the next 10–25 years. Three U.S.-based international NGO's (The Nature Conservancy, the World Wildlife Fund, and Conservation International) contributed approximately $7.5 million to six of the nine agreements, thereby increasing the amount of debt we were able to treat. TFCA agreements have been concluded with Bangladesh, Belize, Colombia, El Salvador, Jamaica, Panama (two agreements), Peru, and the Philippines. In Fiscal Year 2006, the Administration has requested a total of approximately $100 million for certain debt restructuring programs. These programs include bilateral Heavily Indebted Poor Countries (HIPC) and poorest country debt reduction, contributions to the HIPC Trust Fund and TFCA debt reduction.

Illegal Logging

In 2003, the Department of State launched the President's Initiative Against Illegal Logging (PIAIL) to assist developing countries to combat illegal logging and the sale and export of illegally harvested timber products. This initiative represents the most comprehensive strategy undertaken by any nation to address this critical sustainable development challenge and reinforces U.S. leadership in taking action to counter the problem and conserve forest resources that store carbon.

Concluding Remarks

Mr. Chairman, I hope that my testimony this morning conveys a sense of the vast extent to which the United States is working to reduce greenhouse gas intensity and promote energy efficient technologies, while also placing primary importance on supporting economic growth and prosperity. We see economic growth, addressing the climate change problem, and energy security as integrally related. Meeting the chal-

lenge of the expected future growth in global energy demand, and reducing greenhouse gas emissions, will require a transformation in the way the world produces and consumes energy over the next generation and beyond. This is why we are leading global efforts to develop and deploy breakthrough technologies for both the developed and developing world.

I thank you for this opportunity to testify before this Subcommittee on behalf of the Department of State. I would be pleased to answer any questions you may have.

Senator VITTER. Thank you, Mr. Reifsnyder, Dr. Cicerone?

STATEMENT OF RALPH J. CICERONE, PH.D., PRESIDENT, NATIONAL ACADEMY OF SCIENCES

Dr. CICERONE. Thank you, Mr. Chairman, Senator Lautenberg, for the opportunity. I just moved here recently from California where I was Chancellor of one of the U.C. campuses and Professor of Chemistry and Professor of Earth Systems Science. I should have known about the humidity in Washington, but I didn't, so I'm learning firsthand.

This morning I'll be——

Senator VITTER. Being from Louisiana, I would just note, this is spring-like weather.

[Laughter.]

Dr. CICERONE. Thank you. With your permission, I'd like to submit some written testimony as well, and so I'll summarize briefly.

The current state of scientific understanding of climate change, basing largely on findings and recommendations that Academies reports have come up with over the last 15 years or so, these reports are almost always the products of a study process that brings together scientists, engineers, public health officials, and other experts to provide a consensus reading and advice to the Nation on specific scientific and technical questions.

First of all, the Earth is warming, as Senator Lautenberg and Senator Vitter said earlier. Our record is based on hundreds of millions of temperature measurements over the last 140 years or so from weather stations and ship-based observations. One common measure is the Planetary Average Surface Temperature, it's increased about seven-tenths of a degree Fahrenheit just since the mid-1970s, and in my written testimony I have a figure of such data from one of the data sources, there are several. And although the magnitude of this warming varies locally, the warming trend is very widespread. It is consistent with an array of other evidence, such as melting glaciers and ice caps, sea level rise, extended growing seasons that have been observed, and changes in the geographical distributions of plant and animal species.

The ocean, which represents the largest single reservoir of heat in the climate system because of the heat capacity of water, has itself warmed by a little bit more than a tenth of a degree, just in the last 12 years or so, in the surface layer that extends down to about 750 foot depth. Going back further, laboratory measurements of gases which have been extracted from dated ice cores around the world's glaciers have shown that for hundreds of thousands of years, the changes in temperature, that themselves can be deduced from isotopic contents of the ice, have closely tracked atmospheric carbon dioxide concentrations. Carbon dioxide in the atmosphere is now at the highest level in the last 400,000 years, and it continues

to rise, and it's due mostly from the burning of fossil fuels for our energy needs.

Nearly all climate scientists today believe that much of Earth's current warming has been caused by the increases in these greenhouse gases in the air. One of the other ideas is that changes in the sun's total brightness could be causing the recently observed warming, say over the past century, have become much more difficult to accept, due to the fact that humans have been measuring the sun carefully enough over the last 25 years to show that there is no detectable trend in the sun's brightness.

Computations of future climate change project that in this current century, global surface temperatures are going to continue to rise. The range of such temperature increases from, say, two and a half to 10 degrees Fahrenheit, above the levels of 15 years ago, difficult to pin down the range any more than that, for example, because we don't know society's own future actions—we don't know what human numbers will be, we don't know economic growth rates and energy use practices underlying that. On the other hand, we can say the warming will continue, for example, because some latent warming is built into the system already, due to a lack of equilibrium in the energy balance on the planetary energy balance.

However, while future climate change details and regional impacts are inherently uncertain, they're far from unknown. The combined effects of ice melting and sea water expansion from ocean warming alone will likely cause the global average sea level to rise by, oh, say a half a meter, plus or minus four tenths of a meter in this coming century, and in colder climates, such warming could bring longer growing seasons and less severe winters. However, those in coastal communities—especially developing nations—will be vulnerable to increased flooding due to sea level rise and storm surges on top of the mean sea level, and it's also likely that we will experience more severe storms and surges.

In the Arctic regions, where temperatures have risen much more than the global average, the landscape and ecosystems are being altered rapidly, however, in my own opinion, we're not exactly sure why. The National Academies have tried very hard, when requested, to provide advice to Federal agencies that conduct climate change research, now for well over two decades, and recently—as Dr. Mahoney said—the Academy has assisted the U.S. Climate Change Science Program, by reviewing its 10 year strategic plan. And in the 2004 review, the Academy recommended that the plan be implemented as soon as possible, recognized hurdles, complimented the strategic planning involved, the scope of it, and did make comments on the budget perhaps not being—as it's currently arranged, at least—capable of supporting all of the activities in the strategic plan.

We do have working arrangements with Dr. Mahoney's office and several other Federal agencies to continue to provide critical review, using experts from inside the government and outside the government on program priorities implementation, strategy and progress. The Academy is, I hope, fully engaged, and we'll do the best we can to provide independent assessments and advice at every stage.

I'll just conclude by saying that the overall task of mitigating and preparing for the impacts of climate change will require worldwide collaborative efforts and inputs from a wide range of experts, including government leaders, and government at all levels—business leaders, natural scientists, engineers, social scientists, medical people, and economists. And although the scientific understanding of climate change has advanced significantly in the last several decades, there are still many unanswered questions. We all have increased pressure and incentive to decide how best to respond, and I hope that we can continue to work together to do that, thank you.

[The prepared statement of Dr. Cicerone follows:]

PREPARED STATEMENT OF RALPH J. CICERONE, PH.D., PRESIDENT, NATIONAL ACADEMY OF SCIENCES

Good morning, Mr. Chairman and Members of the Committee. My name is Ralph Cicerone, and I am President of the National Academy of Sciences. Prior to this position, I served as Chancellor of the University of California at Irvine, where I also held the Daniel G. Aldrich Chair in Earth System Science. In addition, in 2001, I chaired the National Academies committee that wrote the report, *Climate Change Science: An Analysis of Some Key Questions,* at the request of the White House.

This morning I will summarize briefly the current state of scientific understanding on climate change, based largely on the findings and recommendations in recent National Academies' reports, focusing especially on the 2001 report that I chaired and the 2003 report *Implementing Climate and Global Change Research,* in which the U.S. Climate Change Science Program strategic plan was reviewed. These reports are the products of a study process that brings together leading scientists, engineers, public health officials, and other experts to provide consensus advice to the Nation on specific scientific and technical questions. The recent statement on climate change issued by the G8 countries, China, India, and Brazil is also based on findings in these and other reports of the National Academies.

Science of Climate Change

The Earth is warming. Weather station records and ship-based observations indicate that global mean surface air temperature increased about 0.7 °F (0.4 °C) since the early 1970s (See Figure). Although the magnitude of warming varies locally, the warming trend is spatially widespread and is consistent with an array of other evidence (*e.g.,* melting glaciers and ice caps, sea level rise, extended growing seasons, and changes in the geographical distributions of plant and animal species). The ocean, which represents the largest reservoir of heat in the climate system, has warmed by about 0.12 °F (0.06 °C) averaged over the layer extending from the surface down to 750 feet, since 1993.

Laboratory measurements of gases trapped in dated ice cores have shown that for hundreds of thousands of years, changes in temperature have closely tracked atmospheric carbon dioxide concentrations. Burning fossil fuel for energy, industrial processes, and transportation releases carbon dioxide to the atmosphere. Carbon dioxide in the atmosphere is now at its highest level in 400,000 years and continues to rise. Nearly all climate scientists today believe that much of Earth's current warming has been caused by increases in the amount of greenhouse gases in the atmosphere, mostly from the burning of fossil fuels. In fact, recent analyses of measurements of the Sun's total brightness argue against any detectable long-term trend in the energy Earth receives from the Sun, making it difficult to conclude that the Sun has been responsible for the warming observed over the past 25 years.

Carbon dioxide can remain in the atmosphere for many decades, and major parts of the climate system respond slowly to changes in greenhouse gas concentrations. The slow response of the climate system to increasing greenhouse gases also means that changes and impacts will continue during the twenty-first century and beyond, even if emissions were to be stabilized or reduced in the near future.

Simulations of future climate change project that, by 2100, global surface temperatures will be from 2.5 to 10.4 °F (1.4 to 5.8 °C) above 1990 levels. Pinpointing the magnitude of future warming is hindered both by remaining gaps in understanding the science, and by the fact that it is difficult to predict society's future actions, particularly in the areas of population growth, economic growth, and energy use practices. Other scientific uncertainties about future climate change relate to

the regional effects of climate change, and how climate change will affect the frequency and severity of weather events.

It is important to recognize however, that while future climate change and its impacts are inherently uncertain, they are far from unknown. The combined effects of ice melting and sea water expansion from ocean warming will likely cause the global average sea-level to rise by between 0.1 and 0.9 meters between 1990 and 2100. In colder climates, such warming could bring longer growing seasons and less severe winters. Those in coastal communities, many in developing nations, will experience increased flooding due to sea level rise, and are likely to experience more severe storms and surges. In the Arctic regions, where temperatures have risen more than the global average, the landscape and ecosystems are being altered rapidly.

National Academies Advice on U.S. Climate Change Research

The National Academies have provided advice to the Federal agencies that conduct climate change research for over two decades. Recently, the National Academies assisted the U.S. Climate Change Science Program (CCSP) by reviewing its 10-year strategic plan. The 2004 review of the final strategic plan, recommended that it be implemented as soon as possible, although significant hurdles face the CCSP and participating agencies in doing so. For example, meeting all program goals will require advances in previously under-emphasized, but societally relevant elements of the program, including ecosystems, the water cycle, human dimensions, economics, impacts, adaptation, and mitigation, as well as further development of the program's decision support activities. The strategic plan identifies a much broader scope of activities than has historically been supported. However, the CCSP budget at the time did not appear to be capable of supporting all of the activities in the strategic plan. The National Academies' report also concluded that, given the political sensitivities associated with climate change, special measures may be needed to ensure the scientific independence and credibility of the program and its products.

One of the recommendations from the 2004 National Academies' review to address these hurdles, was for the CCSP to establish a mechanism for independent oversight of the program as a whole. In June 2005, CCSP requested support from the National Academies in two new areas:

1. A new CCSP Committee will provide ongoing, independent advice on on program priorities and implementation strategy and will evaluate progress toward meeting the program's goals. The Committee also will facilitate, when requested by the sponsor or participating agencies, (1) National Academies' reviews of draft CCSP synthesis and assessment products, (2) National Academies' reviews of draft prospectuses for CCSP synthesis and assessment products, and (3) related analyses to bound the uncertainty associated with the interpretation of scientific findings.

2. A committee is now being formed to undertake a comparative study of relevant previous global change assessments conducted around the world, in order to provide background information for the assessments being prepared by CCSP. The committee will evaluate several cases chosen to span the range of assessment approaches in terms of geographic scale, subject matter scope, entity responsible for conducting the assessment, and timing.

Concluding Remarks

The task of mitigating and preparing for the impacts of climate change will require worldwide collaborative inputs from a wide range of experts, including natural scientists, engineers, social scientists, medical scientists, those in government at all levels, business leaders, and economists. Although the scientific understanding of climate change has advanced significantly in the last several decades, there are still many unanswered questions. Society faces increasing pressure to decide how best to respond to climate change and associated global changes, and applied research in direct support of decisionmaking is needed.

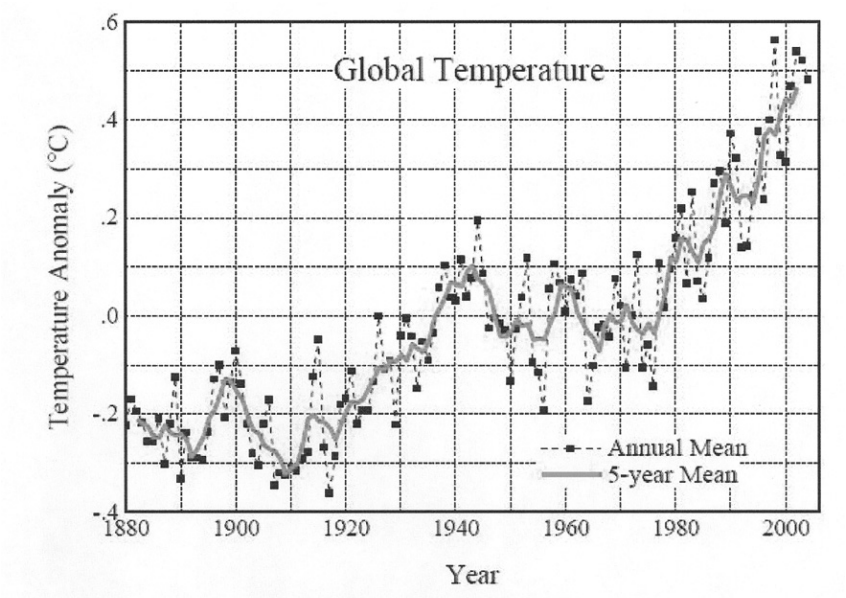
The written testimony that follows describes in more detail important findings and recommendations from a number of recent National Academies' reports on climate change.

U.S. Climate Change Research

The Earth Is Warming

The most striking evidence of a global warming trend are closely scrutinized data that show a relatively rapid increase in temperature, particularly over the past 30 years. Weather station records and ship-based observations indicate that global mean surface air temperature increased about 0.7 °F (0.4 °C) since the early 1970s

(See Figure). Although the magnitude of warming varies locally, the warming trend is spatially widespread and is consistent with an array of other evidence (*e.g.,* melting glaciers and ice caps, sea level rise, extended growing seasons, and changes in the geographical distributions of plant and animal species).



Global annual-mean surface air temperature change derived from the meteorological station network. Data and plots available from the Goddard Institute for Space Sciences (GISS) at http://data.giss.nasa.gov/gistemp/graphs/.

The ocean, which represents the largest reservoir of heat in the climate system, has warmed by about 0.12 °F (0.06 °C) averaged over the layer extending from the surface down to 750 feet, since 1993. Recent studies have shown that the observed heat storage in the oceans is what would be expected by a human-enhanced greenhouse effect. Indeed, increased ocean heat content accounts for most of the planetary energy imbalance (i.e., when the Earth absorbs more energy from the Sun than it emits back to space) simulated by climate models with mid-range climate sensitivity.

The observed warming has not proceeded at a uniform rate. Virtually all the 20th century warming in global surface air temperature occurred between the early 1900s and the 1940s, and since the 1970s, with a slight cooling of the Northern Hemisphere during the interim decades. The troposphere warmed much more during the 1970s than during the two subsequent decades, whereas Earth's surface warmed more during the past two decades than during the 1970s. The causes of these irregularities, and the disparities in the timing, are not completely understood.

A National Academies' report released in 2000, *Reconciling Observations of Global Temperature Change,* examined different types of temperature measurements collected from 1979 to 1999 and concluded that the warming trend in global-average surface temperature observations during the previous 20 years is undoubtedly real, and is substantially greater than the average rate of warming during the twentieth century. The report concludes that the lower atmosphere actually may have warmed much less rapidly than the surface from 1979 into the late 1990s, due both to natural causes (*e.g.,* the sequence of volcanic eruptions that occurred within this particular 20-year period) and human activities (*e.g.,* the cooling of the upper part of the troposphere resulting from ozone depletion in the stratosphere). The report spurred many research groups to do similar analyses. Satellite observations of middle troposphere temperatures, after several revisions of the data, now compare reasonably with observations from surface stations and radiosondes, although some uncertainties remain.

Humans Have Had an Impact on Climate

Laboratory measurements of gases trapped in dated ice cores have shown that for hundreds of thousands of years, changes in temperature have closely tracked with atmospheric carbon dioxide concentrations. Burning fossil fuel for energy, industrial processes, and transportation releases carbon dioxide to the atmosphere. Carbon dioxide in the atmosphere is now at its highest level in 400,000 years and continues to rise. Nearly all climate scientists today believe that much of Earth's current warming has been caused by increases in the amount of greenhouse gases in the atmosphere. The degree of confidence in this conclusion is higher today than it was 10, or even 5 years ago, but uncertainties remain. As stated in the Academies 2001 report, "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."

Carbon dioxide can remain in the atmosphere for many decades and major parts of the climate system respond slowly to changes in greenhouse gas concentrations. The slow response of the climate system to increasing greenhouse gases also means that changes and impacts will continue during the twenty-first century and beyond, even if emissions were to be stabilized or reduced in the near future.

In order to compare the contributions of the various agents that affect surface temperature, scientists have devised the concept of "radiative forcing." Radiative forcing is the change in the balance between radiation (i.e., heat and energy) entering the atmosphere and radiation going back out. Positive radiative forcings (*e.g.,* due to excess greenhouse gases) tend on average to warm the Earth, and negative radiative forcings (*e.g.,* due to volcanic eruptions and many human-produced aerosols) on average tend to cool the Earth. The Academies recent report, *Radiative Forcing of Climate Change: Expanding the Concept and Addressing Uncertainties* (2005), takes a close look at how climate has been changed by a range of forcings. A key message from the report is that it is important to quantify how human and natural processes cause changes in climate variables other than temperature. For example, climate-driven changes in precipitation in certain regions could have significant impacts on water availability for agriculture, residential and industrial use, and recreation. Such regional impacts will be much more noticeable than projected changes in global average temperature of a degree or more.

One area of debate has been the extent to which variations in the Sun might contribute to recent observed warming trends. *Radiative Forcing of Climate Change: Expanding the Concept and Addressing Uncertainties* (2005) also summarizes current understanding about this issue. The Sun's brightness—its total irradiance—has been measured continuously by a series of satellite-based instruments for more than two complete 11-year solar cycles. These multiple solar irradiance datasets have been combined into a composite time series of daily total solar irradiance from 1979 to the present. Different assumptions about radiometer performance lead to different reconstructions for the past two decades. Recent analyses of these measurements, taking into account instrument calibration offsets and drifts, argue against any detectable long-term trend in the observed irradiance to date. Likewise, models of total solar irradiance variability that account for the influences of solar activity features—dark sunspots and bright faculae—do not predict a secular change in the past two decades. Thus, it is difficult to conclude from either measurements or models that the Sun has been responsible for the warming observed over the past 25 years.

Knowledge of solar irradiance variations is rudimentary prior to the commencement of continuous space-based irradiance observations in 1979. Models of sunspot and facular influences developed from the contemporary data base have been used to extrapolate daily variations during the 11-year cycle back to about 1950 using contemporary sunspot and facular proxies, and with less certainty annually to 1610. Circumstantial evidence from cosmogenic isotope proxies of solar activity (^{14}C and ^{10}Be) and plausible variations in Sun-like stars motivated an assumption of long-term secular irradiance trends, but recent work questions the evidence from both. Very recent studies of the long term evolution and transport of activity features using solar models suggest that secular solar irradiance variations may be limited in amplitude to about half the amplitude of the 11-year cycle.

Warming will continue, but its impacts are difficult to project

The Intergovernmental Panel on Climate Change (IPCC), which involves hundreds of scientists in assessing the state of climate change science, has estimated that, by 2100, global surface temperatures will be from 2.5 to 10.4°F (1.4 to 5.8°C) above 1990 levels. Similar projections of temperature increases, based on rough calculations and nascent theory, were made in the Academies first report on climate change published in the late 1970s. Since then, significant advances in our knowl-

edge of the climate system and our ability to model and observe it have yielded consistent estimates. Pinpointing the magnitude of future warming is hindered both by remaining gaps in understanding the science and by the fact that it is difficult to predict society's future actions, particularly in the areas of population growth, economic growth, and energy use practices.

One of the major scientific uncertainties is how climate could be affected by what are known as "climate feedbacks." Feedbacks can either amplify or dampen the climate response to an initial radiative forcing. During a feedback process, a change in one variable, such as carbon dioxide concentration, causes a change in temperature, which then causes a change in a third variable, such as water vapor, which in turn causes a further change in temperature. *Understanding Climate Change Feedbacks* (2003) looks at what is known and not known about climate change feedbacks and identifies important research avenues for improving our understanding.

Other scientific uncertainties relate to the regional effects of climate change and how climate change will affect the frequency and severity of weather events. Although scientists are starting to forecast regional weather impacts, the level of confidence is less than it is for global climate projections. In general, temperature is easier to predict than changes such as rainfall, storm patterns, and ecosystem impacts. It is very likely that increasing global temperatures will lead to higher maximum temperatures and fewer cold days over most land areas. Some scientists believe that heat waves such as those experienced in Chicago and central Europe in recent years will continue and possibly worsen. The larger and faster the changes in climate, the more difficult it will be for human and natural systems to adapt without adverse effects.

There is evidence that the climate has sometimes changed abruptly in the past—within a decade—and could do so again. Abrupt changes, for example the Dust Bowl drought of the 1930s displaced hundreds of thousands of people in the American Great Plains, take place so rapidly that humans and ecosystems have difficulty adapting to it. *Abrupt Climate Change: Inevitable Surprises* (2002) outlines some of the evidence for and theories of abrupt change. One theory is that melting ice caps could "freshen" the water in the North Atlantic, shutting down the natural ocean circulation that brings warmer Gulf Stream waters to the north and cooler waters south again. This shutdown could make it much cooler in Northern Europe and warmer near the equator.

It is important to recognize that while future climate change and its impacts are inherently uncertain, they are far from unknown. The combined effects of ice melting and sea water expansion from ocean warming will likely cause the global average sea-level to rise by between 0.1 and 0.9 meters between 1990 and 2100. In colder climates, such warming could bring longer growing seasons and less severe winters. Those in coastal communities, many in developing nations, will experience increased flooding due to sea level rise and are likely to experience more severe storms and surges. In the Arctic regions, where temperatures have risen almost twice as much as the global average, the landscape and ecosystems are being altered rapidly.

Observations and Data Are the Foundation of Climate Change Science

There is nothing more valuable to scientists than the measurements and observations required to confirm or contradict hypotheses. In climate sciences, there is a peculiar relation between the scientist and the data. Whereas other scientific disciplines can run multiple, controlled experiments, climate scientists must rely on the one realization that nature provides. Climate change research requires observations of numerous characteristics of the Earth system over long periods of time on a global basis. Climate scientists must rely on data collected by a whole suite of observing systems—from satellites to surface stations to ocean buoys—operated by various government agencies and countries as well as climate records from ice cores, tree rings, corals, and sediments that help reconstruct past change.

Collecting and Archiving Data To Meet the Unique Needs of Climate Change Science

Most of the instrumentation and observing systems used to monitor climate today were established to provide data for other purposes, such as predicting daily weather; advising farmers; warning of hurricanes, tornadoes and floods; managing water resources; aiding ocean and air transportation; and understanding the ocean. However, collecting climate data is unique because higher precision is often needed in order to detect climate trends, the observing programs need to be sustained indefinitely and accommodate changes in observing technology, and observations are needed at both global scales and at local scales to serve a range of climate information users.

Every report on climate change produced by the National Academies in recent years has recommended improvements to climate observing capabilities. A central theme of the report *Adequacy of Climate Observing Systems* (1999) is the need to dramatically upgrade our climate observing capabilities. The report presents ten climate monitoring principles that continue to be the basis for designing climate observing systems, including management of network change, careful calibration, continuity of data collection, and documentation to ensure that meaningful trends can be derived.

Another key concept for climate change science is the ability to generate, analyze, and archive long-term climate data records (CDRs) for assessing the state of the environment in perpetuity. In *Climate Data Records from Environmental Satellites* (2004), a climate data record is defined as a time series of measurements of sufficient length, consistency, and continuity to determine climate variability and change. The report identifies several elements of successful climate data record generation programs, ranging from effective, expert leadership to long-term commitment to sustaining the observations and archives.

Integrating Knowledge and Data on Climate Change Through Models

An important concept that emerged from early climate science in the 1980s was that Earth's climate is not just a collection of long-term weather statistics, but rather the complex interactions or "couplings" of the atmosphere, the ocean, the land, and plant and animal life. Climate models are built using our best scientific knowledge, first modeling each process component separately and then linking them together to simulate these couplings.

Climate models are important tools for understanding how the climate operates today, how it may have functioned differently in the past, and how it may evolve in the future in response to forcings from both natural processes and human activities. Climate scientists can deal with uncertainty about future climate by running models with different assumptions of future population growth, economic development, energy use, and policy choices, such as those that affect air quality or influence how nations share technology. Models then offer a range of outcomes based on these different assumptions.

Modeling Capability and Accuracy

Since the first climate models were pioneered in the 1970s, the accuracy of models has improved as the number and quality of observations and data have increased, as computational abilities have multiplied, and as our theoretical understanding of the climate system has improved. Whereas early attempts at modeling used relatively crude representations of the climate, today's models have very sophisticated and carefully tested treatment of hundreds of climate processes.

The National Academies' report *Improving Effectiveness of U.S. Climate Modeling* (2001) offers several recommendations for strengthening climate modeling capabilities, some of which have already been adopted in the United States. At the time the report was published, U.S. modeling capabilities were lagging behind some other countries. The report identified a shortfall in computing facilities and highly skilled technical workers devoted to climate modeling. Federal agencies have begun to centralize their support for climate modeling efforts at the National Center for Atmospheric Research and the Geophysical Fluid Dynamics Laboratory. However, the U.S. could still improve the amount of resources it puts toward climate modeling as recommended in *Planning Climate and Global Change Research* (2003).

Climate Change Impacts Will Be Uneven

There will be winners and losers from the impacts of climate change, even within a single region, but globally the losses are expected to outweigh the benefits. The regions that will be most severely affected are often the regions that are the least able to adapt. For example, Bangladesh, one of the poorest nations in the world, is projected to lose 17.5 percent of its land if sea level rises about 40 inches (1 m), displacing tens of thousands of people. Several islands throughout the South Pacific and Indian Oceans will be at similar risk of increased flooding and vulnerability to storm surges. Coastal flooding likely will threaten animals, plants, and fresh water supplies. Tourism and local agriculture could be severely challenged.

Wetland and coastal areas of many developed nations including the United States are also threatened. For example, parts of New Orleans are as much as eight feet below sea level today. However, wealthy countries are much more able to adapt to sea level rise and threats to agriculture. Solutions could include building, limiting or changing construction codes in coastal zones, and developing new agricultural technologies.

The Arctic has warmed at a faster rate than the Northern Hemisphere over the past century. *A Vision for the International Polar Year 2007–2008* (2004) reports

that this warming is associated with a number of impacts including: melting of sea ice, which has important impacts on biological systems such as polar bears, ice-dependent seals and local people for whom these animals are a source of food; increased rain and snow, leading to changes in river discharge and tundra vegetation; and degradation of the permafrost.

Preparing for Climate Change

One way to begin preparing for climate change is to make the wealth of climate data and information already collected more accessible to a range of users who could apply it to inform their decisions. Such efforts, often called "climate services," are analogous to the efforts of the National Weather Service to provide useful weather information. Climate is becoming increasingly important to public and private decisionmaking in various fields such as emergency management planning, water quality, insurance premiums, irrigation and power production decisions, and construction schedules. *A Climate Services Vision* (2001) outlines principles for improving climate services that include making climate data as user-friendly as weather services are today, and active and well-defined connections among the government agencies, businesses, and universities involved in climate change data collection and research.

Another avenue would be to develop practical strategies that could be used to reduce economic and ecological systems' vulnerabilities to change. Such "no-regrets" strategies, recommended in *Abrupt Climate Change: Inevitable Surprises* (2002), provide benefits whether a significant climate change ultimately occurs or not, potentially reducing vulnerability at little or no net cost. No-regrets measures could include low-cost steps to: improve climate forecasting; slow biodiversity loss; improve water, land, and air quality; and make institutions—such as the health care enterprise, financial markets, and transportation systems—more resilient to major disruptions.

Reducing the Causes of Climate Change

The climate change statement issued in June 2005 by 11 science academies, including the National Academy of Sciences, stated that despite remaining unanswered questions, the scientific understanding of climate change is now sufficiently clear to justify nations taking cost-effective steps that will contribute to substantial and long-term reduction in net global greenhouse gas emissions. Because carbon dioxide and some other greenhouse gases can remain in the atmosphere for many decades and major parts of the climate system respond slowly to changes in greenhouse gas concentrations, climate change impacts will likely continue throughout the 21st century and beyond. Failure to implement significant reductions in net greenhouse gas emissions now will make the job much harder in the future—both in terms of stabilizing their atmospheric abundances and in terms of experiencing more significant impacts.

At the present time there is no single solution that can eliminate future warming. As early as 1992, *Policy Implications of Greenhouse Warming* found that there are many potentially cost-effective technological options that could contribute to stabilizing greenhouse gas concentrations. These options range from personal choices such as driving less, to national choices such as regulating emissions, to international choices such as sharing energy technologies.

Meeting Energy Needs Is a Major Challenge to Slowing Climate Change

Energy—either in the form of fuels used directly (i.e., gasoline) or as electricity produced using various fuels (fossil fuels as well as nuclear, solar, wind, and others)—is essential for all sectors of the economy, including industry, commerce, homes, and transportation. Energy use worldwide continues to grow with economic and population growth. Developing countries, China and India in particular, are rapidly increasing their use of energy, primarily from fossil fuels, and consequently their emissions of CO_2. Carbon emissions from energy can be reduced by using it more efficiently or by switching to alternative fuels. It also may be possible to capture carbon emissions from electric generating plants and then sequester them.

Energy efficiency in all sectors of the U.S. economy could be improved. The 2002 National Academies' report, *Effectiveness and Impact of Corporate Average Fuel Economy (CAFE) Standards,* evaluates car and light truck fuel use and analyzes how fuel economy could be improved. Steps range from improved engine lubrication to hybrid vehicles. The 2001 Academies report, *Energy Research at DOE, Was It Worth It?* addresses the benefits of increasing the energy efficiency of lighting, refrigerators, and other appliances. Many of these improvements (*e.g.,* high-efficiency refrigerators) are cost-effective means to significantly reducing energy use, but are being held back by market constraints such as consumer awareness, higher initial costs, or by the lack of effective policy.

Electricity can be produced without significant carbon emissions using nuclear power and renewable energy technologies (*e.g.,* solar, wind, and biomass). In the United States, these technologies are too expensive or have environmental or other concerns that limit broad application, but that could change with technology development, or if the costs of fossil fuels increase. Replacing coal-fired electric power plants with more efficient, modern natural gas-fired turbines would reduce carbon emissions per unit of electricity produced.

Several technologies are being explored that would collect CO_2 that would otherwise be emitted to the atmosphere from fossil fuel-fired power plants, and then sequester it in the ground or the ocean. Successful, cost-effective sequestration technologies would weaken the link between fossil fuels and greenhouse gas emissions. The 2003 National Academies' report, *Novel Approaches to Carbon Management: Separation, Capture, Sequestration, and Conversion to Useful Products,* discusses the development of this technology.

Capturing CO_2 emissions from the tailpipes of vehicles is essentially impossible, which is one factor that has led to considerable interest in hydrogen as a fuel. As with electricity, hydrogen must be manufactured from primary energy sources. Significantly reducing carbon emissions when producing hydrogen from fossil fuels (currently the least expensive method) would require carbon capture and sequestration. Substantial technological and economic barriers in all phases of the hydrogen fuel cycle must first be addressed through research and development. The 2004 National Academies' report, *The Hydrogen Economy: Opportunities, Costs, Barriers and R&D Needs,* presents a strategy that could lead eventually to production of hydrogen from a variety of domestic sources—such as coal (with carbon sequestration), nuclear power, wind, or photo-biological processes—and efficient use in fuel cell vehicles.

National Academies Advice on U.S. Climate Change Research

Review of the 2003 U.S. Climate Change Science Program Strategic Plan

Implementing Climate and Global Change Research (2004) reviewed the *Strategic Plan for the U.S. Climate Change Science Program,* released in July 2003. The report finds that the strategic plan articulates a guiding vision, is appropriately ambitious, and is broad in scope. It encompasses activities related to areas of long-standing importance, together with new or enhanced cross-disciplinary efforts. It appropriately plans for close integration with the complementary Climate Change Technology Program. The CCSP responded constructively to the National Academies' review and other community input in revising the strategic plan. In fact, the approaches taken by the CCSP to receive and respond to comments from a large and broad group of scientists and stakeholders, including a two-stage independent review of the plan, set a high standard for government research programs. As a result, the revised strategic plan includes the elements of a strategic management framework that could permit it to effectively guide research on climate and associated global changes over the next decades. Advancing science on all fronts identified by the program will be of vital importance to the Nation. The report recommends that the CCSP implement the activities described in the strategic plan with urgency.

The revised strategic plan identifies a much broader scope of activities than has historically been supported under the auspices of the Global Change Research Program. To succeed, such an expansion in scope will require a concomitant expansion in funding. A fully informed assessment of whether adequate funding is available for the proposed program was not possible because the CCSP did not provide the committee with prospective budget information and because many of the objectives in the plan are too vaguely worded to determine what will constitute success. However, the CCSP budget at the time did not appear to be capable of supporting all of the activities in the strategic plan. While well-established program elements have a track record of funding, the newer or expanded areas in the strategic plan lack clear budget lines and agency homes, and are therefore likely to be under supported. The major expansion in climate modeling and the observing system that the plan calls for will also require an increase in funding above current levels. There is no evidence in the plan or elsewhere of a commitment to provide the necessary funds for these newer or expanded program elements. The report recommends that whatever the budget allocations, the CCSP and its parent committees: (1) develop a clear budgetary process linking tasks to agency and program budgets; (2) secure the financial resources, for the present and the future, that will ensure the overall success of the plan; and (3) consider new approaches to funding that will enable new initiatives and the shifting of resources to respond to the Nation's evolving needs.

Significant hurdles face the CCSP and participating agencies as they implement the strategic plan. First, meeting all program goals will require advances in previously underemphasized but societally relevant elements of the program, including ecosystems, the water cycle, human dimensions, economics, impacts, adaptation,

and mitigation, as well as further development of the program's decision support activities. Second, a clearer strategic approach is needed to achieve the necessary expansion of observation systems and modeling capabilities. Third, the management structure proposed by the CCSP is very complex, will require significant interagency cooperation, and is essentially untested. Fourth, given the political sensitivities associated with climate and associated global change, special measures may be needed to ensure the scientific independence and credibility of the program and its products. The report recommends that the CCSP establish a mechanism for independent oversight of the program as a whole in order to maintain its long-term scientific credibility. Likewise, the CCSP should ensure the credibility of synthesis and assessment products by producing them with independent oversight and review from the wider scientific and stakeholder communities throughout the process. Finally, the CCSP needs to evaluate the available capacity within the community to implement the plan, and address any capacity gaps that are revealed.

The Nation and the global community will be better prepared to address the challenges of climate and associated global changes if the CCSP's vision and overarching goals are achieved. In this effort, the CCSP represents a transition from the science-based Global Change Research Program of the past decade to a program that employs science in the service of societal objectives. While many opportunities exist to improve the plan, as discussed in *Implementing Climate and Global Change Research,* the major challenge ahead is for vigorous implementation.

New National Academies Committee: Strategic Advice on the U.S. Climate Change Science Program

One of the recommendations of *Implementing Climate and Global Change Research* was for the CCSP to establish a mechanism for independent oversight of the program as a whole. In June 2005, CCSP asked the National Academies to establish a committee to provide independent advice on the strategy and evolution of the CCSP. This CCSP Committee will produce annual reports on specific topics mutually agreed upon by the program and the National Academies. Topics to be addressed during the first 3 years likely will include the following:

(1) Strategic advice on program priorities and implementation strategy in the context of scientific and societal objectives, including the identification of high priority program areas not supported in the past;

(2) An evaluation of progress toward meeting the program's goals; and

(3) A high-level review of the program's decision support activities in the context of the program's strategic goals.

The committee also will facilitate, when requested by the sponsor or participating agencies, (1) National Academies' reviews of draft CCSP synthesis and assessment products, (2) National Academies' reviews of draft prospectuses for CCSP synthesis and assessment products, and (3) related analyses to bound the uncertainty associated with the interpretation of scientific findings.

New National Academies Study: Analysis of Global Change Assessments

Assessments of global environmental changes and their effects on humans and ecosystems are increasingly being conducted to synthesize the state of knowledge, inform dialogue about policy and resource management decisions, and guide plans for future research. The scientific community invests significant time into conducting assessments. A better understanding is needed of the strengths and weaknesses of assessment processes and the value of the end products for achieving their overall purposes. This new study, requested by the CCSP in June 2005, will seek to identify lessons learned from a wide range of past assessments to guide future assessment activities of the CCSP. An ad hoc committee will conduct a comparative analysis of past assessments that have stated objectives broadly similar to those of the CCSP. The committee will evaluate several cases chosen to span the range of assessment approaches in terms of geographic scale, subject-matter scope, entity responsible for conducting the assessment, and timing. The committee will provide specific advice about which purposes, approaches, and products are most effective for meeting the CCSP's stated objectives for assessments.

Concluding Remarks

The task of mitigating and preparing for the impacts of climate change will require worldwide collaborative inputs from a wide range of experts, including natural scientists, engineers, social scientists, medical scientists, those in government at all levels, business leaders, and economists. Although the scientific understanding of climate change has advanced significantly in the last several decades, there are still many unanswered questions. Society faces increasing pressure to decide how best

to respond to climate change and associated global changes, and applied research in direct support of decisionmaking is needed.

National Academies Reports Cited in the Testimony

Radiative Forcing of Climate Change: Expanding the Concept and Addressing Uncertainties (2005)

Climate Data Records from Environmental Satellites (2004)

Implementing Climate and Global Change Research (2004)

A Vision for the International Polar Year 2007–2008 (2004)

The Hydrogen Economy: Opportunities, Costs, Barriers and R&D Needs (2004)

Understanding Climate Change Feedbacks (2003)

Planning Climate and Global Change Research (2003)

Novel Approaches to Carbon Management: Separation, Capture, Sequestration, and Conversion to Useful Products (2003)

Abrupt Climate Change: Inevitable Surprises (2002)

Effectiveness and Impact of Corporate Average Fuel Economy (CAFE) Standards (2002)

Climate Change Science: An Analysis of Some Key Questions (2001)

Improving the Effectiveness of U.S. Climate Modeling (2001)

A Climate Services Vision: First Steps Toward the Future (2001)

Energy Research at DOE, Was It Worth It? (2001)

Reconciling Observations of Global Temperature Change (2000)

Adequacy of Climate Observing Systems (1999)

Policy Implications of Greenhouse Warming (1992)

Senator VITTER. Thank you very much, Doctor, now we'll move on to questions from the Subcommittee, I'll kick it off with Dr. Mahoney.

Doctor, I wanted to focus and ask you a few things about climate models. Tell me what climate models you fund through your offices and activities, and something about how we develop those models and validate them—is there an independent validation process? What sort of data is used, and should we use taxpayer funds, generally speaking, for multiple models? What is your general philosophy on that?

Dr. MAHONEY. Thank you, Senator. The Climate Change Science Program, through its agencies, funds model development, evaluation and validation activities, principally through four agencies—that is, through ourselves in NOAA, where the climate models have, in part, grown out of our weather forecasting models, although I stress that the climate model development stands on its own right, and actually is largely conducted in another center, where we work a great deal to make sure that we take advantage of all the lessons learned from the shorter-term weather forecasting, and apply them into the longer-term modeling.

Second, the National Science Foundation has had, for many years, a very significant climate model development activity, largely through its core support for the National Center for Atmospheric Research in Boulder, but that NCAR support, in turn, has emanated out to a very broad-based, what is called, Community Climate Model Development Activity that involves hundreds of climate scientists dealing not only with the computational models, but with the underlying processes that are necessary to capture in the models.

Third, the Department of Energy has a long record of working on climate model development, and continues to do that, and

fourth, NASA also has played a role in significant climate model development, also dating back to the 1980s.

One fair question would be, why have these different groups doing this? I think that is a fair question, but the fair answer I would give is this is such an important area that I view it as an element of sort of the free market development of ideas, it's so important that we get exposed to the best possible modeling capability, that we would not want to put all of our bets on one particular group in an area which is core to the development of national skills here.

Moving on to your question about validation and evaluation. When the prior international assessments, the work of the IPCC, the Intergovernmental Panel on Climate Change, which produced its third assessment in the year 2000, and is scheduled to produce its fourth assessment in the year 2007, and similarly when the national assessment conducted in the United States in the late 1990s were conducted, the models used for those exercises, state-of-the-art at the time, did not include the U.S. models because they were not considered to be as advanced as models available from the U.K., from other European sources, and from the Canadians.

That situation, all modeling, has advanced substantially. I think we certainly believe that the advances in the U.S. modeling capability has really put our modeling efforts really at the forefront of this these days, and we see substantially more skill, and everything we're doing now in the U.S. is based on our models, in close collaboration with our international partners, and even in the IPCC international activity, the U.S. models will be a major contributor, and indeed the U.S. model runs were the first ones completed for use in IPCC assessments underway now.

Just a final word on the validation—the broad issue, of course, is that related to looking back over the past 25 years, or sometimes the past century, to see how well the models work in so-called hindcasting, so we can better understand their ability to forecast going forward, and that activity has proceeded a great deal. At the core, though, is the question of, well, when we fit our parameters, since they're literally hundreds of parameters in the models, are we at risk that we've just parameter-ized, based on past data, so that we don't really have a good forecast going forward?

With that in mind, the modeling community has done a great deal to deal with other methods of validation—looking at regional patterns, looking at shorter-term influences and the like, and in all of this, we've seen major improvement in these models. We have a large model validation effort which runs on a long-term basis, sponsored by DOE at Lawrence Livermore laboratory, and a program on climate model validation and interpretation. That activity is the core U.S. resource in this area that has logged very substantial improvements in recent years. Thank you.

Senator VITTER. Thank you, Mr. Conover, briefly, what are some of the most promising technologies identified by the technology program, and could you briefly describe the technology transfer process, and how it could be improved, if you have any thoughts on that?

Mr. CONOVER. Sure, thank you, Mr. Chairman. The intent of our program is to ensure that we maintain a diversified portfolio of re-

search and development investments, the Federal Government doesn't have a particularly good track record on picking winners in the technology area, and so the idea is to ensure that we are funding a variety of promising technologies that can be brought to the marketplace, and where they will compete against one another in the marketplace, ultimately, then, determining which ones succeed and which ones fail.

The President is committed to the hydrogen fuel initiative, that a child born today has an opportunity to drive a vehicle powered by hydrogen with zero emissions. We've been very successful—the Department through its Energy Efficiency and Renewable Energy program in advancing that goal—very promising area is in carbon sequestration, where we have established a network of seven regional consortia, with the University, state and local governments, industry all grappling with a variety of issues associated with carbon sequestration—what the technology needs to be, what the regulatory framework needs to be, how are we going to make sure that it is acceptable to local communities, *et cetera.* We're very excited about the prospects for the Future Gen Program, which is based on today's technology—integrated gasification and combined cycles for cleaner coal technology, but with an ability to separate out carbon dioxide, and then sequester the carbon dioxide, producing both electric power and a hydrogen stream that can be used for our transportation sector with zero emissions from the power generation itself.

All of these projects are conducted in partnership with the private sector, the contribution of the private sector ranges from about 20 percent to 50 percent in any individual project, and what we have found is that as these technologies become more mature, the fact that the private sector actually has a stake in an individual research and development or demonstration project helps to ensure that the transfer ultimately, of the technology to the marketplace, will be smooth.

We have an ongoing effort on an annual basis to evaluate and monitor our technology transfer activities, both within the Department and through our network of national laboratories, and I think most people are perhaps surprised to learn that the first largest investment in our portfolio is energy efficiency R&D, but the second is deployment. So with respect, I believe, that we have a very good track record on deploying these technologies, obviously things like hydrogen and sequestration are some years down the road, but there is a robust public/private partnership that bodes well for the future and transferring these technologies into the marketplace.

Senator VITTER. Thank you, Mr. Conover, I'll come back to the other witnesses, but let me move on to Senator Lautenberg.

Senator LAUTENBERG. Thank you very much, Mr. Chairman, obviously the subject is a fairly complicated one, global warming, and it needs a fair amount of explanation, but I would ask whenever possible to crystallize, or reduce the answering time so that we can get through the questions, but understand exactly what it is that you're saying. The scientific influences in this are critical, but I come from the world of business, and we always try to get to the bottom line if we can, and that, I think, is the mission here. I notice that there are a substantial number of young people that

cleared the room, and I don't know whether it was something that was said or wasn't said, but the fact is that if we can get it quickly into comprehensible language, it would help.

I would like, Dr. Cicerone, have you seen the Pentagon report that came out in 2003, that presented, or projected, a worse-case scenario in the event of an abrupt climate change, have you seen that report?

Dr. CICERONE. Yes.

Senator LAUTENBERG. What do you think about the veracity, or the value of the conclusions that they make? Do you think this is reliably, scientifically-based?

Dr. CICERONE. I assume we're speaking about the same report.

Senator LAUTENBERG. This is the one that projects significant disaster in the latter part of this century as a result of flooded nations, and people looking for higher ground, and the military responsibility for keeping them off of it.

Dr. CICERONE. At first I saw only press reports about that, perhaps a year and a half ago, and some people in the business community in California asked my opinion of it, so I found a website, dug up part of the report and read it, and I thought that the writers made it pretty clear that they were speaking about plausibilities that were within the realm of possibility, and it was well done. I didn't think that it was fictional, on the other hand, I thought the writers made it clear that they were speaking from a range of possibilities that have been identified, and weren't necessarily saying, "This is exactly what's going to happen," but they did put their finger on some vulnerabilities.

Senator LAUTENBERG. Forecast about flooded nations, I mean, you know, if we look at recent history and October 2003, the Ward Hunt Ice Shelf, the largest ice shelf in the Antarctic broke up. I mean, is this true, or isn't it true? If it's true, what's the significance of something like that?

Dr. CICERONE. Well, the amounts of sea ice and continental ice around the world are enormous. The ones that we would be most concerned about are the ice formations which are now on land, so that if they were to melt, they would increase sea level, the ones that are already floating in the ocean, melting them might have some biological effects, and would, but wouldn't raise sea level. So, there has been a massive effort underway, not as big as it should be, to learn more about the sea ice mechanics, what it's vulnerable to, and studying the climate feedbacks, much in the way that Dr. Mahoney just mentioned about the climate modeling business.

There are different ways to describe and predict the way that these land-held ice amounts will respond in the early days of climate change, and in the later days. And the predictions are not yet very clear—generally speaking, people think that changes will be slow, and inexorable, on the other hand, I'm not convinced that we know enough about the mechanics of this ice to make that prediction. Therefore, the Pentagon report was plausible. We cannot rule it out, we cannot rule out those scenarios.

Senator LAUTENBERG. They talk about things like, in 20 years—and this goes back to February 2004—warned that in the next 20 years, major European coastal cities could sink, beneath the sea, and the military defines a likelihood of its responsibilities in the

second half of this century as in preparing the kind of equipment they need to fight off waves of refugees looking for higher land coming here, and people whose lives are threatened to begin with are going to take any chance they can to climb aboard. Well, I mean, that scene of chaos sounds like something that we see in these movies, Star Wars and so forth, and that is an ominous kind of projection.

Dr. Mahoney, it's been 5 years since the last national assessment of climate impacts report. Can you explain why the Climate Change Science Program failed to produce a report that was due in 2004?

Dr. MAHONEY. Senator, first of all we put our effort—when I came on board at the beginning of 2002, we put our effort into addressing what we believed to be a real core question, which was to assure that we were advancing the science, understanding better issues that were left very uncertain from the time of the prior assessment activity, so that strategic plan is the document I mentioned awhile ago, that was published just 2 years ago, just now, in fact it was released that day, I conducted a large briefing for staff here in the Senate, and a similar briefing the same day for House staff to try to get the word out very quickly. So, we've been on record very clearly with a plan and schedule for the work that we propose to do for 2 years. And we've taken a view in that that we would produce a series of 21 synthesis and assessment reports.

Senator LAUTENBERG. Are these far off the time target that we expected to meet?

Dr. MAHONEY. When we produced the plan, we expected that they would be all prepared within a 4-year period. We still plan to finish within the 4-year period.

Senator LAUTENBERG. Four-year period starting when, Dr. Mahoney?

Dr. MAHONEY. Starting from the time the plan was produced in the middle of 2002, we're now projecting producing all of these, at least, we'll have to make one exception, we're planning to produce most of them by the end of the year 2007, and in correspondence we've sent just recently, because we've been asked for some changes in the coverage on the reports, we have undertaken to agree to include those changes. The result of that is some that were considered to be not directly responsive to the requirements of the law, we have proposed to delay submitting those until the beginning of 2008, because there's only so much work the community can do at one time. But we were originally on a program of producing this through 2007, we're still largely on that program, what slipped was that in the first year of our activity, we fell behind in the expected early production of this, and we're in a catch-up mode for that now.

Senator LAUTENBERG. Because all of these things are fairly long-range, but I think they're imminent because of the prospective problems that we face, and we don't want to continue to put things off, we're spending a lot of money, but the question is whether we're spending it as wisely and as efficiently as we might.

Mr. Chairman, we're going to continue the questioning process.

Senator VITTER. Sure. Thank you, Chairman Stevens?

STATEMENT OF HON. TED STEVENS,
U.S. SENATOR FROM ALASKA

The CHAIRMAN. Thank you very much. Dr. Mahoney, I was saddened to get the call yesterday concerning your possible departure. I want to thank you very much for what you've done, I hope that your departure is not too quick, but I understand that it will come.

I want to thank all of you for responding to my request for additional funds to be released to carry out the continued observation of the temperature changes in the Arctic Ocean. There are three to four icebreakers out there this summer around the circumference of the Arctic Ocean on an international basis. I think the continued use of those to find out what's really happening in the Arctic will be very important in this overall question.

Some years ago, as Chairman of the Appropriations Committee, I took the Committee down to Antarctica, because at the time I noticed the disparity between funding for the Antarctic and the Arctic, and after I visited there, I came back and told you all that the work going on down there should not be disturbed, but we had to find some additional money for the Arctic. I'm still trying to find that money. I have here, I think, they're your documents, the October 19, 2004 Nome storm, which was classified as a 949 milibar cyclone, totally unpredicted, as was the Barrow storm that took place on September 9th of 2003. I do hope we'll find some way to deal with prediction of storms in the Arctic, we have very little capability of doing that right now, and I think the basic global climate changes are more evident in the Arctic, and I would hope we would find some way to implement general forecasting of the weather in the Arctic. If that cyclone happened in California, Dr. Cicerone, we would have known about it by the minute, with this one, we knew it about 2 hours after it happened. I really think we need better prediction and better information for our people with regard to those storms.

Now, one of my basic problems, however, is the question of what to do about the situation in our state. I think as far as the United States is concerned, the evidence of global climate change is more apparent in Alaska than anywhere else. I will request a National Guard aircraft to fly me up the West Coast of Alaska to take a look at that damage that occurred from the storms last year. Very clearly we have to address those issues as the Senator has said, to help protect the people that were involved in the past storms. We need some predictions as to what we should do for the future of the nine villages that suffered the most.

I'm sure you've seen the GAO report, at my request, that indicates at least three of them are in eminent need of some attention. One of the small villages, costs an estimated $200 million to move. I think we've got to figure out a way to relocate some of these villages before they're destroyed—it's easier to move them piece by piece than it is to move them after the disasters occur. One of the basic problems still facing us is whether we have a way to distinguish between natural and man-made causes of global climate change, or warming. How far are we from being able to do that?

Dr. MAHONEY. Well, Senator, I'll take that on for a minute, and I'll try to give a brief, direct answer as Senator Lautenberg advised. I will comment, too, it is my plan to stay on board until my

successor is confirmed, so I hope to be at it for many months, still working with you. While my health has deteriorated some, and I can't go on over years, I don't want to leave any of this open, so I look forward to working with you for quite some time.

On your question about this difference between natural variability and human-caused—first of all, it's important to sort out sometimes there are, what I will call, political arguments that want to go to one extreme or the other, the scientific argument is much more complicated in the middle. There is no question there's natural variability, and I will say very directly, there's also no question that there is an important element of human-caused effects, so the science challenge is to tease out those differences. And it's not especially easy to do at the outset because when you look at the record, it's just a noisy record, and it's a question of how you pull it apart. Even so, the last few years, and even the last two or 3 years have seen substantial progress in being able to better identify the human cause, elements, and some of the work on this deals with regional patterns of temperature change, and salinity change in the ocean that tends to relate to regional factors associated with the carbon dioxide in the atmosphere. So, we're beginning to see from the oceanic record more help in what we call "fingerprinting" of these changes that can be related to human effects.

The same way we see this generally, and when we look at the atmosphere overall, there is now enough information again on doing regional correlations as well as long-term studies to give us a better picture that indicates that in the end, both natural variability and human causes are playing a role, so there is no one can make a statement that it's exactly 50/50 or 40/60 or something, but we have enough information to say human effects are significant, and I would say that's where we are, and without taking the time with long, complicated questions or answers, there is substantially better information to help make this difference, but we will need to continue to sharpen that because it's such an important point, I expect we'll need to sharpen that distinction through these field measurements and model studies in the years immediately ahead.

The CHAIRMAN. Dr. Cicerone, if you look at the information that's available to us, we have a lot more information available from the area you just left in California than we do for the Arctic, but we do have some information coming in about the so-called Atlantic and Pacific Oscillation, and what it may mean in terms of dumping more heat into the Arctic Ocean, how far along is that before people start talking about it? I haven't really heard about it, except from the scientists associated with the International Arctic Research Center in Fairbanks, but are you all looking into this?

Dr. CICERONE. Yes, and I know some individual scientists who are, I wish I could tell you when people will be able to say whether they think the rapid and large warming in the Arctic is more attributable to humans or natural variation. I started out thinking that whatever is going on in the Arctic must be some unknown natural variation, but others in the last few years are telling me no, they think, they're working on ideas that link it more to global warming, I don't see the answer, I don't know if anybody has a definitive answer yet, but because of the dramatic warming, the loss of permafrost, the loss of sea ice, the raised temperatures, the in-

creased growing season length—in the Arctic a lot more people are working on it.

I'm reminded, though, of the ozone layer business that we went through 20 some years ago, where the appearance of the Antarctic ozone hole was totally unexpected, unpredicted, and perhaps a little bit fortunate that the first large damage to the ozone layer occurred over Antarctica rather than over more populated regions. People in New Zealand, Australia, and Southern Chile might disagree because they're dealing with the increased ultraviolet light now, but the reason we didn't predict it—and I remember taking a lot of heat in public lectures—people came up to me and said, "Why didn't you predict this? You never said that it was going to be this bad," is that there were mechanisms, the chemistry of the atmosphere that we didn't understand. All we can do is do the best we can with the available science, and it gets to the question of Senator Vitter about these different models that are being used to do these computations, I think they're absolutely essential to have different sources of funding, different competing scientists, and different approaches to these questions. The seriousness of the Arctic situation is a great example, where the approximations that some scientists are making in the way they solve these equations will be more accurate in the Arctic, or less accurate in the tropics. And the only way to find out is to try different techniques.

In the meantime, the Arctic situation is much more widespread than people realized, the temperature records are showing a warming over the Arctic, a bigger east/west extent, and a longer period of time than any of us knew, it just got more rapid recently.

The CHAIRMAN. Well, how much of it is related to this ocean oscillation, has anyone really measured that?

Dr. CICERONE. That was the biggest initial invest hypothesis, that the so-called North Atlantic Oscillation might have a mode that would lead to some kind of rapid warming every 40 years or so, but I don't think that is turning out to provide all of the answers either. It's still one of the major hypotheses, that we should better map out natural variation, but it doesn't seem to be yielding, it doesn't seem to be explaining what we're seeing completely, at least.

The CHAIRMAN. Well, am I wrong to say that the world seems to be looking to us to examine this because of our scientific community and the way it's funded, as opposed to other areas? For instance, those ships in the Arctic. We're financing those and I thank you for that, someone has to do it. We don't have very much observation in the Arctic, I don't think Canada has a lot, and we're not increasing the emphasis of research or observation there, which I think should be taken into account. I don't want to see us taking anything away from Antarctica, I think that's very important to mankind in the long run. The short run of trying to find out what's going on for us is in the Arctic, everyone says, "Stevens, you're getting another pork barrel."—it has nothing to do with that, it has to do with getting the information we need about what has happened, and get some predictions of what might happen in the Arctic because of the location of our state. Where do we have the ability to act? I don't think many nations do.

Dr. CICERONE. At one time, the former Soviet Union had a very active presence there, I don't think it was as large, so I think your statement is very fair, however, because of the dramatic changes in Alaska and the rest of the Arctic, the Norwegians and English are paying attention and trying to do their part of it, but I think your statement is fair, they're looking to us to do more.

The CHAIRMAN. Thank you very much, I will see if Congress will try, thank you.

Senator VITTER. Thank you, Mr. Chairman.

The CHAIRMAN. I hope you've noticed, we've organized three Subcommittees of this Committee to get into this basic area, and I do want you to know we're going to continue that emphasis as long as I'm Chairman, thank you.

Senator VITTER. Let me go back to Mr. Reifsnyder. You mentioned upcoming climate forums in Montreal and another recently announced in London. What will be the U.S. goals at those meetings?

Mr. REIFSNYDER. Thank you, Chairman. The London meeting, as we understand it, will seek to look at the specific items in the Gleneagles Program of Action, and to try to devise ways and means of taking those forward, so our goal there will be to try to put some flesh on the bones of what was contained in the Gleneagles Program of Action, specifically. As I say, we don't have a great deal more information at the moment, we know that the United Kingdom plans to convene a meeting on the first of November, with respect to the 11th conference of the parties under the U.N. Framework Convention on Climate Change, we have sought in the past two or 3 years to highlight what we're doing with respect to science and technology, we did that at the COP–9 in Milan last year, we sought to highlight what we're doing with respect to our domestic programs, as well as our international programs. We've taken an active approach to these COPs, not just dealing with the issues that come up there, but using them as an opportunity to showcase all that the United States is doing, and I think we will try to take the same approach in Montreal this year.

Now, much of the discussion in Montreal will focus on the entry and into force of the Kyoto Protocol among the parties that have ratified Kyoto. And there were a number of decisions, Kyoto was, in effect, a kind of framework, there was much work that took place under the Framework Convention on Climate Change to prepare for entry into force of Kyoto that has happened, and now those decisions have to be taken up by the meeting of the parties under the Kyoto Protocol, so that will be a large part of the focus in Montreal.

Senator VITTER. OK, thank you. Dr. Cicerone, Chairman Barton over on the House side, recently had some inquiries into the backup data and work behind some of the climate science, and in response to that, you've sent in a letter, and there has been some uncertainty about exactly where you're coming from in the letter in terms of whether you were just offering help to folks involved in Congressional oversight, or whether you were suggesting that oversight belongs somewhere else outside of Congress—could you sort of speak to that, and clarify your letter?

Dr. CICERONE. Yes, I drove across country at the end of June, and all of this was happening while I was driving. When I got here, I received a large number of contacts from scientists around the country, and people who represent them, scientific society, saying they were very concerned with that kind of request, that they hadn't seen anything like it before, and that it's difficult for scientists to go back and get everything that was asked for, and they said, "Is this a new way of doing business?" And I tried to put myself in Congressman Barton's position of trying to get at the bottom of that particular climate record, so I wrote a letter that expressed the concern that had been conveyed to me, that some scientists find it to be intimidating to receive that kind of a letter—by the way, I don't know the three scientists to whom it was addressed, I've never met any one of them, and so I'm not dealing with anything personal here—so the letter basically said, to express concern over the way the letter was being received, and offer any help that we could provide in helping Congressman Barton and his colleagues to get to the heart of this very specialized matter, how you read the climate record of the last thousand years, during most of which time people were not measuring temperatures. And so I offered that we could convene a study to help, if necessary, or to find others to do it for them if they would rather work with somebody else, and we had the letter personally delivered to Congressman Barton last Friday morning.

Senator VITTER. Following up on that, how would you describe a valid oversight role of relevant Committees in the Congress?

Dr. CICERONE. I think that's up to you, Senator Vitter. I suspect that everything the Congressman asked for, he's entitled to ask for, we certainly don't challenge that. What I would really like to get across is science—one of the reasons I've been attracted to it over my lifetime is it's perhaps the only, but one of few human endeavors that is self-correcting. And that we can rely on the method to get at the truth of the matter eventually—we just keep going over things, find independent ways to ask the same question, find answers so what we've volunteered, and hope that the Academy can help with, is to convene an up-to-date group to look at where we are right now, at any point in time, on any question, and give Congress, if it wishes, what we hope is the best available information. I'm sure part of your role is getting that information one way or the other.

Senator VITTER. OK, Doctor, and one other question. Recently, as you know, there was some controversy regarding a recent joint Science Academy statement, and how it was characterized by different parties, and specifically, the British Royal Society's characterization, could you sort of speak to that?

Dr. CICERONE. Yes, in fact, some of you may have seen the exchange between my predecessor who just left town a couple of weeks ago, with the head of the Royal Society where we objected to the way they characterized the statement that the Science Academies from the G8 nations, and India, and China, and Brazil had agreed to, we thought that the press release went beyond what we had agreed to, and we were surprised by the timing of it. But the intention of the Science Academies of these nations is driven by the hope and the belief that a scientific reading of scientific data of any

situation will be helpful to our governments, so there will probably be more efforts of these Academies to work together in the future on such statements, guided by the lessons of this time, I hope.

Senator VITTER. And have those lessons been agreed to within the Societies? Has their been a response from the British Royal Society that is satisfactory to you, or are you still frustrated by the experience?

Dr. CICERONE. A little frustrated, we have some work to do.

Senator VITTER. Senator Lautenberg?

Senator LAUTENBERG. Thanks, Mr. Chairman.

Dr. Cicerone, you said that the melt on land—if I understood you correctly—was more significant as you looked at it now, then the sea melt, because the sea melt couldn't yet be fully assessed, but do I generally phrase correctly what you've said?

Dr. CICERONE. And one raises the sea level, and the other doesn't.

Senator LAUTENBERG. Right. But, when we look at Glacier National Park, and Kilimanjaro, and places like that, that were homes for ice and snow, and now they're almost barren, that's a pretty worrisome indicator, is it not?

Dr. CICERONE. Inland glaciers generally are disappearing around the world, perhaps not at the rate of Kilimanjaro, but yes.

Senator LAUTENBERG. And that portends problems in a disturbed ecology, the Union of Concerned Scientists in 2004 released a critical report on the Administration's use of science in forming policy, and the report was signed by 64 scientists, including 20 Nobel Laureates. And part of the criticism evolved around something, Dr. Mahoney, about changes to the references, EPA, to remove references in a report to the 2001 National Academy of Science study, that confirmed that Intergovernmental Panel on Climate Change finding human activity is contributing to climate change, and to insert instead a discredited study of temperature records that were funded, in part, by the American Petroleum Institute.

I wrote you a letter on June 29, requesting that you remove from NOAA's website, two reports on climate change which were altered by a former member of the White House staff, and I thank you for your written reply. But it's not clear to me from your response whether changes made by Mr. Cooney, the gentleman in question, and approved by non-partisan scientists, did scientists sign-off on Mr. Cooney's changes?

Dr. MAHONEY. Senator, I think the short, simple answer is yes, in particular in the sense that all of the edit comments we receive come back and are vetted by our core office, and by me. It's a responsibility I have, and the other key staff who work with me on that are all Ph.D. level scientists.

Senator LAUTENBERG. So, it was OK to alter the report as it was produced?

Dr. MAHONEY. Well, Senator, there was no alteration of the report, the phrasing you're using makes it sound like a report was prepared and then it was changed by this person. The fact is that a draft was prepared, and that draft was circulated to the representatives of all 13 agencies who take part in the program, as well as representatives of OMB, and CEQ, and OSTP, all White

House functions, so basically, everything we produce first exists as a draft, then it goes to 16 addresses.

Senator LAUTENBERG. So, you're satisfied, Dr. Mahoney, that the hand of science was firmly imprinted on that report as it finally came out? Because you suggest that a draft was only a draft, but this isn't a novel, a fictional novel that is being written and someone is editing, I mean, I assume that we're dealing with facts, determined, developed in the production of the draft, is that not so?

Dr. MAHONEY. Well, that's true, however, the principle of the two documents—the one that we're speaking about—is the strategic plan I mentioned earlier. That plan was not a statement of fact or finding, it was a statement of our planned work program over the years ahead, so that is not the same thing as a document that would be saying, "Here are our key findings about climate change," it was, instead, "Here's our work plan." And that work plan was very heavily commented on by all 16 of those entities that I mentioned, the 13 agencies and the three White House offices.

Senator LAUTENBERG. I thank you for that explanation. The Union of Concerned Scientists, are they a reliable organization?

Dr. MAHONEY. Yes, I think they're an advocacy organization, but that doesn't mean they're unreliable, but sometimes advocacy organizations——

Senator LAUTENBERG. What do you think of them, Dr. Cicerone? Are they a lobbying organization more than they are a science organization?

Dr. CICERONE. They're pretty activist. A lot of great individual scientists work with them, so I certainly don't dismiss them, but I do know they're pretty activist.

Senator LAUTENBERG. Which says that what they issue is not necessarily unbiased, scientific discovery?

Dr. CICERONE. No, I think they use a record that can be checked, so I think they try to use a scientific method. I think that the topic that they've been concerned about is their reading that science advice generally hasn't been used as much in the last decade as previously, so this is part of their view, a lot of scientists feel that way.

Senator LAUTENBERG. OK, but what they would produce, or they would publish, would be fairly well based on scientific knowledge, and it wouldn't be largely on advocacy, kind of mission, but would they be stimulated to produce a report based on the knowledge of science?

Dr. CICERONE. I think so, and they usually document what they say.

Senator LAUTENBERG. OK. So, Dr. Mahoney, if the commentary that accompanied their criticism, or their information developed as a result of a change in the report, the National Science Association, the NAS study that confirmed the Intergovernmental Panel on Climate Change finding that human activities contributing to climate change, and to insert a discredited study of temperature records that was funded, in part, by the American Petroleum Institute—are you aware of that assertion?

Dr. MAHONEY. Senator, I'm not aware of the specific assertion, what I do know is that the Union of Concerned Scientists has written at least one broad letter criticizing the use of science in this

Administration. I know that the Union of Concerned Scientists also expressed displeasure, and I think it may have been in a written document about information in an EPA document that dealt, in part, with climate issues. I'm not aware of any written statement or even verbal statement from the Union of Concerned Scientists about the documents for which I'm responsible in the Climate Change Science Program, so I don't have the basis to respond directly, I'm not aware of it.

Senator LAUTENBERG. I just want to confirm something and I'll turn the podium back to the Chairman, but you feel that what Mr. Cooney did, that to your knowledge, you're familiar with the changes?

Dr. MAHONEY. Absolutely, the comments he made——

Senator LAUTENBERG. They were approved by those with a science background? People who understood and saw no harm or no change of materiality in the changes that he'd made?

Dr. MAHONEY. Well, I think you're asking a question, sort of, with two parts. One, were they approved, and then saying, did anybody see any change, any materiality? I don't want to parse the words too much.

Senator LAUTENBERG. That's not for us to argue, but I'm not talking about the process, I'm talking about the outcome. Were Mr. Cooney's comments, you said they were vetted by those who have science as their background?

Dr. MAHONEY. Yes.

Senator LAUTENBERG. And that there were not significant, there were no changes as a result of his comments. He's not in the Administration any longer, as we know.

Dr. MAHONEY. That's correct, he's not in the Administration. He, like many other commenters, made a very large number of suggested edits to these draft reports, and our job after getting those draft edits from everyone was to consider them all, and then to recast the report, making our best judgment about the right things to say and the right science. I've now done two stints in government dealing with this kind of interagency work, I did this with acid rain back in the late 1980s, too, and in both of these cases, basically every document that is produced goes for review by all of those who might want to comment on it, but then it all comes back, so that someone is responsible for deciding what comments to accept or partly accept, or reject, and I would say specifically, relative to Mr. Cooney's comments, they came, sometimes, to others first, but they all come to me. So that document, at the end of the day is my responsibility.

Senator LAUTENBERG. And you're confirming you were satisfied with the changes you made?

Dr. MAHONEY. To get to the core of it, absolutely. I confirm that I am——

Senator LAUTENBERG. That you endorse it?

Dr. MAHONEY. I endorse it.

Senator LAUTENBERG. Thank you very much, Dr. Mahoney.

Senator VITTER. All right, I want to thank all of our witnesses again for your participation in this hearing, we certainly appreciate it. We'll also be sending along some follow-up written questions,

and would appreciate those answers so we can consider them and make them part of the record.

[Whereupon, at 11:35 a.m., the hearing was adjourned.]

A P P E N D I X

RESPONSE TO WRITTEN QUESTION SUBMITTED BY HON. DANIEL K. INOUYE TO HON. JAMES R. MAHONEY

Background: The recent announcement of a new Asian-Pacific climate pact involving India, China, and the U.S. highlights the important role of international collaboration in climate change policy and in the scientific research that will continue to improve our understanding of the consequences of changes in climate for communities, governments, and businesses in the Asia-Pacific region and throughout the world. As you know, the State of Hawaii is home to a number of scientific institutions and programs that will be important assets as the U.S. moves forward with this new Asian-Pacific climate pact including, for example: the International Pacific Research Center (IPRC) at the University of Hawaii; the NOAA Joint Institute for Marine and Atmospheric Research (JIMAR); the East-West Center; the new NOAA Integrated Environmental Applications and Information Center (NIEAIC); and a number of ongoing NOAA-supported programs such as the Pacific Islands Regional Integrated Science and Assessment (RISA) program, NWS international weather and climate research and services, and regional contributions to environmental observing system programs such as the Global Climate Observing System and the Global Ocean Observing System.

Question. Please describe the Administration's plans, with specific focus on NOAA's plans, for engaging these assets in support of the observations, research, modeling, and assessment programs that will be necessary to support the new Asian-Pacific climate pact as well as other regional and international climate agreements in the region such as the U.S.-New Zealand and U.S.-Australia Climate Change Science bilaterals and the long-standing science bilateral with Japan.

Answer.

Asia-Pacific Partnership

The Asia-Pacific Partnership on Clean Development and Climate (AP–6) and the activities NOAA are involved with such as the United States Group on Earth Observations (USGEO) are two separate programs with separate objectives. The AP–6 is a public/private partnership for addressing the challenges of assuring economic growth and development, poverty eradication, energy security, pollution reduction, and mitigating climate change. The U.S. joined by Australia, China, India, Japan, and South Korea, are actively engaging leaders in the private sector in our various countries to develop and implement programs and projects that implement the objectives of AP–6 while making good business sense. This creative partnership is unique because it made up of 6 countries with common energy needs, and because of the substantial private sector involvement.

NOAA, through its leadership of the United States Group on Earth Observations (USGEO), plans to work with the 15 other agencies and 3 White House offices to identify parameters for measuring success in energy efficiency and emissions reduction. These parameters could include emissions output, energy consumption, particulate matter and air quality, weather conditions affecting energy load, etc. Tools such as those being developed through the USGEO should prove very useful to initiatives such as the Asia-Pacific Partnership.

Working through the international mechanism, the intergovernmental Group on Earth Observations (GEO), which is co-chaired by the U.S. (Under Secretary Lautenbacher) and China, and in which all 6 Asia-Pacific Partnership countries participate, the United States can provide leadership in establishing common data formats for measuring like parameters in each country by providing a trusted, but verifiable metric. Common formats will ensure more accurate performance measures.

Pacific Climate Science and Information Services

NOAA and its extramural partners at the East-West Center, the University of Hawaii (including the International Pacific Research Center, the School of Ocean

and Earth Science and Technology, and the Social Science Research Institute), the University of Guam, and other agency partners continue their substantial collaboration toward the development of an integrated, regional climate information system for the Pacific.

The Pacific climate information system will engage and build on a strong legacy of ongoing programs including:

- The Pacific ENSO (El Niño Southern Oscillation) Applications Center (PEAC) which delivers ENSO-based climate forecast and applications services to the American Flag and U.S.-Affiliated Pacific Islands in the Pacific and represents a key node in the emerging WMO Regional Climate Centre for the Pacific;
- The Pacific Regional Integrated Science and Assessment (Pacific RISA) program designed to understand and reduce regional vulnerability to climate-related extreme events (*e.g.,* droughts, floods, and tropical cyclones) through a number of program objectives including: sustained, interactive dialogue with decision-makers in climate-sensitive sectors; enhanced regional efforts to develop and apply climate forecasts and information products; develop enhanced data and information products that address the nature and consequences of climate-related extreme events; and adapt and apply model-based decision support tools and techniques designed to more effectively manage the risks associated with climate-related extreme events; and
- NOAA's climate information services in the Pacific are being coordinated with the efforts of other Federal, state, and local agencies, regional organizations and scientific partners in universities and the private sector).

U.S. Climate Science Bilateral Agreements in the Pacific

Since 2003, the U.S. (led by the State Department) has entered into a number of important bilateral climate agreements. Specifically, the U.S. GCOS Program Office is involved in funding projects with Australia and New Zealand that directly relate toward furthering the progress of GCOS and GOOS in the region. The bilateral projects cover a wide range of projects dealing with climate prediction, ocean observing, stratospheric detection, water vapor measurements, capacity building and training, and communication of information, and will focus the attention and resources of all these countries toward developing a more sustainable and robust GCOS program.

For example, in conjunction with the National Institutes of Water and Atmosphere (NIWA) in New Zealand, there are now two new projects which have been implemented on a long-term basis. The first one involves the implementation of a global stratospheric water vapor measurement station in Lauder, New Zealand. A second significant project involves the implementation of a new ship track for trace gas measurements, which has been implemented on a car carrier ship on a route between Nelson, New Zealand, and Nagoya, Japan. This is a brand new route and is unique in that it crosses both the Intertropical and South Pacific convergence zones.

RESPONSE TO WRITTEN QUESTIONS SUBMITTED BY HON. JOHN F. KERRY TO HON. JAMES R. MAHONEY

Question 1. Given that we now know, as the President has said, that "the surface of the Earth is warmer and that an increase in greenhouse gases caused by humans is contributing to the problem," when does the Administration intend to produce a plan to reduce emissions and stabilize the concentrations of greenhouse gases in the atmosphere?

Answer. The goal of the Climate Change Science Program (CCSP) is to advance the science and provide scientific results that can be used to *support* policies and planning to address climate change for policymakers. In fact, CCSP recently held a public workshop on Climate Science in Support of Decision Making,[1] which drew more than 700 participants from the research, decisionmaking, and international communities, as well as students, users, and individuals interested in the applications of climate science. The workshop included discussion of decision-maker needs for scientific information on climate variability and change, as well as expected outcomes of CCSP's research and assessment activities that are necessary for sound resource management, adaptive planning, and policy formulation.

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[1] *http://www.climatescience.gov/workshop2005/default.htm.*

Over the past few years, several actions—in addition to the roughly $2 billion annual investment in science—have been taken by the Administration to address the reduction of greenhouse gas emissions and concentrations, which include:

- Setting a national goal to reduce greenhouse gas intensity by 18 percent by 2012.
- Asia-Pacific Partnership for Clean Development and Climate.[2]
- Energy Policy Act of 2005, which includes $9.2 billion in tax incentive over the period of 2005–2015 and other important provisions that will promote new, cleaner technologies.
- Reaffirming the commitment to the United Nations Framework Convention on Climate Change and regular participation in the Conference of Parties meetings.
- Approximately $2 to $3 billion in annual investments into the development and deployment of transformational technologies through the Climate Change Technology Program.[3] Key research and development areas are included in the President's Advanced Energy Initiative: biomass, solar, wind, hydrogen, nuclear, and clean coal. CCTP deployment programs include Climate VISION[4] (Voluntary Innovative Sector Initiatives: Opportunities Now), Climate Leaders,[5] and SmartWay Transport Partnership.[6]
- Leadership in the Group on Earth Observations[7] and the development of the Global Earth Observation System of Systems.
- United States Department of Agriculture's conservation programs, which provide incentives for actions that may increase carbon sequestration.
- Increased fuel economy standards for new light trucks and sport utility vehicles by 1.5 miles per gallon over the next three model years.

Question 2. If you do not intend to do so, I want to point out that the National Academies of Science said: "[L]ack of full scientific certainty about some aspects of climate change is not a reason for delaying an immediate response that will, at a reasonable cost, prevent dangerous anthropogenic interference with the climate system." What specific scientific questions does the Administration need answered before it is convinced that we need such a plan to reduce emissions and stabilize concentrations?

Answer. A key finding of the 2001 NAS report on climate science requested by the President was as follows: "While scientific uncertainties remain, we can begin now to address the factors that contribute to climate change." Key scientific uncertainties being addressed by the Climate Change Science Program include:

- How much humans contribute to climate change (*i.e.,* what percentage of the warming is contributed by humans versus natural variability)?
- How much of the change in climate is reversible?
- How effective would various mitigation and adaptation strategies be?

In addition, the President stated in 2001 that the Academy's report tells us that we do not know how much effect natural fluctuations in climate may have had on warming. We do not know how much our climate could, or will change in the future. We do not know how fast change will occur, or even how some of our actions could impact it. CCSP is addressing these questions as well.

Despite not having answers to these key questions, the Administration, as explained in response to *Question 1,* has already invested in several programs and has provided tax incentives to slow the growth of greenhouse gas emissions. Our approach draws upon the best scientific research, harnesses the power of markets, fosters the creativity of entrepreneurs, and works with the developing world to meet shared aspirations for our people, our economy, and our environment.

Question 3. Eleven national science academies (including the U.S. National Academy of Sciences) said in their statement issued on 7 June 2005: *"It is likely that most of the warming in recent decades can be attributed to human activities."* Do you agree with this statement?

Answer. Since 2001, the President has stated that humans are contributing to changes in climate. However, as explained in response to *Question 2,* there are still

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[2] *http://www.whitehouse.gov/news/releases/2005/07/20050727-11.html.*
[3] *http://www.climatetechnology.gov.*
[4] *http://www.climatevision.gov.*
[5] *http://www.epa.gov/climateleaders.*
[6] *http://www.epa.gov/smartway.*
[7] *http://earthobservations.org/.*

uncertainties around how much humans are contributing versus natural variability and what types of strategies will be most effective.

Question 4. The National Academy of Sciences' review of the new CCSP strategic plan was particularly glowing. In your written testimony you highlight this fact with an extended quote from the review. Left out of your excerpt, however, is NAS' conclusion that the CCSP budget did not appear sufficient to meet all of the goals in the strategic plan. If the President's climate budget is enacted unchanged, the CCSP budget will have shrunk by $84 million, or 4 percent, from Fiscal Year 2004 enacted levels. How will these cuts alter implementation of the strategic plan that was so well received by the National Academies?

Answer. CCSP priorities are reviewed on an annual cycle through the budget process. A critical function of CCSP is coordinating the CCSP budget across the 13 CCSP agencies. In Fiscal Year 2006, this coordination process involved the alignment of agency climate programs with the goals and key research focus areas in the CCSP Strategic Plan, thus helping to ensure consistency. The emphasis is on ensuring alignment of current funding with a recommended list of priorities and identifying gaps that may occur, as well as identifying measurable milestones and deliverables that reflect accountability toward meeting program goals.

Each year, we expect that agency budgets will fluctuate. Thus, the current CCSP program is a high-priority selection of activities that merit continued support. However, new initiatives are required to move in directions identified in the CCSP Strategic Plan. CCSP must maintain key research activities, while encouraging innovation in a constrained budget environment. There is a need for continuing evolution of program priorities and activities through new initiatives, the competitive grant process within agencies, and other evolutional redirection reflecting new focus areas for high-priority research in climate science.

Question 5. Could you elaborate on the different activities undertaken by the Climate Change Research Initiative and the U.S. Global Change Research Program? How are they different?

Answer. The U.S. Global Change Research Program (USGCRP) supports research on the interactions of natural and human-induced changes in the global environment and their implications for society. The USGCRP began as a Presidential initiative in 1989 and was codified by Congress in the Global Change Research Act of 1990, which mandates development of a coordinated interagency research program. USGCRP organized its research in seven areas: Atmospheric Composition, Climate Variability and Change, Global Water Cycle, Land-Use and Land-Cover Change, Global Carbon Cycle, Ecosystems, and Human Contributions and Responses.

The Climate Change Research Initiative (CCRI) was launched by the President in 2001 with four key priorities: (1) to reduce significant uncertainties in climate science; (2) improve global observing systems; (3) develop science-based information resources to support policymaking and resource management; and (4) communicate findings broadly among the international scientific and user communities.

The Climate Change Science Program (CCSP) was announced in 2002 with strong focus on advancing scientific understanding of global climate change, as well as coordinating and integrating scientific research on global change and climate change sponsored by 13 Federal departments and agencies. This new structure required CCSP to incorporate and integrate the long-standing work of USGCRP and the more recent research organized within CCRI.

As CCSP has evolved, the four CCRI priorities continue to form the basis for the nine priorities areas of CCSP overall for Fiscal Year 2006. However, there is still a current budget line for CCRI, as displayed in *Our Changing Planet,* the annual report to Congress. The CCRI line budget totals include research specifically to reduce uncertainties in the areas listed above. For example, CCRI line items for NOAA in Fiscal Year 2006 include Global Climate Observing System and Global Ocean Observing System to support the CCRI priority to improve global observing systems. The USGCRP line items for NOAA in Fiscal Year 2006 include Global Carbon Cycle and Atmospheric Composition research which are two of the seven science elements established under USGCRP. These topics are not necessarily mutually exclusive, but specific research items under each program determine how they are reported for budget purposes. Both the CCRI and USGCRP lines make up the CCSP totals.

Question 6. What contribution is the CCSP making to the Global Earth Observation System? Please be specific in terms of both money and other programmatic support.

Answer. Under NOAA's Climate Change Research Initiative (CCRI) budget line for the support of atmospheric Global Climate Observing System (GCOS) networks, the U.S. remains committed to improvements in the management and operation of

GCOS and GCOS-related atmospheric and oceanographic networks in line with the GCOS Implementation Plan approved in October 2004 (see *http://www.wmo.int/web/gcos/gcoshome.html*). GCOS is an international program with inputs from many countries as well as U.S. Government agencies. The U.S. National GCOS Report done in 2001 was a multi-agency effort. GCOS also serves as an organizing focus for the CCSP's Observations Program. Finally, GCOS is the formal climate component of the Global Earth Observations System of Systems (GEOSS) and forms the basis for the Climate component of the U.S. Strategic Plan for the Integrated Earth Observations System.

NOAA's U.S. GCOS Program Office, which represents the U.S. on the GCOS Cooperation Board, has committed to leading the way for facilitating improvements in the management and operation of GCOS and GCOS-related atmospheric networks. The U.S. GCOS Program Office has taken leadership, working with our partners at the World Meteorological Organization, in further GCOS improvements. The U.S. GCOS Program Office has been the catalyst for revitalizing the GCOS Cooperation Mechanism process by organizing the second meeting of the GCOS Cooperation Donor Board that took place on November 30, 2005, in Montreal, Canada, in conjunction with the meeting of the United Nations Framework Convention on Climate Change. This work began in Fiscal Year (FY) 2003 and plans are for continued efforts in this area for the foreseeable future. The GCOS program reflects a broad-based approach that looks at supporting observing and data management activities at the international, regional, and bi-lateral levels. In addition, support for Pacific Islands Ocean and Climate observing regional coordinators in Fiji and Samoa to aid in coordinating these observing activities among developing countries in the region has been a great boost toward capacity building in that critical region.

Support for developing nations has primarily been to retrofit surface and upper air observing stations that had been silent but are key to global climate monitoring activities. Countries that have received new equipment and resources over the past 2 years include: Argentina, Armenia, Congo, Cook Islands, Costa Rica, Ecuador, Ivory Coast, Kenya, Maldives, Namibia, the Philippines, and Zimbabwe. In addition, and in cooperation with the U.S. State Department, a number of workshops for enhancing climate change monitoring in support of the Intergovernmental Panel on Climate Change (IPCC) have or are being staged in South Africa, southern South America, northern South America and Central America, Southwest Asia, Southern Asia, and Southern and Eastern Africa. These workshops are all hands-on, involving seminars and hands-on work with data from the various countries in attendance. In addition, the State Department has been instrumental in aiding the establishment of regional GCOS maintenance facilities which have been established in the Pacific and the Caribbean. In 2005, a third regional GCOS Maintenance Center was established in Botswana to aid in monitoring and maintaining GCOS equipment in Eastern and Southern Africa. The maintenance centers have demonstrated real progress in improving the performance of GCOS in those three regions.

The support provided is used to: (1) Support the operations of the GCOS Secretariat; (2) stage GCOS regional workshops in developing countries; and (3) support critical GCOS data management activities at the GCOS Lead Data Center at NCDC in Asheville, North Carolina. The Fiscal Year 2005 budget of $3.5M continued the work begun in 2003 and 2004 and expanded support to GCOS Upper Air Network observing sites in Argentina, Armenia, Congo, Cook Islands, Costa Rica, Ecuador, Ivory Coast, Kenya, the Maldives, Namibia, the Philippines, and Zimbabwe.

Over the past decade NOAA has worked with national and international partners to begin building a sustained global ocean system for climate, focusing first on the tropical Pacific, and expanding to the Atlantic and the Indian Oceans. It is now well understood that documenting and forecasting climate will require continuous measurements from space, along with the measurements obtained from instruments deployed across the entire global ocean. The present international effort is about 51 percent of what will ultimately be needed for the global system. NOAA presently maintains approximately 60 percent of the *in situ* networks and 30 percent of the space components, and is committed to the goal of providing at least 50 percent of the composite system over the long term. The existing foundation is comprised of twelve complementary *in situ,* space based, data and assimilation subsystems: (1) Global Tide Gauge Network; (2) Global Surface Drifting Buoy Array; (3) Global Ships of Opportunity Network; (4) Tropical Moored Buoy Network; (5) Argo Profiling Float Array; (6) Ocean Reference Stations; (7) Coastal Moorings; (8) Ocean Carbon Monitoring Network; (9) Arctic observing System; (10) Dedicated Ship Operations; (11) Satellites for Sea Surface Temperature, Sea Surface Height, Surface Vector Winds, Sea Ice, and Ocean Color; and (12) Data and Assimilation Systems and their products.

NOAA's plan includes an additional element—System Management and Product Delivery—to focus program resources on answering the Nation's highest priority policy- and economically-relevant questions. The global ocean observing system, when fully implemented, will provide specific ocean outcomes such as data sets that can be used to drive forecast models, and analysis products describing the present state of the ocean, how the present state compares with the past, and the confidence/uncertainty in the analysis. NOAA's contribution to this global implementation is represented in the program budget profile illustrated in Appendix B. Implementation of this program plan demonstrates to the world community that the United States is taking action to observe climate, is playing a leadership role in achieving global coverage of the ocean networks, and is committed to sustained operations.

The progress that the U.S. GCOS Program has made over the past few years was recently recognized by the United Nations Framework Convention on Climate Change (UNFCCC). In September 2004, the UNFCCC Secretariat published an In-depth Review (IDR) of the Third National communication from the U.S., entitled "*U.S. Climate Action Report—2002 (Climate Action Report 3)*". The IDR was performed by an independent review team on behalf of the UNFCCC and is now available online at *http://unfccc.int/resource/docs/idr/usa03.pdf. Climate Action Report 3 (CAR3)* can be found online at *http://unfccc.int/resource/docs/natc/usnc3.pdf.* The IDR had a number of findings related to *CAR3,* however the U.S. GCOS program was specifically identified in findings 130 and 131 on pages 28–29 of their report as follows:

> 130. The United States has one of the most impressive national Global Climate Observing Systems (GCOS) for climate monitoring in five distinct yet integrated areas. The system acquires detailed local and large-scale national data, including observation of environmental variables, representing a major contribution to the Integrated Global Observing Strategy.
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> 131. The review team was informed that NOAA has formulated a framework for international GCOS support. It focuses on needed improvements to meteorological surface-based networks and on the GCOS terrestrial and oceanic surface-based and satellite-based observation networks. NOAA has identified nine activities that it proposed to launch in 2003 in association with the GCOS Secretariat, with a total spending of USD 4 million annually. Additional funding for rescue and digitization of long-period observational data in Africa and Asia is also provided. The provision of these datasets comprises a major contribution to the science of climate change, and is likely to enhance the Intergovernmental Panel for Climate Change (IPCC) process. The review team noted a NOAA initiative for the development of radio and Internet-based climate information dissemination tools for rural farmers in developing countries.

The work undertaken by the U.S. GCOS Program is consistent with the G8 Gleneagles Plan of Action on Climate Change, Clean Energy, and Sustainable Development issued in July 2005; item number 34 from that plan addresses particular needs with respect to GCOS that the U.S. program will continue to work on.

> The G8 made a commitment at Evian to strengthen international cooperation on global Earth observations. We will continue to exercise leadership in this area, and welcome the adoption of the 10-year implementation plan for development of the Global Earth Observation System of Systems (GEOSS) at the Third Earth Observations Summit which took place in Brussels in February this year. We will: (a) move forward in the national implementation of GEOSS in our member states; (b) support efforts to help developing countries and regions obtain full benefit from GEOSS, including from the Global Climate Observing System (GCOS) such as placement of observational systems to fill data gaps, developing of in-country and regional capacity for analysing and interpreting observational data, and development of decision-support systems and tools relevant to local needs; (c) in particular, work to strengthen the existing climate institutions in Africa, through GCOS, with a view to developing fully operational regional climate centres in Africa.

In summary, the inception of the U.S. GCOS Program Office in 1999, coupled with the resources provided via the CCRI program has led to a robust and active U.S. GCOS program. The program has been working with a number of partners in order to provide support across a broad range of international, regional, and bi-lateral climate activities that are leading to progress for GCOS in-line with the overall GCOS Implementation Plan. Appendices A and B of this document details the amount of funding contributed toward GCOS from Fiscal Year 2003–05, including more than

$12.3M for atmospheric climate observing support and more than $43.4M for ocean climate observing support.

APPENDIX A

Summary of U.S. GCOS Support for FY 2003, FY 2004 and FY 2005

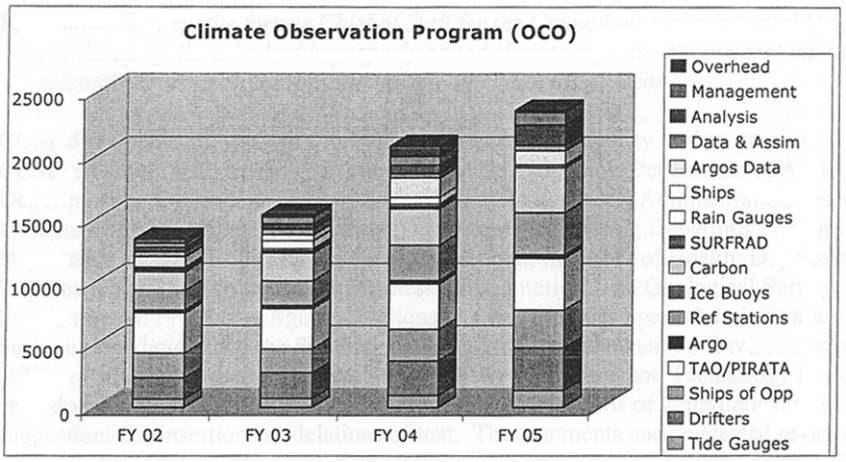
[NOAA and State Dept Funds]

Support Area	Funding Level	Activities Supported
FY 2003		
GCOS Upper Air Network (GUAN)	$1650K	7 Sites Upgraded with Radiosonde Support
Atmospheric Brown Cloud (ABC)	$1462K	New ABC Observatory Support
Regional Maintenance	$500K	Regional GCOS Maintenance (*e.g.,* spares, radiosondes) for RA–I; RA–IV; and RA–V)
Global Atmosphere Watch (GAW) Aerosol Observations	$300K	Enhanced Observing Equipment for South Africa and China GAW Stations
GAW	$215K	Support for North American QA/SAC #
Data Management	$189K	Support for National Climatic Data Center as a Global GCOS Data Center
GCOS Secretariat	$150K	Support for Full-Time Equivalent GCOS Implementation Project Manager
GCOS/IPCC Workshops	$108K	4 Climate Workshops in RA–I, RA–II, RA–III, and RA–IV
GAW	$100K	Regional Ozone Calibration Facility for South America
Regional Activities, and Other GCOS-related Support	$100K	GCOS regional workshop in South America, upper air site surveys, and Pacific Region GCOS/GOOS support
Administrative Travel	$7K	ABC Science Panel Meeting for 2 persons
Total	$4853K	
FY 2004		
GUAN	$1475K	10 Sites Upgraded with Radiosonde
ABC	$1398K	New ABC Observatory Support
GCOS/IPCC Workshop Support	$225K	Climate Workshop in India (and associated IPCC software work)
GAW	$215K	Support for North American QA/SAC #
Data Management	$202K	Support for Global GCOS Data Center
Bi-Lateral Support	$180K	Pacific GCOS Support
Global Observing System Information Center	$125K	GCOS Data Management
Regional Support	$115K	Regional GCOS-related activities
GCOS Secretariat	$110K	Support for GCOS Secretariat
GCOS Surface Network (GSN)	$56K	Prototype high-altitude GSN site
Total	$4099K	
FY 2005		
ABC	$1398K	New ABC Observatory Support
GUAN	$535K	4 Sites Upgraded with Radiosonde
U.S. GCOS Office Support	$375K	Travel and Salaries
GSN Support	$350K	4 Prototype Reference Sites in AK and HI
GAW	$265K	Support for North American QA/SAC #
Bi-Lateral Climate Support	$250K	Pacific GCOS Support
Data Management	$200K	Support for GCOS Lead Data Center
Global Observing System Information Center	$125K	GCOS Data Management
Full-Time GCOS Implementation Manager at GCOS Secretariat—Geneva	$110K	Salary and Travel for Project GCOS Project Improvement Projects
Regional Support (Pacific)	$95K	Regional GCOS-related activities

Summary of U.S. GCOS Support for FY 2003, FY 2004 and FY 2005—Continued
[NOAA and State Dept Funds]

Support Area	Funding Level	Activities Supported
Central UV Calibration Facility	$40K	Critical Support for Baseline Surface Radiation Network now Radiation Component of GCOS
Total	$3743K	

APPENDIX B—GLOBAL OCEAN CLIMATE OBSERVATIONS SUPPORT



Question 7. The scientific and international communities have found it very useful to have a single document, such as the IPCC Third Assessment report, to point to as a universal overview of climate science knowledge. In a recent letter addressed to this committee you suggest that the conclusions of all 21 CCSP assessments will be summarized in a standard programmatic progress report, presumably in 2007 or 2008. This hardly seems like the appropriate place for establishing a true synthesis of all the knowledge gained over the previous seven or 8 years. Why has the CCSP elected not to produce a single synthesis volume?

Answer. The current position of the Climate Change Science Program is to incorporate a summary of findings of all completed products required by the 1990 Global Change Research Act in our annual *Our Changing Planet* report to Congress, starting in 2006. The CCSP assessment activity is an ongoing process, and this is the most efficient mechanism to disseminate summaries of each completed product. The alternative would be to wait for the completion of the entire set of 21 products before beginning the preparation of a single summary document. While CCSP is committed to providing timely dissemination of the summary information on an annual basis through the mechanism of the existing OCP series, we will seriously consider the question of providing a single summary document upon the completion of the series of 21 Synthesis and Assessment documents.

Question 8. Phillip Cooney, the former Chief of Staff for the Council on Environmental Quality resigned amidst allegations he had improperly edited climate reports. Do you feel his editing of a scientific report was appropriate for an official in his position?

Answer. CCSP documents are produced through a customary interagency review process. The thirteen CCSP agencies (U.S. Agency for International Development; Department of Agriculture; Department of Commerce, National Oceanic and Atmospheric Administration and National Institute of Standards and Technology; Department of Defense; Department of Energy; Department of Health and Human Services, National Institutes of Health; Department of State; Department of Transportation; Department of the Interior, U.S. Geological Survey; Environmental Protection Agency; National Aeronautics and Space Administration; National Science

Foundation; and the Smithsonian Institution), the Council on Environmental Quality, the Office of Management and Budget, and the Office of Science and Technology Policy review draft documents and propose edits that range from corrections of grammatical errors to suggestions for insertions or deletions of text. The comments and suggested revisions are considered by CCSP Office scientific staff working under the supervision of the CCSP Director or directly by the CCSP Director. Subsequently revised drafts are prepared and these drafts are again circulated for final clearance and release. As Director of the CCSP, I have had final authority over the editorial process and the approved content of all CCSP reports disseminated since 2002.

We do not view the edits proposed by CEQ as inappropriate, but rather suggestions made through a review process that may or may not appear in the final version of the document.

Question 9. Has the Administration learned anything from this incident? Why was Phillip Cooney involved in editing scientific literature at all?

Answer. All CCSP planning and program report documents undergo a well established review process that involves all thirteen of the Federal agencies participating in CCSP (DOC/NOAA, EPA, DOE, NSF, NASA, USDA, DOI, State, USAID, DOD, Smithsonian, DOT, and HHS), as well as three or more units within the Executive Office of the President (OSTP, CEQ, and OMB, and occasionally other elements). Each CCSP document begins as a draft that is circulated to the sixteen (or more) agencies or offices mentioned above. Representatives of all sixteen entities—both scientific and non-scientific personnel—are invited to comment on the draft document by means of individual responses to the CCSP Office. The CCSP *Office* Director (who coordinates the day-to-day operations of the interagency CCSP Office) and his immediate technical staff (Ph.D.-level scientists), as well as the CCSP Director (Senate-confirmed appointee who supervises the entire CCSP program and products) and his immediate technical staff (also Ph.D.-level scientists) are responsible for considering all suggested editorial comments, and for final decisions about the text contained in the published document. It is common that many of the proposed editorial comments are not adopted, or are only partially adopted, by the CCSP senior technical management. In the end, the CCSP Director is responsible for the scientific integrity of these CCSP planning and program report documents.

Question 10. Why not go back to commissioning scientific reports from independent teams of eminent scientists, and let them write their reports without subjecting them to a clearance process by the White House?

Answer. The Federal Government has a process in place to develop scientific information with the best possible science and assurance of information quality. The CCSP was created to advance the understanding of climate science and to develop scientific information useful to decision and policymakers. The CCSP was also created on the premise that open and transparent processes would be used during the development of its deliverables. CCSP has a wide range of resources (technical, administrative, and financial support from 13 agencies) to develop and deliver the best possible scientific information. The Information Quality Act (IQA)[1] required the Office of Management and Budget (OMB) to issue guidance to Federal agencies designed to ensure the "quality, objectivity, utility, and integrity" of information disseminated to the public. The IQA also required agencies to issue their own information quality guidelines, and to establish administrative mechanisms that allow affected persons to seek correction of information maintained and disseminated by the agencies that does not comply with the OMB guidance. IQA also requires a rigorous peer review mechanism for scientific and technical papers from a panel that has the appropriate expertise and is balanced, independent, and free of conflicts.

Most CCSP deliverables will have significant input from non-Federal experts (*e.g.,* non-Federal scientists, academicians, the National Academy of Sciences, and Federal Advisory Committees). However, because they will be CCSP products, these documents are held to a higher standard using the best available science, open and transparent processes, and must comply with the Information Quality Act.

RESPONSE TO WRITTEN QUESTIONS SUBMITTED BY HON. FRANK R. LAUTENBERG TO HON. JAMES R. MAHONEY

Question 1. Dr. Mahoney, $1.8 billion is a lot of money. I understand you are doing an enormous amount of research with it, but for Congress to benefit from that research, *NOAA must produce a report* summarizing its research. The GAO rec-

[1] *http://www.whitehouse.gov/omb/inforeg/iqg_oct2002.pdf.*

ommended that NOAA prepare at least a *summary* of the 21 reports you've proposed. Will you do that?

Answer. As stated in a letter sent transmitted to the Hill on July 15, 2005, the Climate Change Science Program will incorporate a summary of findings of all completed products required by the 1990 Global Change Research Act in our annual *Our Changing Planet* report to Congress, starting in 2006. The CCSP assessment activity is an ongoing process, and this is the most efficient mechanism to disseminate summaries of each completed product. The alternative would be to wait for the completion of the entire set of 21 products before beginning the preparation of a single summary document. While CCSP is committed to providing timely dissemination of the summary information on an annual basis through the mechanism of the existing OCP series, we will seriously consider the question of providing a single summary document upon the completion of the series of 21 Synthesis and Assessment documents.

Question 2. What do you see as the key potential impacts of climate change, and what are you doing to study and report on them?

Answer. The purpose of the Climate Change Science Program is to obtain the best possible science that is useful in managing climate variability and change. Research conducted through CCSP is building on scientific advances of the last few decades and is deepening our understanding of the interplay of natural and human-caused forces. CCSP is developing information to facilitate comparative analysis of different approaches to adaptation and mitigation of climate change. CCSP also promotes capacity development among scientists and information users—both in the developed and developing world—to address the interactions between climate change, society, and the environment.

The potential impacts of climate change are vast and we include many of these impacts in the CCSP research elements—Atmospheric Composition, Climate Variability and Change, Global Water Cycle, Land-Use and Land-Cover Change, Global Carbon Cycle, Ecosystems, Decision Support Resources Development, Related Research on Human Contributions and Responses, and Observations and Monitoring.

As described in the last two editions of *Our Changing Planet,* hundreds of research and impact studies are produced each year to enhance our understanding of climate science. CCSP is preparing 21 Synthesis and Assessment Products to support informed discussion and decision-making on climate variability and change by policymakers, resource managers, stakeholders, the media, and the general public. These products will integrate research results focused on key issues and related questions frequently raised by decision-makers.

CCSP recently held a public workshop, titled Climate Science in Support of Decision Making. The workshop which drew more than 700 participants from the research, decisionmaking, and international communities, as well as students, users, and individuals interested in the applications of climate science. The workshop included discussion of decision-maker needs for scientific information on climate variability and change, as well as expected outcomes of CCSP's research and assessment activities that are necessary for sound resource management, adaptive planning, and policy formulation. The principal topics covered in the workshop provide a useful guide for some of the most climate-impacted areas being studied by CCSP. These include Water Management, Ecosystems Management, Coastal Management, Air Quality Management, and Energy Systems Management. The abstracts for the presentations are available on the CCSP website.[1]

RESPONSE TO WRITTEN QUESTIONS SUBMITTED BY HON. JOHN MCCAIN TO HON. JAMES R. MAHONEY

Question 1. Do you agree with the recent joint statement by the National Academies from the G8 countries concerning the state of climate change science?

Answer. We rely on the continued efforts and leadership of the U.S. National Academy of Sciences, working with its sister societies, to ensure the U.S. response to climate change is informed by the best available scientific knowledge. The Joint Academies' Statement on Climate Change reaffirms the central findings of the 2001 National Academy of Sciences report on climate science requested by the President. Based on this advice, President Bush stated his comment back in 2001 that "While scientific uncertainties remain, we can begin now to address the factors that contribute to climate change."

We recognize that action is needed to address climate change and we have already taken several important steps toward that goal, including leading public investment

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[1] *http://www.climatescience.gov/workshop2005/default.htm.*

in the development of low greenhouse gas (GHG) emissions technology suitable for application by all nations; continuing investments on essential climate research questions; major participation in the development of an integrated Global Earth Observation System of Systems (GEOSS); extensive industry and sector specific GHG emissions control programs; and collaborative bilateral and multilateral programs with key partners throughout the developed and developing world. More information on this effort can be found at: *http://www.whitehouse.gov/news/releases/2005/05/20050518-4.html.*

Question 2. In terms of being responsive to the science which the President has stated the Administration would be, do you believe that the Climate Science Program is being responsive and taking urgent action as called for by the joint statement by delaying the national assessment report further?

Answer. The Climate Change Science Program (CCSP) is taking urgent action to obtain the best scientific information that is useful to Congress, stakeholders, the media, and the general public. CCSP was announced in February 2002 and by November 2002, CCSP published a Discussion Draft Strategic Plan for public review. After holding an international workshop and considering comments from a National Academy of Sciences review and the public, CCSP released its revised 10-year Strategic Plan in July 2003. This strategic plan describes a strategy for developing knowledge of variability and change in climate and related environmental and human systems, and for encouraging the application of knowledge. The plan also identifies 21 Synthesis and Assessment products to fulfill the assessment required by statute. Modifications have been made to the list of 21 products, with the products required by law scheduled for completion by 2007.

While much of the focus from Congress and the media has been on the 21 deliverables, the CCSP agencies continue to publish hundreds of papers each year that deepen our understanding of climate science. These papers are referenced in *Our Changing Planet.* We take climate change very seriously, and we are aggressively working to deliver our findings to Congress and the public in a timely manner without compromising the scientific process.

Question 3. The *Washington Post* recently reported that the White House's Council of Environmental Quality has been altering the scientific reports. Many are concerned that this type of altering will only seek to undermine and destroy the credibility of the not only the Climate Change Science Program, but all Federal science programs. How do you respond to such criticisms?

Answer. CCSP documents are produced through a customary interagency review process. The thirteen CCSP agencies (U.S. Agency for International Development; Department of Agriculture; Department of Commerce, National Oceanic and Atmospheric Administration and National Institute of Standards and Technology; Department of Defense; Department of Energy; Department of Health and Human Services, National Institutes of Health; Department of State; Department of Transportation; Department of the Interior, U.S. Geological Survey; Environmental Protection Agency; National Aeronautics and Space Administration; National Science Foundation; and the Smithsonian Institution), the Council on Environmental Quality, the Office of Management and Budget, and the Office of Science and Technology Policy, and other offices as necessary review draft documents and propose edits that range from corrections of grammatical errors to suggestions for insertions or deletions of text. The comments and suggested revisions are considered by CCSP Office scientific staff working under the supervision of the CCSP Director or directly by the CCSP Director. Subsequently revised drafts are prepared and these drafts are again circulated for final clearance and release. As Director of the CCSP, I have had final authority over the editorial process and the approved content of all CCSP reports disseminated since 2002.

We do not view the edits proposed by CEQ as alterations of a document, but rather suggestions made through a review process that may or may not appear in the final version of the document.

Question 4. There has been a lot of controversy concerning the "hockey stick" or the 1,000 year temperature record for the Northern Hemisphere over the past few months. Chairman Barton of the House Energy and Commerce Committee has requested an extraordinary amount of information from the individual scientists who develop the temperature record. Others, including Dr. Cicerone, have criticized this request for information as an attack on the individual scientists. As head of the Climate Change Science Program, what are your views of the technical merits of the "hockey stick?"

Answer. The scientific conclusion that climate change, or more specifically "global warming," has been observed rests in part on analysis of surface temperature records. A 1998 study (Mann *et al.,* 1998) reconstructed temperatures using a com-

bination of instrumental records and proxy data derived from tree rings, ice cores, and corals, and concluded that warming during the 20th century was unprecedented in the last 600 years. The resulting curve of surface temperature plotted over time resembles a hockey stick laid on its side. That conclusion, which was extended to the last 1,000 years in subsequent studies, figured prominently in the 2001 IPCC Third Assessment Report and seemed to mark a turning point in the scientific debate about climate change.

Two Canadian researchers (MacIntyre and McKitrick, 2005) criticized the Mann *et al.* study on a number of grounds. Their reanalysis of the Mann *et al.* data concluded that the 14th century was roughly as warm as the 20th century and hence that current temperatures are not unique, as Mann *et al.* concluded. In addition, MacIntyre and McKitrick said that Mann *et al.* used data that biased the results toward the "hockey stick" shape. Subsequently, Mann has been accused of filtering data, and MacIntyre and McKitrick have been accused of using "bad" (no quality control) data.

A number of additional studies have been conducted since the original Mann *et al.* study, some extending the analysis even further back in time and some using different techniques in both use of the data and the analytic methods.

Two key differences among the studies relate to the answers they provide to the following questions:

(1) Is the warming trend observed in the 20th century unique? Specifically, was a period in the Medieval Period as warm or warmer?

(2) How much has temperature varied naturally?

Subsequent analyses have been conducted. Rutherford *et al.* (2005) is an updated version of the Mann *et al.* (1998) analysis and includes the Mann *et al.* (1998) team as co-authors. Moberg *et al.* (2005) uses a completely different analysis technique called wavelet decomposition and reconstruction, a time series signal processing technique frequently used in telecommunications. Rutherford *et al.* (2005) and Moberg *et al.* (2005) both support the Mann *et al.* (1998) conclusion that the late 20th century is anomalous in the context of the last millennium. As stated by Moberg *et al.,* "We find no evidence for any earlier periods in the last two millennia with warmer conditions than the post-1990 period—in agreement with previous similar studies." Moberg *et al.,* believe that the main implication of their study is that "natural multicentennial climate variability may be larger than commonly thought, . . . [although] this does not imply that the global warming of the last few decades has been caused by natural forcing factors alone. . . ." There are secondary controversies over the "medieval warm period" and the "little ice age" (this is not new, see Hughes and Diaz 1994), but no controversy remains on the late 20th century anomalous warming.

As Director of CCSP, I feel that the Mann *et al.* reconstruction is one of many that are broadly consistent with a finding of unusual warming in the late 20th century. I also note that this type of debate is the result of a sound scientific process whereby there is encouragement of varying scientific ideas. The scientific community does not often "walk in step" and we often find that continued probing with different processes may yield divergent results.

References:

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Mann, M.E., R.S. Bradley, and M.K. Hughes, Global-scale temperature patterns and climate forcing over the past six centuries, *Nature,* 392, 779–787, 1998.

Mann, M.E., R.S. Bradley, and M.K. Hughes, Northern Hemisphere Temperatures During the Past Millennium: Inferences, Uncertainties, and Limitations, *Geophysical Research Letters,* 26, 759–762, 1999.

McIntyre, S. and McKitrick, R., 2005. The M&M critique of the MBH98 Northern Hemisphere climate index: updata and implications. *Energy and Environment* 16:69–100.

Moberg, A., Sonechkin, D.M., Holmgren, Datsenko, N.M., and Karlen, W., 2005. Highly variable Northern Hemisphere temperatures reconstructed from low- and high-resolution proxy data. *Nature* 443:613–617 (10-Feb–2005).

Rutherford, S., Mann, M.E., Osborn, T.J., Bradley, R.S., Briffa, K.R., Hughes, M.K., Jones, P.D., 2005, Proxy-based Northern Hemisphere Surface Temperature Reconstructions: Sensitivity to Methodology, Predictor Network, Target Season and Target Domain, *Journal of Climate,* (in press, July 2005 issue).

Question 5. Obviously, we have a difference of opinion as to when the next national assessment is due. You stated in your July 15, 2005 letter to me, you request that the Congress recognize the year 2007 as the required completion date for those

products required by the section 106 of the Global Change Research Act of 1990. Why should we accept this date when the U.S. Global Change Research Program's website still indicate the previous assessment was submitted to the President and Congress in November 2000? This is also the date the GAO indicated in its April 14, 2005 report.

Answer. The CCSP Strategic Plan was published in July 2003 and in the plan we identified 21 Synthesis and Assessment Products, that would fulfill the requirements for an updated assessment contained in Section 106 of the Global Change Research Act, to be delivered 4 years from the release of the plan or 2007. We used our resources to develop the plan in 2002 and 2003 and provide direction to the scope and breadth of the program and its deliverables. We have since begun the production of the Synthesis and Assessment Products as well as continue publishing papers, many of which will be considered during the development of these products.

As previously stated, we have had to make some modifications to the schedule of some products due to some administrative issues as well as an underestimate of the complexity and scope of the development of the products. In the July 15, 2005 letter, we requested that Congress consider establishing a longer cycle for future assessments, to be prepared under the provisions of the GCRA, which reflects the increasing complexity of climate science and related information. We note that the Intergovernmental Panel on Climate Change has adopted a six-year cycle for its Fourth Assessment Report.

Question 6. The Administration has worked with other nations to develop an implementation plan for the Global Earth Observation System of Systems. Can you discuss the coordination of this implementation plan with the Strategic Plan for the Science program?

Answer. Chapter 12 of the Climate Change Science Program's (CCSP) Strategic Plan of July 2003 [*http://climatescience.gov/Library/stratplan2003/final/*] lays out the basis for a climate observing system strategy in the U.S. that is based upon several key Global Climate Observing System (GCOS) documents. GCOS is an international program sponsored by the World Meteorological Organization (WMO), the Intergovernmental Oceanographic Commission (IOC), the United Nations Environment Program (UNEP), and the International Council for Science (ICSU), and forms the climate component of the Global Earth Observation System of Systems (GEOSS). In addition to being sponsors of GCOS, the WMO, IOC, UNEP, and ICSU are also part of the GEOSS process.

In setting forth the CCSP's climate observing system priorities, as stated in the CCSP Strategic Plan, the guiding document has been the *GCOS Second Adequacy Report*, April 2003 [*http://www.wmo.ch/web/gcos/gcoshome.html*] table of "Essential Climate Variables" as a baseline of required observables for climate. The *GCOS Second Adequacy Report* was developed by an international panel of scientists, including several in the U.S., and this scientific document forms the basis for the *GCOS Implementation Plan* of October 2004 [*http://www.wmo.ch/web/gcos/gcoshome.html*]. If fully implemented, the *GCOS Implementation Plan* will provide most of the observations of Essential Climate Variables. This plan is in response to the *GCOS Second Adequacy Report* and has considered existing global, regional, and national plans, programs and initiatives. The implementation plan was developed in consultation with a broad and representative range of scientists and data users, and included an open review of the implementation plan. Review occurred both within CCSP, through the Observations Working Group, and at workshops organized by the ad hoc Interagency Working Group on Earth Observations, IWGEO (now the U.S. Group on Earth Observations). The plan identifies implementation priorities, resource requirements and funding options, and includes indicators for measuring progress in implementation and is fully aligned with the CCSP Strategic Plan.

The goal of the *GCOS Implementation Plan* is to specify the actions required to implement a comprehensive observing system for the Essential Climate Variables that would, if fully implemented provide for:

- Global coverage.
- Free and unrestricted exchange and availability of observations of the Essential Climate Variables required for global-scale climate monitoring in support of the UNFCCC.
- The availability of integrated global climate-quality products.
- Improvements to and maintenance of the global *in situ* surface and airborne networks and satellites required to sustain these products, including system improvements and capacity building in developing countries, especially in the least developed countries and small island developing states.

- Internationally accepted standards for data and products especially in the terrestrial domain and adherence to the GCOS Climate Monitoring Principles.
- Characterization of the state of the global climate system and its variability.
- Monitoring of the forcing of the climate system, including both natural and anthropogenic contributions.
- Support for the attribution of the causes of climate change.
- Support for the prediction of global climate change.
- Projecting global climate change information down to regional and local scales.
- Characterizing extreme events important in impact assessment and adaptation, and to the assessment of risk and vulnerability.

As the U.S. plan for climate observations moves forward, we strive to build on the GCOS Implementation Plan by addressing priority elements over the near-term (2–4 years); mid-term (4–7 years), and long-term (7–10 years), which are in line with the goals of the CCSP Strategic Plan.

Furthermore, GCOS is the climate component of the Global Earth Observation System of Systems (GEOSS). *Understanding, Assessing, Predicting, Mitigating and Adapting to Climate Variability and Change* has been identified as one of the 9 societal benefits of the Global Earth Observation System of Systems. As the implementation plan states:

> "The climate has impacts in each of the other eight societal benefit areas. Coping with climate change and variability demands good scientific understanding based on sufficient and reliable observations. GEOSS outcomes will enhance the capacity to model, mitigate, and adapt to climate change and variability. Better understanding of the climate and its impacts on the Earth system, including its human and economic aspects, will contribute to improved climate prediction and facilitate sustainable development while avoiding dangerous perturbations to the climate system."

The need for enhanced observations was clearly identified in the Climate Change Strategic Plan as a necessity for understanding the science underlying climate variability and change.

As a participant in the National Science and Technology Council's committee structure which develops the U.S. input into the international process to implement GEOSS, the Climate Change Science Program contributed to the development of the GEOSS Implementation Plan to ensure the two were consistent.

Question 7. What is the status of the *Our Changing Planet* report for Fiscal Year 2006?

Answer. *Our Changing Planet* for Fiscal Year 2006, was published November 9, 2005. Copies were distributed to the office of every Member of the House and the Senate, and to relevant majority and minority staff of key Committees in both Houses. The document is also being widely distributed within the global climate science community. It is available on the CCSP website,[1] and CDs are being prepared for distribution to include the full document.

RESPONSE TO WRITTEN QUESTIONS SUBMITTED BY HON. FRANK R. LAUTENBERG TO DR. RALPH J. CICERONE

Question 1. I am very disturbed by the mounting series of attacks on science and scientists in recent years. I appreciate your recent suggestion to an independent panel to help settle scientific disputes. Do you think a permanent non-partisan congressional office of science could be effective in settling these disputes?

Answer. The National Academies have long recommended a permanent non partisan office of science and technology advice to the Congress. It did so when the old Office of Technology was created in the early 1970s, and also recommended against its closure in 1994. We think such an office would have many benefits and continue to think so now.

Question 2. During the Energy Bill debate, I offered an amendment to protect agency reports that were based on peer-reviewed science from being tampered with. I was unable to get a vote on my amendment. Is there a role for the National Academy of Sciences in countering this trend of the politicization of science?

Answer. The National Academies have made a number of recommendations concerning the structure of the peer review system over the last twenty years. How-

[1] *http://www.climatescience.gov.*

ever, since we are not a governmental entity, it is difficult for us to actually govern the actions of government. We can only give advice.

Question 3. Recent press accounts have reported that the 2001 National Assessment entitled, "Climate Change Impacts on the United States, " published by Cambridge University Press, is being removed from all documents and reports generated by the United States Climate Change Science Program (CCSP). The CCSP recently asked the National Research Council (NRC) to conduct a comparative analysis of lessons learned from prior assessments. Will the 2001 National Assessment be included in this NRC study? I would like to see the full task list and related documents regarding this analysis, including the original proposal.

Answer. The NRC will be beginning to look at the use of climate assessments, which will include the 2001 National Assessment. The task statement for that project is as follows:

> "An ad hoc committee will seek to identify lessons learned from past assessments to guide future global change assessment activities of the U.S. Climate Change Science Program (CCSP). The study will be approached in two steps.

(1) The committee will conduct a comparative analysis of past assessments that have stated objectives similar to those of the CCSP. Specifically, the committee will examine the strengths and weaknesses of selected past assessments in the following areas:

- establishing clear rationales and appropriate institutional structures;
- designing and scheduling assessment activities;
- involving the scientific community and other relevant experts in the preparation and review of assessment products;
- engaging the potential users of assessment products;
- accurately and effectively communicating scientific knowledge, uncertainty, and confidence limits;
- guiding plans for future global change research activities, including observation, monitoring, and modeling of past and future changes; and
- creating assessment products that are valued by their target audiences.

(2) The committee will identify approaches (in terms of geographic scale, scope, assessment entity, and timing) and products that are most effective for meeting the CCSP's stated objectives for assessments."

RESPONSE TO WRITTEN QUESTION SUBMITTED BY HON. FRANK R. LAUTENBERG TO DANIEL A. REIFSNYDER

Question. The G8 Summit statement claimed that there is *uncertainty* with regard to global warming, but at the same time, the U.S. and 10 other National Academy of Sciences issued this statement.

> "The U.S. National Academy of Sciences joined 10 other national science academies today in *calling on world leaders,* particularly those of the G8 countries meeting next month in Scotland, to *acknowledge that the threat of climate change is clear and increasing,* to address its causes, and to prepare for its consequences." National Academy of Sciences—June 7, 2005.

Isn't there a serious intellectual gap between what the scientists are saying and what the G8 leaders are willing to say? Using energy efficiency measures alone, IBM, DuPont, Bayer and three other corporate giants have reduced their carbon emissions by 60 percent since the early 1990s, while at the same time growing business. What data supports the Administration's claim that mandatory carbon reductions will harm businesses and our economy?

Answer. No, there is no gap between what the scientists are saying and what the G8 leaders said at Gleneagles. In their statement on Climate Change, Clean Energy and Sustainable Development, G8 leaders said:

> "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 warming of the 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 then reverse the growth of greenhouse gases."

The Academy report encapsulates the diverse views of the many distinguished scientists that served on the panel. While significant gaps remain in our understanding of climate change, many of them described in the Academy report, we are taking steps now to address the factors that contribute to it, in a serious and sensible way.

The G8 Summit highlighted that the issue of climate change is a part of an interrelated set of challenges dealing with energy security, economic development, and air pollution. The climate document frames the issue in those terms and contains a concrete set of actions and initiatives that the G8 have agreed upon to advance work cooperatively in advancing our objectives in those interrelated areas.

The Gleneagles outcomes are fully consistent with our longstanding approach of practical, cost-effective actions in the near term along with substantial, strategic investments in key longer-term technologies. Moreover, they highlight the interrelated nature of energy security, climate change and other sustainable development issues. The plan puts climate change in the context of broader sustainable development goals, a key United States priority.

The Administration applauds the private sector for looking at ways to continue to apply technologies to addressing climate change. This demonstrates how the private sector is able to identify and take advantage of opportunities that offer both financial benefits and address other issues such as reducing air pollution and greenhouse gas emissions while diversifying sources of energy.

It is widely acknowledged that the mandatory carbon limits for the United States contained in the Kyoto Protocol would have required at least a 30 percent reduction in U.S. greenhouse gas emissions from the level that would otherwise have obtained in the 2008–2012 time period, with significant implications for the U.S. economy. Examples of the projected impacts in the U.S. economy can be found in many studies, including:

- Management Information Services Inc. (MISI), Potential Economic Impacts of the Kyoto Climate Change Protocol on Blacks and Hispanics in the U.S. (Washington, D.C.: MISI, June 2000) (*http://www.nationalbcc.org/downloads/MISIStudy.pdf*).
- Energy Information Administration, I Analysis of the Impacts of an Early Start for Compliance with the Kyoto Protocol, SR/OIAF/99–02 (Washington, D.C., July 1999). (*http://www.eia.doe.gov/oiaf/kyoto3/pdf/sroiaf9902.pdf*).
- Charles River and Associates, The Post Kyoto Climate: Impacts on the U.S. Economy (Washington, D.C.: Charles River and Associates, 1999).
- Energy Information Administration, Impacts of the Kyoto Protocol on U.S. Energy Markets and Economic Activity, SR/OIAF/98–03 (Washington, D.C., October 1998). (*http://www.eia.doe.gov/oiaf/kyoto/pdf/sroiaf9803.pdf*).
- WEFA, Inc., Global Warming: The High Costs of the Kyoto Protocol, National and State Impacts (Washington, D.C.: WEFA, 1998).

RESPONSE TO WRITTEN QUESTION SUBMITTED BY HON. FRANK R. LAUTENBERG TO DAVID W. CONOVER

Question. Most of the reductions in carbon emissions so far have resulted from corporations who invest in renewables and conservation, yet the President's budget would cut funding for both renewable energy and energy conservation by nearly $50 million. Could you explain the rationale for these cuts?

Answer. The Administration's R&D investment criteria help guide 2006 Budget decisions. The Fiscal Year 2006 request reduces or closes out several program efforts that were identified as complete (*e.g.,* Hydropower Program) or have reached a point where Federal funding for some program activities is no longer appropriate (*e.g.,* Industrial Technologies Program). We have focused our research, development and deployment funds on projects that will most cost-effectively help us achieve public benefits (such as reduced energy consumption or energy costs) that the private sector would not undertake on its own. Also, excessive Congressional earmarks in renewable energy programs have slowed many programs' technological progress.

It is important to note that the President's Fiscal Year 2006 budget request also included $3.6 billion in tax incentives to deploy energy efficiency and renewable energy technologies. These incentives included credits for residential solar heating systems, the purchase of hybrid and fuel cell vehicles, energy produced from landfill gas, electricity produced from alternative energy sources such as wind and biomass, and combined heat and power systems.

RESPONSE TO WRITTEN QUESTIONS SUBMITTED BY HON. JOHN F. KERRY TO DAVID W. CONOVER

Question 1. In a 2003 report, the Government Accountability Office found that this Administration had no plans to generate an interim report on progress toward its 2012 greenhouse gas intensity reduction goal. Without this report, GAO noted that the Administration would have no means of gauging its success in meeting its stated goals until its Climate Change Initiative was a decade old. Do you have plans to assess progress in the interim?

Answer. Under the provisions of the U.N. Framework Convention on Climate Change (UNFCCC), the United States periodically prepares and submits a "national communication" detailing its activities in support of the Framework Convention. These reports provide detailed information on GHG inventories, policies and measures taken to limit or remove GHG emissions, the estimated mitigation impacts of these policies and measures, and their projected impacts on future emissions, among other information. An interagency process is underway to develop the fourth U.S. national communication, which the Administration plans to submit to the UNFCCC sometime next year. This and subsequent national assessments will help the Administration and the Congress assess our progress.

Question 2. If so, are your voluntary programs on track to achieve the 18 percent reduction in greenhouse gas intensity?

Answer. Yes. The President's 18 percent intensity goal represents an average annual rate of improvement off about 2.0 percent (compounded) over the ten-year period. Recent data suggest that we are making good progress in achieving this goal.

According to the Energy Information Administration's (EIA) *Emissions of Greenhouse Gases in the United States 2003,* the GHG emissions intensity of the U.S. economy was 2.3 percent lower in 2003 than in 2002. The report said:

> "U.S. emissions of greenhouse gases in 2003 totaled . . . 0.7 percent more than in 2002. . . . The U.S. economy grew by 3.0 percent in 2003, which is equivalent to the average annual growth rate that has prevailed during the 1990–2003 period. Consequently, U.S. greenhouse gas intensity (greenhouse gas emissions per unit of real economic output) was 2.3 percent lower in 2003 than in 2002." [*http://www.eia.doe.gov/oiaf/1605/ggrpt/index.html*].

This is 0.3 percentage points better than the annual rate of improvement needed to meet President Bush's objective.

Moreover, in June 2005, EIA released it 2004 "flash estimate" of *energy-related* GHG emissions—which account for about 83 percent of total U.S. GHG emissions—and reported an improvement in the energy-related carbon intensity of the U.S. economy of 2.6 percent [*http://www.eia.doe.gov/oiaf/1605/flash/flash.ppt*]. These EIA carbon emissions data suggest that we are maintaining an annual rate of improvement greater than that needed to achieve the President's goal.

Question 3. How is the Administration tracking progress annually toward this goal?

Answer. The Administration is able to track general progress in meeting its overall goal of an 18 percent reduction in greenhouse gas (GHG) emissions intensity using publicly available emissions, sequestration/sinks data, and economic data.

EIA publishes an annual report on greenhouse gas emissions, *Emissions of Greenhouse Gases in the United States,* usually in December. EIA also provides estimates of energy-related carbon emissions in flash estimates based on preliminary energy data, and its *Annual Energy Outlook* presents projections of energy-related carbon emissions.

The Environmental Protection Agency's *U.S. Emissions Inventory* reports, published annually each April, provides a very detailed and comprehensive look at the U.S. GHG emissions, individual greenhouse gases, emissions from specific economic and industrial sectors, emissions trends, removals and sinks, and factors that affect changes in emissions. The data used to produce this report are derived from a number of agencies and organizations. Economic data from the Department of Commerce is used to the measure GHG emissions intensity, which is calculated as emissions per unit of economic output.

Question 4. GAO has also reported, and the Administration has confirmed, that emissions intensity reductions will still result in increased annual emissions. How much has greenhouse gas intensity decreased (or increased) since 2002 and what does this translate to in terms of reducing or increasing emissions of greenhouse gases since 2002? How much have greenhouse gas emissions increased annually since 2000? What are projected emissions levels in 2012?

Answer. From 2002 to 2003, total net U.S. GHG emissions intensity decreased 2.3 percent. Although total GHG data are not yet available for 2004, preliminary EIA data show an improvement in *energy-related* carbon emissions intensity of 2.6 percent (see the response to *Question 2*). Given that energy-related carbon emissions represent about 83 percent of total GHG emissions, it is unlikely that the improvement in total GHG intensity for 2004 will differ appreciably from this figure, absent significant revisions to the underlying energy consumption data.

Between 2002 and 2003 (the most recent year for which data are available), total GHG emissions grew 0.7 percent, rising from 6,031.6 to 6,072.2 $MMTCO_2$ [*http://yosemite.epa.gov/oar/globalwarming.nsf/UniqueKeyLookup/RAMR5CZKVE/$File/ghgbrochure.pdf*]. EIA data for *energy-related* carbon emissions are available through 2004. From 5,746 $MMTCO_2$ in 2002, carbon emissions rose to 5,796 $MMTCO_2$ in 2003 (an annual increase of 0.9 percent) and to 5,896 $MMTCO_2$ in 2004 (an annual increase of 1.7 percent) [*http://www.eia.doe.gov/oiaf/1605/flash/flash.ppt*].

Total net GHG emissions from 2000 to 2003 decreased at an annual rate of 0.3 percent owing primarily to a large decline in emissions in 2001 caused by a weak economy [*http://yosemite.epa.gov/oar/globalwarming.nsf/UniqueKeyLookup/RAMR5CZKVE/$File/ghgbrochure.pdf*]. EIA *energy-related* carbon emissions data are available through 2004. Over the 2000 to 2004 period, these emissions increased by an average of 0.4 percent per year [*http://www.eia.doe.gov/oiaf/1605/flash/flash.ppt*].

Projections of total GHG emissions out to 2012 will be included in the U.S. national communication to the UNFCCC, which is now being prepared. The last (third) U.S. national communication, issued in 2002, included projections of total net GHG emissions of 6,972 $MMTCO_2$ in 2010 and 7,604 $MMTCO_2$ in 2015 [*http://unfccc.int/resource/docs/natc/usnc3.pdf*]. More recently, ETA's *Annual Energy Outlook 2005* reference case projects *energy-related* carbon emissions of 6,812 $MMTCO_2$ in 2012 [*http://www.eia.doe.gov/oiaf/aeo/pdf/aeotab__18.pdf*].

Question 5. Could you please provide the Committee with documentation for the intensity reduction and total emissions figures?

Answer. Web links to data sources have been provided in the response to each question.