

CRS Report for Congress

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Climate Change: Federal Research and Technology and Related Programs

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Climate Change: Federal Research and Technology and Related Programs

Summary

For over 20 years there have been federal programs directly or indirectly related to climate change. Direct programs have focused largely on scientific research to improve the capability to understand climate systems and/or predict climatic change and variability. Energy use has been a major focus of efforts related to possible climate change because carbon dioxide, the major “greenhouse gas,” is added to the atmosphere when fossil fuels are burned. Those efforts, which sought to reduce oil imports, manage electricity needs, and address environmental concerns including climate change, involve many parts of the government. Similarly, climate science efforts in various agencies have sought to expand scientific understanding of the dynamics of climate and its societal consequences as a basis for policy decisions that rely on improved predictions of future climate conditions and climate impact assessments. Coordinating these efforts has been challenging. This report identifies and discusses only the direct climate scientific and research programs of the federal government, and does not focus on the wide array of programs on energy that, though relevant indirectly to climate change, do not include climate as a specific goal.

The U.S. Global Change Research Program in the first Bush Administration, and subsequently in the Clinton Administration, funded studies to improve scientific understanding of the processes that influence Earth’s climate, including trends on global and regional scales. The Climate Change Technology Initiative (CCTI) was the Clinton Administration’s package of research and development (R&D) to develop renewable energy sources and more efficient technologies, targeted tax credits (to encourage purchase and deployment of more efficient technologies), and voluntary information programs (so businesses and schools might be better informed when making purchasing and operating decisions involving energy use and emissions).

The CCTI was followed by the current Bush Administration’s Climate Change Research Initiative (CCRI) and National Climate Change Technology Initiative (NCCTI), both parts of a cabinet-level Committee on Climate Change Science and Technology Integration. The CCRI and the extant U.S. Global Change Research Program were combined into the Climate Change Science Program (CCSP) in the FY2004 budget. Various major activities of the CCTI appear to continue at different funding levels through the Bush Administration, while using a different name. The Final Report of the Strategic Plan for the Climate Change Science Program was released in July 2003.

The FY2004 budget requests \$1.7 billion to sponsor scientific research directly managed by the CCSP, and \$1.2 billion for technology R&D in the NCCTI. An interagency review process is underway to identify specific research areas.

With various details about the Bush Administration’s climate change efforts still in development, some critics highlight the need for clearer goals for climate change R&D, while some proponents note that further R&D is needed if certain climate change management strategies are to be put in place. This report will be updated as events warrant.

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Climate Change: Federal Research and Technology and Related Programs

To address global climate change concerns, the Administration's FY2004 budget seeks \$1.7 billion to directly sponsor scientific research,¹ and \$1.2 billion for technologies.² This report describes federal climate change research and technology activities, and related programs.

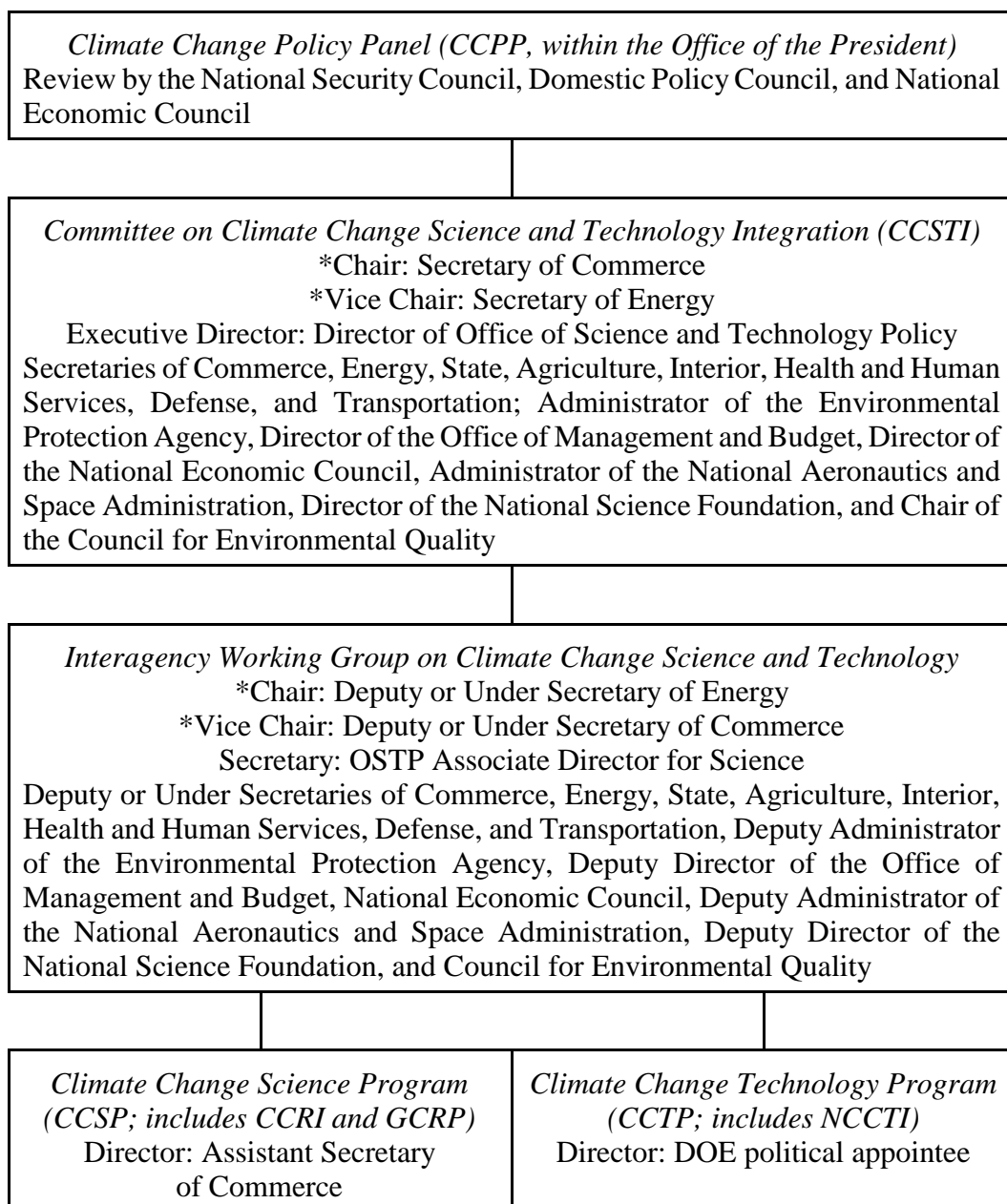
Many research and technology programs related to climate change are of long standing. Coordinating these myriad interagency activities has always been a challenge. The federal structure interrelating these activities, recently reorganized by the Bush Administration, has grown more complex over time. In June 2001, President George Bush announced the National Climate Change Technology Initiative (NCCTI) and the Climate Change Research Initiative (CCRI), two major federal initiatives on climate change. The Administration described in April 2002 its Climate Change Science and Technology Research Management Structure, responsible for managing the federal government's research and technology efforts related to global climate change. In January 2003 the Administration issued statements that further described its climate change activities and structure, including the CCRI, the U.S. Global Change Research Program, and the NCCTI.

In general, while organizational and nomenclature details differ from previous years, research and technology efforts largely appear to continue many of those of past initiatives, at somewhat different funding levels. The current structure, outlined most recently in the July 2003 Strategic Plan for the Climate Change Science Program, has two main components, which encompass most previous programs, overseen by a complex set of interagency bodies (see Table 1).

¹Directly sponsored climate change research is specified in the request for thirteen federal entities: the Departments of Agriculture, Commerce, Defense, Energy, Health & Human Services, Interior, State, and Transportation, along with the Environmental Protection Agency, the National Aeronautics and Space Administration, the National Science Foundation, the Agency for International Development, and the Smithsonian Institution. Descriptions of the activities of these entities are provided in this report. Testimony on January 8, 2003 given by Assistant Secretary of Commerce James Mahoney to the Senate Commerce Committee mentions an additional \$1.3 billion "of related research conducted by the thirteen CCSP collaborating agencies", but no further details were provided in the testimony or in the budget request.

²This report is not about the underlying question of the reality and impacts of climate change, and is intended to cover only the research programs and related funding addressing the issue. For additional background, see CRS IB89005 *Global Climate Change*.

Table 1. Current Climate Change Science and Technology Research Management Structure³



*Chairs and Vice Chairs rotate annually.

Major steps in the progression of federal research and technology and related programs are summarized in Table 2, and described in more detail further in this report.

³Compiled from various Administration sources, including [www.usgcrp.gov/usgcrp/images/ccstmanagement.jpg].

Table 2. Major Steps in Federal Research and Technology and Related Programs on Climate Change

National Climate Program Act of 1978 (PL 95-367) (See p. 6 of this report)	Coordinated twelve federal agencies with responsibilities in climate research and services.
U.S. Global Change Research Program (p. 7)	Officially created by the Global Change Research Act of 1990 (PL 101-606), integrated federal research in global change, which includes climate change, in the GCRP.
Climate Change Action Plan (p. 5)	Announced by the Clinton Administration in 1993, coordinated more than forty on-going federal programs with state and local governments and business, with the goal of reducing U.S. greenhouse gas emissions.
Climate Change Technology Initiative (p. 5)	Announced by the Clinton Administration in 1997, attempted to stimulate the development and use of renewable energy technologies and energy efficiency products, to help reduce greenhouse gas emissions.
National Climate Change Technology Initiative (p. 9)	Announced by President George W. Bush on June 11, 2001, Departments of Commerce and Energy, with other agencies, are to evaluate the state of climate change technology R&D and recommend improvements.
Climate Change Research Initiative (p. 8)	Also announced on June 11, 2001 by President Bush, the CCRI was to improve the integration of scientific knowledge with policymaking in a 2-5 year time frame. The CCRI was combined with the GCRP on January 20, 2003 to form the Climate Change Science Program (following).

Committee on Climate Change Science and Technology Integration (p. 9)	Announced by President Bush on February 14, 2002, the CCSTI coordinates federal climate change research with the OMB and recommends to the President programs and funding across agencies.
Climate Change Technology Program (p. 11)	Announced on April 1, 2002, the CCTP, through the Secretary of Energy, will develop, review, and implement federal climate technology programs consistent with the NCCTI.
Climate Change Science Program (p. 10)	Announced on January 30, 2003, the CCSP combines elements of the CCRI with elements of the GCRP.
CCSP Strategic Plan (p. 13)	Announced on July 24, 2003, the CCSP Strategic Plan's major research goals are to improve climate change knowledge and understanding, reduce uncertainty, and explore ways to manage risks and opportunities.

Historical Background

Carbon dioxide, the major “greenhouse gas” of concern in possible climate change, is produced in large part as a result of energy production and use. The federal government has had programs dealing with energy efficiency and with climate research and services for more than 20 years. The Congress has held hearings about them since the mid-1970s, when a major goal of such programs was to reduce U.S. dependence on oil imports during the energy crisis, and to expand scientific understanding of the dynamics of the climate system and its societal consequences as a basis for policy decisions that depend on improved predictions of future climate conditions and on better climate impact assessments.

U.S. government policies explicitly addressing possible climate change linked to “greenhouse gas” emissions date back to the mid-1980s.⁴ These policies have focused heavily on scientific research. The Energy Policy Act of 1992, in conjunction with the U.S. ratification of the 1992 United Nations Framework Convention on Climate Change (UNFCCC), influenced the direction of U.S. efforts, which continued in the first Bush and Clinton Administrations toward energy

⁴For details, please see CRS Issue Brief IB89005, *Global Climate Change*.

efficiency, renewable energy, and R&D,⁵ to try to move toward reducing greenhouse gas emissions.

The Climate Change Action Plan, designed with the goal of reducing U.S. greenhouse gas emissions and announced in 1993 by the Clinton Administration, included more than 40 on-going federal programs to influence, assist, or work with business, state and local governments, scientific and other entities. R&D and other programs since then were largely maintained or modified with some new activities and names. With evolution from prior efforts, coupled with some augmentation, packages of programs in the Clinton Administration such as the 1997 Climate Change Technology Initiative (CCTI) were built upon the earlier efforts, including efforts originally aimed at reducing dependence on oil imports.

During the preparations for the final negotiations of the December 1997 Kyoto Protocol to the UNFCCC,⁶ President Clinton announced the three-stage CCTI on October 22, 1997.⁷ It was described as “the cornerstone of the [Clinton] Administration’s efforts to stimulate the development and use of renewable energy technologies and energy efficiency products that will help reduce greenhouse gas emissions,”⁸ through a combination of R&D, and information and tax incentive programs. Stage 1 included funding for R&D, tax incentives for early action, a set of federal government energy initiatives including various tax credits to encourage purchase and use of more efficient technologies, and industry consultations to explore ways to reduce greenhouse gas emissions. Stage 2, which was planned to begin around 2004, would have reviewed and evaluated stage 1. Stage 3, as envisioned prior to the Kyoto Protocol, included actions aimed at reducing emissions to 1990 levels by 2008-2012, meeting the binding targets anticipated in the Kyoto Protocol through measures that would include domestic and international emissions trading. The Kyoto Protocol (which the United States signed on November 11, 1998 but which has not been submitted to the U.S. Senate for advice and consent on ratification), outlines an obligation for the United States to reduce its total greenhouse gas emissions by an average of 7% below 1990 levels, on average, between 2008 and 2012.⁹ The Clinton Administration supported United States participation in this protocol. The Bush Administration, on the other hand, has rejected the protocol.

⁵For further details, see CRS Report RL30024, *Global Climate Change Policy: Cost, Competitiveness, and Comprehensiveness*.

⁶Please see CRS Report 98-2 *Global Climate Change Treaty: The Kyoto Protocol* for details.

⁷Details about the plan, as set forth in 1997, can be found at [<http://www.clinton2.nara.gov/WH/Work/102297.html>].

⁸Testimony on May 20, 1999 by Deidre A. Lee, Acting Deputy Director for Management, Office of Management and Budget (OMB), to the House Committee on Government Reform and Oversight, Subcommittee on National Economic Growth.

⁹Please see CRS Report 98-2 *Global Climate Change: The Kyoto Protocol* for further details.

The Congress has in the past passed budget resolutions and appropriations bills with provisions prohibiting the use of funds to implement the Kyoto Protocol, which has not been ratified by the United States or entered into force internationally. Some controversy was engendered by the possible linkage of funding proposals associated with the CCTI to the Kyoto Protocol goals. After some early consideration of these concerns, for the most part the R & D elements were funded by the Congress. Moreover, many of the programs related to the CCTI and other climate research preceded the Kyoto Protocol, and were mainly influenced by the voluntary commitments the United States made in the U.N. Framework Convention on Climate Change to try to meet a voluntary goal of returning greenhouse gas emissions to 1990 levels by the year 2000, and to current efforts to reduce intensity of emissions. (See CRS Report RL30024, *Global Climate Change Policy: Cost, Competitiveness, and Comprehensiveness*).

Federal Structure and Funding for Managing Global Climate Change Research and Technology

The government's activities relating to climate change have been accomplished through several programs, initiatives, and agencies. Coordinating these activities continues to be a challenge. Various organizational structures have been attempted over the past two decades in the effort to improve coordination and efficiency.

An early effort, dating back to the late 1970s, was embodied in the National Climate Program Act of 1978 (H.R. 6669, Public Law 95-367), involving twelve federal agencies vested with responsibilities in climate research and services.¹⁰ Designed to centralize planning and to improve interagency and intergovernmental coordination, the National Climate Program emphasized development and delivery of useful climatic information and services to a wide range of users, based on current knowledge of climate and better use of existing climatic data. Simultaneously, the Program sought an expanded federal effort in scientific research to foster better understanding of the climate system and the societal consequences of climate change as a basis for national decision making that depended on improved predictions of future climate conditions and better climate impact assessments.

Some ten years after its enactment, however, the National Climate Program was faced with criticisms that involved charges of paucity of funding and concerns expressed among agency principals that any program combining individual agency capabilities and resources into a coordinated effort could compromise or impede existing agency responsibilities.

¹⁰U.S., Library of Congress, Congressional Research Service, "The National Climate Program Act of 1978: Background and Legislative History," by John Justus. Appears in *Implementation of the Climate Act*, Hearing before the Subcommittee on Natural Resources and Environment of the Committee on Science and Technology, U.S. House of Representatives, 96th Congress. Washington, U.S. Govt. Print. Off., 1979, p. 190-228.

United States Global Change Research Program

By the early 1990s, the National Climate Program faded from the scene¹¹ as the newly created U.S. Global Change Research Program gained adherents, achieved prominence as a Presidential Initiative with discretely identifiable budget items,¹² and eventually acquired legislative underpinning in the form of the Global Change Research Act of 1990 (S. 169, Public Law 101-606).¹³ It continues as part of current federal climate activities, as described below and as shown in Table 1.

The GCRP was created with the recognition that global change issues are complex and far reaching, extending beyond the mission, resources, and expertise of any single agency, requiring instead the integrated efforts of several governmental entities. The program involves scientific research on global change generally, including but not limited to climate change. GCRP agencies support scientific research through coordination and joint activities. Members of the GCRP are the Departments of Agriculture, Commerce (notably, its National Oceanic and Atmospheric Administration), Defense, Energy, Health and Human Services (notably, the National Institutes of Health), Interior (United States Geological Survey), and State, plus the Environmental Protection Agency, National Aeronautics and Space Administration, National Science Foundation, and Smithsonian Institution. The GCRP coordinates and funds research on, among other things, natural fluctuations of earth processes, possible impacts of human activities on the environment, and ways to increase the predictive power of climate change models.

The GCRP¹⁴ is mandated by statute to undertake scientific assessments of the potential consequences for the United States of global change.¹⁵ The Global Change

¹¹P.L. 95-367 was never formally repealed, however.

¹²Annual budget presentations appeared in a separate document *Our Changing Planet*, first produced by the National Science and Technology Council (NSTC) in 1995. Further information about the NSTC comes later in this report.

¹³The Act defined “global change” as including alterations in climate, land productivity, oceans or other water resources, atmospheric chemistry, and ecological systems, that may alter the earth’s capacity to sustain life.

¹⁴ The GCRP, which focuses on improving the understanding of global change, reported to the Committee on Environment and Natural Resources (CENR). This was established in 1993 as an element of the NSTC until the CENR’s sunset date of December 31, 2002. The NSTC, created by Executive Order on November 23, 1993, continues and is chaired by the President. The NSTC is the primary means for the President to coordinate science, space, and technology across the Federal government. Members of the NSTC include the Vice President, the Assistant to the President for Science and Technology, Cabinet Secretaries, and Heads of Agencies with significant science and technology responsibilities, and other White House officials. The CENR advised and assisted the NSTC to increase the effectiveness and productivity of federal R&D involving the environment and natural resources. Climate change research was coordinated through the NSTC, in accordance with the Global Change Research Act of 1990. As shown in Table 1 and described later in this report, the GCRP is now a part of the Climate Change Science Program.

¹⁵Global change encompasses the multidirectional interactions of the physical, chemical, and
(continued...)

Research Act of 1990 (P.L. 101-606, Section 106) stated that the federal government “shall prepare and submit to the President and the Congress a National Assessment which:

- ! integrates, evaluates, and interprets the findings of the Program and discusses the scientific uncertainties associated with such findings;
- ! analyzes the effects of global change on the natural environment, agriculture, energy production and use, land and water resources, transportation, human health and welfare, human social systems, and biological diversity; and
- ! analyzes current trends in global change, both human-induced and natural, and projects major trends for the subsequent 25 to 100 years.”

Research conducted by the GCRP was the scientific foundation on which the Assessment was built. The National Assessment Synthesis Team (NAST), a committee of experts drawn from government, academe, industry, and nongovernmental organizations, provided the leadership in writing the Assessment. Approvals for the work were given by the NSTC, the cabinet-level body of agencies responsible for scientific research. The Assessment is composed of the Overview report and the Foundation report; the Foundation report is more detailed than the Overview.¹⁶ The two reports are national-level, peer-reviewed documents which synthesized results from studies conducted by regional and sector teams, and from the broader scientific literature.¹⁷

Climate Change Research Initiative

On June 11, 2001, the Bush Administration issued the White House Initial Review on Climate Change, a Cabinet-level review of U.S. climate change policy. Members of the Cabinet, the Vice President, and senior White House staff examined the science, technologies, U.S. activities, and options for addressing atmospheric concentrations of greenhouse gases. The White House Initial Review included the concurrent announcement of the U.S. Climate Change Research Initiative (CCRI) and the National Climate Change Technology Initiative (NCCTI). The CCRI’s general mission was to “improve the integration of scientific knowledge into effective decision support systems with performance metrics and deliverable products useful

¹⁵(...continued)

biological processes that affect the whole earth system. Changes in climate are a subset.

¹⁶The full titles of the two reports are similar: “Climate Change Impacts on the United States, The Potential Consequences of Climate Variability and Change, Foundation”, and “Climate Change Impacts on the United States, The Potential Consequences of Climate Variability and Change, Overview.”

¹⁷From [www.usgcrp.gov/usgcrp/nacc]. The National Assessment was formally challenged under the Data Quality Act (DQA; Section 515a of PL 106-554) by the Competitive Enterprise Institute (CEI). The DQA empowers affected parties to challenge the objectivity, utility, and reproducibility of data used and/or disseminated by the federal government. The CEI later filed a lawsuit seeking to prevent further dissemination of the report. An official response to the suit is pending.

to policymakers in a 2-5 year time frame.”¹⁸ Specific priorities begun in FY2003 include new efforts to better understand the North American carbon cycle, to develop reliable representations of the global and regional climate interactions of atmospheric aerosols, to invest in more refined computer modeling, and to ensure long term climate data records that are of higher quality.

Additional organizational elements to deal with climate change were announced in 2002. An organization chart was released by the Bush Administration at a meeting on April 1, 2002 of the Subcommittee on Global Change Research (GCR), a part of the now-extinct CENR.¹⁹ The chart provided some details about new governmental structures and activities that are part of the Administration’s efforts to advance climate change science and technology. The organizational background information for the chart released at the CENR’s GCR Subcommittee meeting on April 1, 2002 is summarized in Table 1. As described further in this report and shown in Table 2, the CCRI was combined in January 2003 with the GCRP to form the Climate Change Science Program.

National Climate Change Technology Initiative

The NCCTI was announced by President George W. Bush on June 11, 2001. The Secretaries of the Departments of Commerce and Energy, working with other agencies, were directed to evaluate the state of climate change technology R&D in the United States and make recommendations for improvement; provide guidance on strengthening basic research in academe and in the national laboratories; develop opportunities to enhance public-private partnerships in applied R&D; make recommendations for funding demonstration projects of cutting-edge technologies; and evaluate improved technologies for measuring and monitoring gross and net terrestrial greenhouse gas emissions.

The FY2004 budget requests \$1.2 billion for climate change technology, within the President’s NCCTI. The FY2004 budget request for climate change science is described later in this report.

Climate Change Policy Panel

The Climate Change Policy Panel (CCPP; see Table 1) combines the concerns of the National Security Council, the Domestic Policy Council, and the National Economic Council. The chair of the CCPP is the National Security Advisor or other presidential appointee. The chair is responsible for program and policy review and reports to the president.

The Committee on Climate Change Science and Technology Integration (CCSTI), which had been announced by the President on February 14, 2002, also continues. The CCSTI membership is shown in Table 1. The Executive Director of

¹⁸Statement of James Connaughton, Chair of the White House Council on Environmental Quality, in the Hearing on Global Climate Change and the U.S. Climate Action Report before the Senate Committee on Commerce, July 11, 2002, tab 5, p. 24.

¹⁹The CENR had a sunset date of December 31, 2002.

the CCSTI is the Director of the White House Office of Science and Technology Policy. The CCSTI's functions include recommending to the President climate change science and technology activities and movement of funds and programs across agency boundaries, and coordinating with the OMB. The chair of the CCSTI is responsible for the final review of recommendations to the Climate Change Policy Panel.

Working Group on Climate Change Science and Technology

Reporting to the CCPP and the CCSTI, as seen in the organizational chart in Table 1, is the Interagency Working Group on Climate Change Science and Technology. The group's secretary was expected to be the Assistant Director for Climate Science and Technology from the Office of Science and Technology Policy (OSTP), a position the Administration said it intended to create;²⁰ while the position had not been created as of the date of this report, the function is performed by OSTP's Associate Director for Science.²¹ The functions of the Interagency Working Group on Climate Science and Technology include reviewing all programs relating to climate change science, providing recommendations to the CCSTI regarding climate science funding and program allocations, and accepting and acting on recommendations by the Joint Climate Change Science Program Office and the Climate Change Technology Program Office.

Climate Change Science Program

On January 30, 2003, the Administration announced that the CCRI and the GCRP would be combined into the Climate Change Science Program (CCSP), which is separate from climate change technology work which is part of the President's National Climate Change Technology Initiative. The FY2004 budget seeks \$1.75 billion to directly sponsor scientific research managed by the CCSP. Included in the \$1.75 billion CCSP funds are \$182 million for the CCRI. Although the total CCSP request for spending in FY2004 was up only 0.1% over the FY2003 request, that portion of the funding request allocated to the embedded CCRI was up 355% from \$40 million in FY2003 to \$182 million in FY2004. An issue for Congress is the extent to which that large CCRI increase represents new money versus how much is attributable to the reclassification of ongoing research programs.

The CCSP reports to the Interagency Working Group on Climate Science and Technology and will have joint membership of all agencies with climate research funding, according to materials presented on April 1, 2002 in a meeting of the Subcommittee on Global Change Research. The CCSP is to be staffed by interagency detailees. The Director is a detailee from the Department of Commerce (James Mahoney, Assistant Secretary of Commerce and Deputy Administrator of the National Oceanic and Atmospheric Administration). The function of the CCSP will

²⁰Disclosed on April 1, 2002 in a meeting of the Subcommittee on Global Change Research, available at [www.climatescience.gov/Library/stratplan2003/vision/actions.htm].

²¹Personal communication with OSTP on November 5, 2003.

be to review all climate change science programs, not just the GCRP. The Director of the CCSP reports to the chair of the Interagency Working Group.²²

Climate Change Technology Program

The Climate Change Technology Program (CCTP), announced April 1, 2002, located in DOE, is a new entity and reports to the Interagency Working Group on Climate Change Science and Technology through the Secretary of Energy. The CCTP's Director is a DOE senior political appointee, according to materials presented on April 1, 2002 in a meeting of the Subcommittee on Global Change Research.²³ The functions of this office are to develop, review, and implement climate technology programs within the federal government consistent with the National Climate Change Technology Initiative (NCCTI). The CCTP works with the current participants of the NCCTI. The CCTP began in FY2003 (and continues in FY2004) to create an inventory of climate change technology efforts, with the goal of recommending priority programs to help meet the Administration's goal of an 18-percent reduction in energy intensity (ratio of energy use to economic productivity) by 2012. This ongoing creation of a variety of climate change technology efforts makes comparisons of technology programs and funding before and after FY2003 very difficult; as such, the comparative details as presented in Table 5 are unavailable for FY2004.²⁴

In a hearing of the House Science Committee held on November 6, 2003, the Administration stated its intention to release during the first quarter of 2004, for public comment, a draft plan for the CCTP's activities. DOE also said that the CCTP will release two reports on near- and long-term goals and the state of research and current technology activities. In a statement, some of the priorities to be highlighted in the FY2005 budget include the Hydrogen Fuel Initiative (to accelerate the transition to a hydrogen economy), "FutureGen" (for zero-emissions electricity generation using coal), and fusion energy (the same form of energy that powers the sun).²⁵ Comments made in the hearing noted that the Administration appeared to be focused mostly on long-term technologies, that energy efficiency and other proven technologies exist for short-term gains, and that there remain questions about the specifics for the timeframe and the level at which atmospheric carbon concentrations will be stabilized.²⁶

²²From materials distributed in an April 2002 meeting of the Subcommittee on Global Change Research, available at www.climatescience.gov/Library/stratplan2003/vision/actions.htm].

²³Confirmed in a personal communication with DOE on November 5, 2003.

²⁴Disclosed and discussed in various meetings, summarized and available at www.climatescience.gov/Library/stratplan2003/nrc-presentations25Aug2003/ccctp.pdf

²⁵Statement of David Conover, Director of the U.S. Climate Change Technology Program, before the House Science Committee on November 6, 2003.

²⁶From House Science Committee media announcement on November 6, 2003; further details about the hearing can be found at [\[www.house.gov/science/hearings/energy03/index.htm\]](http://www.house.gov/science/hearings/energy03/index.htm).

National Academy of Sciences Review and Recommendations

The GCRP member agencies had been directed by the President in June 2001 to develop the previously-mentioned Climate Change Research Initiative to accelerate climate change research over the next five years, in order to assist in the development of climate change policy. A Strategic Plan would guide the climate change research.

The National Academy of Sciences (NAS) was asked by the Administration in September 2002 to review the draft Strategic Plan. The draft Strategic Plan was made available in November 2002 for scientific and public comments. A Planning Workshop for Scientists and Stakeholders was held in December 2002 to formally gather comments about the draft Strategic Plan. The NAS review, and assembled outside comments, were reported by NAS in February 2003. Recommendations from the NAS report addressed the federal structure for managing climate change research and technology, among other things. They included these comments:

- ! “The revised strategic plan should articulate a clear, specific and ambitious vision statement in the context of national needs ... (with) tangible goals, ... an explicit process to establish priorities, and ... an effective management plan.
- ! The plan should present clear goals for the CCRI and ensure activities are consistent with these goals; maintain CCRI’s ... emphasis on ... near-term decisions ... and include an explicit mechanism to link GCRP and CCRI activities.
- ! The plan should describe the management processes to be used to foster agency cooperation towards common CCSP goals.
- ! Clear mechanisms for coordinating and linking CCSP activities with the technology development activities of the CCTP should be described.
- ! [The plan should] more fully describe how models and knowledge supporting regional decision making and place-based science will be developed.
- ! [The plan should] strengthen treatment of human, economic, and ecological dimensions of climate and associated global changes.
- ! [The plan should] better describe a strategic program for an integrated observing system for climate variability and change on scales from regional to global.
- ! [The plan should] improve the description of how decision support capabilities will be developed.
- ! [The plan should] identify what sources and magnitudes of uncertainty reductions are especially needed.

- ! [The plan should] address the major requirements in building capacity in human and computing resources.
- ! [The plan should] use the clear goals and program priorities and advice from an independent advisory body to guide future funding decisions.”²⁷

Climate Change Science Program Strategic Plan

Subsequent to the NAS recommendations reported in February 2003, the Administration released its new CCSP Strategic Plan on Climate Change, on July 24, 2003. The plan describes five major research goals:

- ! Improve knowledge of past and present climate, including natural variability, and improve understanding of causes of variability and change;
- ! Improve understanding of forces causing climate change;
- ! Reduce uncertainty in projections of future climate change;
- ! Understand the sensitivity and adaptability of natural and managed ecosystems to climate change;
- ! Explore the uses and limits of knowledge to manage risks and opportunities related to climate variability and change.

Specific research targets accompany each goal. There also are schedules for research papers and synthesis reports, including a report within two years on how to resolve temperature data differences between satellite and ground-based readings, and a report within four years on abrupt climate change. The plan provides no budget details. Some critics say the plan overemphasizes the uncertainties in climate science, covers little new ground, and allows delay in taking actions to curb greenhouse gas emissions; some proponents say the plan will more sharply focus research, with clearer goals and schedules.²⁸ The 360-page plan can be viewed at [www.climate-science.gov/Library/stratplan2003/final/default.htm].

Funding

The Administration’s FY2004 budget seeks \$1.7 billion to directly sponsor scientific research managed by the CCSP. Included in the \$1.7 billion CCSP funds are \$182 million for the Climate Change Research Initiative (CCRI). The FY2004 budget requests \$1.2 billion for climate change technology, as part of the NCCTI.

²⁷*Planning Climate and Global Change Research: A Review of the Draft U.S. Climate Change Science Program Strategic Plan.* National Research Council of the National Academies. February 26, 2003.

²⁸Malakoff, David. “New Climate Science Plan Garners Split Opinions”. *Science Magazine*. 1 August 2003. Pages 575 - 576.

The total amounts for research and for technologies are similar from the Clinton through the Bush Administrations (through the years, each year about \$1.7 billion for research, about \$1.2 billion for technologies). This comparison is shown in Table 3.

**Table 3. Funding for Climate Change Research, Technologies:
A Four Year Comparison**

(\$ billion)

	FY2001	FY2002	FY2003	FY2004 request
Bush Admin: scientific research (CCSP)	---	---	1.7 (0.04 for CCRI, balance for GCRP)	1.7 (CCSP; now includes GCRP)
GCRP (research)	1.7	1.6		(now in CCSP)
Bush Admin: technologies (CCTP)	---	---	1.3	1.2
CCTI (technologies)	1.2	1	(now in Bush Admin. technologies)	(now in Bush Admin. technologies)

Science and Technology Programs and Funding Levels by Agency

Climate change research is specified in the budgets for thirteen federal entities: the Departments of Agriculture, Commerce, Defense, Energy, Health & Human Services, Interior, State, and Transportation, along with the Environmental Protection Agency, the National Aeronautics and Space Administration, the National Science Foundation, the Agency for International Development, and the Smithsonian Institution. Testimony on January 8, 2003 given by Assistant Secretary of Commerce James Mahoney to the Senate Commerce Committee mentions an additional \$1.3 billion “of related research conducted by the thirteen CCSP collaborating agencies,” but no further details were provided in the testimony or in the budget request.

Funding by agency for climate change science programs is summarized in Table 4. Funding by agency for climate change technology programs is summarized in Table 5. Agencies in both tables are listed in order of decreasing levels of funds.

Table 4. Funding for Climate Change Science Program
(\$ millions)

	FY2003	FY2004 req.
NASA	1,112	1,068
National Science Foundation	203	213
Department of Commerce / NOAA	118	136
Department of Energy	129	133
Department of Agriculture	66	73
National Institutes of Health	59	61
Environmental Protection Agency	22	22
Smithsonian Institution	6	6
US Agency for Intern'l Development	6	6
Department of Transportation	0	4
Department of State	0	1
Total, CCSP	1,747	1,749
Subtotal, CCRI (included in CCSP total)	40	182

Table 5. Clinton Administration CCTI, and Bush Administration National Climate Change Technology Initiative (and Related) Funding by Agency
(\$ millions)²⁹

Dept., Agency	FY98	FY99	FY00	FY01	FY02	FY03	FY04 req.
DOE	729	902	980	1,103	1,065	991	1,080
EPA	90	109	103	123	115	130	130
HUD	0	10	10	10	0	na	na
Agriculture Department	0	0	0	3	0	na	na
Commerce Department	0	0	2	0	0	na	na
TOTAL	819	1,021	1,095	1,239	1,180	1,121	1,210

National Aeronautics and Space Administration. NASA's Global Change Research Program observes the global carbon cycle, water cycle, ecosystems, climate variability, atmospheric chemistry, and land cover-land use, to try to determine how the global earth system is changing, what the primary causes of change are, how the earth system responds to natural and human-induced changes, what the consequence for human civilization might be, and how better to predict future changes in the earth system. The FY2003 amount to fund these activities was slightly over \$1.1 billion. The FY2004 request is slightly under \$1.1 billion, and is included in the CCSP total.

National Science Foundation. The National Science Foundation, an independent government agency, *inter alia* initiates and supports scientific and engineering research through grants, contracts, and fellowships with academic, nonprofit, and other institutions and organizations. Climate change research funded through NSF includes studies of carbon cycling, Antarctic ecosystems, climate modeling-analysis-prediction, sea-level changes, ecological diversity, water cycling, polar ozone depletion-ultraviolet radiation effects, greenhouse gas dynamics, solar influences, climate variability-predictability, human dimensions of global change,

²⁹ "Briefing on Research and Development Funding in President's FY2004 Budget" Office of Science and Technology Policy January 30, 2003; "President Clinton's FY2001 Climate Change Budget," page 13, "Federal Climate Change Expenditures Report to Congress June 2001", [www.usgcrp.gov/usgcrp/Library/gcinitiative2002/gcstorybook.htm] pp. 43, 46. "na" = data not available; specific data are being identified through an interagency review process.

and other related topics . The FY2003 funding level was \$203 million. The FY2004 request is \$213 million.

Department of Commerce/National Oceanic and Atmospheric Administration (NOAA). Two main programs within the Department of Commerce addressed issues relating to climate change. The wide range of research in Commerce's National Oceanic and Atmospheric Administration (NOAA), one of 11 federal entities participating in the GCRP, included long-standing climate-related work, much of it not specifically identified as CCTI or CCRI but rather part of NOAA's generic mission. Among other things, research at NOAA sought to determine "the impacts of climate variability and change on ecosystems; ... understand how radiative, chemical, and dynamical processes interact in the upper troposphere/lower stratosphere to affect climate; ... (and) study the effects of climate variability and change on health..."³⁰ There also were programs at the National Institute of Standards and Technology (NIST) which looked at climate change issues.³¹ The \$2 million requested and provided in the FY2000 budget specifically for the CCTI specifically was new to the Department of Commerce and did not go to NOAA³² or NIST as a single CCTI line-item but to various climate-related R&D projects. NOAA's funding for climate change research activities (including climate change observations and research to reduce scientific uncertainty) in FY2003 amounted to \$118 million, and the FY2004 request is \$136 million.

Department of Energy. Carbon dioxide, which as noted above is the major greenhouse gas, arises mostly from combustion of fossil fuels. The Department of Energy, which has long had R&D programs relating to fossil fuel energy use, was by far the largest recipient of both CCTI and similar later funding (DOE has received and continues to receive about 90% of interagency climate change funding). While the Administration has stated that the total interagency FY2004 request for climate change technology is \$1,210 million, agency-specific amounts are being reviewed through an interagency process (in comparison, as shown in Table 3, the FY2004 request for the climate change science program is \$1,749 million).

Funding for the DOE's efforts has been for the research, development, and deployment of more energy efficient and renewable technologies such as:

- ! "Buildings:" low-power sulfur lamps, advanced heat pumps, chillers and commercial refrigeration, fuel cells, insulation, energy conserving building materials, and advanced windows;
- ! "Electricity:" generation using alternatives to fossil fuels such as solar energy, biomass power, wind energy, geothermal power, hydropower, and optimized nuclear power;

³⁰Department of Commerce budget initiative, details of which can be found at [<http://www.oarhq.noaa.gov/>]

³¹Telephone communication with the National Institute of Standards and Technology on December 6, 1999.

³²Personal communication with the National Oceanic and Atmospheric Administration on December 6, 1999.

- ! “Industries:” greater efficiency in industries such as aluminum, steel, mining, agriculture, chemicals, forest products, and petroleum;
- ! “Transportation:” researching, developing, and deploying more efficient technologies, such as advanced engines, hybrid systems, fuel cells and emission controls; these constituted the federal component of the Partnership for a New Generation of Vehicles (PNGV) which was a 10-year government/domestic auto industry partnership begun in the Clinton Administration in 1993 that aimed to produce by 2004 a prototype midsize family car with 80 mile per gallon gasoline efficiency and a two-thirds reduction in carbon emissions. Seven federal agencies were involved in the PNGV (Commerce, Defense, Energy, Transportation, EPA, National Aeronautics and Space Administration, and the National Science Foundation) (for details on PNGV, see CRS Report RS20852); the Bush Administration cancelled the PNGV program and began the Freedom CAR program which will focus on fuel cell vehicles;
- ! “Remove and Sequester Carbon:” trying to find better ways to remove and sequester carbon from fossil and other fuels, via agricultural and other approaches (in conjunction with EPA, and originally planned in conjunction with USDA); and
- ! “Management, Planning, Analysis and Outreach:” governmental efforts (federal, state, and others) to conserve energy through more highly coordinated management, planning, analysis and outreach.³³

As with the PNGV/FreedomCAR program, many of DOE’s research and technology dollars have been spent in partnership with other federal entities such as EPA, with other governmental units, and with private sector entities.

Table 6 shows funding levels for these DOE climate change research and technology programs.

³³Analysis of the Climate Change Technology Initiative, Research and Development Support. Energy Information Agency, U.S. Department of Energy. [http:www.eia.doe.gov/oiaf/climate99/research.html]

Table 6. DOE Climate Change Research and Technology
(\$ millions)³⁴

Program	FY98	FY99	FY00	FY01	FY02	FY03	FY04 req.
Buildings	102	124	141	105	131	93	na
Transpo.	223	250	274	255	306	263	na
Industry	136	167	170	149	149	138	na
Electricity	239	311	307	421	400	408	na
Carbon Removal & Sequestrtn	--	13	9	39	32	54	na
Mgmt	29	38	43	43	44	na	na
Basic science	--	--	33	--	3	35	na
Total	729	903	977	1,012	1,065	991	1,080

Department of Agriculture. Funding for climate change research at Agriculture amounted to \$66 million in FY2003, and the FY2004 request is \$73 million. This research includes efforts to improve measurements of carbon inventories at the national level, and to develop methods to manage crops, soils, and grazing systems to optimize agricultural productivity, resource conservation, and greenhouse gas emissions and carbon sequestration. The FY2001 amount of \$3 million in technology was principally to develop agriculture-centered technologies to better manage the carbon cycle, from sources to sequestration. No funds were specified for Agriculture Department climate change technology activities in subsequent budget requests

³⁴ U.S. Department of Energy. "Department of Energy Report to Congress on FY2000 Expenditures for Energy Supply, Efficiency, and Security Technologies Supporting the Climate Change Technology Initiative" May 18, 1999. P. 3. Federal Climate Change Expenditures Report to Congress June 2001. Personal communication with DOE legislative liaison May, August, September 2002, January 2003.

na = not available at this time because climate change technology programs are being recategorized by the Administration (mentioned earlier in this report).

Categorizations varied through the years, e.g., "Basic science" was presented in FY00 and FY02 as a specific category, but had been funded in a fragmented fashion throughout other categories in other years.

National Institutes of Health. Within the Department of Health and Human Services, the National Institutes of Health conducted research identified as related to climate change, including study of the health effects of ultraviolet radiation and of chemical replacements for chlorinated fluorocarbons. This work amounted to \$59 million in FY2003. The FY2004 request is for \$61 million.

Department of the Interior. The United States Geological Survey (USGS), within the Department of the Interior, has conducted global change research including historical research on climate variability and change, and global carbon cycling through lakes, streams, wetlands, soils, sediments, and vegetation. The USGS also manages and disseminates satellite land-surface and ecosystem data which may be used in climate change activities. In FY2003 the Department received \$26 million for its climate change research. The FY2004 request is also \$26 million.

Environmental Protection Agency. The Environmental Protection Agency uses two main budget categories: Science and Technology (S&T, which includes R&D and technology development and diffusion efforts), and Environmental Programs and Management (EPM, which are the costs to run programs). Therefore, it is difficult to consistently separate R&D from technology assistance and diffusion efforts. For example, in EPA's climate change Buildings Sector, the owner of a building can have EPA's benchmarking tool voluntarily applied to that building as a target for energy reduction. Various activities can be tried, e.g., plugging leaks and replacing less efficient lights with more efficient lights, to see if the benchmark will be met. If not, other activities can be tried in an iterative fashion, trying and recording and incorporating the findings in the benchmark. This program includes activities that can be described as both research-related and technology diffusion and assistance. EPA's figures for climate change S&T are used here.

While there has been some discussion about the proper roles for government, industry, and academe in climate change and other R&D,³⁵ the climate change R&D activities have not been highly controversial. In general, EPA funds targeted for R&D, especially areas of more basic R&D that predate the CCTI and the Kyoto Protocol, were less controversial, and funds for new programs intended to assist technology deployment and diffusion and to help consumers learn about and choose more efficient commodities and processes have sometimes been more controversial.

The elements and levels of EPA's climate change research and technology funds are summarized in Table 7. Activities related to these program areas are briefly described below. Some of these funding areas focused heavily on R&D, while others involved information dissemination and other activities.

³⁵Please see CRS Report 98-365 *Some Perspectives on the Changing Role of the U.S. Government in Science and Technology* for details.

Table 7. EPA Climate Change Research and Technology Programs
(\$ millions)

Program	FY99	FY00	FY01	FY02	FY03	FY04 req.
Buildings	38.8	42.6	52.5	48.6	49.8	48.3
Transportation	31.8	29.6	29.4	30.8	21.6	22.9
Industry	22.1	22.0	31.9	25.4	25.4	26.4
Carbon Removal	0.0	1.0	1.0	1.5	1.6	1.7
State & Local Govts.	5.0	2.5	2.5	2.2	2.3	2.6
International Capacity, Partnerships, Cooperation	6.0	6.0	6.3	7.0	7.1	6.6
Research	26	20.6	22.6	21.4	21.7	21.5
Total	129.7	124.3	146.2	136.9	129.5	130.0

Source: EPA FY2004 Budget [www.epa.gov/ocfo/budget/budget]

! The “Buildings” component of EPA’s climate change research and technology activities include housing and commercial structures. EPA and others (including DOE) argue that efforts by individual and organizational consumers to secure the most energy efficient process or commodity are hampered by a lack of objective information on which to make comparisons (for details, see IB10020 *Energy Efficiency: Budget, Oil Conservation, and Electricity Conservation Issues*). Through the Agency’s ENERGY STAR Program and ENERGY STAR Buildings and Green Lights Partnership, EPA evaluates and certifies energy-saving building-related products (including such items as televisions, appliances, residential lighting, and whole houses), and makes that information available so that consumers and businesses can choose energy-saving and pollution-reducing products more easily.

! “Transportation” activities of EPA include the following:

- ▶ expanded support for a program which provides new incentives for commuters to consider transit, ridesharing, or other alternatives to driving;
- ▶ continued support of state and local efforts toward livable communities and smart growth;

- ▶ continued efforts in the Transportation Partners network which links about 340 local governments, community organizations, and companies in order to produce knowledge that is designed to reduce vehicle miles traveled;
 - ▶ work which contributed to the Partnership for a New Generation of Vehicles and now contributes to the Freedom CAR (both being government/domestic-auto-industry partnerships described previously under DOE).
- ! “Industry” efforts include working with industries (especially energy-intensive industries such as cement, chemicals, steel, petroleum, airlines, and food processing), commonly through technical assistance, to audit and identify greenhouse gas emission sources and to help in formulating appropriate reduction goals and strategies, including removal of regulatory and other barriers. This includes working with ongoing privately-funded energy efficiency programs at private companies.
- ! “Carbon Removal” efforts at EPA were planned in coordination with the Departments of Agriculture and Energy. The EPA/USDA/DOE funds for this activity are for studying ways to increase environmental storage of carbon, as well as the kinds and sizes of incentives that could be given to land owners and crop growers to increase the quantity of carbon stored on agricultural and forest lands, and at the same time improve soil quality, reduce soil erosion, and enhance other environmental and conservation goals.
- ! EPA works with “State and Local Governments” to help find ways to reduce energy use and pollution, sometimes by supporting existing state and local programs. The Cities for Climate Protection program, for example, involves more than 54 local governments in implementing building, transportation, waste, and renewable energy projects to eliminate about 3 million metric tons of carbon dioxide. A state-level example is New Jersey’s state carbon bank program, established to help achieve New Jersey’s greenhouse gas emissions reduction goal of 3.5% below 1990 levels by 2005.
- ! “International Capacity Building, Partnerships, and Cooperation” involves EPA and other agencies working to study ways to provide technical and other assistance to developing countries to aid in reducing their emissions. Developing countries currently emit more than half the global total of greenhouse gases, and such emissions are growing rapidly.

Smithsonian Institution. Global change research at the Smithsonian Institution attempts to understand more fully atmospheric processes, ecosystem dynamics, natural and human-induced environmental change on daily to decadal time scales, and longer-term climate metrics. The Smithsonian also serves as a repository of climate change findings. These activities amounted to \$6 million in FY2003, the same amount requested in FY2004.

United States Agency for International Development. The US Agency for International Development has worked with foreign governments with the goal of reducing net greenhouse gas emissions and lowering vulnerability to the threats posed by climate change impacts, by studying ways to increase use of environmentally sound energy, forestry, and biodiversity conservation methods. Foreign governments have included Brazil, the Philippines, and Russia. These efforts amounted to \$6 million in FY2003, the same amount requested for FY2004.

Department of Transportation. The Department of Transportation will conduct research and analysis relating to greenhouse gas models for the surface transportation sector, greenhouse gas control strategies, and transportation and global climate change. While there were no funds for this activity at DOT in FY2003, the FY2004 request is for \$4 million.

Department of State. Joined by various European Union environmental policy makers, the Department of State issued a joint statement on February 7, 2003 identifying six areas for possible cooperative research: carbon cycle research; aerosol-climate interactions; feedbacks, water vapor and thermohaline circulation; integrated observation systems and data; carbon capture and storage; and hydrogen technology and infrastructure. A government-industry partnership involving the Departments of State and Energy, and representatives from several countries, was announced on February 27, 2003 to design, build, and operate what was labeled “the world’s first pollution-free, coal-fired power plant. The facility will cost an estimated \$1,000 million over the next 10 years.”³⁶ While no climate change research funds for State were identified in FY2003, the FY2004 request is for \$1 million.

Department of Housing and Urban Development. Climate change research and technology programs, new to the Department of Housing and Urban Development (HUD) in FY1999, were for the government/ housing developers/ builders Partnership for Advancing Technology in Housing (PATH). Identified as part of the CCTI through FY2001, PATH research had a number of goals in addition to climate change. PATH efforts sought “to develop and disseminate technologies that will result in housing that is substantially more affordable, durable, disaster resistant, safer and energy/resource efficient...”³⁷ No known money for HUD has been requested since FY2001, but HUD continues to administer the overall operations of the PATH.

Conclusion

Possible climate change linked to “greenhouse gas” emissions has been addressed by various U.S. government policies since the mid-1980s, with an emphasis on energy R&D and on climate research and services. U.S. efforts in the

³⁶<http://usinfo.state.gov/topical/global/climate/03022802.htm>

³⁷Department of Housing and Urban Development Policy Development and Research, from [<http://www.hud.gov/bdfy2000/summary/pdandr/randt.cfm>]

former Bush and Clinton Administrations toward R&D in energy efficiency and renewable energy, and research into climate and global change were given direction by the Energy Policy Act of 1992, which implemented United States responsibilities under the UNFCCC, and by the Global Change Research Act of 1990. The 1993 Climate Change Action Plan linked or made partnerships among various federal agencies, business, state and local governments, and other entities with the goal of reducing U.S. greenhouse gas emissions. The Clinton Administration's CCTI built upon these earlier efforts. The current Bush Administration has introduced its U.S. Climate Change Research Initiative, the National Climate Change Technology Initiative, and the Climate Change Science Program Strategic Plan. The Plan, as released on July 24, 2003, describes five major research goals (improve knowledge of past and present climates, improve understanding of climate change forces, reduce uncertainty in climate change projections, understand sensitivity and adaptability of ecosystems to climate change, and explore uses and limits of knowledge to manage risks and opportunities). As funding and other details become available, similarities to and differences from earlier climate-change programs may become apparent. The evolving organizational structure, however, makes it difficult to determine precisely some of the interrelationships among science and technology programs.

Some critics of current climate change policy call for sharper goals, better defined priorities, and more detailed, clearly stated objectives for climate change R&D, and its associated funding profile. Some observers point out, for example, that the total CCSP request for spending in FY2004 was up only 0.1% over the FY2003 request, from \$1.747 billion to \$1.749 billion, while that portion of the funding request allocated to the embedded CCRI was up 355% from \$40 million in FY2003 to \$182 million in FY2004. An issue for Congress in this regard is the extent to which such a demonstrably large CCRI increase actually represents new money, and how much is attributable to the reclassification of ongoing research programs, especially given the fact that the overall request is up only 0.1%. On the other hand, some proponents note that further R&D is needed to justify certain climate change management strategies, to focus those strategies on key policy questions, and to reduce scientific uncertainties surrounding prospective climate change so that policymakers can make better, more informed decisions.

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