

# CRS Report for Congress

## Climate Change: Federal Funding and Tax Incentives

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Prepared for Members and  
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# Climate Change: Federal Funding and Tax Incentives

## Summary

As the prospect of climate change induced by greenhouse gases has gained increased attention, U.S. federal funding to address this issue has expanded from a few million dollars per year in the 1970s to \$5.44 billion in FY2007. The rise in funding is primarily attributed to the evolution of the federal effort — from scientific research in the early years to later inclusion of technology development, voluntary and regulatory programs, and international assistance. However, the accounting of activities related to climate change also has changed somewhat over the years, introducing some uncertainty in the degree to which funding has actually increased over time.

The President's FY2008 budget request includes \$5.95 billion for federal programs and activities identified as addressing climate change, a 9.4% increase above FY2007. In addition to this funding, certain tax incentives may encourage reductions in greenhouse gas emissions. Tax incentives are not spending *per se*, but they do result in less revenue than would be accrued otherwise, and as such, are costs to the federal government referred to as "tax expenditures." The Office of Management and Budget (OMB) estimates climate change tax expenditures would total \$1.42 billion in FY2008, an 18% decrease below expenditures of \$1.73 billion in FY2007.

The President's strategy on climate change is directed by the Cabinet-level Committee on Climate Change Science and Technology Integration. This strategy places management responsibility and accountability for the various programs in individual agencies. The executive branch reports funding for specific programs administered by these agencies according to three consolidated areas: Climate Change Science Program (CCSP), Climate Change Technology Program (CCTP), and International Assistance.

Although more than a dozen federal agencies administer the programs and activities within these areas, most of the funding is allocated among a few agencies. The President's FY2008 budget would allocate almost 60% of the total \$5.95 billion climate change request to the Department of Energy (DOE). The National Aeronautics and Space Administration (NASA) would receive about 20% of the requested funding, whereas the Department of Agriculture, Department of Commerce, and National Science Foundation (NSF) would each receive 4% to 5% of the total request. The remaining agencies would receive smaller portions, ranging from 2% to less than 1% each.

Key policy issues associated with federal climate change funding include

- prioritizing spending among individual programs, and articulating measurable goals and milestones against which to track progress;
- improving clarity in reporting of funding, including changes in accounting that make comparisons from year to year difficult; and
- the relationship of stability of funding and incentives to program effectiveness.

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# Climate Change: Federal Funding and Tax Incentives

## Overview

As the prospect of climate change induced by human-related pollution has gained increased attention,<sup>1</sup> U.S. federal funding has expanded for activities aimed at understanding and addressing the phenomenon. Both the amounts and purposes of funding have evolved. In 1971, a panel of the National Academy of Sciences<sup>2</sup> recommended that the United States increase its research into understanding the dynamics of climate and climate change by \$25 million<sup>3</sup> for the 10-year period of 1970-1979.<sup>4</sup> A jump in funding occurred in FY1990, following several major international scientific conferences in the late 1980s and an extraordinary period of heat and drought in the United States. In addition, international negotiations had begun toward a new United Nations Framework Convention on Climate Change, opened for signature in 1992. Also in 1992, President George H.W. Bush expanded climate related activities and funding beyond research with a national action program aimed at limiting greenhouse gas emissions. It was revised and expanded in 1993 by President William J. Clinton.

The funding data reviewed and summarized in this report derive primarily from the 2007 report to Congress on Federal Climate Change Expenditures by the Office of Management and Budget. It should be noted that these funds are reported by agencies as *relevant* to climate change, but a substantial number of these agencies' programs were initiated — and are supported — primarily for other purposes, such as controlling traditional air pollutants and enhancing energy security — and the climate change benefits are supplemental to these original purposes.

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<sup>1</sup> Pollution affecting the Earth's climate includes the greenhouse gases (GHG) carbon dioxide (CO<sub>2</sub>), methane (CH<sub>4</sub>), nitrous oxide (N<sub>2</sub>O), and chlorinated and fluorinated chemicals (such as CFC, HFC, HCFC). It also includes tropospheric ozone, black carbon, organic carbon, and sulfates. For more information, see CRS Report RL33849, *Climate Change: Science and Policy Implications*, by Jane A. Leggett.

<sup>2</sup> National Research Council, *The Atmospheric Sciences and Man's Needs: Priorities for the Future* (Washington: National Academies Press, 1971).

<sup>3</sup> In 1970 dollars.

<sup>4</sup> Office of Management and Budget, *Federal Climate Change Expenditures: Report to Congress* (Washington, 2007), at [[http://www.whitehouse.gov/omb/legislative/fy08\\_climate\\_change.pdf](http://www.whitehouse.gov/omb/legislative/fy08_climate_change.pdf)].

Most recently, the Office of Management and Budget (OMB) reported that federal funding for programs and activities related to climate change totaled \$5.44 billion in budget authority in FY2007. The President's FY2008 budget request included a 9.4% increase in funding for these programs and activities, proposing a total of \$5.95 billion. The federal government also offers a variety of tax incentives that could encourage reductions in greenhouse gas (GHG) emissions. Although tax incentives are not federal spending *per se*, they do reduce revenues to the federal government that would have been accrued otherwise. In that sense, the loss of revenues resulting from tax incentives are often presented by OMB as "tax expenditures" of the federal government. OMB has estimated a total of \$1.42 billion in climate change-related "tax expenditures" in FY2008, down from \$1.73 billion in FY2007.

**Program Areas.** OMB groups funding related to climate change according to three program areas that consolidate many individual programs and activities into each respective area based on three primary purposes: scientific research, technological research, and international assistance. These three program areas reflect the total programmatic effort of the federal government to address climate change across all agencies, as reported by OMB. These areas are as follows:

- Climate Change Science Program (CCSP);
- Climate Change Technology Program (CCTP); and
- International Climate Change Assistance.

**Tax Expenditures.** In addition to funding for specific programs and activities within the above program areas, various tax provisions may provide incentives to encourage reductions in greenhouse gas emissions. As alluded to earlier, "tax expenditures" are "revenue losses resulting from Federal tax provisions that grant special tax relief designed to encourage certain kinds of behavior by taxpayers or to aid taxpayers in special circumstances. These provisions may, in effect, be viewed as spending programs channeled through the tax system."<sup>5</sup> Examples of tax incentives related to climate change include credits for purchase of cleaner automobiles, and investment in renewable electricity generation technologies.

**International Context.** The U.S. climate-related programs support the commitments of the United States as a Party to the United Nations Framework Convention on Climate Change (UNFCCC), ratified by the U.S. Senate in 1992. The objective of the UNFCCC is "the stabilization of greenhouse gases in the atmosphere at a level that would prevent dangerous anthropogenic<sup>6</sup> interference with the climate system ... within a time-frame sufficient to allow ecosystems to adapt naturally to climate change, to ensure that food production is not threatened and to enable

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<sup>5</sup> Congressional Research Service. 2006. Tax Expenditures: Compendium of Background Material on Individual Provisions. Washington DC: Committee on the Budget, U.S. Senate. p.2. Tax expenditures are defined by Section 3(3) of the Congressional Budget and Impoundment Control Act of 1974 [2 U.S.C. 622(3)]. [[http://frwebgate.access.gpo.gov/cgi-bin/getdoc.cgi?dbname=109\\_cong\\_senate\\_committee\\_prints&docid=f:31188.pdf](http://frwebgate.access.gpo.gov/cgi-bin/getdoc.cgi?dbname=109_cong_senate_committee_prints&docid=f:31188.pdf)].

<sup>6</sup> Human-related.

economic development to proceed in a sustainable manner.”<sup>7</sup> Parties agreed to produce national action plans aiming voluntarily to reduce greenhouse gases to 1990 levels by 2000, along with other reporting and cooperative provisions, but with no meaningful consequences for failing to meet the commitments.<sup>8</sup> The U.S. commitment to adopting a national action plan to mitigate greenhouse gas emissions resulted in expanding the scope of climate-related federal activities, and overall funding levels in response to that expansion.

**Categories of Reported Funding.** Almost all the data presented in this CRS report are as reported in OMB’s annual *Federal Climate Change Expenditures Report to Congress* (of May 2007 and those of previous years). OMB prepares this annual report in response to specific statutory requirements.<sup>9</sup> Its report indicates amounts of funding in terms of budget authority for the three program areas discussed above, and estimates of tax expenditures for incentives intended to encourage reductions in greenhouse gases.

The amounts of budget authority presented by OMB appear to represent *new* budget authority in a given year, as opposed to *total* budget authority that includes new budget authority plus carryover of unobligated balances of funding appropriated in prior years.<sup>10</sup> As such, total budget authority equals the total amount of money that Congress has allowed an agency to obligate to spend in a given year, whereas new budget authority is generally synonymous with appropriations provided in a given year, excluding any funds that may be carried over from past years. Consistent with OMB’s reports, the amounts of budget authority presented in this CRS report are new budget authority, not total budget authority.

In its annual report, OMB also *estimates* the amount of funding the executive branch expects to obligate under the three program areas in the fiscal year during which the report is submitted, and *estimates* the amount of obligated funding that the executive branch expects to expend in that year, referred to as outlays. However, OMB does not report *actual* obligations or outlays (i.e. expenditures) of funds for completed fiscal years. Rather, OMB only reports actual amounts of budget authority for completed fiscal years, and estimates obligations and outlays only for the pending fiscal year in which its report is submitted to Congress.

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<sup>7</sup> United Nations Framework Convention on Climate Change (Rio de Janeiro, 1992) [[http://unfccc.int/essential\\_background/convention/background/items/2853.php](http://unfccc.int/essential_background/convention/background/items/2853.php)].

<sup>8</sup> For further information, see CRS Report RL33826 *Climate Change: The Kyoto Protocol and International Actions*, by Susan R. Fletcher and Larry Parker.

<sup>9</sup> P.L.101-606, the Global Change Research Act of 1990, requires annual reporting of expenditures to Congress on global change science. Section 555(b) of P.L. 108-7, enacted in February 2003, also required that the President submit a report to the Committees on Appropriations, describing in detail all federal agency obligations and expenditures, domestic and international, for climate change programs and activities in FY2003, as well as additional requirements. Congress has included this reporting requirement in subsequent annual appropriations bills. See Appendix I of this report. Language currently under consideration in H.R. 906 would change existing reporting requirements.

<sup>10</sup> According to OMB, “The Budget System and Concepts,” 2007, budget authority is “the authority provided by law to incur financial obligations that will result in outlays,” or spending. See [<http://www.whitehouse.gov/omb/budget/fy2008/pdf/concepts.pdf>].

Based on OMB's figures, this CRS report presents the total impact to the federal budget resulting from budget authority made available for the three major climate change program areas, and the loss of revenues to the federal government from tax expenditures for incentives intended to encourage reductions in greenhouse gases. This total budgetary impact is intended to illustrate the overall level of federal effort, or cost to the federal government, in response to concerns about climate change.

**Consistency Issues.** OMB's reported levels of funding to address climate change are approximate, and have varied over time not only because of differences in dollar amounts for specific activities, but also as a result of changes in the individual activities included within the major program areas. Such accounting shifts within the program areas make it difficult to compare the funding levels consistently across years, resulting in some uncertainty as to how funding levels have changed over time. OMB's reported funding levels are further complicated by the inclusion of certain activities and incentives that may be related to the Administration's climate change goals, but that serve broader purposes, such as energy efficiency and nuclear energy programs. In some instances, activities arguably related to climate change also appear not to be included in OMB's reporting, such as programs to control tropospheric ozone or to conserve carbon in soils.

The Government Accountability Office (GAO) investigated the Administration's reporting practices, in 2005<sup>11</sup> and 2006.<sup>12</sup> GAO recommended greater clarity and consistency of reporting on federal funding for climate change activities. OMB reports in 2006 and 2007 appear to have complied with many of the GAO recommendations, although fully consistent accounting remains unavailable, particularly for years prior to 2006.

Several agencies also have revised the set of programs and projects that they report to OMB as supporting climate change goals, or have refined the methods of accounting for these activities. For example, within the budgets of NASA and NOAA, costs of salaries, laboratories, certain satellites and other expenses have been newly reported as climate change funding in recent years, whereas they were not reported as such earlier. Consequently, such changes in accounting continue to make it difficult to ascertain and compare aggregate levels of funding for climate change across the years.

## **Recent Funding and the President's FY2008 Request**

OMB reports that federal funding for the three major climate change program areas has fluctuated over the past several years, with overall increases from year to year in some cases, and decreases in others. Without adjusting for inflation, budget authority rose from \$4.88 billion in FY2003 to \$5.12 billion in FY2004, and then declined to \$4.91 billion in FY2005 and \$4.72 billion in FY2006. OMB reports that enacted budget authority increased to a high of \$5.44 billion in FY2007. The President has requested a further increase to \$5.95 billion in FY2008.

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<sup>11</sup> GAO. *Climate Change: Federal Reports on Climate Change Funding Should Be Clearer and More Complete*. GAO-05-461. August 2005. 47 p.

<sup>12</sup> GAO. *Climate Change: Greater Clarity and Consistency Are Needed in Reporting Federal Climate Change Funding*. GAO-06-1122T. September 2006. 23 p.

These increases are primarily due to greater funding for technology programs, whereas funding for scientific research and international assistance generally has declined since FY2003. Relative to FY2007 alone, the President has proposed increases in funding for all three program areas, with technology programs accounting for the greatest portion of the increase. OMB's estimates of tax expenditures have risen sharply overall from \$580 million in FY2003 to \$1.73 billion in FY2007. The more recent rise in the estimates from FY2006 to FY2007 is primarily due to expected loss of revenues resulting from tax incentives included in the Energy Policy Act of 2005 (P.L. 109-58). In FY2008, OMB estimates that climate-change related tax expenditures will fall to \$1.42 billion.

As indicated in **Table 1**, OMB reports that the total impact to the federal budget resulting from budget authority for the three program areas, and the loss of revenues resulting from tax expenditures, has grown from \$5.45 billion in FY2003 to \$7.17 billion in FY2007. The President's FY2008 budget estimates a further increase to \$7.37 billion. The overall increase over the past several years is primarily due to rising investments in technology programs, and a generally upward trend in the expansion of tax incentives intended to encourage reductions in greenhouse gas emissions. However, the accounting of activities related to climate change also has changed somewhat over the years, introducing some uncertainty in the degree to which actual funding has increased over time, as discussed above in the "Consistency Issues" section of this CRS report.

**Table 1. Total Budgetary Impact of U.S. Climate Change Initiatives: FY2003-FY2006 Actual, FY2007 Enacted, and the President's FY2008 Request**  
(in millions of dollars)

Major Climate Change Program Areas	Budget Authority						% Change 2007-08
	FY2003 Actual	FY2004 Actual	FY2005 Actual	FY2006 Actual	FY2007 Enacted	FY2008 Request	
Climate Change Science Program	\$2,078	\$1,996	\$1,864	\$1,691	\$1,822	\$1,836	< 1%
Climate Change Technology Program	\$2,533	\$2,870	\$2,808	\$2,789	\$3,441	\$3,917	14%
International Climate Change Assistance	\$270	\$252	\$234	\$249	\$188	\$212	13%
<b>All Areas</b>	<b>\$4,881</b>	<b>\$5,118</b>	<b>\$4,906</b>	<b>\$4,716</b>	<b>\$5,436</b>	<b>\$5,951</b>	<b>9%</b>
Tax Provisions That May Reduce Greenhouse Gas Emissions	Estimated Tax Expenditures						% Change 2007-08
	FY2003	FY2004	FY2005	FY2006	FY2007	FY2008	
	\$580	\$500	\$369	\$1,160	\$1,730	\$1,420	-18%
<b>Total Budgetary Impact <sup>a</sup></b>	<b>\$5,454</b>	<b>\$5,582</b>	<b>\$5,269</b>	<b>\$5,876</b>	<b>\$7,166</b>	<b>\$7,371</b>	<b>3%</b>

**Source:** OMB, *Federal Climate Change Expenditures Report to Congress*, FY2008, May 2007, Table 8, p. 27. OMB adjusted the science and technology amounts for FY2003, FY2004, and FY2005 to reflect more recent accounting within these program areas.

- a. The total impact to the federal budget in each year as reported by OMB differs somewhat from the sum of budget authority for each program area and the estimates of tax expenditures, due to exclusion by OMB of dollar amounts for certain activities to avoid double-counting.



**Table 2** indicates the amount of budget authority reported by OMB for the three major climate change program areas broken out by the 14 federal departments and agencies that administer them, for the same years as provided in **Table 1** above. OMB's totals for the three program areas presented in Table 1 are consistent with the department and agency totals in Table 2 for FY2006, FY2007, and the President's FY2008 request. However, these totals in each table are not consistent for FY2003, FY2004, and FY2005, because of adjustments in these years that OMB made in the accounting of the science and technology program areas displayed in Table 1. These adjustments do not appear to be reflected in OMB's historical accounting of program funding broken out by department and agency displayed in Table 2. Such inconsistencies in OMB's reporting make it difficult, in certain years, to compare funding for the consolidated program areas to funding for the departments and agencies that administer specific programs within these areas.

**Table 2. Budget Authority for U.S. Climate Change Programs  
by Federal Department and Agency: FY2003-FY2006 Actual,  
FY2007 Enacted, and the President's FY2008 Request**  
(in millions of dollars)

Department or Agency	FY2003 Actual	FY2004 Actual	FY2005 Actual	FY2006 Actual	FY2007 Enacted	FY2008 Request	% Change 2007-08
Department of Agriculture	\$104	\$116	\$110	\$110	\$104	\$290	179%
Department of Commerce	\$156	\$144	\$146	\$253	\$244	\$255	5%
Department of Defense	\$83	\$51	\$59	\$77	\$72	\$33	-54%
Department of Energy	\$2,214	\$2,519	\$2,469	\$2,504	\$3,158	\$3,511	11%
Department of Health & Human Services	\$61	\$62	\$57	\$50	\$50	\$49	-2%
Department of the Interior	\$28	\$29	\$29	\$27	\$26	\$27	4%
Department of State	\$6	\$6	\$7	\$12	\$41	\$41	0%
Department of Transportation	\$27	\$9	\$3	\$17	\$18	\$17	-6%
Department of the Treasury	\$56	\$52	\$44	\$46	\$46	\$56	22%
Environmental Protection Agency	\$124	\$127	\$130	\$128	\$121	\$118	-2%
National Aeronautics & Space Administration	\$1,298	\$1,548	\$1,449	\$1,082	\$1,224	\$1,203	-2%
National Science Foundation	\$213	\$226	\$209	\$215	\$226	\$231	2%
Smithsonian Institution	\$6	\$6	\$6	\$6	\$6	\$6	0%
U.S. Agency for International Development	\$214	\$195	\$183	\$190	\$100	\$115	15%
<b>All Departments and Agencies</b>	<b>\$4,584</b>	<b>\$5,090</b>	<b>\$4,900</b>	<b>\$4,716</b>	<b>\$5,436</b>	<b>\$5,951</b>	<b>9%</b>

**Source:** OMB, op. cit., FY2008 (May 2007), FY2007 (April 2006), FY2006 (March 2005), FY2005 (May 2004).

## Interagency Objectives and Coordination

In 2002, President George W. Bush announced a goal to cut the U.S. greenhouse gas intensity — the quantity of greenhouse gases emitted per unit of economic activity (GDP) — by 18% through 2012.<sup>13</sup> He included in the U.S. policy framework other goals for global climate change aimed at

- reducing scientific uncertainties;
- advancing development and introduction of energy efficient, renewable, and other low- or non-emitting technologies; and
- improving standards for measuring and registering emissions reductions.

Specific outcome-oriented performance targets have been set for some climate-related programs, such as for greenhouse gas reductions achieved by EPA's appliance efficiency Energy Star program, and several of the smaller voluntary partnerships. Quantitative greenhouse gas, science, or technology performance targets have not been identified for most of the climate-related funding requests.

The President's strategy established a new Cabinet-level Committee on Climate Change Science and Technology Integration to oversee the implementation of the science and technology research programs across agencies. This committee meets approximately quarterly, but the principal program design and management occurs within each agency. The strategy, thus, puts accountability and leadership for the science and technology programs in each of the relevant agencies. Communication and coordination are facilitated through a series of inter-agency working groups that meet with varying frequencies. Budget levels are established primarily through dialogue between each agency and OMB. This contrasts with the practice in the early 1990s of reaching agreement among the science agencies about any increments to the global change research budgets.

Under the Climate Change Science Program (CCSP) announced in 2002, the President set up a Climate Change Research Initiative (CCRI) that supplements the U.S. Global Change Research Program (US GCRP), established by Congress in 1990,<sup>14</sup> which emphasizes long-term scientific research. The 2002 strategy also established a Climate Change Technology Program (CCTP), parallel to the science research program. It includes a National Climate Change Technology Initiative (NCCTI) in addition to pre-existing clean energy research. The Department of State takes the lead on most aspects of international cooperation.

The remainder of this report briefly describes each of the three major climate change program areas, including science, technology, and international assistance, and tax provisions that may encourage reductions in greenhouse gases. The report

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<sup>13</sup> The "business-as-usual" decline for this period is estimated to be about 14%.

<sup>14</sup> U.S. Global Change Research Act of 1990 (P.L. 101-606; 104 Stat.3096-3104).

also identifies several policy issues related to federal funding for climate change programs and activities.

## Climate Change Science Program

Significant advances have been made over the past two decades to collect observations of Earth processes relevant to climate change; to develop a variety of models to analyze and forecast economic, energy, atmospheric, ocean and land systems; and to understand the potential impacts of climate change on humans and ecosystems.

Congress established the Global Change Research Program (GCRP) in the Global Change Research Act of 1990 (P.L.101-606), aimed at understanding and responding to global change. The Global Change Research Act requires a scientific assessment report to Congress at least every four years, as well as annual reports on climate change activities and budget. As discussed below, the first and only national assessment complying with the Global Change Research Act was published in December 2000.

In the FY2004 budget, the Administration integrated the long-standing Global Change Research Program with the more recent Climate Change Research Initiative (CCRI) noted above, establishing the current programmatic framework of the Climate Change Science Program (CCSP). However, there appears to be little practical distinction between these two efforts within this larger program area, in terms of their similar goals of advancing climate change research. The overall strategy, the *Climate Change Science Program Strategic Plan*, was published in 2003 and is supported by ongoing reviews by the National Academy of Science. The CCSP Strategic Plan groups research into seven elements:

- atmospheric composition,
- climate variability and change,
- global water cycle,
- land use/land cover change,
- global carbon cycle,
- ecosystems, and
- human contributions and responses.

The CCSP Strategic Plan further lays out five goals, which do not correspond closely with the seven research elements. It plans to produce 21 “synthesis and assessment” (SAR) products, originally intended to be completed in 2007.<sup>15</sup> The Administration intends these SAR products, taken together to meet the four-year reporting requirement of the Global Change Research Act of 1990. Others disagree that this series of reports will suffice to meet the statutory requirement or to meet the needs of policy-makers.

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<sup>15</sup> Additional information on the SARs, including their content and status, can be found at [<http://www.climate-science.gov/Library/sap/>].

A National Academy of Science panel, convened at the request of the former director of the CCSP to consider how to measure progress for the program, noted that the CCSP Strategic Plan “does not contain measures of success, and program objectives are written too broadly for them to be inferred.”<sup>16</sup> The panel concluded that metrics could be developed and used for the CCSP, but highlighted the considerable challenge and cost in identifying, producing, and using a set of metrics to measure progress for all elements of the CCSP. It also noted that “while some metrics can measure short-term impacts (e.g., CCSP payoffs scheduled to occur within two to four years), it may take decades to fully assess the substantial contributions to the global debate on climate change being made by the CCSP and its predecessor US GCRP.”<sup>17</sup>

The President requested \$1.84 billion for FY2008 to support climate change research under the CCSP. This proposed level of funding would be provided to 13 federal agencies through nine appropriations bills. The FY2008 request is \$14 million (0.8%) above the FY2007 budget authority of \$1.82 billion, and \$145 million (8.6%) above the FY2006 level. The research in this area is intended to help reduce uncertainties in the science, as highlighted by a National Academy of Sciences report<sup>18</sup> requested by the President in 2001. Nearly 60 percent of the President’s FY2008 budget request for climate change science is proposed for NASA, primarily for space-based observations. The history of U.S. funding for climate change science since FY1989 is presented in **Figure 1** and **Table 3**. The amounts are as reported by the CCSP, which do not appear to reflect OMB’s adjustments to the amounts for FY2003, FY2004, and FY2005, as presented in **Table 1** of this CRS report.

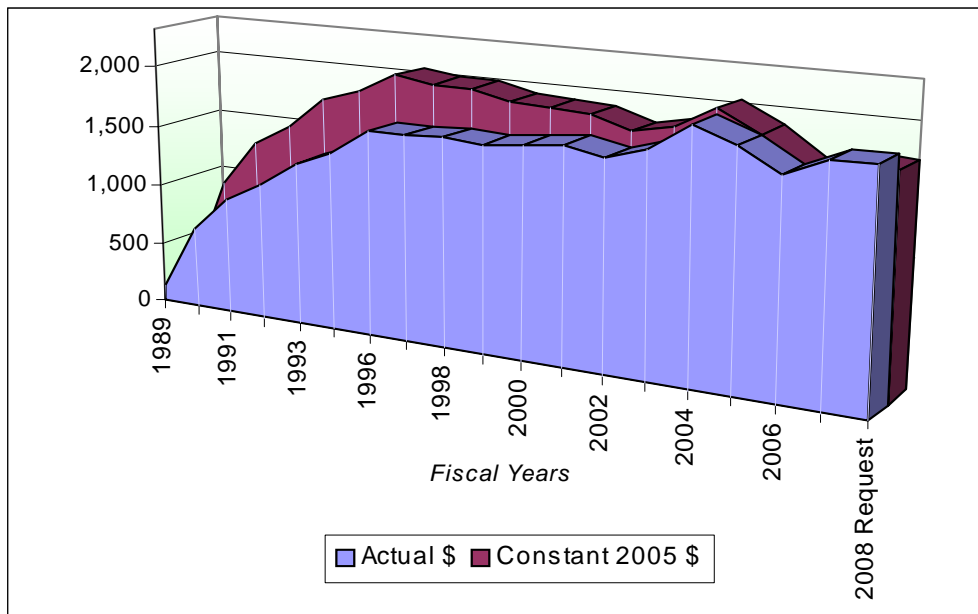
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<sup>16</sup> National Research Council, *Thinking Strategically: The Appropriate Use of Metrics for the Climate Change Science Program*, 2005.

<sup>17</sup> *Ibid.* Executive Summary, p. 9.

<sup>18</sup> National Research Council, *Climate Change Science: An Analysis of Some Key Questions* (Washington: National Academies Press, 2001).

**Figure 1. Budget Authority for U.S. Climate Change Science: FY1989-FY2006 Actual, FY2007 Enacted, and FY2008 Request**



**Source:** Prepared by CRS with information from the Climate Change Science Program (CCSP), at [<http://www.climatescience.gov/infosheets/highlight2/default.htm#funding>]; accessed August 2, 2007.

**Note:** Constant amounts adjusted for inflation in 2005 dollars are as reported by the CCSP. The dollar amounts for FY2003, FY2004, and FY2005 do not appear to reflect accounting adjustments by OMB in its *FY2008 Federal Climate Change Expenditures Report to Congress*.

The tightening fiscal environment of federal discretionary budgets is resulting in shifting of funds within several agencies from climate change to other priorities. For example, NASA's climate-related budget has declined by more than 30% since FY2000.<sup>19</sup> NASA funds associated with the Climate Change Science Strategic Plan, and the greatest portion of CCSP funds, are aimed at research on the natural carbon cycle, climate modeling, and the link between atmospheric chemistry and climate.

NASA has changed some of its accounting methods since 2005, and has revised the set of programs and projects it counts within the CCSP. These revisions make comparison of budget authority difficult to track across multiple years. Elements of several satellite systems, including the Landsat Data Continuity Mission, the Gravity Recovery and Climate Experiment (GRACE) and portions of the High-End Computing and Scientific Computing projects are newly included in the 2007 White House report. Due to cost overruns in major missions of NASA, funds have been shifted since FY2005 from programs that support climate change to other priorities, such as the Mission to Mars. Analysis operations in the Earth Sciences is cut in the President's FY2008 budget request from \$461 million in FY2006 and \$454 million

<sup>19</sup> National Research Council, *An Assessment of Balance in NASA's Science Programs* (Washington: National Academies Press, 2006).

in FY2007 to a proposed \$429 million in FY2008.<sup>20</sup> An NAS panel<sup>21</sup> noted that cutting research and analysis of observations from missions already launched reduces the “return on investment” from the high front-end expenditures to acquire satellite-based data. The NAS report was released too late to influence the President’s FY2008 request.

**Table 3. Budget Authority for U.S. Climate Change Science:  
FY1989-FY2006 Actual, FY2007 Enacted,  
and the President’s FY2008 Request**

(in millions of nominal dollars, and adjusted for inflation in 2005 dollars)

Fiscal Year	Nominal Dollars	2005 Dollars
1989	\$134	\$209
1990	\$659	\$975
1991	\$954	\$1,355
1992	\$1,110	\$1,531
1993	\$1,326	\$1,775
1994	\$1,444	\$1,885
1995	\$1,760	\$2,234
1996	\$1,654	\$2,039
1997	\$1,656	\$1,995
1998	\$1,677	\$1,989
1999	\$1,657	\$1,925
2000	\$1,687	\$1,896
2001	\$1,728	\$1,886
2002	\$1,667	\$1,792
2003	\$1,766	\$1,857
2004	\$1,975	\$2,021
2005	\$1,865	\$1,865
2006	\$1,691	\$1,656
2007	\$1,822	\$1,745
2008 Request	\$1,836	\$1,719

**Source:** Prepared by CRS with information from the Climate Change Science Program (CCSP), at [<http://www.climatescience.gov/infosheets/highlight2/default.htm#funding>]; accessed August 2, 2007.

**Note:** Constant amounts adjusted for inflation in 2005 dollars are as reported by the CCSP. The dollar amounts for FY2003, FY2004, and FY2005 do not appear to reflect accounting adjustments by OMB in its *FY2008 Federal Climate Change Expenditures Report to Congress*.

<sup>20</sup> Freilich, Michael H. 2007. NASA Earth Science Division Overview: Status, Constraints and Challenges. April 11 [[http://oceancolor.gsfc.nasa.gov/DOCS/ScienceTeam/OCRT\\_Apr2007/Freilich\\_OCRT2007.pdf](http://oceancolor.gsfc.nasa.gov/DOCS/ScienceTeam/OCRT_Apr2007/Freilich_OCRT2007.pdf)].

<sup>21</sup> National Research Council. 2007. *Earth Science and Applications from Space: National Imperatives for the Next Decade and Beyond*. (Washington, DC: National Academies Press.)

The first and only national assessment of climate change science and impacts, required by the Global Change Research Act of 1990, was published in December 2000. The act mandates a subsequent report no later than 2004. The Government Accountability Office found in February 2005 that the Administration had failed to comply with the congressional requirement. As noted above, the CCSP is due to produce 21 Synthesis and Assessment Reports on specific topics; the first was published in April 2006,<sup>22</sup> whereas the remaining reports are due to be released through 2008. The Bush Administration contends that these will, in aggregate, comply with the requirement of the Global Change Research Act of 1990. Others disagree that this series of reports will suffice to meet the statutory requirement or to meet the needs of policy-makers.

## **Climate Change Technology Program**

The U.S. Climate Change Technology Program (CCTP) is the technology component of the climate change strategy announced by President Bush in 2002, though many of these programs existed prior to establishment of the CCTP. Currently, the CCTP is composed of programs administered by 11 agencies plus the Executive Office of the President. The CCTP objective is to accelerate the technological advances needed to facilitate the reduction and avoidance, as well as capture and storage, of man-made emissions of greenhouse gases (GHG). While the Strategic Plan sets many milestones for demonstrations of specific technologies, there are no specific targets or measures for greenhouse gas emissions or capture in the CCTP Strategic Plan,<sup>23</sup> which was released in September 2006.

The six strategic goals outlined for the CCTP are to advance development of technologies that:

- reduce emissions from energy end-use and infrastructure,
- reduce emissions from energy supply,
- capture and sequester carbon dioxide,
- reduce emissions of non-CO<sub>2</sub> greenhouse gases,
- improve capabilities to measure and monitor GHG emissions, and
- bolster basic scientific contributions to technology development.

As reported by OMB, federal funding for climate change technology has increased from \$845 million in FY1993 to \$3.44 billion in FY2007, a \$2.60 billion (307%) increase. The President's FY2008 budget request includes \$3.92 billion for FY2008, a \$476 million (14%) increase above FY2007. However, the actual increase in funding for these efforts may be lower than the dollars amounts suggest, as OMB has redefined the initiatives included within the CCTP over time, and individual

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<sup>22</sup> Karl, Thomas R., Susan J. Hassol, Christopher D. Miller, and William L. Murray, eds., *Temperature Trends in the Lower Atmosphere: Steps for Understanding and Reconciling Differences*, a Report by the Climate Change Science Program and the Subcommittee on Global Change Research (Washington, 2006).

<sup>23</sup> U.S. Climate Change Technology Program, U.S. Climate Change Technology Program Strategic Plan (Washington, 2006); [<http://www.climatechange.gov/stratplan/final/index.htm>].

programs funded within larger accounts are often counted in more than one initiative. For example, an increasing number of existing nuclear energy programs, as well as some clean coal programs, have been counted in later years that originally were not included in OMB's earlier reporting of climate change technology funding.

Such changes make it difficult to track the content and evolution of specific climate change technology programs, and funding for them, across the years. GAO has made similar observations, and has identified several ways that technology funding presented in OMB's more recent reports may not be comparable to previously reported technology funding,<sup>24</sup> introducing some uncertainty in the funding trend. As quantified results expected from programs are set and monitored (as required under the Government Performance and Results Act of 1993),<sup>25</sup> redefinitions of program areas also may complicate performance tracking and accountability, in addition to making funding comparisons difficult from year to year.

Congress appropriates funds to DOE, the Environmental Protection Agency (EPA), and the Department of Agriculture (USDA) to administer more than 60 programs to support voluntary deployment of existing technologies. Programs include Energy Star, Climate Leaders, the Methane Partnership Initiatives, Value Added Producer Grants, and many others. In FY2007, DOE represented 88% (\$3.0 billion) of the budget authority enacted for the CCTP, with EPA and NASA receiving about 3% and 4%, respectively of the \$3.44 billion total.

From FY2003 to FY2004, the total budget authority for the CCTP rose, largely due to inclusion of a greater share of funding for DOE's Clean Coal Power Initiative than in prior years. While the clean coal program previously had focused on reduction of major pollutants, its focus was reported by OMB to have shifted to improving efficiency, which would reduce greenhouse gas emissions per unit of electricity produced. On the other hand, the reported increase in the CCTP funding from FY2005 reflects less of the previously reported infrastructure funding in DOE's nuclear energy program, and a redirection in FY2006 of \$400,000 from energy supply and conservation programs into analysis and other activities of the CCTP.

The President's FY2008 request includes numerous changes to funding that Congress enacted for FY2007 to support DOE's climate change technology programs. Some of these proposed changes include:

- a \$175 million (12%) reduction for energy efficiency and renewable energy, including reductions for wind energy, efficient lighting and increases for cellulosic biofuels and hydrogen storage;
- a \$5 million (5%) reduction for energy supply and conservation for electricity transmission and distribution;

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<sup>24</sup> GAO. *Climate Change: Greater Clarity and Consistency Are Needed in Reporting Federal Climate Change Funding*. GAO-06-1122T. September 2006, p. 3.

<sup>25</sup> P.L. 103-62.



- a \$31 million (6%) increase for Fossil Energy Research and Development/Efficiency and Sequestration, while reducing funds for carbon sequestration (-\$19 million) and integrated combined cycle generation technology (-\$6 million);
- a \$299 million (61%) increase for nuclear energy supply and conservation to support the Global Nuclear Energy Partnership; and
- a \$208 million (42%) increase for nuclear fusion research, sequestration and hydrogen research, including support to the international ITER nuclear fusion partnership and three bioenergy research centers.

The President's FY2008 budget request also includes a substantial increase of more than 400% for the USDA to administer certain programs under the CCTP, from \$46 million in FY2007 to \$234 million in FY2008. About two-thirds of this funding would be for proposed mandatory programs for bioenergy research, grants and loans included in the Administration's 2007 Farm Bill proposal.<sup>26</sup> Another one-third would be for increases in discretionary spending on bioenergy research, education and extension service.

The President's budget proposal also would cut climate change technology funding for the Department of Defense (DOD) by \$39 million (54%), from \$72 million in FY2007 to \$33 million in FY2008. This proposed reduction reflects an omission of funding not to continue congressionally designated projects, as well as less funding requested because of the completion of research on military use of waste materials for electricity production.

**Appendix II** provides tables highlighting the Administration's priorities for specific technologies planned for development by DOE and EPA under the CCTP, over the near-, medium-, and long-term. Of note, research on carbon sequestration in the oceans (sometimes proposed as a geo-engineering approach to reducing carbon dioxide concentrations in the atmosphere) was ended in FY2006 due to findings of adverse effects (e.g., mortality of invertebrates) on deep ocean biology and chemistry.<sup>27</sup>

The Administration also has reviewed the progress of the CCTP in meeting its priorities. In its *Vision and Framework for Strategy and Planning*,<sup>28</sup> the Administration calls for the need to "periodically assess the adequacy of the multi-agency portfolio with respect to its ability to achieve, or make technical progress toward, CCTP strategic goal attainment; identify gaps, opportunities, and make

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<sup>26</sup> Title-by-Title details of USDA's 2007 Farm Bill proposal are available at [[http://www.usda.gov/wps/portal/usdafarmbill?navtype=SU&navid=FARM\\_BILL\\_FORUMS](http://www.usda.gov/wps/portal/usdafarmbill?navtype=SU&navid=FARM_BILL_FORUMS)].

<sup>27</sup> Department of Energy, FY2008 Congressional Budget Request, 2007, available at [<http://www.er.doe.gov/ober/CCRD/tcp.html>].

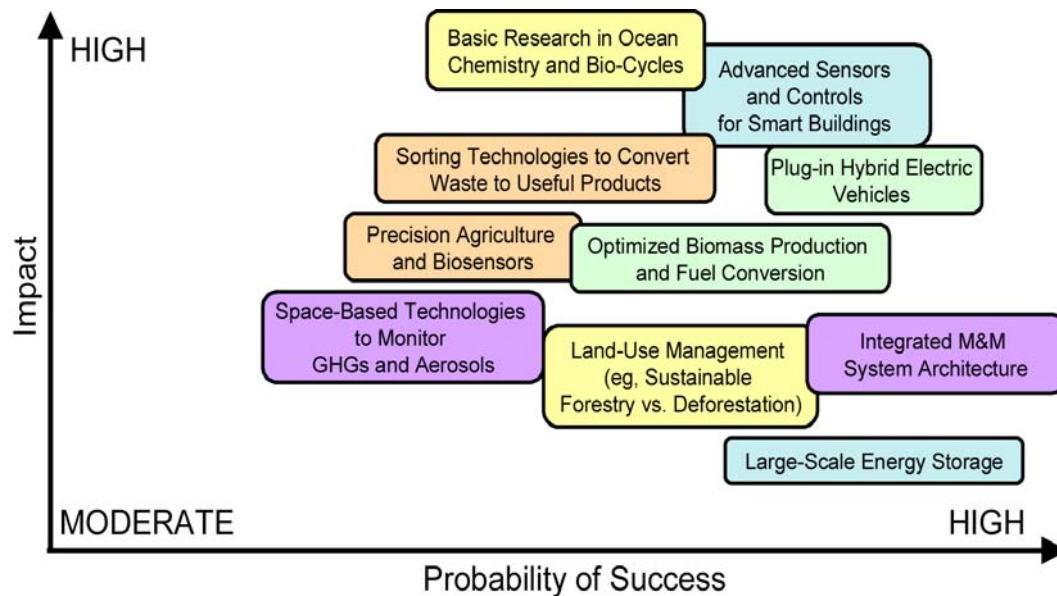
<sup>28</sup> U.S. Climate Change Technology Program, U.S. Climate Change Technology Program: Vision and Framework for Strategy and Planning (Washington, 2005) [<http://www.climatechange.gov/vision2005/index.htm>].

recommendations.” The CCTP contracted a review of the R&D portfolio, with a report issued in July 2006.

The review panel concluded that, while the CCTP portfolio is strong in near-term technology options, there is also a need to accelerate R&D on more mid- and long-term technology solutions to climate change over the next century. The review noted gaps in the portfolio, particularly for the CCTP goals concerning non-CO<sub>2</sub> greenhouse gases and for measuring and monitoring greenhouse gases; the gaps are associated with a low level of funding for these areas. Other gaps were identified for exploratory research addressing novel and advanced concepts aimed at *breakthrough technologies* and research in the basic sciences and potentially enabling disciplines of materials, biology, physical sciences, computational sciences, and nanotechnology.

The review designed a conceptual framework to assist in setting priorities for future CCTP R&D portfolios, as illustrated in **Figure 2**. It defines “Impact” as progress toward a particular CCTP strategic goal; “Probability of Success” is defined as the level of certainty that the technology would be successfully developed and achieve the specified impact. The concept appears, in this formulation, not to include the relative costs of R&D to achieve the impact. The figure is illustrative and not intended by the review panel as a statement of prioritization among actual opportunities; it provides a conceptual example of how priorities among the large array of R&D opportunities might be evaluated for future expenditures.

**Figure 2. Evaluation of R&D Opportunities for the CCTP**



**Source:** Brown, Marilyn, Matt Antes, Charlotte Franchuk, Burton H. Koske, Gordon Michaels, Joan Pellegrino, et al., *Results of a Technical Review of the U.S. Climate Change Technology Program's R&D Portfolio*, 2006, [[http://www.ornl.gov/sci/eere/PDFs/CCTP\\_Wkshp\\_Rpt\\_6-28Final.pdf](http://www.ornl.gov/sci/eere/PDFs/CCTP_Wkshp_Rpt_6-28Final.pdf)].

## International Climate Change Assistance

In addition to domestic programs that support climate change science and technologies, the United States expends funds in its work with other nations and private enterprises to address climate change. For example, the President's FY2008 budget request includes \$5 million to support the Department of State (DOS) contributions to the United Nations Framework Convention on Climate Change (UNFCCC) and the Intergovernmental Panel on Climate Change (IPCC).

The request also includes a larger amount of \$115 million for international climate change assistance through the United States Agency for International Development (USAID). The request is \$15 million (15%) more than the funding level of \$100 million in FY2007, and is \$75 million (39%) down from the level of \$190 million in FY2006.<sup>29</sup> Of the cut from FY2006 to FY2007, \$28 million was a reduction of funding for "modern energy services" in Afghanistan. USAID does not distinguish funding for measuring, monitoring, reporting, verification and reduction of greenhouse gas emissions from other activities in the relevant sectors. The OMB report states, "All of the activities that assist with technology transfer and carbon capture promote the reduction of greenhouse gas emissions."<sup>30</sup>

Beginning with the FY2007 budget request, the international assistance category included \$26 million for the Department of State to support the Asia-Pacific Partnership on Clean Development and Climate (APP). The President's FY2008 budget request for the APP includes \$30 million for the Department of State, \$15 million for the Department of Energy, \$5 million for the Department of Commerce, and \$2 million for the Environmental Protection Agency. The APP is a voluntary partnership among six countries that aims to advance technologies that may help reduce the greenhouse gas intensity of partner nations: the United States, China, India, South Korea, Australia and Japan. The initial set of projects under the APP's workplan emphasize sectoral assessments, capacity building, identifying best practices, and technology research and demonstration.<sup>31</sup> Some critics argue that the APP is a diversion from cooperation under the United Nations and the UN FCCC, but few would deny that technological advance in the major developing countries will be essential to reducing their greenhouse gas emission projections. The FY2008 request also includes \$133.9 million for the Treasury Department to contribute to the

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<sup>29</sup> The foreign operations appropriations bill for FY2006, Section 585(a) stated, "Of the funds appropriated under the heading 'Development Assistance,' ... not less than \$180,000,000 shall be made available to support clean energy and other climate change policies and programs in developing countries, of which \$100,000,000 should be made available to directly promote and deploy energy conservation, energy efficiency, and renewable and clean energy technologies, and of which the balance should be made available to directly: (1) measure, monitor, and reduce greenhouse gas emissions; (2) increase carbon sequestration activities; and (3) enhance climate change mitigation and adaptation programs."

<sup>30</sup> OMB, op. cit., 2007, p. 40, footnote 2.

<sup>31</sup> For more information, see CRS Report RL33826, *Climate Change: the Kyoto Protocol and International Actions*, by Susan R. Fletcher and Larry Parker, for a brief summary of the APP.

Asian Development Bank, which may fund a new environmental program that would be related to the APP.

For the International Climate Change Assistance category, the President's FY2008 budget request includes \$36 million for the Global Environment Facility (GEF). The GEF supports projects to demonstrate innovative clean energy production and efficient energy use.<sup>32</sup> The climate-related portion is about one-third of the total funding for the GEF proposed in the President's FY2008 request, and would be an increase of 38% over the FY2006 and FY2007 amounts for climate change-related activities.

The United States also encourages countries to conserve tropical rain forests, thereby avoiding greenhouse gas emissions and protecting the removal by trees of carbon dioxide from the atmosphere. It does this by a "swap" of a country's debt for payment into conservation funds, authorized by the Tropical Forest Conservation Act (TFIP). The President's FY2008 budget request would provide \$20 million in FY2008 — the same as in recent years — in the Treasury Department's budget for climate-related debt restructuring programs.<sup>33</sup>

## Tax Provisions

Tax provisions, often not for the explicit purpose of addressing climate change, may contribute to reducing greenhouse gas emissions by establishing incentives for incremental investments in technologies (e.g., wind energy) that emit less than the technologies they are thought to replace (e.g., fossil fuel combustion). In its federal expenditures report, OMB reports *tax expenditures*, which are the estimated loss of federal revenues that result from taxpayers taking advantage of these preferential tax treatments.

Tax expenditures are reported for 11 types of tax credits, deductions, and exclusions for a wide variety of energy efficiency and renewable energy investments. OMB's estimated value of these tax expenditures jumped sharply from \$369 million in FY2005 to \$1.16 billion in FY2006, and to \$1.73 billion in FY2007. This rise in estimates is primarily based on new and expanded tax incentives authorized in the Energy Policy Act of 2005 (P.L. 109-58), specifically in Title XIII of that statute, the Energy Tax Incentives Act of 2005. OMB estimates that climate change-related tax expenditures in FY2008 would decline by more than \$300 million to \$1.42 billion. Although OMB expects tax expenditures to constitute almost one-quarter of the estimated budgetary impact of climate change activities in FY2007, this share is projected to fall to under one-fifth in the President's FY2008 budget.<sup>34</sup>

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<sup>32</sup> 26 For background on the GEF, see CRS Report RS21858, *Global Environment Facility (GEF): Overview*, by Susan R. Fletcher.

<sup>33</sup> For more information, see CRS Report RL31286, *Debt-for-Nature Initiatives and the Tropical Forest Conservation Act: Status and Implementation*, by Pervaze A. Sheikh.

<sup>34</sup> OMB, op. cit. 2007.

For FY2006, the largest of the tax expenditures — about 47% of the total projected for FY2008 — is the set of *new technology credits* for solar, geothermal, wind, biomass, poultry waste, municipal solid waste energy, and certain hydropower installations. The share of these over OMB's projection for the period 2008-2012 is expected to be 66%.

Although tax credits and deductions for clean-fuel burning vehicles are expected to result in tax expenditures of about \$260 million in FY2007, this figure is projected by OMB to drop to zero and below (i.e. net revenues) by 2010. Likewise, the second largest category of tax expenditures, credits for energy efficiency improvements to existing homes, is estimated to rise from \$230 million in FY2006 to \$380 million in FY2007, then decline to \$150 million in FY2008 and to zero by FY2009. Other tax credits due to expire by FY2009 include credits for energy efficient appliances and for residential purchases or installations of solar and fuel cells.

One policy issue related to the tax provisions is their continuity over periods of time that are consistent with planning and construction of large capital projects, such as commercial wind and other renewable energy installations. Because these take a number of years to execute, tax provisions may not predictably be available for a sufficiently long period for investors to take advantage of them for entirely new facilities (as opposed to facilities that may already have been planned). This could reduce their effectiveness in encouraging actions that may help to reduce greenhouse gas emissions. On the other hand, the tax incentives are intended to stimulate deployment of new technologies, rather than to support a market that may not become commercially viable.

## Key Policy and Funding Issues

Members of Congress and others have expressed interest in the priorities and evaluation of federal climate change funding and tax incentives. Key policy and funding issues include the following:

- Establishing priorities across different opportunities to address climate change, including scientific research, technology development, programs to encourage mitigation of greenhouse gases, and adaptation to potential future climate change.
- Policy preferences extended differentially among energy choices, such as clean coal, nuclear, the variety of renewable energy alternatives, and energy efficiency, as part of a U.S. strategy that must address multiple concerns, including energy security, trade deficits, and affordable energy.
- Defining and articulating measurable goals and milestones for climate change programs, and monitoring of achievements towards those goals. Because initiatives have been redefined and otherwise modified, tracking achievements from specific funding may be especially challenging.

- Improving clarity in the reporting of funding and expenditures, particularly to address the difficulty in comparing funding across years because of the shifts in accounting of activities within larger program areas, as well as the need for consistent use of funding categories, such as budget authority, appropriations, and actual expenditures, to make apt comparisons from year to year.
- Assuring coordination and accountability within the federal government of the dozens of identified climate change programs, and many others that are related to — or potentially conflicting with — goals that address climate change.
- Maintaining stability of funding and tax incentives over a period that is consistent with planning and executing the targeted projects. This has been a concern with a number of federal research programs, such as shifts within NASA, as well as for investment tax incentives that require several years for planning and to reap the intended tax benefits.
- Establishing spending priorities among the many federal agencies that administer climate change programs, and balancing climate change with other domestic spending priorities that compete in a fiscally tightening environment, such as the shifting of funds within NASA from observation satellites and research and analysis to larger space missions within the agency.

## **Related CRS Reports**

CRS Report RL31931, *Federal Laws and Policies Related to Greenhouse Gas Reductions*, by Brent D. Yacobucci and Larry Parker.

CRS Report RL33588, *Renewable Energy: Tax Credit, Budget and Electricity Production Issues*, by Fred Sissine.

CRS Report RL33599, *Energy Efficiency: Budget, Oil Conservation, and Electricity Conservation Issues*, by Fred Sissine.

## **Appendix I. Congressional Language Requiring Reports to Congress on Federal Climate Change Obligations and Expenditures**

Each year since at least 2003, Congress has included specific language in the annual appropriations bill for foreign operations, requiring the President to report to Congress on all federal agency obligations and expenditures for climate change programs and activities. Congress most recently included this reporting requirement in the Foreign Operations, Export Financing, and Related Programs Appropriations Act for FY2006 (Section 585(b) of P.L. 109-102).

This language was not included in the Revised Continuing Appropriations Resolution for FY2007 (P.L. 110-5), which funded foreign operations and many other federal agencies and activities. However, that law did require agencies to adhere to the same authorities and conditions that were enacted for FY2006, in effect continuing the requirement for the President to report on climate change obligations and expenditures in FY2007.

The statutory language from Section 585(b) of P.L. 109-102 is provided below:

CLIMATE CHANGE REPORT- Not later than 60 days after the date on which the President's fiscal year 2007 budget request is submitted to Congress, the President shall submit a report to the Committees on Appropriations describing in detail the following —

(1) all Federal agency obligations and expenditures, domestic and international, for climate change programs and activities in fiscal year 2006, including an accounting of expenditures by agency with each agency identifying climate change activities and associated costs by line item as presented in the President's Budget Appendix; and

(2) all fiscal year 2005 obligations and estimated expenditures, fiscal year 2006 estimated expenditures and estimated obligations, and fiscal year 2007 requested funds by the United States Agency for International Development, by country and central program, for each of the following: (i) to promote the transfer and deployment of a wide range of United States clean energy and energy efficiency technologies; (ii) to assist in the measurement, monitoring, reporting, verification, and reduction of greenhouse gas emissions; (iii) to promote carbon capture and sequestration measures; (iv) to help meet such countries' responsibilities under the Framework Convention on Climate Change; and (v) to develop assessments of the vulnerability to impacts of climate change and mitigation and adaptation response strategies.

## Appendix II. Climate Change Technology Priorities

**Table 4. Climate Change Technology Development and Deployment for the 21<sup>st</sup> Century in the Strategic Plan for the Climate Change Technology Program**

Goal	Short Term 10-20 years	Midterm 20-40 years	Long Term 40-60 years
Goal 1: Energy End-Use and Infrastructure	Hybrid and plug-in hybrid electric vehicles	Fuel cell vehicles and hydrogen fuels	Widespread use of engineered urban designs and regional planning
	Engineered urban designs	Low emission aircraft	Energy managed communities
	High-performance integrated homes	Solid-state lighting	Integration of industrial heat, power, process and techniques
	High efficiency appliances	Ultra-efficient HVACR	Superconducting transmission and equipment
	High efficiency boilers and combustion systems	“Smart” buildings	
		Transformational technologies for energy-intensive industries	
		Energy storage for load leveling	
Goal 2: Energy Supply	IGCC Commercialization	FutureGen scale-up	Zero-emission fossil energy
	Stationary hydrogen fuel cells	Hydrogen co-production from coal/biomass	Hydrogen and electric economy
	Cost-competitive solar photovoltaics	Low wind speed turbines	Widespread renewable energy
	Demonstrations of cellulosic ethanol	Advanced biorefineries	Bio-inspired energy and fuels
	Distributed electric generation	Community-scale solar	Widespread nuclear power
	Advanced fission reactor and fuel cycle technology	Gen IV nuclear plants	Fusion power plants
		Fusion pilot plant demonstration	



Goal	Short Term 10-20 years	Midterm 20-40 years	Long Term 40-60 years
Goal 3: Capture, Storage, and Sequestration	CSLF and CRSP	Geologic storage proven safe	Track record of successful CO <sub>2</sub> storage experience
	Pos combustion capture	CO <sub>2</sub> transport infrastructure	Large-scale sequestration
	Oxy-fuel combustion	Soils uptake and land use	Carbon and CO <sub>2</sub> based products and materials
	Enhanced hydrocarbon recovery	Ocean CO <sub>2</sub> biological impacts addressed	Safe long-term ocean storage
Goal 4: Other Gases	Methane to Markets	Advanced landfill gas utilization	Integrated waste management system with automated sorting, processing and recycling
	Precision agriculture	Soil microbial processes	Zero-emission agriculture
	Advanced refrigeration technologies	Substitutes for SF <sub>6</sub>	Solid-state refrigeration/AC systems
Goal 5: Measure and Monitor	Low-cost sensors and communications	Large-scale, secure data storage system	Fully operational integrated MM systems architecture (sensors, indicators, data visualization and storage, models).
		Direct measurement to replace proxies and estimators	

**Source:** U.S. Climate Change Technology Program, *U.S. Climate Change Technology Program: Vision and Framework for Strategy and Planning* (Washington, 2005) [<http://www.climatechange.gov/vision2005/index.htm>].

**Table 5. Budget Authority for National Climate Change Technology Initiative Priorities by Federal Agency, FY2005-FY2006 Actual, FY2007 Enacted, and the FY2008 Request**  
(in millions of dollars)

Activity	Agency	FY2005 Actual	FY2006 Actual	FY2007 Enacted	FY2008 Request	Explanation Provided by the NCCTI Strategic Plan
Hydrogen Storage	DOE	\$22	\$26	\$35	\$44	Addresses key challenge to advancing a hydrogen-based transportation system, which could substitute for oil and dramatically reduce greenhouse gas (GHG) emissions. A major technological breakthrough is needed to be able to store enough hydrogen on board a fuel cell vehicle to provide a driving range comparable to today's vehicles.
Low Wind Speed Technology	DOE	\$10	\$6	\$12	\$6	Currently, wind power is only cost competitive in areas of high wind speeds, which are relatively sparse and not near major load centers. Improving technologies to make wind power competitive in low-wind speed areas could expand this GHG-free power producer and displace (or reduce future need for) coal- and gas-fired electricity generation. Includes R&D on deepwater off-shore systems.
Solid State Lighting	DOE	\$14	\$19	\$30	\$19	Such lighting has the potential to double the efficiency of conventional lighting. Deployment could reduce GHG emissions and slow the growth of future base load electricity generation capacity, which will largely use coal.

Activity	Agency	FY2005 Actual	FY2006 Actual	FY2007 Enacted	FY2008 Request	Explanation Provided by the NCCTI Strategic Plan
Cellulosic Biomass (Biochemical Platform R&D)	DOE	\$11	\$14	\$33	\$38	The research focuses on converting complex cellulosic carbohydrates of biomass into simple sugars. Ultimately, this could lead to use of “waste” biomass to produce power, chemicals, and fuel, such as ethanol. Cellulosic biofuels can displace fossil fuel products and have the potential to be nearly “carbon neutral” by cyclically capturing and releasing carbon dioxide, the main GHG, to the atmosphere.
Transportation Fuel Cell Systems	DOE	\$8	\$1	\$8	\$8	This activity works to incorporate fuel cells into vehicles — converting hydrogen into electricity and water vapor — directly displacing the burning of fossil fuels in vehicles. Sequestration DOE 78.2 The continued use of fossil fuels, particularly coal, to generate electricity may be important to maintain both a diversified fuel mix and ensure adequate energy supplies at a reasonable price. A successful carbon sequestration research and development effort could allow the continued use of economical fossil fuels, while also limiting GHG emissions to the atmosphere.

Activity	Agency	FY2005 Actual	FY2006 Actual	FY2007 Enacted	FY2008 Request	Explanation Provided by the NCCTI Strategic Plan
Sequestration	DOE	\$44	\$65	\$105	\$86	Present technology for geologic carbon sequestration has costs in the range of \$100 to \$300/ton of carbon emissions avoided. DOE's sequestration program aims to reduce the cost of carbon sequestration to \$10 or less per net ton of carbon emissions avoided by 2015. Achieving a mid-point stabilization scenario (e.g., 550 parts per million CO <sub>2</sub> ) would not require zero emission systems in the near term but would allow 10-15 years to develop cost effective technology for new electricity generation capacity and capital stock replacement.
Integrated Gasification Combined Cycle (IGCC)	DOE	\$45	\$56	\$59	\$53	Instead of burning coal, IGCC technology gasifies coal in such a way so as to enable the more efficient conversion of coal and other carbon-based feedstocks into electricity and other useful products, providing the potential for over 50 percent reduction in CO <sub>2</sub> emissions, compared to today's more conventional combustion technologies. It also facilitates capture and sequestration processes.
Nuclear Hydrogen Initiative	DOE	\$9	\$24	\$19	\$23	This program aims to develop technologies that will apply heat available from advanced nuclear energy systems, in combination with power production, to produce hydrogen at a cost that is competitive with other alternative transportation fuels. Although but one of many hydrogen production methods, nuclear energy provides an emissions-free way to produce large amounts of hydrogen.

Activity	Agency	FY2005 Actual	FY2006 Actual	FY2007 Enacted	FY2008 Request	Explanation Provided by the NCCTI Strategic Plan
Advanced Fuel Cycle/Advanced Burner Reactor	DOE	\$0	\$78	\$167	\$395	Advances in nuclear fuel recycling can make nuclear power, which emits no GHG emissions, more attractive. The Advanced Burner Reactor (ABR) is a component of a multifaceted research program aimed at recycling spent nuclear fuel; reducing waste; promoting non-proliferation; and enabling the expansion of nuclear power — a GHG-free energy source. With ABR technology, the only waste to be placed in a repository is of a less challenging content, absent long-lived radioactive isotopes and other transuranics. One Yucca Mountain size repository would be able to accommodate the waste from many reactor years of operation — a content that would fill as many as 21 equal repositories taking all that spent fuel directly.
Methane Partnership Initiatives	EPA	\$9	\$10	\$13	\$13	Includes EPA's domestic partnership programs with industry, as well as the international Methane to Markets Partnership. These programs encourage development and deployment of technologies to reduce methane emissions and make a substantial contribution to achievement of the President's GHG intensity reduction goal.
Climate Leaders <sup>a</sup>	EPA	\$2	NA <sup>a</sup>	NA <sup>a</sup>	NA <sup>b</sup>	Climate Leaders is a set of flagship voluntary industry-government partnerships that encourage private entities to develop and implement long-term, comprehensive climate strategies, and set GHG emission reduction goals.

Activity	Agency	FY2005 Actual	FY2006 Actual	FY2007 Enacted	FY2008 Request	Explanation Provided by the NCCTI Strategic Plan
Climate Change Technology Program (CCTP) Support	DOE	<sup>c</sup>	\$0	\$1	\$1	The U.S. Climate Change Technology Program (CCTP) is multi-agency planning and coordination activity, led by DOE, that carries out the President's climate change technology initiative and implements relevant climate change provisions of the Energy Policy Act of 2005. It is important to the support of the larger CCTP portfolio.
<b>All Priority Activities<sup>b</sup></b>		<b>\$173</b>	<b>\$299</b>	<b>\$481</b>	<b>\$685</b>	

**Source:** *Climate Change Technology Program Strategic Plan*, Appendix B, pp. 221-223, available at [<http://www.climatechange.gov/stratplan/final/index.htm>], and OMB, *Federal Climate Change Expenditures Report to Congress*, May 2007, Table 5, p. 16.

- a. "Climate Leaders" is listed in the CCTP Strategic Plan but is not included in Table 5 of the OMB Report to Congress, op cit., May 2007. The CCTP Strategic Plan reported FY2006 enacted budget authority, and a FY2007 budget request, of \$2.0 million for each of those fiscal years.
- b. Totals for the President's FY2008 budget request reflect only those proposals that are listed in Table 5 of the OMB Report to Congress, op cit., May 2007.
- c. In FY2005, \$1.5 million was enacted for CCTP within DOE's Cellulosic Biomass, and Transportation Fuel Cells Programs.