
# Climate Change: Federal Program Funding and Tax Incentives

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# Summary

Federal funding to address global climate change was enacted at $6.37 billion for FY2008, extended by a Continuing Resolution for FY2009 at or below FY2008 levels to March 6, 2009. Members of Congress have expressed interest in how federal funding may reflect and enable an overall strategy, and priorities within it, to address climate change. This report summarizes federal funding and tax incentives identified as climate change-related under the Bush Administration. It identifies the organization of programs, how funding may reflect priorities, and external evaluations or recommendations for the broad programs, to the degree they are available.

Barack Obama has made direction-changing pledges to abate U.S. greenhouse gas emissions and to engage more aggressively internationally on climate change. The change in Executive leadership and the evolving Congressional debate over appropriate policies to address climate change may shift priorities among climate change activities. Calls to expand climate change funding, despite deepening budget pressures, may require that programs do a better job of demonstrating benefits to compete effectively with other budgetary demands. This review of federal funding of climate change activities suggests that there may be opportunities to better align funding with strategic policy goals, and to assure that programs are organized to accomplish those goals more efficiently.

Fourteen federal agencies administer climate change-related activities. The packaging of mostly existing programs into a climate change strategy has resulted in a lack of a unifying mission jointly shared across agencies to address climate change. Funding has largely reflected departmental missions and support for each activity, rather than each activity's expected contribution to an over-arching strategy. The new Obama Administration is expected to provide more action-oriented leadership, but will face the challenge of aligning programs, resources, and tax incentives into a cross-agency, inter-governmental strategy. Associated legislative issues include how legislation to control greenhouse gases may affect funding and tax incentive priorities; the sufficiency and alignment of federal resources to support a strategy to achieve long-term climate change policy goals; demands for additional and predictable resources to support actions by low income countries to mitigate greenhouse gases or adapt to climate change; possible legislative proposals to restructure or improve collaboration among climate change activities; addressing recommendations from evaluations, to the degree they exist, to improve climate change programs; exploring options for financing climate change programs, especially if greenhouse gas emission allowances or fees are enacted by the 111th Congress; and possible requirements for reporting to Congress of funding, budget justifications and programmatic progress that are adequate to support Congressional decision-making and oversight.

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# Introduction

Human-driven climate change, once considered a topic only for scientific research, has evolved into a policy debate. Congressional proposals have identified numerous actions aimed at closer observation and analysis, mandatory pollution control, financial assistance for technological change, adaptation to cope with changes, and a host of additional policy options. Despite calls to expand federal funding to address climate change, federal budgeting overall faces increasingly stark choices among competing fiscal demands.

Federal funding for climate change activities was enacted at $6.37 billion for FY2008; adding in the effects of tax incentives, the budgetary impact of climate change-related activities totaled $7.73 billion for FY2008. For FY2009, funding continues at or below those levels through March 6, 2009 under a Continuing Resolution (P.L. 110-329).[1] In some cases, the Continuing Resolution may have sustained funding to many climate change programs at a higher level than President Bush's FY2009 request, since many had been proposed to bear cuts. Tax incentives for renewable energy and other similar incentives were passed late in 2008 and the uncertainty may have affected the budgetary impacts of those incentives in FY2009. As the 111th Congress evaluates the value of past funding and future priorities to address climate change, this report provides an overview of federal funding and tax incentives in the context of Presidential goals from 2001 through 2008, as well as legislative requirements for these programs.

With a new Administration, the context for climate change funding will change: President Barack Obama has outlined a new set of policies, including a goal to return U.S. greenhouse gas (GHG) emissions to their 1990 levels by the year 2020, to reduce GHG emissions by 80% below 1990 by 2050, and to achieve these goals through a system of emission caps and trading.[2] As President-elect, Obama stated, on December 15, 2008, that "the effort before us will demand coordination across the government, and my personal engagement as President."[3] To assist with these, he has designated former EPA Administrator Carol Browner to be Assistant to the President for Energy and Climate Change. It remains to be seen how his goals and new leadership in the White House will translate into funding proposals and program alignment.

## Recent Federal Policy Goals for Climate Change Programs

In 2002, President George W. Bush announced a goal to cut the U.S. greenhouse gas (GHG) intensity—the quantity of greenhouse gases emitted per unit of economic activity (GDP)—by 18% through 2012.[4] In parallel, he directed U.S. programs addressing climate change to aim at:

- reducing scientific uncertainties;

[1] Although appropriations for FY2009 for the Department of Defense (DOD) were passed in the 110th Congress, it is unclear whether the levels for climate change-related activities were changed, as these are funded below the appropriations account detail in DOD's budget.

[2] For more information on emissions cap-and-trade systems, see CRS Report RL33799, *Climate Change: Design Approaches for a Greenhouse Gas Reduction Program*, by (name redacted).

[3] See http://change.gov/newsroom/entry/president_elect_barack_obama_announces_key_members_of_energy_and_environmen/.

[4] The "business-as-usual" decline for this period was estimated to be about 14%.

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

On April 16, 2008, President Bush announced a new national goal for climate policy—to halt increases in U.S. emissions of GHG by 2025.[5] Emissions would begin to decline thereafter "so long as technology continues to advance."[6] According to President Bush, the United States would achieve this goal by regulatory measures and market incentives to encourage use of clean technologies.

Presidential requests for funding have been linked only in a general way to achieving stated climate change policy goals. Specific outcome-oriented performance targets have been set for some programs, such as for greenhouse gas reductions achieved by the Environmental Protection Agency's and the Department of Energy's Energy Star programs, and several other voluntary partnerships. However, quantitative greenhouse gas, science, or technology performance targets are not identified for most of the requested climate-related funding. Clearer relationships among programs, their funding, and their contributions to meeting measurable climate change goals may be considered by the Obama Administration and the 111th Congress, especially if GHG targets are legislated as proposed in a number of bills.

## The Congressional Role

The appropriation of funds by the Congress alters the total amount and distribution of funding requested by the President to address climate change across agencies and activities. Because most Congressional scrutiny of specific funding, and primary choices, occurs in appropriations subcommittees—further altered by Congressionally directed funding—the appropriations process has not facilitated a broad view of over-arching climate change policy goals and priorities, or consistency with goals across agencies and diverse activities. Enhancing an over-arching vision and prioritization would require greater coordination across subcommittees or at the committee level than typically occurs.[7]

## Evolution of Federal Climate Change Programs

Evidence of human influence[8] on the Earth's climate and its potentially catastrophic impacts gained the attention of some Members of Congress by the 1980s. Congress enacted a scientific

[5] This is not the first quantitative GHG goal set for U.S. climate change policy: on April 21, 1993, President William J. Clinton "announce[d] our nation's commitment to reducing our emissions of greenhouse gases to their 1990 levels by the year 2000," consistent with the Article 4 aim of the United Nations Framework Convention on Climate Change (UNFCCC). The challenge in meeting that aim with voluntary measures led to agreement on mandatory GHG reduction obligations in the Kyoto Protocol (though the United States did not become a Party to that treaty).

[6] White House. *Fact Sheet: Taking Additional Action to Confront Climate Change. Press Release*, April 16, 2008. See http://www.whitehouse.gov/news/releases/2008/04/print/20080416-7.html.

[7] The challenges of such "cross-cut" issues are not unique to climate change, and may not be solved by reorganization of the programs, as occurred with homeland security cross-cut. New types of processes might be explored to address cross-cutting issues and appropriations.

[8] Pollution affecting the Earth's climate includes the greenhouse gases (GHG) carbon dioxide ($CO_2$), methane ($CH_4$), nitrous oxide ($N_2O$), and chlorinated and fluourinated chemicals (such as CFC, HFC, HCFC). It also includes tropospheric ozone, black carbon, organic carbon, and sulfates. Additional trace gases, such as nitrogen trifluoride (continued...)

research program in 1990, and U.S. federal funding subsequently expanded to better understand and address the phenomenon. Both the amounts and purposes of funding for climate change efforts have evolved since 1990.

This report describes federal funding of climate change activities across 14 agencies. Most emphasis is on changes from the enacted FY2007 and FY2008 levels to President Bush's FY2009 request. A Continuing Resolution (P.L. 110-329) extended the FY2008 enacted levels through March 6, 2009, which is in some cases higher than the levels requested. Some longer historical perspective is provided where data are available. As this report discusses, the availability and clarity of funding information continues to impede full understanding of the federal effort and its effectiveness,[9] and so the estimates provided in this report are best viewed with caution. In addition, the limited political agreement that has evolved around climate change in the United States has resulted in packaging of all activities as research on science or technologies, or international assistance. This emphasis on research may not adequately characterize the actual work and evolving priorities—especially if calls for greater action on GHG abatement, impacts assessment, and adaptation are answered by federal programs and incentives.

There has been an historic emphasis on climate change science within the overall U.S. effort to address climate change. Concerns about climate change first issued from the research community. Even as public concern rose, some decision-makers emphasized improving the science in order to make wise policy decisions. Some observers expressed concern that such emphasis on uncertainties and the need for additional scientific research were a rationale not to undertake more concrete mitigative or adaptive actions to address climate change.[10] Nonetheless, there has been a long-standing consensus that continued scientific research on climate change, its impacts and possible adaptation strategies is desirable. Funding levels for climate change increased rapidly from 1989 to 1995, but have generally declined for climate change science since then (when amounts are adjusted for inflation).

By the mid-1990s, scenario analyses had made clear that effectively avoiding human-induced climate change would require major changes in energy and other technologies in use. Not surprisingly, another consensus emerged surrounding federal support to advance technologies that allow a transition to a lower greenhouse (GHG)-emitting society without compromising economic well-being.[11] The growing set of activities and funds to support "clean" technologies were packaged as a second major component of the climate change effort by President William J.

(...continued)

($NF_3$) and other fluorine gases, have potentially climate-forcing properties but are rarely considered in policy discussions. In most cases, however, many people are referring only to the "basket of six" GHG: $CO_2$, $CH_4$, $N_2O$, $SF_6$, HFC and PFC. For more information, see CRS Report RL33849, *Climate Change: Science and Policy Implications*, by (name redacted).

[9] See, for example, GAO. 2006. *Climate Change: Greater Clarity and Consistency are Needed in Reporting Federal Climate Change Funding.* Statement of John B. Stephenson, Director, Natural Resources and Environment. GAO-06-1122T. Washington DC.

[10] "Throughout [1989], the President [George H.W. Bush] was criticized for not exercising greater leadership in support of early negotiations on an international framework convention on global warming.... [In 1989,] [r]esearch was considered especially important because existing uncertainty on the extent and timing of global warming was the Administration's chief argument for remaining uncommitted to negotiating an international convention. The Administration insisted that more data was required before action could be taken." From CRS Report 90-364, *Congress and International Environmental Issues in 1989*, by (name redacted), Washington DC, August 1, 1990.

[11] See CRS Report RL33970, *Greenhouse Gas Emission Drivers: Population, Economic Development and Growth, and Energy Use*, by (name redacted) and (name redacted).

Clinton for FY1997 as the Climate Change Technology Initiative, and then by President George W. Bush for FY2003 as the Climate Change Technology Program (CCTP). The technology programs have grown to be about two-thirds of all climate change funding. (Budget data are insufficient at this time to analyze the historical funding prior to FY1998.) A third point of broad agreement—and associated funding—has been that the developing countries would need assistance—financial and technical—to adopt less emitting economic paths than those followed by the United States and other industrialized countries. In 1992, the United States and other developed countries committed to providing such assistance under the United Nations Framework Convention on Climate Change. In association with that treaty, in 1992, President George H.W. Bush established a two-year, $25 million Country Studies Program to build the capacities of developing and transition countries to assess and implement climate change policies. Most funding for international assistance has been through the Agency for International Development (US AID), and has generally declined since the late 1990s, due variously to Executive Branch decisions and Congressional opposition.

This report provides an overview of climate change funding in three major climate change program areas (science, technology, and international assistance) as well as tax provisions that may encourage reductions in greenhouse gases. Increasingly, there are overlaps and gaps among these program areas. Alternative ways to categorize the funding might better serve Congressional decision-making. Though limited by data, this report provides preliminary analysis of the federal effort—for example, by type of activity or by types of technologies supported. The report also identifies several legislative issues related to federal funding for climate change programs and activities.[12]

### Box 1. Definitions of Selected Budget Terms

Budgetary terminology has very specific meanings, although those terms are sometimes used in a broader sense. This CRS report uses both the specifically defined terms as well as other words meant to be synonyms, as explained below:

**Budget Authority (BA):** According to the Office of Management and Budget, in *The Budget System and Concepts* (2008), "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. Budget authority enacted in a given year is "new budget authority"—which this report uses interchangeably with "funding." New budget authority differs from the **budgetary resources**, or total budget authority available for a specific purpose in a given year, which may include new BA plus residual BA left unobligated, or unspent, from previous years.

**Expenditures:** "Expenditures" are not formally defined but generally mean the "outlays" (or funds paid out) of financial resources in a given year. Expenditures must always be lower than the total budget authority, but may be higher or lower than the new budget authority for a year. Because expenditure data are generally unavailable regarding climate change, this report does not use the term "expenditures" except where quoting another source.

**Tax Expenditures:** As defined by law, "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." 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. This report uses the term "tax expenditures" throughout, as defined above.

[12] This report discusses the "crosscut" budget for federal climate change activities. Other issue areas confront similar challenges of crosscut budget reporting and evaluation. For a discussion of crosscut budget issues and options, see CRS Report RL34328, *America COMPETES Act: Programs, Funding, and Selected Issues*, by (name redacted).

# Historical Climate Change Funding: FY2001 to Present

## New Budget Authority by Year and Program

**Table 1** shows new federal budget authority enacted for FY2001 through FY2008 and the FY2009 request, in nominal dollars as reported by the Office of Management and Budget (OMB), and in constant 2007 dollars only for the annual totals, adjusted for inflation by CRS. While information has not been reported yet for FY2009, a Continuing Resolution (CR) (P.L. 110-329) extended the FY2008 enacted levels through March 6, 2009 for almost all climate-related programs. The CR continues funding in some cases at levels higher than requested, and in some cases, lower that the request. The Bush Administration has grouped all funding into three major program areas: the Climate Change Science Program (CCSP), the Climate Change Technology Program (CCTP), and International Assistance. Funding has wavered through the years, in total and in each of the program areas. Notable increases occurred in the FY2008 enacted and FY2009 proposed funding, largely for new satellites, nuclear energy, and international technology financing.

**Box 2**
**Status of Administration Reports to Congress**

The funding data described in this report derive primarily from the 2007 Report to Congress on *Federal Climate Change Expenditures* by the Office of Management and Budget (OMB), and previous years' reports beginning from 2002. Because this series of reports was no longer required in any FY2008 appropriations law, the Office of Management and Budget did not produce a similar report in 2008. For FY2008 and adjustments to previous years, this CRS report relied heavily on unpublished data provided to CRS by OMB and other federal agencies. Without a Congressional requirement to produce a cross-cut budget for federal climate change activities, it is unclear whether future Administrations will prepare any more. If the 111th Congress finds data on climate change funding and programs useful for oversight and other legislative purposes, it may consider requirements for reporting of climate change-related activities, including directions that would improve clarity and consistency compared to previous reports.

Understanding the level of effort over time is obscured by changes in the levels of aggregation, scope of programs reported, and methods of budget accounting. (See discussion in the **Box 3**, Clarity and Consistency of Reporting of Climate Change Funding.)[13]

[13] For more information on budget terms and processes, see CRS Report 98-721, *Introduction to the Federal Budget Process*, by (name redacted).

**Table 1. Total Budgetary Impact of U.S. Climate Change Initiatives: FY2003-FY2007 Actual, FY2008 Enacted, and President Bush's FY2009 Request**

(in millions of nominal dollars, except where noted)

| Major Climate Change Program Areas | Budget Authority | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|
| | FY2001 Actual | FY2002 Actual | FY2003 Actual | FY2004 Actual | FY2005 Actual | FY2006 Actual | FY2007 Actual | FY2008 Enacted | FY2009 Request |
| Climate Change Science Program | $1,728 | $1,667 | $2,078 | $1,996 | $1,864 | $1,691 | $1,825 | $1,864 | $2,080 |
| Climate Change Technology Program | $1,675 | $1,637 | $2,533 | $2,870 | $2,808 | $2,789 | $3,485 | $4,303 | $4,416 |
| International Climate Change Assistance | $218 | $224 | $270 | $252 | $234 | $249 | $188 | $202 | $657 |
| **All Areas** | **$3,603** | **$3,528** | **$4,881** | **$5,118** | **$4,906** | **$4,729** | **$5,498** | **$6,369** | **$7,153** |
| *All Areas in Constant 2007 Dollars* | ***$4,208*** | ***$4,043*** | ***$5,483*** | ***$5,603*** | ***$5,204*** | ***$4,856*** | ***$5,498*** | ***$6,248*** | ***$6,879*** |
| **Tax Provisions That May Reduce Greenhouse Gas Emissions** | **Estimated Tax Expenditures** | | | | | | | | |
| | **FY2001** | **FY2002** | **FY2003** | **FY2004** | **FY2005** | **FY2006** | **FY2007** | **FY2008** | **FY2009** |
| | $0 | $0 | $580 | $500 | $369 | $1,160 | $1,520 | $1,520 | $1,440 |
| *Tax Expenditures in Constant 2007 dollars* | *$0* | *$0* | *$651* | *$547* | *$391* | *$1,191* | *$1,520* | *$1,491* | *$1,385* |
| **Total Budgetary Impact**[a] | **$3,603** | **$3,522** | **$5,454** | **$5,618** | **$5,275** | **$5,889** | **$7,004** | **$7,875** | **$8,573** |
| ***Total Budgetary Impact in Constant 2007 Dollars*** | ***$4,208*** | ***$4,036*** | ***$6,126*** | ***$6,150*** | ***$5,596*** | ***$6,047*** | ***$7,004*** | ***$7,726*** | ***$8,244*** |

**Source:** OMB, including Federal Climate Change Expenditures Report to Congress, FY2008, May 2007, Table 8, p. 27; Federal Climate Change Expenditures Report to Congress, August 2003, Table 1; and Federal Climate Change Expenditures Report to Congress, July 2002, Table 1. OMB adjusted the science and technology amounts for FY2003, FY2004, and FY2005 to reflect more recent accounting within these program areas. Remaining inconsistencies are likely across years due to changes in the scopes of what is considered for "climate change" and methods of allocating certain costs to programs.

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.

## Tax Expenditures

In addition to budget authority for CCSP, CCTP, and International Assistance, the federal government offers a variety of tax incentives to encourage reductions in greenhouse gas (GHG) emissions. **Table 1** shows an OMB- estimated total of $1.52 billion in climate change-related "tax expenditures" in FY2008 and FY2007, and has projected these tax expenditures to decrease in FY2009 to $1.44 billion. Although tax incentives are not federal spending *per se*, they reduce revenues to the federal government that would otherwise accrue. In that sense, the loss of revenues resulting from tax incentives are often presented by OMB as "tax expenditures" of the federal government. (Hereafter, this report refers to these as "tax expenditures.") Examples of tax expenditures related to climate change include credits for purchases of cleaner automobiles, and investment in renewable electricity generation technologies. **Table 1** does not include estimates of other tax expenditures that may aggravate climate change, such as provisions that promote fossil fuel production and use.[14]

## Budgetary Impact of Climate Change Programs

Based on OMB's data, **Table 1** presents the total impact to the federal budget, from FY2001 through FY2008 and the FY2009 request, resulting from budget authority for the three major climate change program areas and tax expenditures. Though federal spending and losses of revenues are not alike, this total budgetary impact illustrates the overall level of federal effort, or cost to the federal government, of identified climate change programs and incentives.

**Table 1** suggests that the budgetary impact of reported climate change activities has increased nearly 85% from FY2001 to the enacted FY2008 level (in constant 2007 dollars). Of the actual $4.3 billion increase, $2.6 billion—more than 60%—is attributable to expansion of technology research and development; another $1.5 billion of the budgetary impact is due to tax incentives to stimulate greenhouse gas reductions (which the Office of Management and Budget projected to decline in FY2009). For scientific research funding in actual dollars increased by $0.1 billion from FY2001 to FY2008 enacted, though this represents a decline in funding for climate change science when accounting for inflation. President Bush's request for FY2009 would have brought the funding back up to the FY2001 level in real terms. As discussed in **Box 3**, however, conclusions regarding the levels of funding over time can be considered only approximate because of reporting issues.

[14] See also CRS Report RL33578, *Energy Tax Policy: History and Current Issues*, by (name redacted).

**Box 3**
**Clarity and Consistency of Reporting of Climate Change Funding**

Interpreting how funding relates to levels of effort to address climate change is challenged by several reporting issues; these have been described earlier by the Government Accountability Office (GAO). Actual funding for climate change activities is clouded by the levels of aggregation of the budget request, changes in scope of what is reported, changes in accounting methods over time, lack of descriptions by agencies in their budget documentation, and omissions of reporting of some arguably climate-related activities in the overall program. While some improvements were made following the 2006 GAO report, many issues persist, confounding analysis of the climate change funding.

The President's budget typically is presented as the aggregation of appropriations accounts, and as changes to certain activities (but not the totals) below the account level.

Some reported funding changes represent differences in dollar amounts for the same activities over time. Other changes are because the scope of the climate change programs (which programs are included) has changed; for example, reporting of nuclear energy and certain coal programs as "climate change" activities began in the FY2003 budget request, though such programs existed in earlier years. This effect of scope adjustments may be substantial: redefining those two components constituted 9.5% of the entire request for climate change activities in FY2003.

Also, methods of accounting for some activities have changed over time, introducing inconsistencies across years. For example, within the budgets of the National Aeronautics and Space Administration (NASA) and the National Oceanic and Atmospheric Administration (NOAA), costs of salaries, laboratories, certain satellites and other expenses were newly reported as climate change funding in some recent years, whereas they had not been reported as such earlier. Similar changes in accounting in the FY2009 request continue to make it difficult to ascertain and compare aggregate levels of funding for climate change over time.

Further, the activities counted as relating to climate change often are below the budget account level; while some agencies provide adequate detail—though dispersed throughout their budget documentation—others do not mention the "climate change" relevance in their documentation of certain accounts although portions of them are included in the climate change reporting. Where the climate change funding is not itemized by an agency, reproducing the accounting or fully understanding its purpose is not possible.

GAO investigated the Administration's reporting practices, in 2005 and 2006. GAO recommended that the Administration provide 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. As discussed above, inconsistencies continue to hamper precise comparisons of budgets for climate change activities from year-to-year.

**Reference:** GAO. Climate Change: Greater Clarity and Consistency Are Needed in Reporting Federal Climate Change Funding. Statement of John B. Stephenson, Director, Natural Resources and Environment GAO-06-1122T. Washington DC, September 21.

# President Bush's FY2009 Request for Climate Change Funding

Budget authority in FY2008 for activities related to climate change totaled $5.44 billion, according to the Office of Management and Budget (OMB).[15] President Bush's budget request for FY2009 would have increased this funding by 12.3%, to $7.15 billion.[16] A Continuing Resolution

[15] Data provided by OMB to CRS on April 29, 2008. Tables with data for FY2009, as provided by OMB, are included in **Appendix A** of this report. For at least 10 years prior to 2008, OMB prepared an annual report to Congress on federal climate change budget authority and tax incentives in response to specific statutory requirements. The statutory requirement was not included in FY2008 appropriations. OMB did not produce a report in 2008 but has provided tables with estimates corresponding to those in previous years' reports. Most of the data presented in this CRS report are as reported in OMB's previous annual Federal Climate Change Expenditures Reports to Congress and the data tables provided in 2008 directly to CRS. Additional, more detailed data have been provided by agencies to CRS.

[16] See Box 1 for more information on budgetary definitions.

(CR) (P.L. 110-329) extended the FY2008 enacted levels through March 6, 2009 for almost all climate-related programs.[17] The CR continues funding in some cases at levels higher than requested, and in some cases, lower that the request. Information has not been reported yet on any changes to climate change funding for FY2009. In addition, extension of tax incentives that may help to stimulate greenhouse gas reductions (i.e., for renewable energy investments) were passed late in 2008; the uncertainty through 2008 may have altered the estimated impacts of these tax incentives for FY2009.

## Major Changes in the FY2009 Request

The major changes requested for climate change purposes, compared to the FY2008 enacted levels, were to:

- **nuclear energy**: increase funding for nuclear energy research by at least $302 million and demonstrations by $129 million;
- **fossil energy**: increase fossil energy research and development (R&D) by $133 million, mostly for carbon capture and storage (CCS) technologies;
- **energy efficiency and renewable energy**: eliminate Weatherization Assistance Grants (-$227 million) to low-income households;
- **satellites**: increase funding for satellite sensors for radiation and other climate-related measurements by $177 million in the NASA and NOAA budgets; and
- **international technology deployment**: provide an initial installment through Treasury of $400 million (and a proposed $2 billion over five years) to a new Clean Technology Fund hosted by the World Bank.

Although the Analytical Perspectives for the FY2009 request[18] stated that the FY2009 proposal for the CCSP would add emphasis to researching the **impacts** of climate change and for the science of **adaptation**, such added emphasis is not apparent in the documentation available in the multi-agency cross-cut nor in individual agencies' budget submissions. Almost all the proposed increases would support observational capacities and technological basic research and demonstration, not applied policy or management research, assessment, planning or actions.

Several programs that now are devoted to impacts and adaptation are proposed to receive less funding, such as programs on abrupt climate change and drought research in NOAA. Several programs for which Congress specifically appropriated funds were not proposed by the Bush Administration to continue in FY2009, such as $3.4 million enacted for the Environmental Protection Agency (EPA) in FY2008 to develop a rule for a mandatory greenhouse gas emission registry.[19] The Administration's requested changes are discussed in more detail in later sections by major program area and agency in **Appendix D** and **Appendix E**.

[17] Although appropriations for FY2009 for the Department of Defense (DOD) were passed in the 110th Congress, it is unclear whether the levels for climate change-related activities were changed, as these are funded below the appropriations account detail in DOD's budget.

[18] Executive Office of the President. *Analytical Perspectives, Budget of the United States Government, Fiscal Year 2009*. U.S. Government Printing Office, 2008.

[19] A new funding item for a greenhouse gas reporting registry was enacted at $3 million (after the 1.56% across-the-board reduction). The joint explanatory statement directs EPA to use $3.5 million "to develop and publish a rule (continued...)

## FY2009 Request by Major Program Areas

Funding related to climate change is grouped by OMB into three program areas (**Figure 1**), each of which consolidates many individual programs and activities across 14 federal agencies. The three program areas and their FY2009 budget requests are:

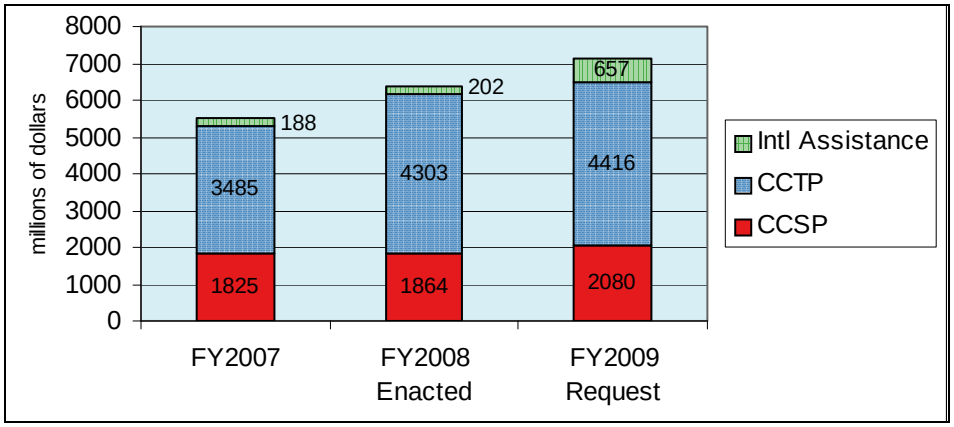
- Climate Change Science Program (CCSP): $2.08 billion;
- Climate Change Technology Program (CCTP): $4.42 billion; and
- International Climate Change Assistance: $0.66 billion.

New budget authority for these three program areas since FY2007 appear in **Figure 1,** as provided by OMB. The categories of science, technology and international assistance may be useful for understanding the purposes of federal climate change programs in broad terms. Arguably, alternative ways of categorizing federal funding for climate change programs may also be useful to Congress.

As **Table 1** and **Figure 1** illustrate, most recent growth of funding to address climate change supports technology research, demonstration and deployment (RD&D)—proposed to expand by almost $1 billion for FY2009 compared with FY2007. Within the Climate Change Technology Program, most of the requested funding growth was to support nuclear energy research. If the Congress had approved the requested $400 million for the Clean Technology Fund, the international assistance category would have experienced the greatest percentage growth—a 325% increase over the FY2008 enacted budget authority (albeit over a much smaller amount for international assistance than for the science and technology program areas).

**Figure 1. FY2009 Requested New Budget Authority for Climate Change by Major Program Area, Compared to FY2008 Enacted and FY2007 Actual**

(in millions of nominal dollars)




**Source:** CRS Graph based on data provided by U.S. Office of Management and Budget, April 2008.

(...continued)

requiring mandatory reporting of emissions above appropriate thresholds in all sectors of the economy." House Committee Report (H.Rept. 110-187, pp. 102-103).

## FY2009 Requests by Applications of Funding

Because of the aggregation of funding information that is publicly available, understanding the specific uses of climate change funds can be challenging. The levels of funding for specific activities are often unreported or unclear. CRS has conducted preliminary analysis of the amounts of the FY2009 request that would fund different kinds of applications, from satellite-based observing systems, to technology R&D, to inventories and registries of greenhouse gas emissions and sinks. A large portion of the funding request could not be determined for the current analysis. Most discussion of the uses of funding follow in the sections on the CCSP and the CCTP. Looking across all applications, though, two categories appear to have the greatest shares of requested funding for FY2009, exceeding other categories by hundreds of millions of dollars:

- Nuclear energy research and demonstrations would receive the largest share of climate-related funding—an estimated $1.40 billion (19.6%) in the FY2009 request. Funding for nuclear energy technology research would be about 30% of the funding requested for climate change technologies.
- Satellite-based observations would constitute about 11.8% of all federal climate change funding for climate change, at the level of $843 million proposed for FY2009.[20] This would be about 11.8% of all climate change funding and 40.5% of the Climate Change Science Program (CCSP) funding. These funds do not cover most data quality assurance, management, accessibility to researchers or analysis needed to create value from the observations.

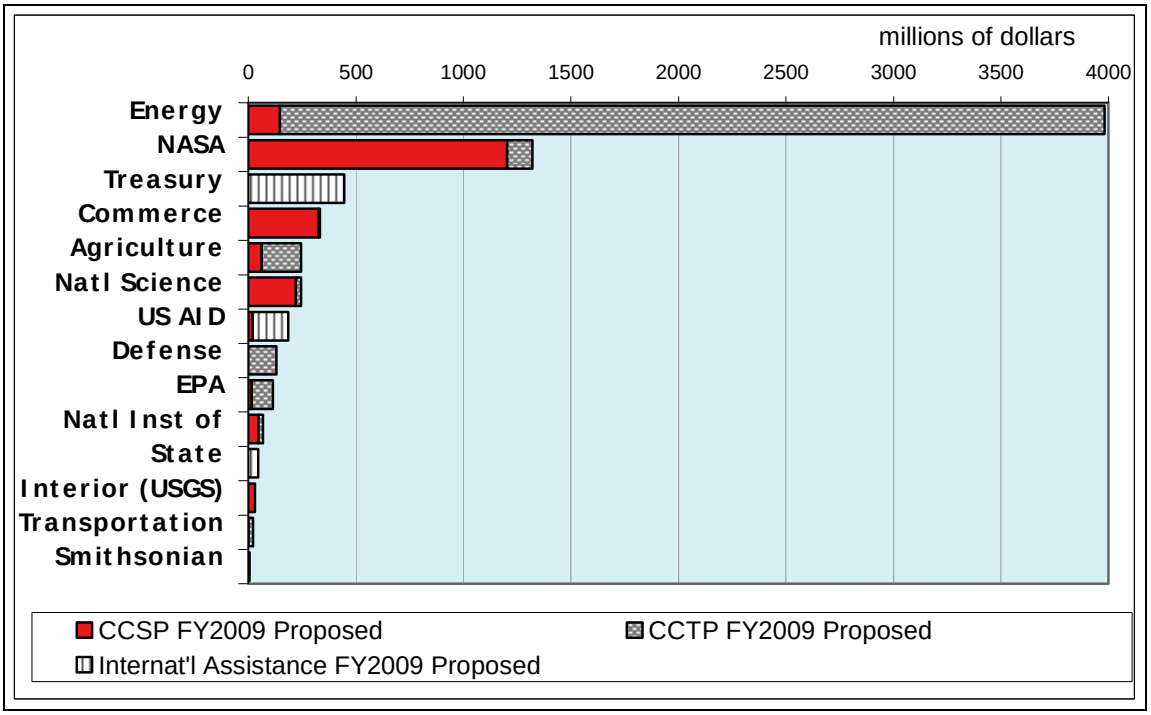
## FY2009 Request by Agency

**Figure 2** illustrates the FY2009 request for new budget authority for 14 participating federal agencies and for the three climate change program areas. Climate change funding is dominated by budget authority to two agencies: the Department of Energy (DOE) and to the National Space and Aeronautics Administration (NASA); together they amount to 74% of the climate change request.

[20] The FY2009 estimate provided in this report includes both the funding for NASA Space-Based Observation as reported by the CCSP Office, as well as the $74 million line item in the President's FY2009 request for the National Oceanic and Atmospheric Administration (NOAA), for climate change-related sensors to be added to upcoming earth observation missions. It does not include operational satellites, which are generally not included in the CCSP budget. CCSP provides the detail for FY2006 to FY2008 in Table 3 at http://www.usgcrp.gov/usgcrp/Library/ocp2008/ocp2008-budget-table3.htm. Nor do these amounts include funds to manage, provide access to, or analyze the acquired observations.

**Figure 2. Requested FY2009 New Budget Authority for Climate Change Program Areas by Agency**

(in millions of dollars)




**Source:** Graph by CRS using budget authority data provided by the Office of Management and Budget, April 30, 2008.

**Table 2** indicates by agency the amount of new budget authority reported by OMB for the FY2003 through the FY2009 request for the 14 federal departments and agencies that administer the three major climate change program areas. (The totals in **Table 1** and **Table 2** are not consistent for FY2003, FY2004, and FY2005 because of OMB accounting adjustments to the science and technology programs in **Table 1**; **Table 2** is derived from earlier years' reports which do not have these adjustments).

The remainder of this report briefly describes each of the three major climate change program areas, including science, technology, and international assistance, as well as tax provisions that may encourage reductions in greenhouse gases. Highlights of the FY2009 request, and particular issues for Congressional consideration are identified in the following sections. Discussions of funding by agency for the CCSP and the CCTP appear in **Appendix D** and **Appendix E**, respectively.

**Table 2. Budget Authority for U.S. Climate Change Programs by Federal Department and Agency: FY2003-FY2007 Actual, FY2008 Enacted, and President Bush's FY2009 Request**

| Department or Agency | FY2003 Actual | FY2004 Actual | FY2005 Actual | FY2006 Actual | FY2007 Actual | FY2008 Enacted | FY2009 Request | % Change FY2008-FY2009 |
|---|---|---|---|---|---|---|---|---|
| Department of Agriculture | $104 | $116 | $110 | $110 | $109 | $270 | $246 | -9% |
| Department of Commerce | $156 | $144 | $146 | $253 | $258 | $274 | $333 | 22% |
| Department of Defense | $83 | $51 | $59 | $77 | $101 | $150 | $131 | -13% |
| Department of Energy | $2,214 | $2,519 | $2,469 | $2,504 | $3,158 | $3,780 | $3,981 | 5% |
| Department of Health & Human Services | $61 | $62 | $57 | $50 | $47 | $47 | $47 | 0% |
| Department of the Interior | $28 | $29 | $29 | $27 | $27 | $34 | $31 | -9% |
| Department of State | $6 | $6 | $7 | $12 | $41 | $41 | $46 | 12% |
| Department of Transportation | $27 | $9 | $3 | $17 | $18 | $20 | $22 | 10% |
| Department of the Treasury | $56 | $52 | $44 | $46 | $46 | $46 | $446 | 870% |
| Environmental Protection Agency | $124 | $127 | $130 | $128 | $121 | $128 | $114 | -11% |
| National Aeronautics & Space Administration | $1,298 | $1,548 | $1,449 | $1,082 | $1,223 | $1,217 | $1,321 | 9% |
| National Science Foundation | $213 | $226 | $209 | $215 | $228 | $226 | $244 | 8% |
| Smithsonian Institution | $6 | $6 | $6 | $6 | $6 | $6 | $6 | 0% |
| U.S. Agency for International Development | $214 | $195 | $183 | $190 | $114 | $129 | $185 | 43% |
| **All Departments and Agencies** | **$4,584** | **$5,090** | **$4,900** | **$4,716** | **$5,498** | **$6,369** | **$7,153** | 12% |

**Source:** OMB, op. cit., FY2009 (April 2008); FY2008 (May 2007), FY2007 (April 2006) , FY2006 (March 2005), FY2003 to FY2005 (May 2004).

# Climate Change Science Program (CCSP)

## FY2009 Request for the CCSP—Overview

The Climate Change Science Program (CCSP) has been the umbrella organization for informal management of scientific research on climate change since 2003. It was the extension of a U.S. research effort that has been underway for several decades. For FY2009, President Bush requested $2.08 billion to support climate change science under the CCSP. The FY2009 request was $216 million (12%) above the FY2008 enacted budget authority of $1.82 billion, and $255 million (14%) above the FY2007 level. The CCSP research was intended to help reduce uncertainties in the science, as highlighted by a National Academies report requested by President Bush in 2001. A revised research strategy for the CCSP was issued in May 2008 (discussed in a later section) and may be reflected in President Obama's request for FY2010.[21]

The proposed CCSP funding for FY2009 would be provided to 11 federal agencies, with NASA continuing to receive the largest share—about 58%—with about 64% of NASA's funding proposed for space-based observations. Of the total request for FY2009, 16% was proposed for NOAA; 11% for NSF; and 7% for DOE. The history of U.S. funding for climate change science since FY1989 is presented in **Figure 3** and **Appendix C**. 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.

In constant dollars (i.e., adjusted for inflation), the CCSP budget declined by 11% from FY2001 ($2.0 billion) through FY2008 enacted ($1.8 billion), down 25% from the funding peak in FY1995. The FY2009 request would have brought the total back to the FY2001 funding in constant dollars, although the composition of the research would be altered. The tightening fiscal environment of federal discretionary budgets has resulted in shifting of funds within almost all agencies from climate change to other priorities. For example, NASA's climate-related budget declined by 24% from FY2000 through FY2008 enacted, after adjusting for inflation (but not for scope and methodological changes), though an addition of $126 million (12%) was proposed for space-based observations in the FY2009 request. The decline in climate change-related funding at NASA reflects the agency's priority for space exploration, as well as budget constraints imposed by cost over-runs in space programs.[22] In the FY2001 to FY2008 time period, only the budget of the National Oceanic and Atmospheric Administration (NOAA) increased—by 217%—while all other agencies saw their climate science budgets decline in dollars adjusted for inflation. The pressure on agencies' budgets has likely aggravated on-going tension within and among agencies over funding for this cross-agency objective (climate change science), when agencies are stretching to meet what they perceive as their core missions.

[21] The Climate Change Science Program Office maintains a website with detailed and useful information about U.S. climate change science, at http://www.climatescience.gov. Available at that site is its annual report, *Our Changing Planet*, which provides descriptions of all elements of the climate science program and of each participating agency.

[22] National Research Council, *An Assessment of Balance in NASA's Science Programs* (Washington: National Academies Press, 2006).

## Background and Historical Funding for Climate Change Science

Federally-supported research has been conducted for many decades on the potential for rising greenhouse gases in the atmosphere to induce global climate change. In 1971, a panel of the National Academy of Sciences[23] recommended that the United States increase its research into understanding the dynamics of climate and climate change to $111 million[24] for the 10-year period of 1970-1979.[25] (All amounts in this paragraph have been adjusted for inflation to 2007 dollars). After several compelling scientific conferences in the 1980s, federal support for climate change research rose from these levels up to a peak of funding in FY1995 of $2.28 billion. Following the FY1995 peak, funds reported for climate change science generally declined through the $1.83 billion enacted for FY2008. (**Figure 3** illustrates the historical funding reported by the Administration in nominal dollars and adjusted for inflation in constant 2007 dollars. Supporting data are in **Appendix C**, **Table C-1**.)

The rapid growth of funding from 1989 paralleled the enactment by Congress of the Global Change Research Act (GCRA)(P.L. 101-606), which established the U.S. Global Change Research Program (US GCRP). The US GCRP in many ways constituted an extension and expansion of existing science programs and had been conceived by some to exist in parallel with other research that would more directly support policy and management decision-making. The latter program was never established, and its absence is reflected in some of the tension today over the goals and balance of federally supported climate change science.

The CCSP states its mandate under the GCRA as "to improve understanding of uncertainties in climate science, expand global observing systems, develop science-based resources to support policymaking and resource management, and communicate findings broadly among scientific and stakeholder communities."[26]

[23] National Research Council, *The Atmospheric Sciences and Man's Needs: Priorities for the Future* (Washington: National Academies Press, 1971).

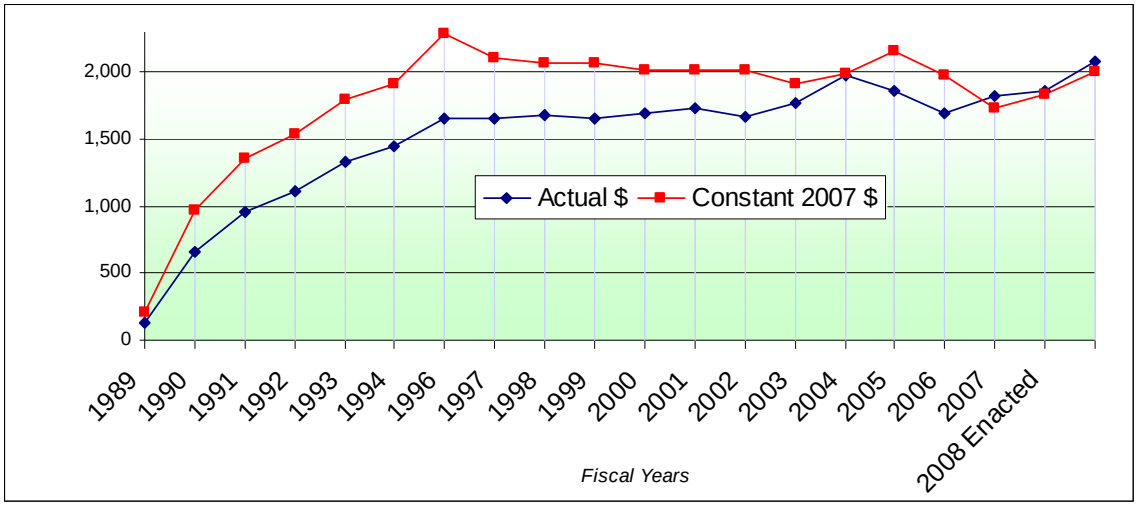
[24] In 1970 dollars, the recommendation was for $25 million over ten years.

[25] 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.

[26] CCSPO. 2008. *Our Changing Planet: The U.S. Climate Change Science Program for Fiscal Year 2009*. Washington DC: A Report by the Climate Change Science Program and the Subcommittee on Global Change Research, August 1.

**Figure 3. Budget Authority for U.S. Climate Change Science: FY1989-FY2007 Actual, FY2008 Enacted, and FY2009 Request**

(millions of U.S. dollars)




**Source:** Climate Change Science Program Office http://www.climatescience.gov.

Arguably, however, little has changed since a 1993 review of the program by the Office of Technology Assessment concluded that:

> Although the program is scientifically well-grounded, it has become overwhelmingly a physical science program focused on basic Earth system processes that largely ignores the behavioral, economic, and ecological aspects of environmental problems. For example, understanding the role clouds play in climate change and the role of the ocean-land-atmosphere interface is now its highest priority.... Although the results of the program, as currently structured, will provide valuable information for predicting climate change, they will not necessarily contribute to the information needed by public and private decisionmakers to respond to global change. Three areas are particularly lacking: ecosystem-scale research, adaptation research (ecological, human, and economic), and integrated assessments (evaluation of all focused and contributing research results and their implications for public policy).[27]

Although there has been some adjustment to address the problems above, a number of critics argue that there remain important gaps in the federal program; some have concluded that structural—potentially legislative—fixes would be necessary, as 15 years of efforts have been largely unsuccessful.[28] As a result, there are several proposals within and outside of the U.S. Congress to restructure and expand climate change research.

[27] OTA. October 1993. *Preparing for an Uncertain Climate—Volume 1*. U.S. Congress. p. 110-111.

[28] For example, in the FY2009 proposal, the single largest item under "Human Contributions" is to investigate health impacts of ultraviolet radiation (in HHS)—arguably not a "climate change" activity though important for health reasons. The second largest element is in NASA—not an agency closely allied with human-related research. These two agencies manage more than two-thirds of this CCSP element. In earlier years, this category had been called "Human Dimensions." The resource management and environment agencies have $23.5 million for human-related research related to climate change—1% of the total CCSP budget.

Since the FY2004 budget, the Climate Change Science Program (CCSP) has been composed of the US GCRP and the Climate Change Research Initiative (CCRI), the latter having been established by President Bush in 2003. There appears to be little practical distinction between these two efforts within the CCSP. **Appendix B** describes the organization of agencies under the federal climate strategy of President Bush, while **Appendix D** identifies the major climate science activities of the major agencies.

The CCSP has not been formalized through legislation; the GCRA remains the principal legal authorization and framework for U.S. federal climate change science. However, there were several hearings and bills introduced in the 110th Congress concerning the content and organization of the CCSP, and it is likely that bills to amend or replace the GCRA will be introduced in the 111th Congress.

## CCSP Goals, Strategies, Products and Evaluations

The CCSP is described in an overall strategy, the *Climate Change Science Program Strategic Plan*. This plan was published in 2003, with ongoing reviews by the National Academy of Sciences. The strategic plan was updated in May 2008 under court order.[29] As the revised plan was released in May 2008, its priorities were not necessarily reflected in the FY2009 request to Congress. The 2008 Strategic Plan did not substantially change the organization of the existing CCSP, as described below.

The 2003 and 2008 CCSP Strategic Plans grouped 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.

Both plans further lay out five goals, which do not correspond closely with these seven research elements. The proposed FY2009 funding for each goal, as self-identified by agencies and excluding satellite-based observation funding, is provided below:

- **Goal 1** ($410.6 million): Improve knowledge of the Earth's past and present climate and environment, including its natural variability, and improve understanding of the causes of observed variability and changes,

[29] On August 21, 2007, a U.S. District Court Judge ruled that the Administration has "unlawfully withheld action" to update its global change research plan every three years, and ordered that the Administration publish a summary of a revised proposed Research Plan in the Federal Register no later than March 1, 2008, and that the proposed Research Plan itself be submitted to Congress not later than 90 days thereafter. The judge also ordered that the Administration produce an integrated scientific assessment, as required by the GCRA no later than May 31, 2008. Court Order No. C 06-7062 SBA, filed August 21, 2007, from the United States District Court, Northern District of California, Oakland Division, Center for Biological Diversity et al. v. Dr. William Brennan et al.

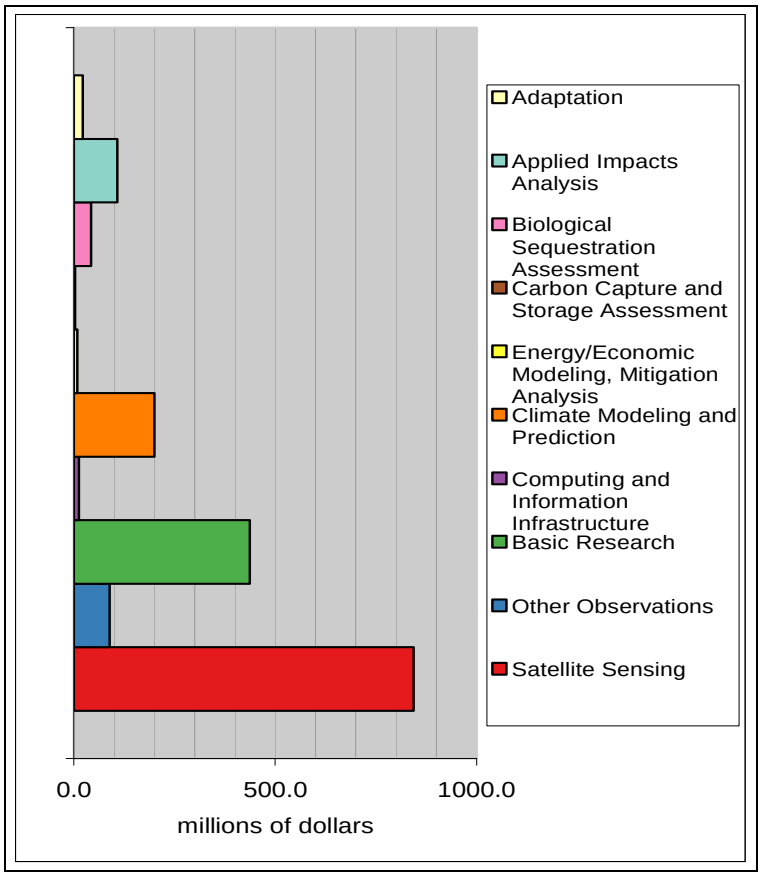
- **Goal 2** (314.8 million): Improve quantification of the forces bringing about changes in the Earth's climate and related systems,
- **Goal 3** ($279.8 million): Reduce uncertainty in projections of how the Earth's climate and related systems may change in the future,
- **Goal 4** ($160.0 million): Understand the sensitivity and adaptability of different natural and managed ecosystems and human systems to climate and related global changes, and
- **Goal 5** ($143.8 million): Explore the uses and identify the limits of evolving knowledge to manage risks and opportunities related to climate variability and change.

The identified funding levels do not include all funding for federal climate-related science (e.g., research on health risks by the Centers for Disease Control and Prevention), and some activities reported within CCSP arguably are only tangentially related to climate change (e.g., the $46.8 million in Health and Human Services for human health effects of ultra-violet radiation). Some reporting issues may have evolved from the absorption by the CCSP of the pre-established Global Change Research Program, the mandate for which is broader than climate change. Such issues, however, increase the challenge of identifying what work, and how much funding, in the federal agencies is directed primarily at climate change science.

## FY2009 CCSP Proposals by Activities

The main applications of proposed funding, according to CRS analysis of available data (again, with limitations), would be satellite-based observations, basic science research, and climate models. **Figure 4** provides preliminary CRS analysis of how federal funding for climate change science is used in different applications, as requested in the FY2009 budget.

**Figure 4. Applications of CCSP Funding Requested for FY2009**




**Source:** CRS using data from CCSP and from agencies.

## Products of the CCSP

The Global Change Research Act of 1990 (GCRA) (P.L. 101-606) requires a scientific assessment report to Congress at least every four years, as well as annual reports on climate change activities and budget. The first national assessment complying with the Global Change Research Act was published in December 2000. The Bush Administration intended a set of synthesis and assessment products (SAPs), taken together, to meet the four-year reporting requirement of the GCRA.

*Synthesis and Assessment Products .* The CCSP Strategic Plan aimed to produce 21 SAPs, originally intended to be completed in 2007.[30] Both Members of Congress and environmental groups disagreed that the series of reports would meet the statutory requirement or meet the needs of policy-makers. Several environmental groups filed suit against officials in the Bush Administration to force production of a revised research plan and an integrated, national scientific assessment.

A Court Order of August 21, 2007 required the following products to be released by the Administration:

[30] Additional information on the SARs, including their content and status, can be found at http://www.climatescience.gov/Library/sap/.

| Product | Expected Completion |
|---|---|
| CCSP Revised Research Plan | May 2008 (completed) |
| Scientific Assessment | May 2008 (completed) |
| "Capstone" Synthesis and Assessment Product | 2009 |
| CCSP Strategic Plan 2013 to 2023 | 2010 |

*Revised Research Plan .* On May 29, 2008, under court order, the Administration released the CCSP Revised Research Plan (RRP), in compliance with Section 104(a) of the Global Change Research Act of 1990.[31] This report focused on the 2008 to 2010 period, and noted that it was a first step toward a new strategy by 2010 covering 2013 to 2023. Public outreach towards that new strategy reportedly has begun. The RRP retains the same five goals and overall structure as the 2003 Strategy. The RRP distills the main emerging priorities, and similarities and differences from the 2003 Strategy, in the following four points:

> CCSP will continue to provide the basic physical science required to understand Earth's past and present climate, including its natural variability, and to improve understanding of the causes of and uncertainties in observed variability and change at global, continental, regional, and local scales. CCSP remains committed to basic, ongoing research to understand climate processes and the forcing factors that cause changes in climate and related systems.
>
> CCSP will increasingly address emerging needs for research to more fully understand the impacts of climate change on unmanaged and managed ecosystems, human health and infrastructure, economic, and other human systems.
>
> CCSP will continue to generate science [to] support decision-making related to the management of risks and opportunities of climate variability and change, including adaptive management and mitigation efforts, with an increased emphasis on generating scientific results at regional and local scales.
>
> CCSP will place greater emphasis on communicating with users and stakeholders (e.g., state and local governments, academia, industry, public utilities, and non-governmental organizations), both to gain the benefit of their experience, perspectives, and input and to ensure that the results of CCSP research, monitoring data, and assessments are widely and easily available and accessible to potential users of this information.[32]

As the CCSP moves towards revision in 2010 of its strategic plan for 2013 to 2023, the Congress may consider legislative options to clarify the goals, measures of progress, organization and processes of federal climate change scientific research.

*New Integrative Scientific Assessments .* On May 28, 2008, the Bush Administration released *Scientific Assessment of the Effects of Global Change on the United States.*[33] In addition, the CCSP will produce an integrative 'capstone' product, called the *CCSP Unified Synthesis Product* (USP) required in 2009 by the court order. The USP will synthesize information from the 21 SAPs, the 2007 Assessment Reports of the Intergovernmental Panel on Climate Change, and

[31] Available at http://www.climatescience.gov/Library/stratplan2008/.

[32] CCSP. (2008) Revised Research Plan for the U.S. Climate Change Science Program.

[33] http://www.climatescience.gov/Library/scientific-assessment/.

other recent research. The USP is intended to analyze current understanding of climate change science, summarize the contributions of the CCSP, and identify important gaps in the science.[34]

## Evaluations of the CCSP

The CCSP has employed many panels of the National Academy of Sciences to review aspects of the climate science program and to provide recommendations for improvements. Multiple agencies similarly seek reviews from the NAS or other external bodies (e.g. science advisory boards) and advice. Some common concerns about the CCSP are identified below.

*Weaknesses in Leadership and Budget Coherence.* While the existing decentralized structure of the climate change science program brings some advantages, most reviews of the program conclude that the CCSP lacks sufficient over-arching authority to overcome agencies' individual interests and to make budget consistent with cross-cutting priorities. A 2007 National Academies panel concluded, for example, that "[t]he separation of leadership and budget authority presents a serious obstacle to progress in the CCSP."[35]

Although a number of Members of Congress and interest groups might be interested in strengthening central leadership of the CCSP through legislative actions, there is no general consensus—and some active dispute—about which federal entity would be the best site in which to invest such authority. Options raised have included the Office of Science and Technology Policy (or a new entity within the Executive Office of the President), the Office of Management and Budget, the National Science Foundation, or the National Oceanic and Atmospheric Administration. Some experts have proposed a "climate czar" in the White House, a "troika" of leaders from existing White House councils, or a new free-standing entity like the U.S. Trade Representative. One question also raised is whether such leadership should cover only the science programs, or be extended to all climate change programs (possibly including the Climate Change Technology Program, new initiatives that might more fully address adaptation or greenhouse gas mitigation, policy analysis, and international strategies). Some would include energy security coordination as well, while at least one proposal would subsume climate change leadership under an "energy czar." President Obama's appointment of Carol Browner to be his Assistant for Energy and Climate Change may fill this role, though the functions and authority of the new position have not been defined.

*Lack of Metrics of Progress .* One challenge facing the CCSP is, arguably, lack of clearly articulated and measurable goals (notwithstanding the qualitative goals cited above). The goals as articulated define directional change with no definable end-points at which one could declare "mission accomplished," or milestones along the way. Such measurable objectives exist for many of the individual projects funded under the CCSP, but not for the program as a whole. This potentially presents a challenge in determining priorities and changes in them over time, when existing or proposed programs cannot be evaluated against their contributions to the overall product. It also exacerbates some continuing tension between funding for fundamental knowledge

[34] More information is available on NOAA's website: http://www.climate.noaa.gov/index.jsp?pg=./ccsp/unified_synthesis.jsp.

[35] National Research Council. 2007. *Evaluating Progress of the U.S. Climate Change Science Program: Methods and Preliminary Results*. Committee on Strategic Advice on the U.S. Climate Change Science Program. Washington DC. (p.3)

and—under budgetary constraints—calls for greater resources for applied research and actions to accomplish climate change policy objectives.

A National Academies 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."[36] 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."[37] With only qualitative, directional goals and an absence of detailed management metrics, a 2008 review of the CCSP by a National Academies panel was forced to rely on a high-level "assessment of strengths and weaknesses of the entire program, based mainly on the reviewers' knowledge of program results."[38]

*Unclear and Inconsistent Reporting of Programs and Funding .* In 2005, the Government Accountability Office (GAO) concluded that "[d]ata and reporting limitations make determining agencies' actual levels of climate change funding difficult."[39] GAO made a number of recommendations and reported in late 2006 that most had been implemented. However, the difficulty of the present CRS analysis leads to the conclusion that, while many GAO-recommended improvements have been helpful, the fundamental problems with lack of clarity and consistency persist and confound understanding of how climate change funds have been applied and evaluation of the efficiency, results, and value of their use.

A recent National Academies panel charged with evaluating the progress of the CCSP concluded in 2007 that "the detailed budget and management information necessary to score the process and input metrics [as laid out in a 2005 report on metrics for the program] is not readily available, even to CCSP agencies."[40] This CRS analysis confirms the 2007 NAS conclusion.

*Imbalance between Space-Based Observations and Other Research Elements .* The National Research Council published another report in 2008[41] evaluating priorities for flight missions and supporting activities for space-based observations over the coming decade. Many of the satellite-based programs reviewed by the NRC are reported under the CCSP. The assessment concluded that the value of the observations could be improved by addessing the balance between space-based and other research components. It concluded that to provide benefits to both science and

[36] The Climate Change Science Program Office maintains a website with detailed and useful information about U.S. climate change science, at http://www.climatescience.gov. Available at that site is its annual report, *Our Changing Planet*, which provides descriptions of all elements of the climate science program and of each participating agency.

[37] Ibid. Executive Summary, p. 9.

[38] National Research Council. 2007. Op.cit. (p. 3)

[39] GAO. 2006. *Climate Change: Greater Clarity and Consistency are Needed in Reporting Federal Climate Change Funding. Statement of John B. Stephenson*, Director Natural Resources and Environment GAO-06-1122T. Washington DC, September 21. http://www.gao.gov/new.items/d061122t.pdf.

[40] National Research Council. 2007. Op. cit. (p.3)

[41] National Research Council. 2008. *Satellite Observations to Benefit Science and Society: Recommended Missions for the Next Decade*. Committee on Earth Science and Applications from Space: A Community Assessment and Strategy for the Future.

society—"of equal priority"—the programs needed a foundation of observations collected from the land, sea, air—as well as space—and that observations needed to be integrated into forecast models and other tools for decision-making. The current observation systems were noted to have major weaknesses; the top priority for improvement was obtaining the needed *range* of continuous observations, rather than implementing individual space missions. The panel further concluded that strong observation systems:

> will prove useful only if they can be effectively analyzed, interpreted, and applied.... To realize the potential offered by these missions, resources must be focused in the following four areas: ensuring sustained observations for operations, research, and monitoring; obtaining complementary non-space-based observations; turning observations into knowledge and information; and sustaining the knowledge and information system.[42]

In sum, the NRC panel found that greater benefits could be gained by redressing existing imbalances in funding for satellite-based observations with other observation systems and greater analysis of the information gathered.

*Science for Expanding Knowledge versus Practical Applications .* An on-going frustration from some quarters with the climate change science enterprise has been the tension between science for "the quest to acquire new knowledge" or for "practical benefits for humankind."[43] These observers conclude that the emphasis of the USGCRP has, since inception, been far more strongly to observe, understand, and predict global change than to provide useful information to policy makers.[44] A recent critique also concluded that "from execution of the program it is clear that the agencies consider their mandate to be primarily the support of basic research according to the specifics of each agency mission."[45] The CRS analysis of the CCSP budget, in the following section, reinforces this author's conclusion. The author continued,

> Almost all oversight or advisory committees providing input on priorities for carbon cycle science, whether at the agency or national level, consist exclusively of practicing scientists.... Even Congress members charged with reviewing budgets for science have been reluctant to challenge the paradigm that 'unfettered' basic research will eventually result in societal benefit, with some notable exceptions.... The processes that govern the prioritization, selection, advocacy and accountability for research stem from the internal operating norms of the scientific community and are extremely appropriate for basic, curiosity-driven research. Should the community wish to shift their research agency to one more focused on the needs of society, however, changes in the operating norms would be appropriate.

Similarly, a 2007 study by the National Research Council concluded that "the full potential of societal benefits from NASA products will not be realized unless users are involved directly in determining priorities, designing products, and evaluating benefits."[46] Looking at the CCSP overall, a National Academies panel concluded in *Evaluating Progress of the U.S. Climate Change Science Program—Methods and Preliminary Results* (2007) that "if the program is to achieve its vision of producing information that can be used to formulate strategies for

[42] Ibid, p. 27.

[43] NRC, ibid, p. 2.

[44] Lengthy discussion of this issue appears in OTA. 1993. *Preparing for an Uncertain Climate—Volume 1*, Chapter 3.

[45] Dilling, Lisa. 2007. "Towards science in support of decision making: characterizing the supply of carbon cycle science." *Environmental Science & Policy* 10:1 (February): 48-61.

[46] National Research Council. 2007. *Assessment of the NASA Applied Sciences Program*. National Academies Press. p. 112.

preventing, mitigating, and adapting to effects of climate change, adjustments will have to be made in the balance between science and applications."[47]

Myriad interest groups have put forward proposals for how the CCSP might be restructured; it is beyond the scope of the current report to review and evaluate these. In sum, alternative proposals would vest more central authority in one agency or in the White House, give that authority greater budgetary control, augment input from potential users of the science, and improve the overall budget decision-making. Some proposals would expand the science program to include more *applied* research and analysis to serve private and government needs, and increase public communications and outreach, while other proposals would expand such activities in a separate institutional structure. Several bills introduced in the 110th Congress[48] would accomplish some of these proposals.

# Climate Change Technology Program (CCTP)

By the 1990s, on-going federal research on various energy technologies and on carbon storage in soils and vegetation were recognized as potentially contributing to the technological change that would be required for a major reduction of GHG in the atmosphere. President Clinton packaged some research into the Climate Change Technology Initiative in 1998. President Bush in 2002 repackaged many of the same activities into the U.S. Climate Change Technology Program (CCTP). The composition of the broad climate technology programs have changed over time.

The CCTP was authorized by the Energy Policy Act of 2005 (EPAct 2005)(P.L. 109-58). EPAct directed the President to establish a Committee on Climate Change Technology to "integrate current Federal climate reports" and carry out climate change technology activities and programs to implement a required strategy (§1610(b)(1)). The Secretary of Energy was designated to chair this Committee. The Committee was required to produce a strategy within 18 months from enactment (which was August 8, 2005) to "promote the deployment and commercialization of greenhouse gas intensity reducing technologies and practices developed through research and development programs conducted by the National Laboratories, other Federal research facilities, institutions of higher education, and the private sector" (§1610(c)(1)). A CCTP *Strategic Plan* was published in September 2006, envisioning a $3 billion program. (By comparison, the FY2008 enacted level was $3.49 billion; the FY2009 request was for $4.41 billion; and, a Continuing Resolution continues funding at the FY2008 enacted level through March 6, 2009.) EPAct requires the strategy to be updated every five years or more frequently.

EPAct 2005 also established the Climate Change Technology Program "within the Department of Energy" (§1610(d)), to "carry out the programs authorized under this section." Besides preparation of the national strategy, the programs authorized under §1610 are:

- to prepare inventories and evaluation of GHG intensity-reducing technologies, including a report to Congress;

[47] National Research Council. 2007. Op.cit. (p. 6).

[48] Including H.R. 6, H.R. 906, H.R. 1961, H.R. 2809, S. 309, S. 1018, and S. 2307.

- to identify the need for technology demonstration projects, including a report to Congress on barriers to, and commercial risks of, technologies and a plan for demonstrations;
- to develop standards and best practices for calculating, monitoring and analyzing GHG intensity;
- to support demonstration projects; and
- to enter into cooperative research and development agreements.

These activities are arguably much narrower than the scope of activities identified under President Bush's CCTP, as described in the FY2009 budget request (and others).

The CCTP, as defined by President Bush, is composed of programs administered by 11 agencies, plus the Executive Office of the President. It is coordinated by the Department of Energy and overseen by the interagency Committee on Climate Change Science and Technology Integration (see **Appendix B**). 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 2006 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.[49]

The six strategic goals outlined by 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-$CO_2$ 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 $4.53 billion enacted for FY2008, a $3.70 billion (536%) increase. President Bush's FY2009 budget requested $4.41 billion for FY2009, a $114 million increase (3%) above FY2008.[50] As requested, the CCTP would constitute 62% of federal funding on climate change (as reported by OMB). However, the actual increase in funding for these efforts may be lower than the reported dollar amounts suggest, as the agencies and OMB have redefined the initiatives included within the CCTP over time. For example, an increasing number of existing nuclear energy programs, as well as some clean coal programs, have been added to the count in later years though they existed but 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 efforts, and funding for them, across the years. GAO has made similar observations,

[49] U.S. Climate Change Technology Program, U.S. Climate Change Technology Program Strategic Plan (Washington, 2006); http://www.climatetechnology.gov/stratplan/final/index.htm.

[50] A Continuing Resolution continue funding for FY2009 at FY2008 enacted levels through March 6, 2009.

and has identified several ways that technology funding presented in OMB's more recent reports may not be comparable to previously reported technology funding,[51] introducing 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),[52] redefinitions of program areas also may complicate performance tracking and accountability, in addition to making funding comparisons difficult from year to year.

## CCTP Funding by Technology

Generally, funding for the CCTP is presented by agency and program. CRS analyzed data for the FY2009 funding request by technology across programs and agencies.[53] The preliminary results are in **Figure 5**. The reported CCTP funds do not constitute all the funding and other financial incentives for research, development and deployment of technologies; they are a subset selected according to OMB guidelines for the CCTP.[54] According to the data available, 29% of the funds requested for the CCTP for FY2009 would support nuclear energy (equivalent to 20% of all funding for climate change activities). Funding for nuclear energy research would be more than twice the amount requested for any other technology category. The next largest categories in the CRS analysis are mixes of technologies: 13% of the FY2009 request is for programs that either support multiple technologies or the specific technologies have not been identified. Another 12% of the funding would support renewable energy technologies other than biomass and biofuels, such as wind, solar, and others.

**Appendix F** provides a table of funding highlighting the Administration's stated priorities for specific technologies planned for development by DOE and EPA under the CCTP. These are not necessarily the technologies receiving the largest funding reported under the CCTP, or among all climate-related R&D.

There is broad support for federal interventions to stimulate technological advance, and multiple studies have shown that effectively stabilizing greenhouse gas emissions over the coming century would require radical technological change compared to current patterns globally.[55] Such rapid change has some precedent, but on narrower geographical and economic scales, for example, the transformation of France's electricity sector to nuclear energy, or the adoption of private motor vehicles. The former example was driven by governmental fiat and the latter by the large private benefits associated with vehicle ownership and use. The U.S. technology strategy has been, thus far, one of federal sponsorship of research on specified technologies. But, there is no clear relationship between federal investment in particular technologies and success in

[51] GAO. *Climate Change: Greater Clarity and Consistency Are Needed in Reporting Federal Climate Change Funding*. GAO-06-1122T. September 2006, p. 3.

[52] P.L. 103-62.

[53] Most of the detailed funding data were provide by the management office of the CCTP in the Department of Energy.

[54] An alternative historical analysis of federal financial support to energy technologies is Management Information Services, Inc. 2008. *Analysis of Federal Expenditures for Energy Development*. Prepared for the Nuclear Energy Institute, Washington DC. The MISI analysis includes broader funding, as well as tax policy effects, government services, regulations and other forms of support that are not included for the CCTP accounts. It concludes that nearly three-quarters of federal support for energy from 1950 to 2006 has promoted fossil fuels.

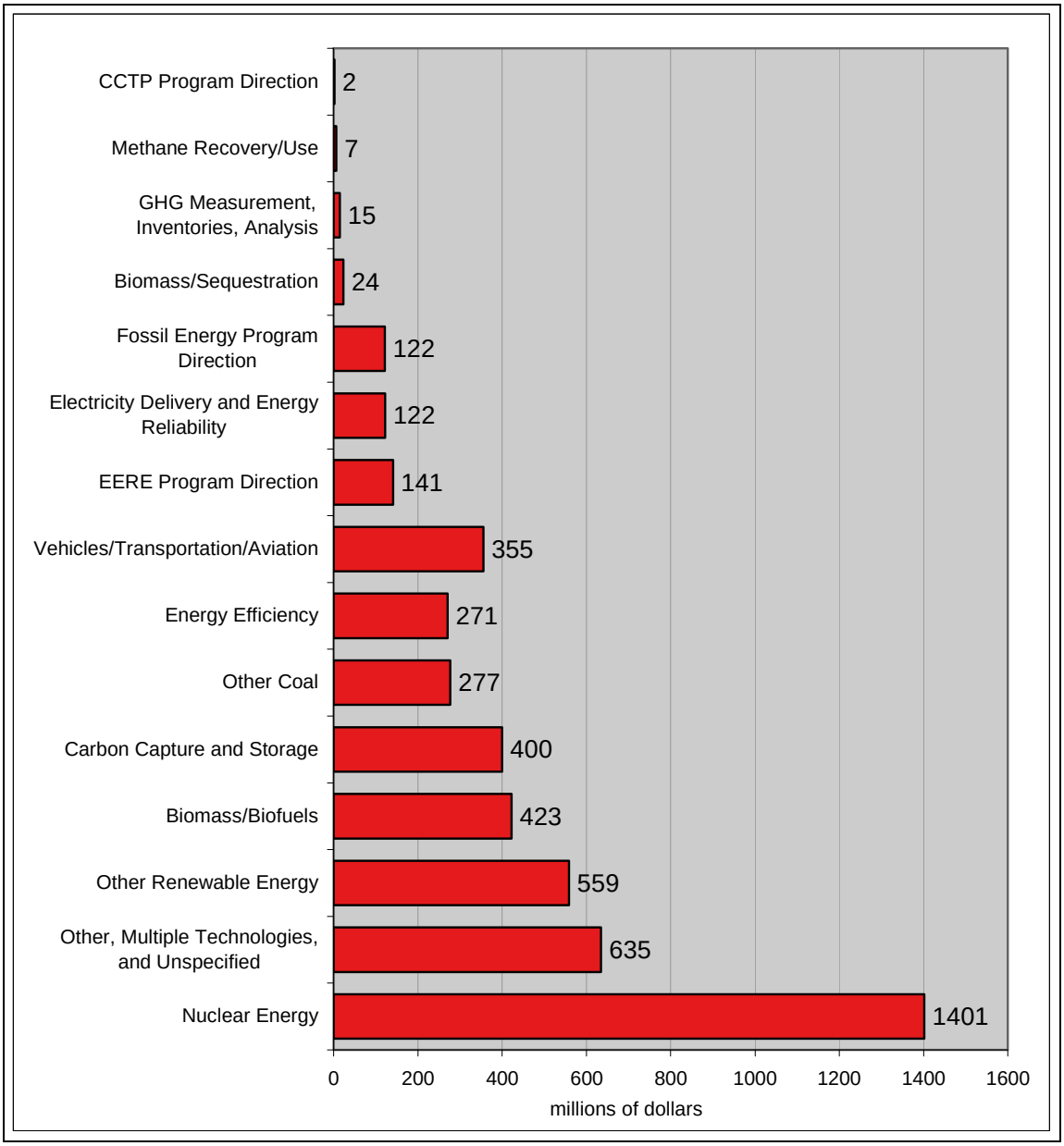
[55] See CRS Report RL33970, *Greenhouse Gas Emission Drivers: Population, Economic Development and Growth, and Energy Use*, by (name redacted) and (name redacted); and CRS Report 98-738, *Global Climate Change: Three Policy Perspectives*, by (name redacted) and (name redacted).

commercialization, and there may be substantial inefficiencies or opposition to governmental "picking and choosing" of technologies.

Moreover, there is a much wider array of public incentives that affect private technology choice than those identified under the CCTP; these other incentives may support the climate-related investments or may counteract them.[56] There are likely opportunities to improve efficiencies of federal stimulation of technological advance by reviewing them all as a package and considering their cumulative effects.

[56] For example, see CRS Report RL33578, *Energy Tax Policy: History and Current Issues*, by (name redacted), or MISI 2008, op.cit.

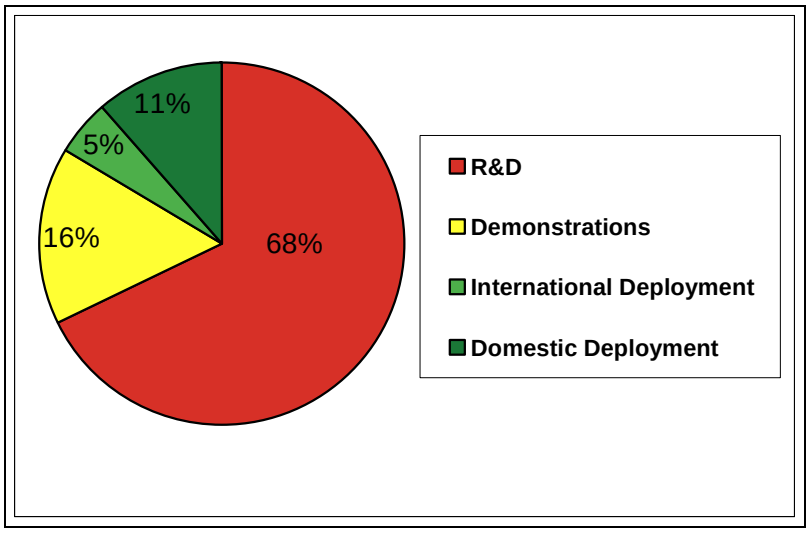
**Figure 5. Estimated CCTP Funding Requested for FY2009 by Technology Type**




**Source:** CRS estimates using data provided by CCTP.

The CCTP supports technological advance at all stages of research, development, demonstrations, and deployment (RDD&D). **Figure 6** shows the shares of the CCTP proposed for FY2009 for these different stages, according to data provided by the CCTP. More than two-thirds of CCTP funding supports basic research as well as development of specific technologies. As technologies prove promising for commercial use, programs support activities such as demonstrations at the pilot and bench scales. When technologies are ready for commercialization, or are already commercialized but adopted in markets more slowly than is advantageous, federal programs encourage deployment through targeted information, technical assistance and other measures.

**Figure 6. FY2009 CCTP Request by Stage of Technology**




**Source:** CRS using data provided by CCTP.

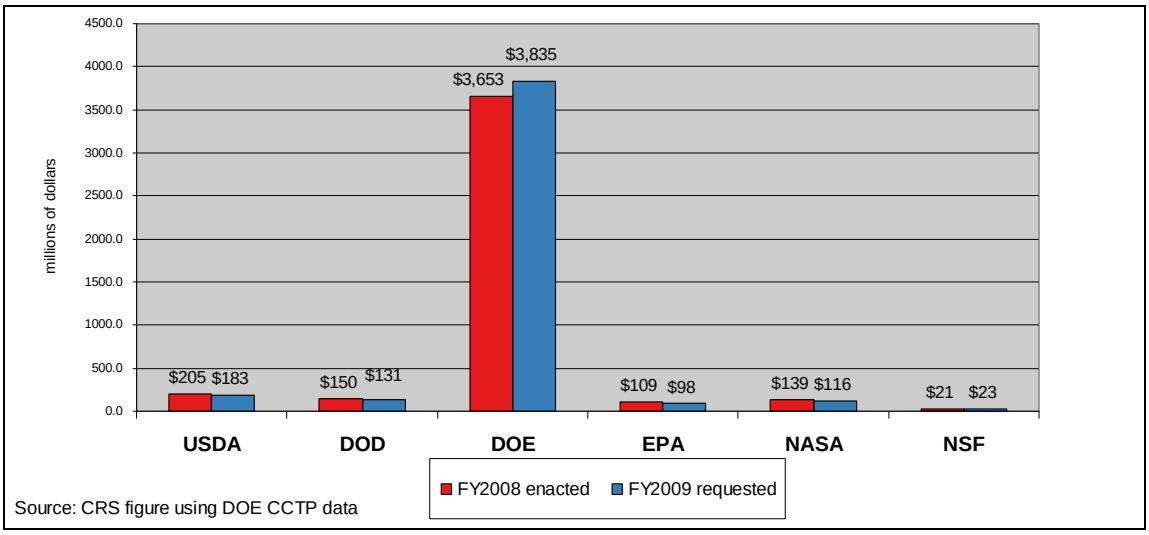
A very small portion of CCTP funding—perhaps 5%—supports technology deployment in the United States. Congress appropriates funds to DOE, the Environmental Protection Agency (EPA), and the Department of Agriculture (USDA) to administer more than 60 programs to promote voluntary adoption of technologies that are more efficient or reduce greenhouses gases, relative to the average of each technology available commercially. Programs include Energy Star, Climate Leaders, the Methane Partnership Initiatives, Value Added Producer Grants, and many others.[57]

## CCTP Funding by Agency

**Figure 7** compares CCTP funding levels by agency as enacted for FY2008 and requested for FY2009. It does not display the agencies with less than 1% of the CCTP funding. Neither does this figure provide all related federal R&D funding, nor does it display other forms of support for technologies, such as tax exemptions or government procurement. In the FY2009 request, DOE would have represented 87% ($3.8 billion) of the new budget authority for the CCTP—two percentage points and $183 million more than in the FY2008 enacted level, which continues in FY2009 under a continuing resolution. USDA would have received about 4%, while DOD and NASA would have each received about 3%, of the $4.42 billion request for CCTP for FY2009. The EPA and NSF would have received 2% and 1%, respectively. Descriptions of CCTP-identified activities by agency are in **Appendix E**.

[57] Some technology deployment programs are described on the EPA's website: http://www.epa.gov/climatechange/policy/neartermghgreduction.html. Also Table 4-2 of the U.S.'s *Fourth Climate Action Report to the UN Framework Convention on Climate Change* identifies the GHG reductions expected to be stimulated by each program, though the individual estimates are not additive. This report can be found on the Department of State website: http://www.state.gov/g/oes/rls/rpts/car/index.htm.

**Figure 7. Comparison of CCTP Funding by Agency for FY2008 Enacted and FY2009 Requested Levels**




Source: CRS figure using DOE CCTP data

# International Climate Change Assistance

The third major program in President Bush's climate change strategy was International Climate Change Assistance, to encourage other countries to slow and then reduce their emissions of greenhouse gas emissions. A major policy challenge is negotiating international commitments to address climate change after 2012, and especially gaining global engagement in GHG mitigation. Developing countries have stated that their degree of participation will depend on the degree to which the industrialized countries have fulfilled their commitments under the United Nations Framework Convention on Climate Change (UNFCCC). These commitments include financial and technological assistance to the lower income countries and to countries that may be harmed by policies to abate greenhouse gas (GHG) emissions. The United States, as one of the wealthiest nations and the leading emitter historically of GHG, is considered worldwide to have extraordinary responsibility to address climate change. Most people consider that, while addressing climate change must be a common, global effort, the United States must play a leading role among nations.

President Bush's request would have more than tripled federal funding of climate change-related international programs, from $202 million enacted for FY2008 to $657 million for FY2009. The principal increase would provide a proposed $400 million "first installment" to a new Clean Technology Fund (CTF) established in 2008 and managed by the World Bank.

## The Clean Technology Fund (CTF)

On Sept. 30, 2008, the U.S. Treasury committed $2 billion for the Clean Technology Fund (CTF), with a first installment of $400 million in grant money to be provided once appropriated by Congress. At the same meeting, up to $6.14 billion in total were pledged by Australia, France, Germany, Japan, the Netherlands, Norway, Sweden, Switzerland, the United Kingdom and the United States for the Climate Investment Funds (CIF) of the World Bank: CTF and the Strategic Climate Fund (SCF). These funds would provide grants and concessional loans to developing

countries in order to facilitate greenhouse gas emission reductions and preparations for adaptation to climate change. According to the CIF website,

> Two trust funds are being created under the Climate Investment Funds. The Clean Technology Fund, will invest in projects and programs in developing countries that contribute to the demonstration, deployment, and transfer of low-carbon technologies. The projects or programs must have a significant potential for long-term greenhouse gas savings. The second fund, the Strategic Climate Fund, will be broader and more flexible in scope. It will serve as an overarching fund for various programs to test innovative approaches to climate change. The first program under this fund is a pilot aimed at increasing climate resilience in developing countries. A Forest Investment Program and a Scaling-Up Renewable Energy Program are also expected to be created in the coming months.[58]

The financing is intended to help meet existing commitments of the United States and other developed countries for financial assistance to developing countries. This commitment would supplement other obligations under the United Nations Framework Convention on Climate Change, for which some multilateral mechanism exist. (See, for example, the discussion on the Global Environmental Facility, below.) Accompanying the funds is the hope that the commitment will increase trust and garner developing countries' engagement in new GHG mitigation commitments in the current round of negotiations on climate change actions.[59] [60]

There is general acknowledgment that more, and more effective, assistance to developing countries would be necessary to reduce their GHG trajectories. Several debates, however, have emerged over the CTF: which technologies should be financed? which countries should receive CTF assistance? should funds aim at transforming recipients' energy economies, or at making marginal changes in large countries? might the CTF substitute for reform of World Bank policy to make all its investments less emitting? and—perhaps most strategic—how does the CTF fit into the confusing set of existing and emerging funds to promote GHG mitigation and adaptation to climate change?

## United States Agency for International Development (USAID)

President Bush's request also would have increased international climate change assistance through USAID by $50 million, from $115 million enacted for FY2008 to a proposed $165 million in FY2009. A Continuing Resolution extends the FY2008 funding level through March 6, 2009. Although the FY2009 requested amount would still be lower than the level of $190 million enacted for FY2006, a large part of the decrease from the FY2006 funding was $28 million eliminated for "modern energy services" in Afghanistan.[61] USAID does not distinguish funding

[58] http://web.worldbank.org/WBSITE/EXTERNAL/NEWS/0,,contentMDK:21916602~pagePK:34370~piPK:34424~theSitePK:4607,00.html.

[59] See CRS Report RL33826, *Climate Change: The Kyoto Protocol, Bali "Action Plan," and International Actions*, by (name redacted) and (name redacted).

[60] For more on the Clean Technology Fund, see CRS Report RS22989, *The World Bank's Clean Technology Fund (CTF)*, by (name redacted) and (name redacted).

[61] For FY2008 and FY2009, no language was included requiring that US AID spending on climate change be itemized. The Foreign Operations appropriation 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; (continued...)

for measuring, monitoring, reporting, verification and reduction of greenhouse gas emissions from other activities in the relevant sectors.

## Asia-Pacific Partnership on Clean Development and Climate (APP)

In the FY2009 request, the international assistance category included $52 million for the Department of State, $37 million of which would support the APP (compared to $32 million enacted for FY2008, extended through March 6, 2009 by a Continuing Resolution). Reported in other agencies under the Climate Change Technology Program (CCTP) and intended for the APP were another $15 million requested for the Department of Energy ($7.5 million enacted for FY2008), and $2 million for the Department of Commerce's International Trade Administration (zero in FY2008), and $5 million for the Environmental Protection Agency (with no appropriation for APP for FY2008). Both the House and Senate passed bills for FY2009 appropriations for many DOE programs (though none was enacted into law) and, in them, both committees rejected the request to fund the Asia Pacific Partnership.[62] This is consistent with past appropriations, and funds for the APP have never been appropriated to the Environmental Protection Agency either.

The APP is a voluntary partnership that aims to advance technologies that may help reduce the greenhouse gas intensity of partner nations: the United States, Canada, China, India, South Korea, Australia and Japan. The initial set of projects under the APP's workplan emphasizes sectoral assessments, capacity building, identifying best practices, and technology research and demonstration.[63] 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 projected greenhouse gas emissions.[64]

## The Global Environment Facility (GEF) and Additional Commitments

Under the United Nations Framework Convention on Climate Change (UNFCCC)—to which the United States became a Party in 1992—the wealthier "Annex I" Parties committed to "provide new and additional financial resources to meet the agreed full costs incurred by developing country Parties" to comply with certain obligations, such as producing GHG inventories, and the "agreed full incremental costs of implementing measures" (UNFCCC Article 3). In federal climate change funding, under international assistance, is $26 million reported for FY2009 as the United States' climate-related contribution to the Global Environment Facility (GEF). The FY2009 requested level was the same as in FY2007 to FY2008. The GEF is the principal financial mechanism of the UNFCCC related to Article 3, and it is managed by the World Bank. The GEF supports projects to demonstrate innovative clean energy production and efficient

(...continued)

(2) increase carbon sequestration activities; and (3) enhance climate change mitigation and adaptation programs."

[62] During debate over the FY2008 request for DOE's Office of Energy Efficiency and Renewable Energy, the Administration threatened to veto the appropriations bill, in part, due to the lack of funding for APP.

[63] For more information, see CRS Report RL33826, *Climate Change: The Kyoto Protocol, Bali "Action Plan," and International Actions*, by (name redacted) and (name redacted), for a brief summary of the APP.

[64] More information about the Asia-Pacific Partnership may be found at http://asiapacificpartnership.org/default.aspx.

energy use.[65] To complement the GEF and bilateral arrangements, the Conference of the Parties to the UNFCCC set up the Least Developed Countries Fund (LDC Fund) to assist the poorest countries to adapt to climate change; it restricts eligibility to Least Developed Countries; projects must be short-term, urgent and meet high priority needs; and projects must be derived from completed National Adaptation Programmes of Action (NAPAs) (the development of which may be supported by the LDC Fund). For FY2009, the Senate-passed bill for foreign operations (S.Rept. 110-425) would have enacted $20 million for the LDC Fund. It was not enacted into law, however. The Continuing Resolution continues funding through March 6, 2009 at FY2008 levels, which did not include an explicit contribution to the LDC Fund.

The UNFCCC Parties also set up the Special Climate Change Fund (SCCF) to leverage additional resources from bilateral and multilateral sources in four areas of action: adaptation to climate change; transfer of technologies; energy, transport, agriculture, forestry and waste management; and activities to assist diversification of the economies of those developing countries that depend greatly on fossil fuel production. The United States has not contributed to the SCCF.

Parties to the Kyoto Protocol—the United States is not a Party—also set up an Adaptation Fund (AF). The AF is to be financed, at least in part, by a 2% surcharge on emission reduction credits exchanged through the Kyoto Protocol's Clean Development Mechanism (CDM). It may also be financed by voluntary contributions of countries or private entities. The United States is not obligated to contribute to the AF, but may face pressure to make voluntary contributions.

The degree to which Congress appropriates assistance to developing countries will likely influence the degree to which the Department of State can enhance U.S. credibility and garner developing countries' engagement in new GHG mitigation commitments for the post-2012 period. On the other hand, providing assistance alone cannot guarantee that developing countries will consider it measurable, reportable and verifiable finance, technology and capacity-building, as called for under the Bali Action Plan of 2007. Another issue, in some countries' views, is whether financial assistance provided outside of the financial mechanisms of the UNFCCC should be regarded as fulfilling financial commitments under the Convention. Controversy is likely as well over how multilateral funds might be managed. Further issues concern whether financing will be considered "new and additional," any conditions placed on the financing, and whether the funds are "adequate" and "predictable."

## Debt Restructuring to Preserve Tropical Forests

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 (TFCA)(P.L. 108-323). The FY2009 request included $20 million for the Treasury Department for debt restructuring for tropical forestry conservation—the same as in recent years—in the Treasury Department's budget for climate-related debt restructuring programs.[66]

[65] For background on the GEF, see CRS Report RS21858, *Global Environment Facility (GEF): Overview*, by (name red acted).

[66] For more information, see CRS Report RL31286, *Debt-for-Nature Initiatives and the Tropical Forest Conservation Act: Status and Implementation*, by (name redacted).

# Tax Provisions

The fourth major type of financial support to climate change activities reported by the Administration is tax provisions or "tax expenditures." 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 reports, OMB enumerates certain *tax expenditures*, which are the estimated loss of federal revenues that result from taxpayers taking advantage of these preferential tax treatments.

OMB's estimates of tax expenditures rose sharply overall from $580 million in FY2003 to $1.52 billion in FY2007 (**Table 1**). The rise in the estimates from FY2006 to FY2007 was primarily due to expected loss of revenues resulting from tax incentives included in the Energy Policy Act of 2005 (P.L. 109-58). These provisions were due to expire at the end of 2008.[67] OMB projected the estimated tax expenditures to remain at $1.52 billion for FY2008 and then fall to $1.4 billion in FY2009, and continue to decline through 2013. These projections are likely altered by the extension in late 2008 of various incentives for renewable energy included in the Emergency Economic Stabilization Act of 2008 (P.L. 110-343).

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, including 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 the effectiveness of tax incentives to 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.

The full effects of tax incentives could be understood only in the context of other tax provisions that support activities that may aggravate climate change, such as support for fossil fuel production and use; data on these are not provided by OMB. Existence of tax incentives for both low-GHG-emitting technologies and high-GHG-emitting technologies likely counteract each other, and together would mask the full cost of energy to consumers. While tax provisions support a variety of policy objectives, such as energy security and employment, overall efficiencies may be gained by revising the counter-acting provisions in the context of meeting several objectives together (and supporting "win-win"measures). Such analysis, however, is beyond the scope of this report.[68]

[67] Tax expenditures were 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 was primarily based on 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.

[68] For related analysis, see CRS Report RL33578, *Energy Tax Policy: History and Current Issues*, by (name reda cted).

# Principal Observations and Legislative Issues

Over the past two decades, federal funding related to climate change has expanded from scientific research, almost exclusively, to a wide variety of programs to: develop and disseminate technologies; build a foundation for future policy actions; plan for adaptation; assist lower income countries; and address additional needs. As the debate continues over appropriate strategies to address climate change, the needs and priorities for funding are likely to evolve further.

## No Single Goal Aligns the Federal Effort

There has not been an overarching policy goal for climate change that guides the programs funded or the priorities among programs. U.S. federal policy on climate change has been a coalescence of separate goals—evolved distinctly for science, technology, energy production, foreign assistance, and trade—not a single, integrated strategy. The current federal effort largely has been built "bottom up" from a variety of existing programs, Presidential initiatives, and Congressionally-directed activities. Choices tend to be based on departmental missions and the degree of support for the input activities. There is no synthesis that establishes quantitatively, or even qualitatively, how federal funding will lead to accomplishment of a national climate change goal.

As President-elect, Barack Obama stated, on December 15, 2008, that "the effort before us will demand coordination across the government, and my personal engagement as President."[69] To assist with these, he has designated former EPA Administrator Carol Browner to be Assistant to the President for Energy and Climate Change. While President Obama has announced the intention of establishing a cap-and-trade system to reduce U.S. greenhouse gas (GHG) emissions to 1990 levels by 2020, and by 80% from 2005 levels by 2050, it remains to be seen how his goals will translate into funding proposals and program alignment.

## Reporting Might Better Serve Congressional Needs

For FY2008, no legislative language required the Executive Branch to report a cross-cut budget for climate change activities, as had been the case for more than a decade. The Executive Branch consequently did not produce a consolidated annual report on climate change funding in 2008. The Global Change Research Program, however produced its annual report, Our Changing Planet, for the science programs, although the detail of budget information is limited. (Spreadsheets were available upon request to the Office of Management and Budget.) The absence of a requirement for a cross-program, cross-cut budget continues into FY2009.

Agencies vary in the degree to which they identify and explain climate-related activities in their separate budget justifications. In some cases, OMB's cross-cut spreadsheets include activities that are not noted in agency budget justifications as related to climate change; in other cases, agencies identify activities as climate change-related that are not included in OMB's tallies. It would be

69 http://change.gov/newsroom/entry/president_elect_barack_obama_announces_key_members_of_energy_and_environmen/.

extremely difficult to construct an accurate overview of climate change funding without such an OMB-assisted cross-cut. The Congress may elect to continue with the status quo, in terms of separate agency budget reports, which may or may not identify climate change-related programs, or wish to re-instate a reporting requirement for climate change funding and tax incentives. If the Congress were to require annual reports, as it did for more than a decade, it may wish also to consider specifying the criteria for including funding (since many programs may exist primarily for other purposes), as well as detailed supporting information that could improve the clarity, consistency, and usefulness of such reports to Congress. It may also be helpful for budget justifications to be more clear about both increases and decreases to activities, the stakeholders affected and their priorities, and to facilitate transparency for decision-making and bargaining about the trade-offs.

Presidents historically have categorized agencies' climate change-related efforts and funding into three broad programs: science, technology, and international assistance. In recent years, the Office of Management and Budget has also provided estimates of annual tax incentives. These broad groupings, given the limited information typically available from each agency, may not clearly express the objectives of many activities. For example, agencies may consider some programs to be directed, say, at impact assessment and management of adaptation, or at policy analysis, neither of which fits neatly into those three program categories. Hence, the traditional OMB reporting by three broad programs may not meet the needs of Congress in its oversight and appropriations functions. If the Congress were to require annual funding or expenditure reports, it may also wish to specify how to organize the information to increase its usefulness. A different organization of budgetary information might, for example, be aligned with elements of climate change legislation likely to be considered in the 111th Congress. In addition, it could be organized by its expected contributions to measurable objectives of a climate policy.

The priorities and achievements of funded climate change efforts have frequently been evaluated at the level of component activities, but not at a more integrated level—except for the Climate Change Science Program. The Climate Change Science Program (CCSP) and component elements have arranged numerous prospective and retrospective evaluations by the National Research Council, particularly the Committee on Strategic Advice on the U.S. Climate Change Science Program, and other independent bodies. A similar degree of evaluation has not been performed on the Climate Change Technology Program (CCTP), although it now constitutes more than two-thirds of all federal funding for climate change. Nor has evaluation been conducted of the international assistance effort and broader foreign policy on climate change. No entity has been charged with, or provided, an evaluation of the federal effort in its entirety. Such evaluations may be useful, however, if calls for additional resources to address climate change are to be persuasive, given many competing national priorities within a constrained federal budget.

## Recent Changes: Technology and Tax Incentives Up, Science Down

Federal funding and tax incentives for climate change activities totaled an estimated $7.73 billion for FY2008. After accounting for inflation, this suggests an increase of about 85% since FY2001. However, due to reporting issues, any comparisons over time must be viewed with caution.

Of the $4.3 billion increase (in actual dollars), $2.6 billion—more than 60%—is attributable to expansion of technology research and development; another $1.5 billion of the budgetary impact is due to enactment of new tax incentives that may stimulate greenhouse gas reductions. For scientific research, federal funding in actual dollars increased by $0.1 billion from FY2001 to the

FY2008 enacted level, though this represents a decline of 23% in funding for climate change science after accounting for inflation.

## The Federal Climate Science Effort Has Declined

The Climate Change Science Program (CCSP) is the Administration's research program established under the umbrella of the Global Change Research Act (GCRA) of 1990. Funding enacted for the CCSP was $1.86 million in FY2008. CCSP constitutes about 29% of federal funding for climate change, and about 24% of the total budgetary impact.[70] Satellite-based observing systems represent almost two-fifths of all climate science funding. The decline of funding for climate change science by 23% (adjusted for inflation) from FY2001 to the FY2008 enacted level led to less buying power to support satellite-based observations, and a proportionately greater decline for other types of observations and for research, analysis and applications.

External evaluations of the CCSP suggest that improvements would be beneficial in: overall leadership and budget coherence; metrics to measure progress; clearer reporting of programs and funding; balance among space-based observations and other research elements; and practical applications of gained knowledge.

As the Climate Change Science Program (CCSP) moves towards revision by 2010 of its strategic plan for 2013 to 2023, in compliance with a court order, the Congress may move to consider legislative options that could clarify the goals, measures of progress, organization and processes of federal climate change scientific research. Performance objectives for technology, regulatory, and assistive programs may also be set through new legislation to control greenhouse gas emissions in the 111th Congress, or through Executive Branch decisions.

## Balancing the Technology Effort

The federal investment in the Climate Change Technology Program (CCTP) has more than doubled since FY2001, from $1.68 billion to $4.30 billion enacted for FY2008. It enjoys broad support, partly due to the widespread recognition that meeting aggressive long-term targets to slow climate change would require radical technological advance in the United States and globally. Funding to support nuclear energy research and development is the largest single component among all climate change-related programs. While some stakeholders may disagree with the federal balance of funding across technology types, almost all agree on the importance of advancing low-emitting technologies. Some have pointed out the need for greater continuity of programs and incentives to be more consistent with the planning and investment cycles of businesses, while others have emphasized the importance of stimulating demand for less-emitting technologies and practices.

No rigorous and systematic evaluations of the CCTP have been performed, although at least one assessment occurred in 2006, managed by a DOE national laboratory.[71] It advised that there may

[70] The total budgetary impact includes "tax expenditures," or the estimated revenues foregone by tax incentives. Tax expenditures are not, as such, exactly comparable to funding.

[71] Brown, Marilyn, Matt Antes, Charlotte Franchuk, et al. 2006. Results of a Technical Review of the U.S. Climate Change Technology Program's R&D Portfolio. Oak Ridge National Laboratory. Sponsored by the U.S. Climate Change (continued...)

be fruitful opportunities to support exploratory and revolutionary technologies, in addition to those that would provide incremental change to existing ones. There also are likely benefits to supporting more "enabling" and "integrative" technologies. The CCTP is largely an aggregation of existing, climate-related technology programs. There are likely opportunities to improve efficiencies of federal stimulation of technological advance by reviewing them together, strategically. Moreover, because federal funds and tax incentives also support technologies that may aggravate greenhouse gas emissions (or other national goals), there also are likely efficiencies that could be gained by evaluating those identified to stimulate greenhouse gas reductions with the others—as a package—considering their cumulative effects, and considering the likely effectiveness of alternative policy instruments that could stimulate technological advance to mitigate GHG emissions.

## Solving a Global Problem Requires a Strategy for International Programs

Climate change funding includes international programs; the FY2008 enacted amount was $202 million and President Bush proposed to increase this by $2 billion over five years. These funds may help to achieve global participation in abatement of greenhouse gas emissions, and to adapt to the impacts of climate change. A major policy challenge is negotiating international commitments to address climate change after 2012, and especially gaining global engagement in GHG mitigation. Developing countries have stated that their degree of participation will depend on the degree to which the industrialized countries have fulfilled their commitments under the United Nations Framework Convention on Climate Change. These commitments include financial and technological assistance to the lower income countries and to countries that may be harmed by policies to abate GHG emissions.

The United States, as one of the wealthiest nations and the leading emitter cumulatively of GHG is considered worldwide to have extraordinary responsibility in addressing climate change. Many people consider that, though addressing climate change must be a common global effort, the United States must play a leading role among nations. From this perspective, the United States and other industrialized countries have already attained a high standard of living, and have greater financial and technological resources to address climate change than developing countries. In view of these facts, the United States committed in 1992, along with other wealthy countries under the United Nations Framework Convention on Climate Change (UNFCCC), to provide financial and technological assistance to emerging economies to mitigate greenhouse gas emissions and to adapt to climate change.

The United States has contributed about one-fifth of total funding to the Global Environmental Facility, the main financial mechanism of the treaty. However, it has made no contribution to two special funds set up to assist the least developed countries. On Sept. 30, 2008, the U.S. Treasury committed $2 billion for the Clean Technology Fund (CTF), with a first installment of $400 in grant money to be provided once appropriated by Congress. At the same meeting, up to $6.14 billion in total were pledged by Australia, France, Germany, Japan, the Netherlands, Norway, Sweden, Switzerland, the United Kingdom and the United States for the Climate Investment Funds (CIF) of the World Bank. The U.S. commitment has not been appropriated by Congress,

(...continued)

Technology Program, May. http://www.ornl.gov/sci/eere/PDFs/CCTP_Wkshp_Rpt_6-28Final.pdf.

however, due in part to concerns about whether the CTF might promote coal use and forestall GHG abatement. There are additional funds and bilateral channels, as well, for providing assistance under the UNFCCC. Moreover, many countries seek technological *cooperation* with the United States, not strictly financing. Federal programs and private partnership will establish the United States' role as leader, collaborator, or follower, depending on their future character.

The degree to which Congress appropriates funds for cooperation with, and assistance to, developing countries will arguably influence the degree to which the Department of State can enhance U.S. credibility and garner developing countries' engagement in new GHG mitigation commitments for the post-2012 period. On the other hand, providing assistance alone cannot guarantee that developing countries will consider it measurable, reportable and verifiable finance, technology and capacity-building, as called for under the Bali Action Plan of 2007. Another issue, in some countries' views, is whether financial assistance provided outside of the financial mechanisms of the UNFCCC should be regarded as fulfilling financial commitments under the Convention. Controversy is likely as well over how multilateral funds might be managed. Further issues concern whether financing will be considered "new and additional," any conditions placed on the financing, and whether the funds are "adequate" and "predictable."

## Possible Efficiencies Among Tax Provisions

Many tax provisions have been enacted that may stimulate technologies that emit less GHG than those currently common. One policy issue related to tax provisions is their continuity over periods of time that are consistent with planning and construction of large capital projects, including 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). The delay through most of 2008 in renewing expiring incentives for certain renewable energy investments, for example, may have reduced their effectiveness to help to reduce GHG emissions because of uncertainties and reduced investor confidence. In addition, tax credits may not be as effective in the current economic situation in which both profit potential is down and financing is difficult to obtain, and may have little effect on individuals or entities that do not pay enough taxes to take advantage of the tax credits. Few evaluations have been conducted of the effectiveness and efficiency of tax incentives, although controversies exist regarding whether tax incentives or other mechanisms are most efficient in achieving a policy goal (e.g., in debates over tax credits or grants for weatherization).

Existence of tax incentives for both low GHG-emitting technologies and high GHG-emitting technologies likely counteract each other, and together would mask the full cost of energy to consumers. Executive Branch reporting on climate change "expenditures" only reports tax incentives that may stimulate GHG reductions. While tax provisions support a variety of policy objectives, such as energy security and employment, data on these are not provided by OMB potentially counter-acting incentives to assist consideration of the overall effects on greenhouse gas emissions. Overall efficiencies may be gained by revising counter-acting tax provisions in the context of meeting several objectives together (and supporting "win-win"measures).

## Opportunities to Improve the Federal Climate Change Effort

The packaging of mostly existing programs into a climate change strategy has resulted in an apparent lack of a unifying mission across agencies to address climate change. Funding for climate change activities has largely reflected departmental missions and support for each activity, rather than each activity's expected contribution to an over-arching strategy. This is not surprising, given the variety of stakeholders and their priorities. The new Obama Administration is expected to provide more action-oriented leadership, but will face a challenge of understanding climate-related programs and funding, and aligning those into an effective cross-agency, inter-governmental mission.

As policy needs have evolved, there increasingly have emerged overlaps and gaps among climate-related program areas. For example, there are gaps in U.S. governance infrastructure, such as data management and accessibility, and public communications. Federal resources for economic evaluations of options and other policy analyses, are well under 1% of total funding. Many stakeholders have argued that programs to assess potential impacts of climate change and plan for adaptation are under-funded. (Although the Analytical Perspectives for the FY2009 request[72] stated that the FY2009 proposal for the CCSP would add emphasis to researching the impacts of climate change and for the science of adaptation, such added emphasis was not apparent in the documentation available in the multi-agency cross-cut nor in individual agencies' budget submissions.) At the same time, in some instances, several agencies all manage programs to address a given issue, such as sequestration of carbon by soils and vegetation, or development of greenhouse gas emissions estimates, and there may be opportunities to improve efficiencies across programs.

Finally, there may be numerous mundane but important constraints on funding that may weaken efficiency or effectiveness of climate change-related programs. Such administrative requirements or constraints can include: authorities to use contracts versus grants; whether agencies may finance entities in foreign countries; sufficiency of travel money to collaborate or oversee international activities; authorization of personal services contracts; etc. One potentially important element in the success of programs is the expertise of federal officials in these programs, and whether federal policies enhance or hinder the recruitment, development and effective use of personnel. Barriers to job mobility of federal personnel across programs and departments also likely discourage development, interaction and collaboration across agencies and disciplines. A number of sources have reported that finding funds can be problematic for interagency teams to accomplish specific "common good" tasks.

Although there have been some adjustments to address some of the issues above, a number of critics argue that there remain important weaknesses in the federal program; some have concluded that structural—potentially legislative—fixes are necessary. As a result, many proposals within and outside of the U.S. Congress to restructure and expand climate change programs may be debated in the 111th Congress. The Congress may seek ways to encourage integrated strategies across climate change programs and to minimize fragmentation of legislative measures across committee jurisdictions, given the high profile and growing accord that addressing climate change appears to have in the legislative agenda.

[72] Executive Office of the President. *Analytical Perspectives, Budget of the United States Government, Fiscal Year 2009*. U.S. Government Printing Office, 2008.

In sum, some Members of Congress and others have expressed interest in how federal funding may reflect and enable an overall strategy to address climate change. With deepening budget pressures, calls to expand funding to address climate change may face challenges in demonstrating program benefits that can compete effectively with other demands. In addition, with direction-changing pledges by the new President and an evolving Congressional debate over appropriate policies to address climate change, priorities among climate change activities will likely change. Such discussion could be served by improved reporting of funding. In addition, this review of federal funding of climate change activities suggests that there will be opportunities to better align funding with strategic policy goals, and to assure that programs are organized to accomplish those goals efficiently.

# Related CRS Reports

CRS Report RL31931, *Climate Change: Federal Laws and Policies Related to Greenhouse Gas Reductions*, by (name redacted) and (name redacted).

CRS Report RL33588, *Renewable Energy Policy: Tax Credit, Budget, and Regulatory Issues*, by (name redacted).

CRS Report RL33599, *Energy Efficiency Policy: Budget, Electricity Conservation, and Fuel Conservation Issues*, by (name redacted).

CRS Report RL33826, *Climate Change: The Kyoto Protocol, Bali "Action Plan," and International Actions*, by (name redacted) and (name redacted).

CRS Report RL33578, *Energy Tax Policy: History and Current Issues*, by (name redacted).

CRS Report RL34417, *Energy and Water Development: FY2009 Appropriations*, by (name re dacted) et al.

# Appendix A. Statutory Language Requiring Reports to Congress on Federal Climate Change Expenditures

Unlike in previous years, the Congress did not include statutory language in the FY2008 appropriations law or in the FY2009 Continuing Resolution requiring the Administration to reports to Congress on federal expenditures for climate change activities. In previous years, for about a decade, Congress had 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. 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. Congress most recently included a reporting requirement in the Foreign Operations, Export Financing, and Related Programs Appropriations Act for FY2006 (Section 585(b) of P.L. 109-102).

Previous requirements were stated in:

- Section 555(b), Division E of P.L. 108-7, the Consolidated Appropriations Resolution, FY2003;
- Division D, Title V, Section 555(b) of P.L. 108-199, the Consolidated Appropriations Act, FY2004;
- Division D, Title V, Section 576(b) of P.L. 108-447, the Consolidated Appropriations Act, 2005;
- Title V, Section 585(b) of P.L. 109-102, the Foreign Operations, Export Financing, and Related Programs Appropriations Act, 2006, as carried forward under P.L. 110-5, requires the President to transmit a report to Congress on climate change expenditures within 60 days after transmittal of the President's Budget.

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 B. Interagency Coordination of Climate Change Under President George W. Bush

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.[73] In parallel, U.S. programs to address climate change have 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 were set for selected programs, such as for greenhouse gas reductions achieved by EPA's appliance efficiency Energy Star program, and several other voluntary partnerships. Quantitative greenhouse gas, science, or technology performance targets have not been identified for most of the climate-related funding requests.

On April 16, 2008, President George W. Bush announced a new national goal for climate policy—to halt increases in U.S. emissions of GHG by 2025.[74] Emissions would begin to decline thereafter "so long as technology continues to advance."[75] According to President Bush, the United States would achieve this goal by regulatory measures and market incentives to encourage use of clean technologies. President Bush said that the United States would be willing to include this plan in a future international agreement as long as all other major emitting economies also include their plans in the agreement. Some stakeholders have criticized the new Bush policy for proposing any cap on future emissions, while others have criticized it as too little, too late.

President Bush's 2002 strategy established a new Cabinet-level Committee on Climate Change Science and Technology Integration (**Figure B-1**) to oversee the implementation of the science and technology research programs across agencies. This committee meets approximately quarterly, typically at the deputies level. The principal program design and management occurs within each agency. According to the Bush Administration, the strategy, thus, puts accountability and leadership for the science and technology programs in each of the relevant agencies. Others argue that this leads to less effective collaboration and accountability for the cross-cutting climate change goals than if there were greater central authority for the programs. 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.

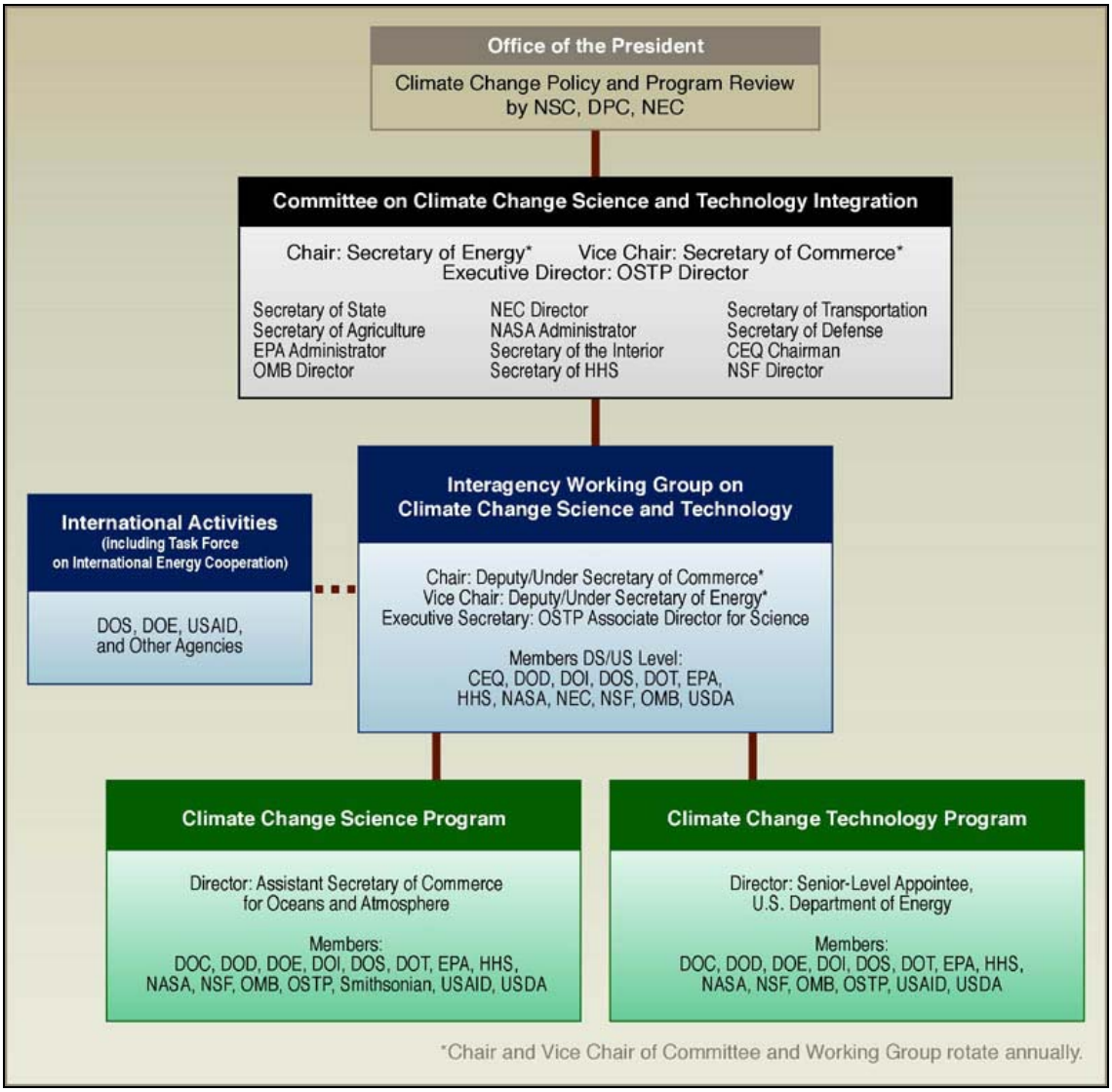
[73] The "business-as-usual" decline for this period was estimated to be about 14%.

[74] This is not the first quantitative GHG goal set for U.S. climate change policy: on April 21, 1993, President William J. Clinton "announce[d] our nation's commitment to reducing our emissions of greenhouse gases to their 1990 levels by the year 2000," consistent with the Article 4 aim of the UNFCCC. The challenge in meeting that aim with voluntary measures only led to agreement on mandatory GHG reduction obligations in the Kyoto Protocol.

[75] White House. *Fact Sheet: Taking Additional Action to Confront Climate Change. Press Release*, April 16, 2008. http://www.whitehouse.gov/news/releases/2008/04/print/20080416-7.html.

Under the Climate Change Science Program (CCSP) announced in 2002, President Bush set up a Climate Change Research Initiative (CCRI) that supplements the U.S. Global Change Research Program (US GCRP), established by Congress in 1990,[76] 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.

**Figure B-1. Coordination of Climate Change Under President George W. Bush**




**Source:** http://www.climatetechnology.gov.

[76] U.S. Global Change Research Act of 1990 (P.L. 101-606; 104 Stat.3096-3104).

# Appendix C. Historical Funding of the CCSP

**Table C-1. Budget Authority for U.S. Climate Change Science: FY1989-FY2007 Actual, FY2008 Enacted, and President Bush's FY2009 Request**

(in millions of nominal dollars, and adjusted for inflation in 2007 dollars)

| Fiscal Year | Nominal Dollars | 2007 Dollars |
|---|---|---|
| 1989 | $134 | $204 |
| 1990 | $659 | $970 |
| 1991 | $954 | $1,353 |
| 1992 | $1,110 | $1,536 |
| 1993 | $1,326 | $1,794 |
| 1994 | $1,444 | $1,912 |
| 1995 | $1,760 | $2,283 |
| 1996 | $1,654 | $2,105 |
| 1997 | $1,656 | $2,071 |
| 1998 | $1,677 | $2,072 |
| 1999 | $1,657 | $2,021 |
| 2000 | $1,687 | $2,017 |
| 2001 | $1,728 | $2,018 |
| 2002 | $1,667 | $1,910 |
| 2003 | $1,766 | $1,984 |
| 2004 | $1,975 | $2,162 |
| 2005 | $1,865 | $1,978 |
| 2006 | $1,691 | $1,736 |
| 2007 | $1,825 | $1,825 |
| 2008 Enacted | $1,864 | $1,829 |
| 2009 Request | $2,080 | $2,000 |

**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; and, from data provided by the Office of Management and Budget, April 30, 2008.

**Notes:** Amounts are as reported by the CCSP and OMB, and amounts in constant dollars have been adjusted for inflation by CRS. 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*.

Almost all climate change-related programs were funded for FY2009 through March 6, 2009 by a Continuing Resolution (P.L. 110-329) that continues funding at the FY2008 enacted levels.

# Appendix D. CCSP-Identified Programs by Agency

This appendix describes the identified climate change science activities of the agencies with almost all of the Climate Change Science Program (CCSP) funding. It provides the FY2008 enacted funding by agency, which has been extended into FY2009 by a Continuing Resolution (P.L. 110-329). This section also provides President Bush's requests for FY2009 and discussion of the proposed changes, some of which address issues which are likely to be raised again in the 111th Congress. Additional information summarizes the roles and activities of the covered agencies within the CCSP.

## National Aeronautics and Space Administration (NASA)

Funding for NASA's contributions to the CCSP were enacted for FY2008 at $1.20 billion—a 12% increase over FY2007 levels. Amid vociferous appeals to increase NASA's budget to boost satellite operations and other efforts, President Bush's FY2009 proposal would have increased NASA's CCSP funding by $125.6 million—12% more than the enacted FY2008 levels. Under the Continuing Resolution for FY2009, NASA's share of all CCSP funding remains approximately 58%.

*Space-Based Observations .* Of NASA's FY2008 funding, $666 million (62%) was for acquiring observations by satellites. Of the total $125.6 million increase proposed by President Bush over FY2008, $102.3 million would have boosted satellite-based observations, based on recommendations from the NRC Decadal Survey and in light of the decline of funding for these observations in recent years.[77] If enacted President Bush's proposal for FY2009 would have increased the satellite share to $769 million (64% of NASA's total). In order to ensure continuity of key climate-related data, the Total Solar Irradiance Sensor (TSIS) would be restored to the first satellite scheduled to fly in the National Polar-Orbiting Operational Environmental Satellite System (NPOESS). In addition, the Clouds and Earth Radiant Energy System (CERES) would be placed on the NPOESS Preparatory Project, the precursor mission for NPOESS. The data acquired by these two sensors would help to determine how much solar variability may be contributing to observed climate variability, and how clouds and other atmospheric changes may influence the Earth's energy balance and the climate. These and other technologies had been cut from NASA's budget in 2006 in response to cost-overruns and other problems.[78] Simultaneously, Earth Sciences have been low among NASA's priorities. Funds were shifted from FY2005 from programs that support climate change to other priorities, such as the Vision for Space Exploration. An NRC report in 2006, charged with examining the balance concluded:

> The program proposed for space and Earth science is not robust; it is not properly balanced to support a healthy mix of small, medium, and large missions and an underlying foundation of scientific research and advanced technology projects; and it is neither sustainable nor capable of making adequate progress toward the goals that were recommended in the National Research Council's decadal surveys.[79]

[77] National Research Council. 2007. *Earth Science and Applications from Space: National Imperatives for the Next Decade and Beyond*.

[78] Government Accountability Office. April 2007. *Polar-Orbiting Operational Environmental Satellites: Restructuring is Under Way, but Technical Challenges and Risks Remain*. GAO-07-498.

[79] National Research Council. 2006. *An Assessment of Balance in NASA's Science Programs*. Washington DC:
(continued...)

Under the FY2009 proposal, the Earth System Science Pathfinder, which includes the Orbiting Carbon Observatory (OCO) and Aquarius, would have seen its funding decrease 22%.

NASA's FY2009 five-year budget projection would provide $910 million to develop two priorities: the SMAP mission for soil moisture mapping; and a second generation ICESat mission, the latter intended to accurately measure ice topography and allow estimation of ice sheet volume changes and sea ice thickness. Formulation and early development work is proposed to proceed also for at least two additional missions by 2013, in response to the NRC Decadal Survey released in 2007. An NRC report published in 2008 provides a set of priorities for future observation systems.[80]

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 were newly included in the FY2006 request and 2007 White House report.

NASA is one of several agencies that support satellite-based climate-related observations, but is the only one that presents this funding distinctly in its CCSP budget submissions. For example, most of the proposed increase for NOAA for FY2009 is also to support the same satellite-sensor systems. The Department of Defense also contributes through its Defense Meteorological Satellite Program. USGS has additional efforts.

*Data Management, Analysis and Applied Sciences.* Within NASA's Earth Science account, Applied Sciences and Education and Outreach are supposed to provide a bridge between NASA's missions and potential users—particularly in the federal agencies—in order to ensure that societal benefits accrue from NASA investments. NASA reports that its FY2009 budget would support evaluation and assessment of potential policy-, market-, and technology-based approaches to adapting to or mitigating the impacts of climate change, as well as the impact of climate change on infectious diseases. While funds for the satellite-based observations have declined in recent years, the funding for other observations, and for research and analysis have declined faster. The NRC study that assessed balance among NASA science programs recommended, in particular, that "NASA should move immediately to correct the problems caused by reductions in the base of research and analysis programs.... "[81] Despite that 2006 recommendation, the NRC Decadal Survey that recommended enhanced space missions[82] also 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. A recent NRC study also commented that users of NASA require better access to the data, rather than new modeling or data analysis tools.[83]

(...continued)

National Academies Press.

[80] National Research Council. 2008. *Satellite Observations to Benefit Science and Society: Recommended Missions for the Next Decade*. Committee on Earth Science and Applications from Space: A Community Assessment and Strategy for the Future.

[81] National Research Council. 2006. *An Assessment of Balance in NASA's Science Programs*. Washington DC: National Academies Press.

[82] National Research Council. 2007. *Earth Science and Applications from Space: National Imperatives for the Next Decade and Beyond*. (Washington, DC: National Academies Press.)

[83] National Research Council. 2007. *Assessment of the NASA Applied Sciences Program*. National Academies Press. p. (continued...)

In the FY2009 budget justifications, however, it is neither clear whether the level of effort is proposed to change, nor how such applied research in NASA would be coordinated with program agencies' needs for their missions related to adapting to or mitigating climate change.[84]

## National Oceanic and Atmospheric Administration (NOAA)

NOAA funding constitutes about 14% of total CCSP funding. NOAA is the second largest of agencies participating in the CCSP.[85] NOAA's Assistant Secretary of Commerce for Oceans and Atmosphere directs the interagency Climate Change Science Program. NOAA has the lead among agencies on the court-ordered Capstone Synthesis and Assessment Product of the CCSP, due in 2009.

The FY2009 proposal would have increased NOAA's budget for climate change science by $20 million (8.3%) over the FY2008 enacted level of $240 million, and $76 million (41.3%) over the FY2007 budget authority of $184 million. Although the Analytical Perspectives for the FY2009 request[86] states that the FY2009 proposal for the CCSP overall adds emphasis to impacts of climate change and the science of adaptation, such added emphasis is not apparent in the FY2009 proposal for NOAA. Almost all the increases proposed are for observational capacities, not applied research, assessment or planning. The proposal would have redistributed funding within NOAA: several decreases would have partially offset an increase of $74 million to develop key satellite climate sensors. The Continuing Resolution until March 6, 2009, puts such redistributions on hold.

The FY2009 request for an increase of $74 million would have supported the Clouds and the Earth's Radiant Energy System (CERES) sensor, intended to measure the Earth's incoming and outgoing radiation, as well as the Total Solar Irradiance Sensor (TSIS) sensor, to help determine solar variations as one driver of climate variability and change. The two sensors could help distinguish the solar influence from other factors (such as greenhouse gases) driving climate variability and change. These climate sensors had been de-manifested in 2006 from the National Polar-orbiting Operational Environmental Satellite System (NPOESS) under the Nunn-McCurdy certification process (but had not been included in CCSP accounting previously). Reinstatement of the sensors is seen as key to assuring overlapping data series for calibration of measurements. The requested increase responds to the Decadal Survey[87] recommendations of the NRC in January 2007 and relates to increases also in the FY2009 request for the NASA. This is the first budget request for the CCSP in which the Administration is counting funding for these items, "to provide the most accurate picture of its climate funding to date."[88] Adding this item to what is

(...continued)

95.

[84] Freilich, Michael H. 2007. NASA *Earth Science Division Overview: Status, Contraints and Challenges*. April 11 http://oceancolor.gsfc.nasa.gov/DOCS/ScienceTeam/OCRT_Apr2007/Freilich_OCRT2007.pdf.

[85] The National Aeronautics and Space Administration (NASA) by far dominates the CCSP, receiving 58% of the Program's enacted budget authority in FY2008, mostly for space-based observation systems.

[86] Executive Office of the President. *Analytical Perspectives, Budget of the United States Government, Fiscal Year 2009*. U.S. Government Printing Office, 2008. [www.budget.gov/budget].

[87] National Research Council. *Earth Science and Applications from Space: National Imperatives for the Next Decade and Beyond*. Washington DC: National Academies Press, 2007. http://books.nap.edu/catalog.php?record_id=11820.

[88] Office of Management and Budget (OMB), footnote 4 in the table of funding for the Climate Change Science Program, as provided to CRS on March 28, 2008.

identified as CCSP would raise NOAA's CCSP FY2007 actual budget authority and FY2008 enacted authority by $7 million each, and the FY2009 request by $81 million, compared to previous Administration accounting of the CCSP.

Offsetting the satellite increase, one proposed reduction would have cut Congressionally directed funding of $5.4 million, eliminating the Regional Climate Centers. A second proposed reduction would have cut $19.1 million from the enacted FY2008 level for "Archive, Access, and Assessment."

NOAA's FY2009 budget justification stated the following objectives:

- development of an integrated earth system analysis capability;
- creating a high quality record of the state of the atmosphere and ocean since 1979 (+$74 million to develop the CERES and TSIS radiation sensors);
- development of an end-to-end hydrologic projection and application capability;
- enhanced carbon cycle research on high latitude systems;
- quantification of climate forcing and feedbacks by aerosols, non-carbon dioxide greenhouse gases, water vapor, and clouds;
- assessment of abrupt change in a warming climate (+$1.0 million, for a total of $5 million, for research on "Atlantic Meridional Overturning Circulation" A-MOC, and -$0.4 million for other abrupt climate change research);
- examination of the feasibility of development an abrupt change early warning system; and
- ecological forecasting (+$0.6 million to$2.1 million in the FY2009 request).

Associating most of these objectives with specific funding proposals was not possible with the information available.

The FY2009 proposal would increase funding in the Climate Data and Information line item by $8.3 million, restoring the request for FY2008 that was not enacted. It would also provide an increase of $2 million for the National Integrated Drought Information System (NIDIS), to develop and bring into operation the next-generation Climate Forecast System.

The FY2009 proposal would increase funding for Water Vapor Process Research by $880 thousand, to improve currently weak but critical understanding of the amount of water vapor in the atmosphere and its distribution. Of this, about two-thirds would be used to initiate work on LIDAR, sondes, satellite and other sensors. The remainder would use the observations to improve computer models by 2013 for analyses of greenhouse gas, aerosol and cloud effects on climate.

In addition, creation of a National Climate Service within NOAA, parallel to but distinguished from the National Weather Service, has been advocated by some people for a number of years. (Currently, there exists a Climate Services Division within the National Weather Service.) The proposed Climate Information Services would aim at improving provision of routine seasonal to multi-annual forecasts and data products, as well as expanded drought information. The proponents would expect benefits for prediction of and responses to drought, hurricanes, fires, floods, and weather extremes. The definition of "climate" in the context of the proposed National Climate Service seems to be seasonal to multi-annual, encompassing such phenomena as El Nino;

it does not appear to aim at the multi-annual to inter-decadal or longer horizon generally embodied in the debate over human-induced climate change. ("Climate" is often defined by long-term averages, such as the "normals" that constitute 30-year averages; the proposed National Climate Service seems aimed at variability on much shorter time frames.)

## National Institute of Standards and Technology (NIST)

The FY2009 proposal for the Department of Commerce's contribution to the CCSP included NIST activities for the first time as a distinct line item. The request would have increased the NIST contribution to the CCSP from $0.2 million enacted in FY2007 and FY2008 by $5.0 million to $5.2 million in FY2009. According to *Our Changing Planet*, these funds would be used for:

> Resolving discrepancies in satellite measurements of radiation, including solar irradiance, reflected solar radiation, outgoing longwave radiation, and surface radiation; and
>
> Providing critical information about aerosols and atmospheric components believed to play a major role in global climate change.[89]

## National Science Foundation (NSF)

With enacted budget authority for FY2008 of just over $205 million, National Science Foundation funding constitutes about 11% of the U.S. Climate Change Science Program (CCSP), and the third largest of agencies participating in the CCSP.[90] Still, NSF funding was only 3% of total federal funding for climate change in FY2008. President Bush's budget proposed to increase NSF's funding by $16 million to $220.6 million (8%) in FY2009.

While funding for most components of NSF's climate change program was proposed for FY2009 to remain flat or decline slightly, two components had been slated for significant increases:

- **Geosciences**: proposed increase of $7.0 million (4.4%—or a little more than inflation); and
- **Office of Polar Programs**: proposed increase of $7.8 million (74.3%).

NSF's climate change science programs invest in "fundamental discovery," research infrastructure, and educational activities. High priorities are stated as including data acquisition, information management, model enhancement, development of new Earth observing instruments and platforms, and new research methods. NSF also has a program for research on "the general processes used by organizations to identify and evaluate policies for mitigation, adaptation, and other responses to varying environmental conditions," according to its FY2009 budget justification. In addition, NSF proposed to initiate a program related to climate change impacts on water, "Dynamics of Water Processes in the Environment."

[89] http://www.usgcrp.gov/usgcrp/Library/ocp2009/ocp2009-doc.html.

[90] The National Aeronautics and Space Administration (NASA) by far dominates the CCSP, with almost 60% of enacted budget authority in FY2008, mostly for space-based observation systems.

## Department of Energy (DOE)

DOE's funding for the CCSP was enacted at $128.3 million for FY2008, and was proposed to increase by $17.6 million in FY2009 to $145.9 million.[91] The largest component of DOE's contribution to the CCSP supports research on "climate forcing," which was proposed in FY2009 to increase by $3.2 million to $81.2 million. Of this, $52.6 (same as FY2008) would support continued Atmospheric Radiation Measurement (ARM), to reduce the largest scientific uncertainty[92] in climate change prediction—the roles of clouds and aerosols and their interactions with solar radiation. Some $14.8 would have funded research while another $37.8 million would have supported the ARM infrastructure—the Climate Research Facility (ACRF): three stationary facilities, a mobile facility and aerial vehicles. The proposed $2.6 million increase over FY2008 levels would have supported an additional mobile facility for deployment in 2010. $13.0 million (+0.4 million) in FY2009 would have funded research on atmospheric aerosols and their effects on the Earth's energy balance. Another $13.6 million would have continued support for Ameriflux, to measure exchanges of carbon dioxide, energy and water between the atmosphere and major terrestrial ecosystems in North America. AmeriFlux is funded also by NASA, NOAA, USGS, the Forest Service and the Agricultural Research Service. About $1.9 million supports the Carbon Dioxide Information and Analysis Center (CDIAC), one of several repositories of data on greenhouse gas emissions, atmospheric concentrations, and related data.

In DOE's Office of Science, $45.4 million was proposed for climate change modeling in FY2009, an increase of $14.1 million of FY2008 enacted levels, and $20.0 million over FY2007 levels. About $7.8 million would have supported work towards a first-generation Earth System model (to include natural, but not human, components). Some $2.6 million would have explored past and potential future abrupt climate change.

The Climate Change Response program would have received $19.4 million under President Bush's request, with $13.2 million for experimental studies of the possible effects of warming, precipitation changes and $CO_2$ increases on terrestrial ecosystems.

In FY2009, research on carbon capture and sequestration (CCS) was proposed to increase to a total in the Office of Biological Research of $17.4 million, up $0.5 million from the FY2008 enacted level. Of the total, $12.3 million (73%) would have supported biological sequestration (e.g., absorption of carbon dioxide from the atmosphere by trees and other vegetation), while the remaining $4.7 million would have supported soil sequestration of carbon associated with switchgrass systems, for ethanol production from cellulose.

## United States Geological Survey (USGS)

The USGS restructured its climate change science research in 2007, and the FY2009 budget was the first under the new organization. The FY2009 request would have provided $31.4 million for

[91] In 2008, both the House and Senate appropriations committees approved bills for DOE's FY2009 funding; those were superceded, however, by the Continuing Resolution that will hold FY2009 funding at the FY2008 level to March 2009. Information regarding items approved by the House and the Senate committees are described in CRS Report RL34417, *Energy and Water Development: FY2009 Appropriations*, by (name redacted) et al.

[92] There are other uncertainties in climate prediction that are currently at least as large as the "scientific" uncertainties; the principal other uncertainty regards future human-related greenhouse gas emissions. Less than $9 million is spent on related research and analysis, across several agencies, according to CRS's estimates (**Figure 4**).

CCSP-related work in FY2009, with $26.6 million consolidated across disciplines into one Global Change activity account. Additionally, in the Geographic and Biologic Divisions, $3.7 million would have supported the National Satellite Land Remote Sensing Data Archive (NSLRSDA), and $1.1 million in the Biological Research and Monitoring activity, would also have contributed to the CCSP.

USGS is embarking on a new climate change science strategy, the National Climate Effects Research and Monitoring Network. The network would include long-term monitoring in "focus areas" of key processes controlling resource or ecosystem responses to climate change; a network of field study sites to assess the sensitivity to climate change of specific resources and ecosystems; regional and national surveys to link the "focus areas" to the broader landscapes; and expanded use of space-based remote sensing to track environmental changes. Eventually, and pending future appropriations, information in an envisioned Global Change Information Management System would be accessible to users through the internet.

USGS also proposed to expand initial adaptation-oriented projects to develop decision tools to help resource managers and policy makers to cope with future climate change.

The FY2009 request would have eliminated $2.5 million of Congressionally directed funding to develop methods to assess capacities for geologic carbon sequestration, as well as to research hazards, carbon management and water availability.

## Bureau of Reclamation

Although the Bureau of Reclamation is not listed explicitly in the CCSP, it reports climate change-related activities. However, other budget information suggests that its funding level (for impact assessment and adaptation) would be greater than many other agencies' identified in the CCSP. In FY2009, the Bureau's budget justification said, "[a]s a part of the Water for America initiative, Reclamation is examining how climate change information can be considered in our water and power operations and planning through several project-specific studies. Additionally, through collaborative research with other Federal agencies and non-Federal entities that have complementary expertise and a common stake in Western water, Reclamation is well positioned to obtain the most relevant climate information and manage our water resources under changing conditions."[93]

According to the Bureau's budget justification, the funding requested for its climate change activities was $31.9 million, of which $19.0 million appeared in the Water for America Initiative line item. Another $12.9 million would fund specific projects for endangered species recovery activities ($8.9 million) and investigation programs ($4.0 million). Reclamation's efforts focus on two of the Initiative's three strategies: Plan for Our Nation's Water Future; and Expand, Protect, and Conserve Our Nation's Water Resources. The third strategy, to Enhance Our Nation's Water Knowledge, will be undertaken by USGS. As part of the Plan for Our Nation's Water Future component of the Initiative, Reclamation will merge the existing investigation programs with a new basin-wide studies program, thus initiating comprehensive water supply and demand studies to assess the impact of increased water demands on finite water sources.[94]

[93] http://www.usbr.gov/newsroom/newsrelease/detail.cfm?RecordID=20461.

[94] http://www.usbr.gov/budget/index.html.

## U.S. Department of Health and Human Services (HHS)

All of the $46.8 million enacted for HHS for climate change science is associated with health effects of ultra-violet radiation due to stratospheric ozone depletion. This is not, strictly speaking, climate change, although the two environmental issues are related. Although no climate-related budget is identified for the Centers for Disease Control (CDC), the CDC is engaged in work on climate change impacts on emerging and re-emerging infectious diseases, allergens, and preparedness. With the FY2008 appropriations, H.Rept. 110-231 contained the following language pertaining to climate change:

> Additional scientific research is needed to further understand the potential health effects of global climate change and to identify tools to educate health professionals about adaptation strategies. The Committee encourages CDC to begin to develop public health research, technical assistance, and surveillance programs to understand the impacts of climate change on health. (p. 116)

In responding to this language, the CDC identified 11 priority health actions and developed a policy statement. The agency reports that five workshops were planned to explore these issues further.

In October 2008, the World Health Organization (WHO) released an agenda of research priorities to address the health effects of climate change globally. The main research priorities were:

- Interactions with other health determinants and trends, such as economic development, globalization, urbanization, and inequities both in exposure to health risks and access to care.
- Better characterization of long-term climate change effects through drought, freshwater resources, and population displacement, including risks to mental health, with a focus on children and other vulnerable groups.
- Comparing effectiveness of short-term interventions dealing with such health threats as heatwaves and floods.
- Assessing health impact of policies of non-health sectors including effects of biofuels incentives on food security and malnutrition.
- Strengthening public health systems to address health effects of climate change.

## Environmental Protection Agency (EPA)

EPA's contribution to the CCSP is research on air and water quality effects of climate change, and related risks to human health and ecosystems. The FY2009 proposal would have reduced funding for this research by $2.8 million from the FY2008 appropriations of $19.6 million. The FY2008 level was below the FY2007 funding of $17.0 million. The agency's Science Advisory Board, in a May 12, 2008 memorandum to Administrator Johnson, reported that the EPA's research on impacts of climate change "performs well considering its declining funding and relatively small, though focused and important role, in the overall Federal program." It also described the "dramatic reductions" since FY2004 of EPA's budget for research on climate change impacts as "eating the seed corn":

> As a consequence we run a considerable risk that we will not be able to address these problems adequately in the future. We also run the risk of incurring much larger future costs because we do not understand the subtle intricacies of these risks and hence could blunder into difficulties, such as inappropriate regulatory responses, from which it may be much more expensive to recover than if we understood what we were facing ahead of time.[95]

Although the EPA does not currently conduct research under the CCSP on GHG mitigation (though the Office of Air and Radiation conducts policy analysis with funds reported under the CCTP), the SAB recommended that EPA adopt some long-term GHG reduction objectives "to inform and to better define their research portfolio" (p. 8). The recommendation reflects the tension in and among many agencies regarding what climate-related research and analysis should be conducted, and by whom (i.e., the research office versus the program office).

## U.S. Department of Agriculture (USDA)

For FY2008, funding was enacted at a level of $64.4 million for climate change science. The FY2009 request forUSDA would have reduced this amount to $60.3 million—a decrease of $4.1 million. Of that overall decrease from FY2008 enacted to FY2009, most—$3.7 million—would have come from the across-the-board cuts to various climate change programs in the Agricultural Research Service (ARS), resulting in a FY2009 request of $35.7 million. Most ARS research is conducted intramurally. ARS carbon cycle activities ($3.1 million requested for FY2009) include the Greenhouse gas Reduction through Agricultural Carbon Enhancement NETwork (GRACEnet) and Agriflux network to understand soil carbon sequestration, minimize greenhouse gas emissions, on range, pasture and crop land sites. Almost $18 million of the ARS funding request under the CCSP concerns emissions, particularly of methyl bromide, which is a substance that depletes stratospheric ozone but is not a greenhouse gas. Another $10.7 million of the FY2009 request would study the impacts of climate change on rangelands and other agricultural ecosystems through drought, warming, snowpack disappearance, and altered fire regimes.

The Forest Services research related to climate change would be reduced by $2.2 million to $18.9 million in FY2009. The Economic Research Service's climate change-related research would remain the same, at $50 thousand.

In contrast, funding for the Cooperative State Research, Education, and Extension Service (CSREES) would have increased by $1.7 million to $5.7 million in FY2009.[96] CSREES provided grants for research on land use, land cover, and managed ecosystems in terms of responses, feedbacks, and drivers of carbon and greenhouse gas fluxes. Its stated long-term goal was to better understand land change through predictive modeling.[97] The research to understand how ultraviolet radiation affects plant and animal physiology and ecosystems would have increased by

[95] EPA Science Advisory Board. 2008. "Comments on EPA's Research Budget for Fiscal Year 2009: A Report of the Environmental Protection Agency (EPA) Science Advisory Board (SAB)" Memorandum to Administrator Stephen L. Johnson. EPA-SAB-08-008. May 12. http://yosemite.epa.gov/sab/sabproduct.nsf/C657C9653FE5398D85257448004E92F5/$File/EPA-SAB-08-008-unsigned.pdf.

[96] The 2008 farm bill (Food, Conservation, and Energy Act of 2008, P.L. 110-246) reorganizes the administration of USDA's research, extension, and economic agencies to coordinate the mission area's intramural and extramural activities across the Department. CSREES, which currently is responsible for managing extramural research, will be eliminated as an agency and will become the National Institute of Food and Agriculture (NIFA).

[97] http://www.carboncyclescience.gov/partners.php#USDA.

$0.8 million and on carbon cycle would have increased by $1.1 million. The FY2009 request proposed $0.5 million for the National Research Initiative (NRI), though the program was not reauthorized in the 2008 farm bill (the Food, Conservation, and Energy Act of 2008, P.L. 110-246).

# Appendix E. CCTP-Identified Programs by Agency

This appendix provides additional information about the climate change technology programs in several of the most important participating agencies. FY2008 funding levels are reported, and are extended through March 6, 2009 for FY2009 levels by a Continuing Resolution (P.L. 110-329). This appendix also provides President Bush's FY2009 request for the Climate Change Technology Program (CCTP), as the FY2009 budget justifications provided the most recent descriptions of on-going programs and priorities, approved by OMB. It remains to be seen how President Obama may re-propose similar modifications.

## Department of Energy (DOE)

The DOE is, by far, the largest component of President Bush's CCTP, at 85% of the FY2008 enacted total. The FY2009 request included numerous changes to funding that Congress enacted for FY2008 to support DOE's climate change technology programs. Some of these proposed changes include:

- a $155 million (11%) reduction for energy efficiency and renewable energy, largely because of proposed elimination of low-income weatherization grants, small business innovation research support, and state energy activities, as well as reductions for hydrogen fuel cell research; increases are proposed for geothermal systems, biofuels, and vehicle, building and industrial technologies;
- a $5 million (5%) reduction for energy supply and conservation for electricity transmission and distribution;
- a $251 million (51%) increase for Fossil Energy Research and Development/Efficiency and Sequestration, including a 52% increase carbon sequestration (+$52 million) and almost a tripling of the funding for FutureGen (to $156 million);
- a $365 million (71%) 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.

Both the House and Senate passed bills in 2008 covering most of the CCTP appropriations, and agreed on a conference bill. The amounts in these bills, which never were enacted into law, frequently deviated substantially from the FY2008 levels and the FY2009 request.[98] In particular, both chambers rejected elimination of the DOE weatherization grants. The Continuing Resolution that holds funding for almost all other programs to the FY2008 levels includes special provisions to add $250 million for weatherization (Division A of P.L. 110-329).

From FY2003 to FY2004, the total budget authority for DOE 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.

[98] For more information on House and Senate actions on FY2009 appropriations for climate-related energy programs, see CRS Report RL34417, *Energy and Water Development: FY2009 Appropriations*, by (name redacted) et al.

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. Funding for nuclear energy has increased by hundreds of millions of dollars in several different programs, and it has become a large share of CCTP funding. However, less was enacted for nuclear than requested for FY2008; the FY2009 request would increase that funding almost to the level requested for FY2008, and would make nuclear energy more than half of the NCCTI funding, if enacted.

According to DOE's FY2009 budget justification, the nuclear energy R&D program is intended "to develop new nuclear energy generation technologies to meet energy and climate goals." However, opponents have criticized DOE's nuclear research program as providing wasteful subsidies to an industry that they believe should be phased out as unacceptably hazardous and economically uncompetitive. The Bush Administration's Global Nuclear Energy Partnership (GNEP) has been intended to develop technologies for recycling uranium and plutonium from spent nuclear fuel without creating pure plutonium that could be readily used for nuclear weapons. According to DOE's budget justification, such technologies could allow greater expansion of nuclear power throughout the world "with reduced risk of nuclear weapons proliferation. "But nuclear opponents have disputed DOE's contention that nuclear recycling technology can be made sufficiently proliferation-resistant for widespread use. In 2008, the House Appropriations Committee sharply criticized GNEP as "rushed, poorly-defined, expansive, and expensive," and eliminated all funding for the program. On the other hand, the House panel would have dramatically boosted funding for advanced nuclear reactors. However, FY2008 funding levels continue under the Continuing Resolution until March 6, 2009. President Obama has indicated that he would support "safely harness nuclear energy" as a component of a strategy to address climate change. It is likely that further scrutiny and modifications of nuclear energy initiatives will continue in the 111th Congress and under the Obama Administration.

## US Department of Agriculture (USDA)

USDA's contributions to the CCTP are a mix of both mandatory and discretionary funding, with shares of 74% and 26%, respectively, estimated for FY2008 prior to passage of the 2008 Farm Bill. The enacted FY2008 funding levels[99] were estimated at about $205 million, up from $48 million in FY2007. The mandatory share was estimated to rise from $14 million in FY2007 to $151 million in FY2008 under President Bush's proposals for the FY2008 Farm Bill. Although discretionary funding would extend into early FY2009 at FY2008 levels under the Continuing Resolution, the mandatory levels will have been altered by the new Farm Bill.

President Bush's FY2009 budget foresaw a $22 million decrease in CCTP funding of the USDA, primarily from the renewable energy program under the Cooperative State Research, Education and Extension Service (CSREES).[100] However, compared to the 424% increase from FY2007 to FY2008 for USDA's CCTP programs, from $48.4 million to $20.4 million, the proposed decrease would have been small. The increases from FY2007 to FY2008 were primarily due to increases in mandatory funding of farm programs of:

[99] Including both discretionary and mandatory funding.

[100] The 2008 farm bill (Food, Conservation, and Energy Act of 2008, P.L. 110-246) reorganizes the administration of USDA's research, extension, and economic agencies to coordinate the mission area's intramural and extramural activities across the Department. CSREES, which currently is responsible for managing extramural research, will be eliminated as an agency and will become the National Institute of Food and Agriculture (NIFA).

- $50.0 million for bioenergy and biobased products research;
- $15.0 million for forest wood to energy;
- $50.0 million for renewable energy system and energy efficiency grants; and
- $21.0 million for renewable energy system and energy efficiency loans.

These grants and loans had been included in the Administration's formal recommendations for the 2007-2008 farm bill debate.[101] Another one-third would be for increases in discretionary spending on formula funds for bioenergy research (+$5.0 million), renewable energy (+$13.0 million), and value-added producer grants (+$2.0 million).

The 2008 farm bill (the Food, Conservation, and Energy Act of 2008, P.L. 110-246) reauthorized, modified and/or expanded several existing programs, and created several new programs, in the enacted bill's Conservation, Energy, and Rural Development titles. While few of these programs directly are geared toward climate change mitigation, these USDA programs likely will indirectly affect various U.S. climate change initiatives. Whether and the extent to which these programs will affect overall funding levels for programs related to climate change is uncertain; also, no accounting of these CCTP changes is yet available for FY2008 or FY2009.

## Department of Defense (DOD)

Funding for DOD reported for the CCTP rose from $100.9 million in FY2007 to $109.6 million enacted for FY2008. President Bush's budget proposal would have increased that funding by an additional $21.4 million in FY2008, to $131.0 million, though with increases and decreases across the different services. DOD appropriations for FY2009 were passed into law and signed on September 30, 2008 (P.L. 110-329). Because the climate change-related activities are below the appropriations account detail, it is unclear at this time what changes may have been made to the FY2008 enacted or FY2009 requested levels.

The Administration requested to raise Air Force funding for the CCTP by $81.7 million from FY2008 to a total of $103 million FY2009. It would decrease CCTP-related funding to the Army by $41.9 million from the FY2008 enacted level to $16.4 million in FY2009, and to the Navy by $16.2 million to $11.1 million in FY2009. No further information was obtainable regarding the uses of these proposed funds. However, the DOD would have many incentives and opportunities to engage in advanced, low-greenhouse gas technologies: in 2005, the DOD accounted for 97% of all U.S. Government fuel consumption, at a federal expense of more than $8 billion (at 2005 energy prices).[102] More than half of this consumption was by the Air Force.

More broadly, the Defense Science Board (DSB) issued a report in February 2008 that concluded that the DOD's current energy consumption patterns put military operations at risk both in the battlefield, due to high and expensive fuel demand, and at installations, due to dependence on an increasingly fragile electricity grid. It noted that, even in battlespace, one half or more of demand may come from equipment such as air conditioners and field kitchens, not combat equipment. It

[101] Title-by-Title details of USDA's Farm Bill recommendations are available at http://www.usda.gov/wps/portal/usdafarmbill?navtype=SU&navid=FARM_BILL_FORUMS.

[102] Ron Sega. 2006. "Air Force Energy Strategy." Powerpoint presentation given April 19, 2006.

also noted that DOD had not implemented two key recommendations from a 2001 task force on energy. Institutionally:

> The Task Force concluded that solving DoD's energy problem would take more than producing documents establishing the new policies, procedures and analytical products recommended by this report. It depends on leadership's willingness to provide the oversight to ensure they are effective. Currently, decisions that affect DoD's energy demand are scattered throughout the organization with little accountability or oversight. While there is a senior official with responsibility for energy use at installations, this function oversees only about a quarter of DoD's energy usage. The Task Force recommends senior leadership establish oversight and accountability for implementing the recommendations in this report, and ongoing measurement of their progress across the whole of DoD.

This 2008 report recommended, among other measures, that DOD "establish a Department-wide strategic plan that establishes measurable goals, achieves the business process changes recommended by the 2001 DSB report and establishes clear responsibility and accountability" (Executive Summary, p. 6).

Decisions and technologies to enhance DOD's energy security could have profound implications for its related greenhouse gas decisions. One vision, of relying on alternative fuels produced from oil shale and other unconventional fossil fuels has been controversial, however, because of its potential for dramatically increasing net greenhouse gas emissions associated with aviation fuels. This dispute culminated in a constraint in the Energy Independence and Security Act of 2007 (P.L. 110-140) barring all agencies from procuring alternative fuels that resulted in higher greenhouse gas emissions than conventional fossil fuels—most critical for the DoD, which accounts for almost all federal oil consumption. Similar language was debated in the FY2009 appropriations for DOD but was not enacted. The DSB, after considering the climate change implications for DOD, concluded:

> The global movement toward constraints on future carbon emissions is gaining support. DoD cannot be oblivious to this trend. Thus, the Task Force recommends that if DoD decides to provide financial backing to synthetic fuel production plants, it should avoid investing in processes that exceed the carbon footprint of petroleum. The Task Force recommends DoD continue to invest in low carbon synthetic fuel technologies that address unique, pressing DoD needs. For example, equipment capable of producing fuel at forward deployed locations using locally available renewable or waste feedstock reduces gallon for gallon the amount needed to be moved and protected in theater. DoD should continue to invest in research into alternative, non-petroleum, renewable and low-carbon footprint fuels for the long term. (p. 22)

The DOD's Defense Advanced Research Projects Agency (DARPA) has been acclaimed by some experts for its contributions to technological advance broadly. Some technology experts have advocated for an expansion of this program to take on a mission of advancing energy technologies to enable deep cuts from current greenhouse gas emission levels, like a new "Apollo" project. The Congress appropriated funds of $6.3 million to initiate such an expansion, DARPA-E, in FY2007. The Administration proposed to eliminate this funding in DOD for FY2009, saying that such research could be accomplished through similar programs in DOE.

In 2008, the 110th Congress amended Section 118 of title 10, United States Code, the Department of Defense (DOD) authorization to require DOD to consider the effects of climate change on Department facilities, capabilities, and missions (P.L. 110-181). The law requires that the next national security strategy and national defense strategy include guidance for military planners to

assess the risks of climate change to current and future defense missions; to update defense plans accordingly, and to engage with allies and partners on climate mitigation strategies, capacity building, and relevant research and development; and to develop the capabilities to reduce future impacts.

The new authorization also requires that the next quadrennial defense review assess DOD's capacities to respond to the consequences of climate change, including extreme weather events, both domestically and abroad. It directs such assessment to use mid-range scenarios of future climate change (which may have roughly a 50-50 likelihood of occurring).

The subsequent section of the law requires the Secretary of Defense to submit a plan to Congress to improve DOD's participation in interagency coordination on a national security strategy. Presumably, such interagency coordination would extend also to the work on responding to, and mitigating, future impacts of climate change.

## Environmental Protection Agency (EPA)

EPA's share of the CCTP funding was proposed to continue to decline from 3.0% in FY2007, 2.5% in FY2008 to 2.2% in FY2009. The FY2007 new budget authority was $105 million, rising by $3 million in the FY2008 enacted level of $108 million, then requested to drop to $98 million in FY2009. Under the Continuing Resolution, funding will continue at FY2008 levels through March 6, 2009. EPA's role has been primarily in inventorying and evaluating greenhouse gas emissions from alternative sectors and technologies, and operating voluntary programs that provide information, technical assistance and marketing incentives to private and public entities to quantify and reduce their greenhouse gas emissions.[103] EPA also provides key scenarios of future greenhouse gas emissions and analyses of the economic impacts of mitigation strategies—including proposed legislation—that are widely used by Congress and the public. President Bush's proposal would have reduced EPA's funding for the Energy Star building-related programs by $4.0 million from the FY2008 omnibus appropriations; Energy Star is one of the principal voluntary GHG reduction initiatives and garners a large portion of the GHG reductions expected by President Bush's climate change strategy. The budget would cut $1.3 million by eliminating the congressionally-directed Industrial Carbon outreach program.

The agency evaluates options to reduce greenhouse gas emissions from vehicles, including effects of biofuel mandates that have been legislated or proposed. The FY2009 request would have reduced these transportation activities by $6.9 million to $11.9 million.

President Bush's proposal would also have eliminated congressionally-directed funding for a greenhouse gas reporting registry, enacted at $3.4 million in the FY2008 omnibus appropriations. The joint explanatory statement for the FY2008 omnibus appropriations directed EPA to use $3.5 million (before an across-the-board 1.6% recision) appropriated within the Federal Support Air Quality Management program "to develop and publish a rule requiring mandatory reporting of emissions above appropriate thresholds in all sectors of the economy." The draft and final rules are due no later than nine and 18 months, respectively, after enactment. President Bush's FY2009 proposal would not have continued the $3.4 million appropriated for FY2008 to develop this national Greenhouse Gas Registry, causing angry responses from some Senators.

[103] For more information see [www.epa.gov/energystar.html].

Consistent GHG reporting is essential to the efficient and equitable functioning of any program to limit emissions, and provisions for early reporting may facilitate rewarding those sources that show leadership in GHG reductions ahead of possible mandatory controls. A number of initiatives are underway besides the current EPA effort that would develop guidance for how sources would report their greenhouse gas emissions and emission reductions in the event of mandatory reporting requirements. No initiative prior to EPA's effort, including DOE's "402(a)" program has gained widespread agreement as sufficient for a mandatory requirement. EPA's FY2009 budget justification likely refers to the existence of these other initiatives when it states that "EPA is reviewing available data to maximize efficiency and reduce potential overlaps while exploring options for integration."

The FY2009 request proposed to add $5.0 million to support the Asia-Pacific Partnership (see section on International Assistance)—a request that has been repeatedly denied in previous years' appropriations. Without FY2008 enacted funding, none is available under the Continue Resolution through March 9, 2009.

As in other agencies, the appropriations line items for the EPA no longer reflect current organization and activity levels of the climate-technology related initiatives. While this may occur to assist continuity of reporting, the next Administration's proposals may include significant changes in activity levels and descriptions.

## National Aeronautics and Space Administration (NASA)

NASA's share of CCTP funding was proposed to decline from 3.2% to 2.6%, or from $139.0 million as enacted for FY2008 to the proposed $116.1 million for FY2009. The largest portion of NASA's CCTP funding is for the Fundamental Aeronautics Program, aimed at developing high performance aircraft and rotorcraft that would significantly reduce emissions of GHG, water vapor, volatile organic compounds, unburned hydrocarbons, and particulate matter. The FY2009 request would have eliminated a congressionally directed increase in FY2008, reducing the level by $19.5 million to $100.5 million.

The 2009 defense reauthorization law (P.L. 110-422) was enacted with a provision, Sec. 302, requiring NASA to support research and development of environmentally friendly aircraft. This provision is intended to "enable", specifically, "[s]ignificant reductions in greenhouse gas emissions compared to aircraft in commercial services as of the date of enactment."

President Bush's request would have reduced Exploration Technology Development Program projects to advance lithium-ion batteries, regenerative fuel cells, and nuclear fission from the FY2008 enacted level of $17.4 to $14.0 in FY2009. Proposed to remain constant would be $1.6 million for measuring surface radiation to support solar heating, as well as other assessment of renewable energy production and efficiency.

# Appendix F. Climate Change Technology Priorities, as Identified by the Bush Administration

Early in President George W. Bush Administration, a set of general technologies were designated as "high priority" within the CCTP. These have continued to be tracked as such by the CCTP, and the evolution of funding in recent years for these is provided in the table below. It is unclear what status these have in funding or other decisions.

**Table F-1. Budget Authority for National Climate Chagne 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 Estimate | FY2008 Enacted | FY2009 Request | Explanation Provided by the NCCTI Strategic Plan |
|---|---|---|---|---|---|---|---|
| Hydrogen Storage | DOE | $22 | $26 | $34 | $42 | $58 | Addresses key challenge to advancing a hydrogen-based transportation system, which could dramatically reduce GHG emissions. Need major technological breakthrough 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 | $3 | Currently, wind power is only cost competitive in high-wind speed areas, which are relatively sparse and not near major load centers. Reducing the cost of wind power in low wind speed areas could 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 | $29 | $24 | $19 | Has the potential to double efficiency of conventional lighting. Deployment could reduce the need to grow base load electricity generation capacity, which largely uses coal and gas. |
| Cellulosic Biomass (Biochemical Platform R&D) | DOE | $11 | $14 | $33 | $39 | $32 | Focuses on converting complex cellulosic carbohydrates of biomass into simple sugars. Ultimately, can lead to use of "waste" biomass to produce power, chemicals, and fuel, such as ethanol. Displaces fossil fuel products and has the potential to be nearly "carbon neutral" by cyclically capturing and releasing carbon to the atmosphere. |
| Transportation Fuel Cell Systems | DOE | $8 | $1 | $8 | $8 | $6 | This activity works to incorporate fuel cells into vehicles - directly displacing the burning of fossil fuels in vehicles. |
| Sequestration | DOE | $44 | $65 | $97 | $119 | $149 | The continued use of fossil fuels to generate affordable electricity is important to maintain a diversified fuel mix to ensure adequate energy supplies at a reasonable price. A successful carbon sequestration research and development effort will allow the continued use of economical fossil fuels while limiting GHG emissions. |
| Integrated Gasification Combined Cycle (IGCC) | DOE | $45 | $56 | $56 | $54 | $69 | The IGCC program conducts research that fosters the development and deployment of technologies to significantly enhance the thermal efficiency of converting coal and other carbon-based feedstocks to electricity, providing the potential for over 50% reduction in $CO_2$ compared to today's technologies. |
| Nuclear Hydrogen Initiative | DOE | $9 | $24 | $19 | $10 | $17 | The program aims to develop technologies that will apply heat available from advanced nuclear energy systems to produce hydrogen at a cost competitive with other alternative transportation fuels. Although only one |

| Activity | Agency | FY2005 Actual | FY2006 Actual | FY2007 Estimate | FY2008 Enacted | FY2009 Request | Explanation Provided by the NCCTI Strategic Plan |
|---|---|---|---|---|---|---|---|
| | | | | | | | of many hydrogen production methods, nuclear energy provides an emissions-free way to produce large amounts of hydrogen. |
| Advanced Fuel Cycle/Advanced Burner Reactor | DOE | $0 | $78 | $166 | $179 | $302 | The Advanced Burner Reactor (ABR) is a critical component within a multifaceted program for recycling spent nuclear fuel; it is where the fabricating fuel assemblies that contain long-lived actinides and other transuranics removed from the treated spent fuel are to be burned. With ABR technology in operation, the only waste to be placed in the repository is of a more benign content consisting only of the remaining radioisotopes and process wastes. One repository would be able to accommodate the waste from many more reactor-years of operation—a content that would fill as many as 21 repositories taking all that spent fuel directly. |
| Methane Partnership Initiatives | EPA | $9 | $10 | $13 | $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 President Bush's GHG intensity goal. |
| Climate Leaders[a] | EPA | $2 | $2 | $2 | $2 | $2 | Climate Leaders is a flagship voluntary industry-government partnership to develop long-term comprehensive climate strategies and set GHG emission reduction goals. |
| Climate Change Technology Program (CCTP) Support | DOE | [b] | $0 | $1 | $1 | $2 | The U.S. Climate Change Technology Program (CCTP) is the multi-agency planning and coordination activity, led by DOE, that will carry out President Bush's climate change technology initiative and implement the requirements of the Energy Policy Act of 2005 (Title XVI, Climate Change). It supports the larger CCTP portfolio. |
| **All Priority Activities[b]** | | **$173** | **$299** | **$468** | **$496** | **$671** | |

**Source:** *Climate Change Technology Program Strategic Plan*, Appendix B, pp. 221-223, available at http://www.climatetechnology.gov/stratplan/final/index.htm, and OMB, *Federal Climate Change Expenditures Report to Congress*, May 2007, Table 5, p. 16; For the FY2009 request, estimates are from data provided to CRS by CCTP staff.

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 funding data in this table were provided by the CCTP directly to CRS.

b. In FY2005, $1.5 million was enacted for CCTP within DOE's Cellulosic Biomass, and Transportation Fuel Cells Programs.

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