

Appendix A

Federal Research, Development, Demonstration, and Deployment Investment Portfolio for Fiscal Years 2005 and 2006, with Budget Request Information for Fiscal Year 2007, U.S. Climate Change Technology Program

In order for the U.S. Climate Change Technology Program (CCTP) to carry out its mission, it is necessary to assess on a periodic and continuing basis the adequacy of Federal investments in the CCTP-relevant research portfolio and make recommendations. A first step in this regard is to establish and maintain a current inventory, or baseline, of all the Federal research, development, demonstration and deployment (R&D) activities among the participating agencies relevant to the vision, mission, and goals of the CCTP. This baseline, and subsequent years of data, can be used to identify and track trends and other changes in the portfolio. It also serves as an index or guide to relevant Federal R&D investments and programs.

In 2003, the CCTP, Office of Management and Budget (OMB) and other agencies agreed on a set of classification criteria to identify R&D activities that would be included as part of the CCTP. These criteria are provided on page A-2.

The baseline information for the Federal R&D budget shown in this Appendix are for Budget Authority as Enacted for Fiscal Years 2005 and 2006, and for the Administration's Budget Request for Fiscal Year 2007. For each year, respectively, the participating Federal agencies submitted budget data for R&D activities that meet the CCTP/OMB criteria. Table A-1 is a summary table for all participating agencies. This process is updated annually. Current versions of Table A-1 may be found at the CCTP Web site.¹

This baseline activity and resulting portfolio contribute to and are consistent with the Congressional requirement that the President report annually on Federal climate change expenditures. The multi-agency R&D baseline for CCTP constitutes the technology component of OMB's Federal Climate Change Expenditures Report to Congress.²

A.1

Climate Change Technology Program Classification Criteria

Research, development, and deployment activities³ classified as part of the Climate Change Technology Program (CCTP) must be activities funded via discretionary accounts that are relevant to providing opportunities for:

- ◆ Current and future reductions in or avoidances of emissions of greenhouse gases (GHGs),⁴
- ◆ Greenhouse gas capture and/or long-term storage, including biological uptake and storage;
- ◆ Conversion of GHGs to beneficial use in ways that avoid emissions to the atmosphere;
- ◆ Monitoring and/or measurement of GHG emissions, inventories and fluxes in a variety of settings;
- ◆ Technologies that improve or displace other GHG emitting technologies, such that the result would be reduced GHG emissions compared to technologies they displace;
- ◆ Technologies that could enable or facilitate the development, deployment and use of other GHG-emissions reduction technologies;
- ◆ Technologies that alter, substitute for, or otherwise replace processes, materials, and/or feedstocks, resulting in lower net emission of GHGs;
- ◆ Technologies that mitigate the effects of climate change, enhance adaptation or resilience to climate change impacts, or potentially counterbalance the likelihood of human-induced climate change;

¹ See <http://www.climatechange.gov>.

² Fiscal Year 2007 "Federal Climate Change Expenditures Report to Congress," April 2006. This report is an account of Federal spending for climate change programs and activities, both domestic and international. The report is provided annually to Congress.

³ In this context, "research, development, demonstration, and deployment activities" is defined as: applied research; technology development and demonstration, including prototypes, scale-ups, and full-scale plants; technical activities in support of research objectives, including instrumentation, observation and monitoring equipment and systems; research and other activities undertaken in support of technology deployment, including research on codes and standards, safety, regulation, and on understanding factors affecting commercialization and deployment; supporting basic research addressing technical barriers to progress; activities associated with program direction; and related activities such as voluntary partnerships, technical assistance/capacity building, and technology demonstration programs that directly reduce greenhouse gas emissions in the near- and long-term.

⁴ GHGs are gases in the Earth's atmosphere that vary in concentration and may contribute to long-term climate change. The most important GHG that arises from human activities is carbon dioxide (CO₂), resulting mainly from the oxidation of carbon-containing fuels, materials or feedstocks; cement manufacture; or other chemical or industrial processes. Other GHGs include methane from landfills, mining, agricultural production, and natural gas systems; nitrous oxide (N₂O) from industrial and agricultural activities; fluorine-containing halogenated substances (e.g., HFCs, PFCs); sulfur hexafluoride (SF₆); and other GHGs from industrial sources. Gases falling under the purview of the Montreal Protocol are excluded from this definition of GHGs.

- ◆ Basic research activities undertaken explicitly to address a technical barrier to progress of one of the above climate change technologies; and
- ◆ GHG emission reductions resulting from clear improvements in management practices or purchasing decisions.

A.2

Climate Change Technology Program Classification Example Activities

Specific examples of climate change technology activities include, but are not limited to:

- ◆ Electricity production technologies and associated fuel cycles with significantly reduced, little, or no net GHG emissions;
- ◆ High-quality fuels or other high-energy density and transportable carriers of energy with significantly reduced, little, or no net GHG emissions;
- ◆ Feedstocks, resources or material inputs to economic activities, which may be produced through processes or complete resource cycles with significantly reduced, little or no net GHG emissions;
- ◆ Improved processes and infrastructure for using GHG-free fuels, power, materials, and feedstocks;
- ◆ CO₂ capture, permanent storage (sometimes referred to as sequestration), and biological uptake;

- ◆ Technologies that reduce, control or eliminate emissions of non-CO₂ GHGs;
- ◆ Advances in sciences of remote sensing and other monitoring, measurement and verification technologies, including data systems and inference methods;
- ◆ Technologies that substantially reduce GHG-intensity, and therefore limit GHG emissions;
- ◆ Voluntary government/industry programs designed to directly reduce GHG emissions; and
- ◆ Programs that result in energy efficiency improvements through grants or direct technical assistance.

Note: Programs and activities presented for consideration can include Congressionally mandated "earmarks," but earmarked activities must be relevant to one or more of the CCTP criteria, and descriptions and funding levels must be clearly called out as such in the information provided. Programs and activities funded by mandatory authorizations should not be included.

A.3

CCTP Participating Agencies, Budgets and Requests

In the following budget table, data are provided on CCTP-related activities, per the criteria above, for Fiscal Years 2005 and 2006, and for the President's Budget Request for Fiscal Year 2007, across all CCTP participating agencies. In each FY, budget data includes activities for CCTP-related research, development and demonstration (R&D).

Table A-1 CCTP Participating Agency – FY 2005 to FY 2007 Budgets and Requests
Categorization of RDD&D Funding To Climate Change Technology
(Funding, \$ Millions) ^{5,6}

DEPARTMENT AND ACCOUNT(S)	FY 2005 ENACTED	FY 2006 ENACTED	FY 2007 REQUEST
Department of Agriculture			
Natural Resources Conservation Service (NRCS) – Biomass R&D (Section 9008 Farm Bill)	13.0	12.0	12.0
– NRCS Carbon Cycle	0.5	0.5	0.5
Forest Service R&D – inventories of carbon biomass	0.0	0.5	0.5
Agricultural Research Service – Bioenergy Research	2.4	2.4	2.4
Cooperative State Research, Education and Extension Service (CRSEES) – Biofuels/Biomass Research; formula funds, National Research Initiative	4.7	4.7	3.4
Forest Service – Biofuels/Biomass, Forest and Rangeland Research	2.4	2.4	2.8
Rural Business Service – Renewable Energy Program and Value Added Producer Grants	24.8	25.3	12.7
Subtotal – USDA	48.2	47.8	34.2
Department of Commerce - ITA			
International Trade Administration (ITA) - Asia Pacific Partnership	0.0	0.0	2.0
Subtotal – DOC/ITA	0.0	0.0	2.0
Department of Commerce - NIST			
National Institute of Standards and Technology (NIST) Scientific and Technological Research and Services	7.7	7.2	7.2
Industrial Technical Services – Advanced Technology Program	18.1	10.3	0.0
Subtotal – DOC/NIST	25.8	17.4	7.2
Department of Defense			
Army	27.0	36.5	5.5
Navy	18.1	23.4	6.9
Air Force	1.0	0.0	0.0
Defense Advanced Research Projects Agency (DARPA)	11.0	7.1	3.0
R&D, Office of Secretary of Defense	2.0	3.6	0.0
Subtotal – DOD	59.1	70.6	15.4
Department of Energy			
Energy Efficiency and Renewable Energy (EERE)	1,234.3	1,174.0	1,176.3
Fossil Energy	373.8	404.5	419.1
Nuclear Energy	291.4	332.5	463.3
Science	385.5	422.6	551.4
Electricity Delivery and Energy Reliability	57.4	73.0	100.3
Climate Change Technology Program ⁷	0.0	0.0	1.0
Subtotal – DOE	2,342.4	2,406.5	2,711.4

⁵ This table is consistent with the Fiscal Year 2007 “Federal Climate Change Expenditures Report to Congress” prepared by the Office of Management and Budget (OMB), <http://www.whitehouse.gov/omb/>, and published in April 2006. Minor differences, if any, are due to arithmetic corrections after the OMB report was finalized and due to differences in rounding.

⁶ All agency data are current, as of April 2006. Totals may not add due to rounding.

⁷ In Fiscal Year 2005, \$1.5M was enacted for CCTP Program Direction within DOE’s EERE Program Direction account.

DEPARTMENT AND ACCOUNT(S)	FY 2005 ENACTED	FY 2006 ENACTED	FY 2007 REQUEST
Department of Interior			
US Geological Survey – Surveys, Investigations and Research - Geology Discipline, Energy Program	2.4	0.0	0.0
Subtotal – DOI	2.4	0.0	0.0
Department of Transportation			
Office of the Secretary for Technology – Transportation, Policy, R&D	0.8	0.0	0.0
National Highway Traffic Safety Admin	0.0	0.9	0.9
Research and Innovative Technology Admin	0.5	0.5	0.5
Subtotal – DOT	1.3	1.4	1.4
Environmental Protection Agency			
Environmental Programs and Management	90.5	90.0	91.9
Science and Technology	19.0	18.6	12.5
Subtotal – EPA	109.5	108.6	104.4
National Aeronautics and Space Administration⁸			
Exploration, Science & Aeronautics	207.8	104.4	85.8
Subtotal – NASA	207.8	104.4	85.8
National Science Foundation			
Research and Related Activities	10.6	17.7	18.6
Subtotal – NSF	10.6	17.7	18.6
Total for CCTP	2,807.1	2,774.4	2,980.4

ACTIVITIES ASSOCIATED WITH CCTP⁹**USAID Activities Associated with CCTP**

Energy Technology Development	80.1	92.0	57.3
Carbon Capture and Sequestration Measures	87.3	80.3	71.7
Subtotal – USAID	167.5	172.2	129.0

Department of State Activities Associated with CCTP

Asia Pacific Partnership	0.0	0.0	30.0
Methane to Markets	0.8	6.0	6.0
Subtotal - STATE	0.8	6.0	36.0

Total CCTP and Associated Activities	2,975.3	2,952.6	3,145.4
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⁸ For Fiscal Year 2006 and Fiscal Year 2007, NASA is realigning its Aeronautics Research and is no longer pursuing previously reported activities in certain vehicle systems areas.

⁹ STATE and USAID activities are not included in the totals for CCTP, as they are associated expenditures promoting deployment and adoption of climate change technologies abroad. They are shown here for completeness to the extent that such activities are consistent with the criteria for inclusion in CCTP.

Appendix B

National Climate Change Technology Initiative Priorities Investment Portfolio for Fiscal Years 2005 and 2006, with Budget Request Information for Fiscal Year 2007, U.S. Climate Change Technology Program

CCTP continues to prioritize its multi-agency portfolio of Federally funded climate change technology R&D, consistent with the goals and objectives of the President's National Climate Change Technology Initiative (NCCTI). NCCTI priorities are defined as discrete research, development, demonstration, or deployment activities that address technological challenges, which, if solved, could advance technologies with the potential to dramatically reduce, avoid, or sequester greenhouse gas emissions. Activities are identified from within the larger CCTP portfolio as shown on Table B-1, are for Budget Authority as Enacted for Fiscal Years 2005 and 2006, and for the Administration's Budget Request for Fiscal Year 2007 by agency.

**Table B-1 National Climate Change Technology Initiative Priorities
FY 2005 to FY 2007 Budgets and Requests
(Funding, \$ Millions)¹**

AGENCY/ PROGRAM/ ACTIVITY	FY 2005 ACTUAL BUDGET AUTHORITY	FY 2006 ENACTED BUDGET AUTHORITY	FY 2007 PROPOSED BUDGET AUTHORITY	NCCTI PRIORITY ACTIVITIES DESCRIPTION
Department of Energy				
Energy Efficiency and Renewable Energy				
Hydrogen Storage	22.4	26.6	34.6	Addresses key challenge to advancing a hydrogen-based transportation system, which could substitute for oil and dramatically reduce GHG emissions. A major technological breakthrough is needed to be able to store enough hydrogen on board a fuel cell vehicle to provide a driving range comparable to today's vehicles.
Low Wind Speed Technology	9.9	5.0	19.1	Currently, wind power is only cost competitive in areas of high-wind speeds, which are relatively sparse and not near major load centers. Improving technologies to make wind power competitive in low-wind speed areas could expand this GHG-free power producer and displace (or reduce future need for) coal- and gas-fired electricity generation. Includes R&D on deepwater off-shore systems.
Solid State Lighting	13.8	19.3	19.3	Such lighting has the potential to double the efficiency of conventional lighting. Deployment could reduce GHG emissions and slow the growth of future base load electricity generation capacity, which will largely use coal.

¹ This table is consistent with the FY 2007 "Federal Climate Change Expenditures Report to Congress" prepared by the Office of Management and Budget <http://www.whitehouse.gov/omb/> and published in April 2006. Minor differences are due to rounding.

AGENCY/ PROGRAM/ ACTIVITY	FY 2005 ACTUAL BUDGET AUTHORITY	FY 2006 ENACTED BUDGET AUTHORITY	FY 2007 PROPOSED BUDGET AUTHORITY	NCCTI PRIORITY ACTIVITIES DESCRIPTION
Department of Energy				
Energy Efficiency and Renewable Energy				
Cellulosic Biomass (Biochemical Platform R&D)	11.1	10.4	32.8	The research focuses on converting complex cellulosic carbohydrates of biomass into simple sugars. Ultimately, this could lead to use of “waste” biomass to produce power, chemicals, and fuel, such as ethanol. Cellulosic biofuels can displace fossil fuel products and have the potential to be nearly “carbon neutral” by cyclically capturing and releasing carbon dioxide, the main GHG, to the atmosphere.
Transportation Fuel Cell Systems	7.5	1.1	7.5	This activity works to incorporate fuel cells into vehicles—converting hydrogen into electricity and water vapor—directly displacing the burning of fossil fuels in vehicles.
EERE Sub-total	64.7	62.4	113.3	
Nuclear Energy				
Nuclear Hydrogen Initiative	8.7	24.8	18.7	This program aims to develop technologies that will apply heat available from advanced nuclear energy systems, in combination with power production, to produce hydrogen at a cost that is competitive with other alternative transportation fuels. Although it is but one of many hydrogen production methods, nuclear energy provides an emissions-free way to produce large amounts of hydrogen.
Advanced Fuel Cycle/Advanced Burner Reactor	0.0	5.0	25.0	Advances in nuclear fuel recycling can make nuclear power, which emits no GHG emissions, more attractive. The Advanced Burner Reactor (ABR) is a component of a multifaceted research program aimed at recycling spent nuclear fuel; reducing waste; promoting non-proliferation; and enabling the expansion of nuclear power—a GHG-free energy source. With ABR technology, the only waste to be placed in a repository is of a less challenging content, absent long-lived radioactive isotopes and other transuranics. One Yucca Mountain size repository would be able to accommodate the waste from many reactor-years of operation—a content that would fill as many as 21 equal repositories taking all that spent fuel directly.
NE Sub-total	8.7	29.8	43.7	

AGENCY/ PROGRAM/ ACTIVITY	FY 2005 ACTUAL BUDGET AUTHORITY	FY 2006 ENACTED BUDGET AUTHORITY	FY 2007 PROPOSED BUDGET AUTHORITY	NCCTI PRIORITY ACTIVITIES DESCRIPTION
Department of Energy				
Fossil Energy				
Sequestration	44.3	66.3	78.2	The continued use of fossil fuels, particularly coal, to generate electricity may be important to maintain both a diversified fuel mix and ensure adequate energy supplies at a reasonable price. A successful carbon sequestration research and development effort could allow the continued use of economical fossil fuels, while also limiting GHG emissions to the atmosphere.
Integrated Gasification Combined Cycle (IGCC)	44.6	55.9	55.6	Instead of burning coal, IGCC technology gasifies coal in such a way so as to enable the more efficient conversion of coal and other carbon-based feedstocks into electricity and other useful products, providing the potential for over 50 percent reduction in CO ₂ emissions, compared to today's more conventional combustion technologies. It also facilitates capture and sequestration processes.
FE Subtotal	89.0	122.2	133.8	
Climate Change Technology Program Direction	– ²	0.0	1.0	The CCTP is the multi-agency planning and coordination activity, led by DOE, that carries out the President's climate change technology initiative and implements relevant climate change provisions of the Energy Policy Act of 2005. CCTP provides strategic direction, planning, analysis and multi-agency coordination for the participating Federal R&D agencies.
Total – DOE	162.4	214.4	291.8	
Environmental Protection Agency				
Methane Partnership Initiatives	9.0	10.0	13.0	Includes EPA's domestic partnership programs with industry, as well as the international Methane to Markets Partnership. These programs encourage development and deployment of technologies to reduce methane emissions and make a substantial contribution to achievement of the President's GHG-intensity reduction goal.
Climate Leaders	2.0	2.0	2.0	Climate Leaders is a set of flagship voluntary industry-government partnerships that encourage private entities to develop and implement long-term, comprehensive climate strategies, and set GHG emission reduction goals.
Total – EPA	11.0	12.0	15.0	
TOTAL – NCCTI³	173.4	226.4	306.8	

² In FY 2005, \$1.5M was enacted for CCTP Program Direction within DOE's EERE Program Direction account.

³ Totals may not add due to rounding. All Agency data are as of April 2006.

