DOE/ME-0048
Volume 3

Department of Energy FY 2006 Congressional Budget Request

Energy Supply

Energy Efficiency and Renewable Energy

Electric Transmission and Distribution

Nuclear Energy

Environment, Safety & Health

Legacy Management

February 2005

Office of Management, Budget and Evaluation/CFO

Volume 3

DOE/ME-0048
Volume 3

Department of Energy FY 2006 Congressional Budget Request

Energy Supply

Energy Efficiency and Renewable Energy

Electric Transmission and Distribution

Nuclear Energy

Environment, Safety & Health

Legacy Management

February 2005

Office of Management, Budget and Evaluation/CFO

Volume 3

Energy Supply

Energy Efficiency
and Renewable Energy

Electric Transmission and Distribution

Nuclear Energy

Environment, Safety and Health

Legacy Management

Energy Supply

Energy Efficiency and Renewable Energy

Electric Transmission and Distribution

Nuclear Energy

Environment, Safety and Health

Legacy Management

Volume 3

Table of Contents

The Department of Energy's FY 2005 Congressional Budget justification is available on the Office of Management, Budget and Evaluation/CFO homepage at http://www.mbe.doe.gov/budget/

Department of Energy
Appropriation Account Summary
(dollars in thousands - OMB Scoring)

	FY 2004 Comparable Approp	FY 2005 Comparable Approp	FY 2006 Request to Congress	FY 2006 vs. FY 2005	
Energy And Water Development					
Energy Programs					
Energy supply	794,897	932,319	902,674	-29,645	-3.2%
Non-Defense site acceleration completion	167,272	157,316	172,400	15,084	+9.6%
Uranium enrichment D&D fund	414,027	495,015	591,498	96,483	+19.5%
Non-Defense environmental services	307,795	288,966	177,534	-111,432	-38.6%
Science	3,536,373	3,599,546	3,462,718	-136,828	-3.8%
Nuclear waste disposal	188,879	343,232	300,000	-43,232	-12.6%
Departmental administration	109,276	119,284	130,259	10,975	+9.2%
Inspector general	39,229	41,176	43,000	1,824	+4.4%
Total, Energy Programs	5,557,748	5,976,854	5,780,083	-196,771	-3.3%
Atomic Energy Defense Activities					
National nuclear security administration:					
Weapons activities	6,447,159	6,583,350	6,630,133	46,783	+0.7%
Defense nuclear nonproliferation	1,367,709	1,422,103	1,637,239	215,136	+15.1%
Naval reactors	761,872	801,437	786,000	-15,437	-1.9%
Office of the administrator	352,949	357,051	343,869	-13,182	-3.7%
Total, National nuclear security administration	8,929,689	9,163,941	9,397,241	233,300	+2.5%
Environmental and other defense activities:					
Defense site acceleration completion	5,433,423	5,725,935	5,183,713	-542,222	-9.5%
Defense environmental services	895,015	845,704	831,331	-14,373	-1.7%
Other defense activities	675,824	672,590	635,998	-36,592	-5.4%
Defense nuclear waste disposal	387,699	229,152	351,447	122,295	+53.4%
Total, Environmental & other defense activities	7,391,961	7,473,381	7,002,489	-470,892	-6.3%
Total, Atomic Energy Defense Activities	16,321,650	16,637,322	16,399,730	-237,592	-1.4%
Defense EM privatization (rescission)	-15,329	—	—	—	—
Power marketing administrations:					
Southeastern power administration	5,070	5,158	—	-5,158	-100.0%
Southwestern power administration	28,431	29,117	3,166	-25,951	-89.1%
Western area power administration	176,873	171,715	53,957	-117,758	-68.6%
Falcon & Amistad operating & maintenance fund	2,625	2,804	—	-2,804	-100.0%
Total, Power marketing administrations	212,999	208,794	57,123	-151,671	-72.6%
Federal energy regulatory commission	—	—	—	—	—
Subtotal, Energy And Water Development Appropriation	22,077,068	22,822,970	22,236,936	-586,034	-2.6%
Uranium enrichment D&D fund discretionary payments	-449,333	-459,296	-451,000	8,296	+1.8%
Excess fees and recoveries, FERC	-19,000	-15,000	-13,000	2,000	+13.3%
Colorado River Basins	1,458	-23,000	-23,000	—	—
Total, Energy And Water Development	**21,610,193**	**22,325,674**	**21,749,936**	**-575,738**	**-2.6%**

Department of Energy
Appropriation Account Summary
(dollars in thousands - OMB Scoring)

	FY 2004 Comparable Approp	FY 2005 Comparable Approp	FY 2006 Request to Congress	FY 2006 vs. FY 2005	
Interior And Related Agencies					
Fossil energy research and development	658,981	571,854	491,456	-80,398	-14.1%
Naval petroleum and oil shale reserves	17,995	17,750	18,500	750	+4.2%
Elk Hills school lands fund	36,000	36,000	84,000	48,000	+133.3%
Energy conservation	867,967	868,234	846,772	-21,462	-2.5%
Economic regulation	1,034	——	——	——	——
Strategic petroleum reserve	170,948	169,710	166,000	-3,710	-2.2%
Northeast home heating oil reserve	4,939	4,930	——	-4,930	-100.0%
Energy information administration	81,100	83,819	85,926	2,107	+2.5%
Subtotal, Interior Accounts	1,838,964	1,752,297	1,692,654	-59,643	-3.4%
Clean coal technology	-98,000	-160,000	——	160,000	+100.0%
Total, Interior And Related Agencies	**1,740,964**	**1,592,297**	**1,692,654**	**100,357**	**+6.3%**
Total, Discretionary Funding	**23,351,157**	**23,917,971**	**23,442,590**	**-475,381**	**-2.0%**

Energy Supply

Energy Supply

Energy Supply

Appropriation Language

For Department of Energy expenses including the purchase, construction, and acquisition of plant and capital equipment, and other expenses necessary for energy supply activities in carrying out the purposes of the Department of Energy Organization Act (42 U.S.C. 7101 et seq.), including the acquisition or condemnation of any real property or any facility or for plant or facility acquisition, construction, or expansion, **[**and the purchase of not to exceed 9 passenger motor vehicles for replacement only, and one ambulance,**]** **[**$946,272,000**]** *$902,674,000,* to remain available until expended. *(Energy and Water Development Appropriations Act, 2005.)*

Explanation of Change

Changes reflect revisions to funding amounts and fiscal year references.

Energy Efficiency and Renewable Energy

Energy Efficiency and Renewable Energy

Table of Contents

Energy Supply
Office of Energy Efficiency and Renewable Energy

Overview

Appropriation Summary by Program[a]

(dollars in thousands)

	FY 2004 Comparable Appropriation	FY 2005 Original Appropriation	FY 2005 Adjustments	FY 2005 Comparable Appropriation	FY 2006 Request
Energy Supply					
Hydrogen Technology	80,412	95,325	-1,319[b]	94,006	99,094
Solar Energy	80,731	86,533	-1,459[c]	85,074	83,953
Wind Energy	39,803	41,600	-796[d]	40,804	44,249
Hydropower	4,673	5,000	-138[e]	4,862	500
Geothermal Technology	24,625	25,800	-530[f]	25,270	23,299
Biomass and Biorefinery Systems R&D	84,608	82,147	-1,301[g]	80,846	50,359
Intergovernmental Activities	14,673	17,000	-224[h]	16,776	11,910
Departmental Energy Management Program	1,963	1,967	-16[i]	1,951	2,019
Renewable Program Support	8,493	3,000	+2,954[j]	5,954	2,901

[a] For Energy Supply, SBIR/STTR funding in the amount of $5,199,000 was transferred to the Science Appropriation in FY 2004. Estimates for SBIR/STTR budgeted in FY 2005 and FY 2006 are $5,871,000 and $6,704,000 respectively. For Energy Conservation, SBIR/STTR funding in the amount of $10,017,000 was transferred to the Science Appropriation in FY 2004. Estimates for SBIR/STTR budgeted in FY 2005 and FY 2006 are $9,290,000 and $9,014,000 respectively.

[b] Reflects the 0.80% rescission of -$753,000 and comparability adjustment for Cross-Cutting Planning, Analysis and Evaluation -$566,000.

[c] Reflects the 0.80% rescission of -$685,000 and comparability adjustment for Cross-cutting Planning, Analysis and Evaluation of -$774,000.

[d] Reflects the 0.80% rescission of -$329,000 and comparability adjustment for Cross-Cutting Planning, Analysis and Evaluation -$467,000.

[e] Reflects the 0.80% rescission of -$40,000 and comparability adjustment for Cross-Cutting Planning, Analysis and Evaluation of -$98,000.

[f] Reflects the 0.80% rescission of -$203,000 and comparability adjustment for Cross-Cutting Planning, Analysis and Evaluation of -$327,000.

[g] Reflects the 0.80% rescission of -$646,000 and comparability adjustment for Cross-Cutting Planning, Analysis and Evaluation of -$655,000.

[h] Reflects the 0.80% rescission of -$134,000 and comparability adjustment for Cross-Cutting Planning, Analysis and Evaluation of -$90,000.

[i] Reflects the 0.80% rescission of -$16,000.

[j] Reflects the 0.80% rescission of -$23,000 and comparability adjustment for Cross-Cutting Planning, Analysis and Evaluation of +$2,977,000.

(dollars in thousands)

	FY 2004 Comparable Appropriation	FY 2005 Original Appropriation	FY 2005 Adjustments	FY 2005 Comparable Appropriation	FY 2006 Request
Facilities and Infrastructure	12,950	11,480	-91[a]	11,389	16,315
Program Direction	16,490	19,211	-147[b]	19,064	19,043
Subtotal, Energy Supply	369,421	389,063	-3,067	385,996	353,642
Use of prior year balances	-17,126	-5,648	0	-5,648	0
Total, Energy Supply	352,295	383,415	-3,067	380,348	353,642
Energy Conservation					
Vehicle Technologies	172,395	169,256	-3,847[c]	165,409	165,943
Fuel Cell Technologies	63,782	76,000	-1,056[d]	74,944	83,600
Weatherization and Intergovernmental Activities	307,932	82,617	+226,388[e]	309,005	298,157
Distributed Energy Resources	59,684	61,480	-1,064[f]	60,416	56,629
Building Technologies	57,799	68,084	-2,620[g]	65,464	57,966
Industrial Technologies	90,450	76,411	-1,610[h]	74,801	56,489
Biomass and Biorefinery Systems R&D	6,966	7,680	-427[i]	7,253	21,805
Federal Energy Management Program	19,420	18,400	-469[j]	17,931	17,147

[a] Reflects the 0.80% rescission of -$91,000.
[b] Reflects the 0.80% rescission of -$147,000.
[c] Reflects the 0.594% and 0.80% rescissions of -$1,005,000 and -$1,346,000 respectively and comparability adjustment for National Energy Technology Laboratory Support of -$1,496,000.
[d] Reflects the 0.594% and 0.80% rescissions of -$452,000 and -$604,000 respectively.
[e] Reflects the 0.594% and 0.80% rescissions of -$491,000, -$657,000 respectively, comparability adjustment for National Energy Technology Laboratory Support of -$624,000, and $230,000,000 reduced by 0.80% (-1,840,000) for the Weatherization Assistance Program.
[f] Reflects the 0.594% and 0.80% rescissions of -$365,000 and -$489,000 respectively and comparability adjustment for National Energy Technology Laboratory Support of -$210,000.
[g] Reflects the 0.594% and 0.80% rescissions of -$404,000 and -$542,000 respectively and comparability adjustment for National Energy Technology Laboratory Support of -$1,674,000.
[h] Reflects the 0.594% and 0.80% rescissions of -$454,000 and -$608,000 respectively and comparability adjustment for National Energy Technology Laboratory Support of -$548,000.
[i] Reflects the 0.594% and 0.80% rescissions of -$46,000 and -$61,000 respectively and comparability adjustment for National Energy Technology Laboratory Support of -$320,000.
[j] Reflects the 0.594% and 0.80% rescissions of -$109,000 and -$146,000 respectively and comparability adjustment for National Energy Technology Laboratory Support of -$214,000.

(dollars in thousands)

	FY 2004 Comparable Appropriation	FY 2005 Original Appropriation	FY 2005 Adjustments	FY 2005 Comparable Appropriation	FY 2006 Request
Program Management	92,362	89,164	+3,847[a]	93,011	89,036
Subtotal, Energy Conservation	870,790	649,092	+219,142	868,234	846,772
Use of prior year balances	-2,823	0	0	0	0
Total, Energy Conservation	867,967	649,092	+219,142	868,234	846,772
Division J – Other Matters, Weatherization Assistance Program	0	230,000	-230,000[b]	0	0
Total, Energy Supply and Energy Conservation	1,220,262	1,262,507	-13,925	1,248,582	1,200,414

Preface

Renewable sources of energy can enhance the Nation's energy security and economic growth by harnessing abundant, naturally occurring, domestic sources of energy that expand our energy resource base and have less impact on the environment than conventional sources. The balanced research, development, demonstration and deployment program supported by the Department of Energy's (DOE) Office of Energy Efficiency and Renewable Energy (EERE) within the Energy Supply appropriation is at the forefront of that effort - developing renewable energy technologies and processes with the energy use and partnering community to enable use in homes, schools, businesses, factories and vehicles.

The President's Hydrogen Fuel Initiative will work through partnerships with industry to develop the technologies and infrastructure needed to produce, store, and distribute hydrogen, and to use it in stationary, portable, and vehicular applications. Key elements of the Initiative are supported by the Hydrogen Technology Program in this budget and the Fuel Cell Technologies Program within the Interior appropriation, where it also has significant interdependence with the FreedomCar Program.

EERE is comprised of 12 main programs:

Hydrogen, Fuel Cells and Infrastructure Technologies; Solar Energy; Wind Energy; Hydropower Technologies; Geothermal Technology; Biomass and Biorefinery Systems R&D; Weatherization and Intergovernmental Activities; the Federal Energy Management Program; Vehicle Technologies; Distributed Energy Resources; Building Technologies; and Industrial Technologies. In addition, EERE funds Facilities and Infrastructure and Program Direction/Management.

Within the Energy Supply appropriation, EERE has eight programs: Hydrogen Technology (five subprograms), Solar Energy, (three subprograms), Wind Energy, (two subprograms), Hydropower Technologies (two subprograms), Geothermal Technology (two subprograms), Biomass and Biorefinery Systems R&D (two subprograms), Intergovernmental Activities (two subprograms), and the Departmental Energy Management Program. EERE is also funded by the Interior and Related Agencies appropriation, which is discussed in a separate budget. Four EERE programs have complementary

---

[a] Reflects the 0.594% and 0.80% rescissions of -$530,000 and -$709,000 respectively and comparability adjustment for National Energy Technology Laboratory Support of +$5,086,000.

[b] Reflects the apportionment of the Weatherization Assistance Program within the Energy Conservation appropriation.

funding in both appropriations: Biomass and Biorefinery Systems R&D; the Federal Energy Management Program (includes the Departmental Energy Management Program); Hydrogen, Fuel Cells and Infrastructure Technologies; and Weatherization and Intergovernmental Activities.

This summary document is organized to present the reader with an understanding of the multi-year strategic planning used by EERE to develop this fiscal year budget request. The budget format is responsive to the key themes of the President's Management Agenda, integrating performance and budget so that the public can readily see the "plan and results" nature of its investment in renewable energy.

This Overview will describe Strategic Context, Mission, Benefits, Strategic Goals, and Funding by General Goal. These items together put the appropriation request in perspective. The Annual Performance Results and Targets, Means and Strategies, and Validation and Verification sections address how the goals will be achieved and how performance will be measured. Finally, this Overview will address R&D Investment Criteria, Program Assessment Rating Tool (PART), and Significant Program Shifts.

Strategic Context

Following publication of the Administration's National Energy Policy, the Department developed a Strategic Plan that defines its mission, four strategic goals for accomplishing that mission, and seven general goals to support the strategic goals. Each appropriation has developed quantifiable goals to support the general goals. Thus, the "goal cascade" is the following:

Department Mission → Strategic Goal (25 yrs) → General Goal (10-15 yrs) → Program Goal (GPRA Unit) (10-15 yrs)

To provide a concrete link between budget, performance, and reporting, the Department developed a "GPRA[a] Unit" concept. Within DOE, a GPRA Unit defines a major activity or group of activities that support the core mission and aligns resources with specific goals. Each GPRA Unit has completed or will complete Program Assessment Rating Tool (PART). A unique program goal was developed for each GPRA unit. A numbering scheme has been established for tracking performance and reporting.[b]

The goal cascade accomplishes two things. First, it ties major activities for each program to successive goals and, ultimately, to DOE's mission. This helps ensure the Department focuses its resources on fulfilling its mission. Second, the cascade allows DOE to track progress against quantifiable goals and to tie resources to each goal at any level in the cascade. Thus, the cascade facilitates the integration of budget and performance information in support of the GPRA and the President's Management Agenda (PMA).

Another important component of our strategic planning – and the President's Management Agenda – is use of the Administration's R&D Investment Criteria to plan and assess programs and projects. The criteria were developed in 2001 and further refined with input from agencies, Congressional staff, the National Academy of Sciences, and numerous private sector and nonprofit stakeholders.

The chief elements of the R&D investment criteria are quality, relevance, and performance. Programs must demonstrate fulfillment of these elements. For example, to demonstrate relevance, programs are expected to have complete plans with clear goals and priorities. To demonstrate quality, programs are

[a] Government Performance and Results Act of 1993

[b] The numbering scheme uses the following numbering convention: First 2 digits identify the General Goal (01 through 07); second two digits identify the GPRA Unit; last four digits are reserved for future use.

expected to commission periodic independent expert reviews. There are several other requirements, many of which R&D programs have and continue to undertake.

An additional set of criteria were established for R&D programs developing technologies that address industry issues. Some key elements of the criteria include: the ability of the programs to articulate the appropriateness and need for Federal assistance; relevance to the industry and the marketplace; identification of a transition point to industry commercialization (or of an off-ramp if progress does not meet expectations); and the potential public benefits, compared to alternative investments, that may accrue if the technology is successfully deployed.

The OMB-OSTP guidance memo to agencies dated June 5, 2003, describes the R&D Investment Criteria fully and identifies steps agencies should take to fulfill them. (The memo is available on line at www.ostp.gov/html/fy05developingpriority.pdf.) Where appropriate throughout these justification materials, especially in Significant Program Shifts and Explanation of Funding Changes subheadings, specific R&D Investment Criteria and requirements are cited to explain the Department's allocation of resources.

Mission

The mission of the Office of Energy Efficiency and Renewable Energy is to strengthen America's energy security, environmental quality, and economic vitality through public-private partnerships that promote energy efficiency and productivity, bring clean, reliable, and affordable energy technologies to the marketplace, and make a difference in the everyday lives of Americans by enhancing their energy choices and quality of life.

Benefits

EERE pursues this mission through a balanced portfolio of research, development, demonstration and deployment efforts that are aimed at improving the energy efficiency of our economy and increasing the productive use of domestic renewable energy resources. Making greater use of our abundant, clean domestic renewable energy resources can provide significant economic, environmental, and security benefits to the United States. Renewable energy can provide economic development opportunities, especially in areas rich in solar, wind, geothermal, and biomass resources. Renewable energy technologies can reduce the environmental and public health impacts associated with mining, refining, transporting, burning and disposing of wastes from fossil fuels, as well as reducing emissions of Clean Air Act criteria pollutants (sulfur dioxide, nitrogen oxide, carbon monoxide, and particulates), mercury, and carbon dioxide. Energy and economic security is enhanced as dependence on imported petroleum (and, increasingly, natural gas) is reduced and the mix of domestic energy resources increases. Renewable energy technologies also enhance energy security by diversifying our energy resource portfolio, effectively lowering energy costs and reducing exposure to energy supply interruptions and price volatility.

EERE has demonstrated its ability to deliver results over its tenure. The Office of Energy Efficiency and Renewable Energy has been awarded 33 R&D 100 awards – known as the "Oscars of Innovation" – between 2001 and 2004. EERE sponsored research has won more R&D 100 awards than universities such as Massachusetts Institute of Technology, companies such as Dupont and Dow Chemical, and nations such as Germany and Great Britain. The most recent independent review of EERE programs, a study of a sample of EERE energy efficiency portfolio over more than 20 years by the National Academy of Science's National Research Council demonstrated one of the values of a portfolio approach. It found that some of these programs (similar to the subprograms in this budget) have yielded significant economic, environmental, and security benefits. The Council estimated the total net realized economic benefits (predominately from a few of the programs in the sample portfolio) associated with the DOE energy efficiency programs that it reviewed had already returned approximately $30 billion (valued in 1999 dollars, from the roughly $7 billion (1999 dollars) total Federal energy efficiency RDD&D investment over that period. The study also indicated there were yet unrealized benefits likely to be achieved. Consistent with the PMA, additional work is underway to enable the programs to more effectively measure and estimate past and potential benefits.

With respect to future benefits based on EIA/EERE benefits estimation models, EERE estimates that U.S. consumption of non-renewable energy resources would, given current policies, a business-as-usual energy future, stable investment, and achievement of technology plans, be over 12 Quads lower in 2025 and over 30 Quads lower in 2050 as a result of being able to realize the energy efficiency and renewable energy improvements proposed in this budget. Those benefits will offset more than 50 percent of the expected growth in energy consumption through 2050. More detailed, integrated and comprehensive economic, and energy security benefits estimates and their sensitivities are provided in the Expected Program Integrated Outcomes section at the end of this Overview and in individual program sections.

Strategic, General, and Program Goals

The Department's Strategic Plan identifies four strategic goals (one each for defense, energy, science, and environmental aspects of the mission) plus seven general goals that tie to the strategic goals. The Energy Supply appropriation supports the following goals:

Energy Strategic Goal: To protect our national and economic security by reducing imports and promoting a diverse supply of reliable, affordable, and environmentally sound energy.

General Goal 4, Energy Security: Improve energy security by developing technologies that foster a diverse supply of reliable, affordable and environmentally sound energy by providing for reliable delivery of energy, guarding against energy emergencies, exploring advanced technologies that make a fundamental improvement in our mix of energy options, and improving energy efficiency.

The programs funded by the Energy Supply appropriation have the following eight Program Goals which contribute to the DOE General Goals in the "goal cascade":

- Program Goal 04.01.00.00: Hydrogen Technology: Develop hydrogen production, delivery and storage technologies to the point that they are cost and performance competitive and are being used by the Nation's transportation, energy, and power industries. Development of these technologies will also make our clean domestic energy supplies more flexible, dramatically reducing or even ending dependence on foreign oil.
- Program Goal 04.03.00.00: Solar Energy. The Solar Program goal is to improve performance of solar energy systems and reduce development, production, and installation costs to competitive levels, thereby accelerating large-scale usage across the Nation and making a significant contribution to a clean, reliable and flexible U.S. energy supply.
- Program Goal 04.05.00.00: Wind Energy. By 2012, complete program technology research and development, collaborative efforts, and provide the technical support and outreach needed to overcome barriers – energy cost, energy market rules and infrastructure, and energy sector acceptance –to enable wind energy to compete with conventional fuels throughout the Nation in serving and meeting the Nation's energy needs.
- Program Goal 04.06.00.00: Hydropower. With the completion of testing on new turbine technologies, and consistent with previous congressional direction, the Hydropower Program's goal

is to closeout this program and effectively transition remaining program activities and information (e.g., R&D results, technical data and findings) to private/public sector programs.

- Program Goal 04.07.00.00: Geothermal. The Geothermal Program goal is to improve technology performance and reduce market entry costs of geothermal energy to competitive levels, thereby making the large geothermal resource available to the Nation.
- Program Goal 04.08.00.00: Biomass. Develop biorefinery-related technologies to the point that they can compete in terms of cost and performance and are used by the Nation's transportation, energy, chemical, agriculture, forestry, and power industries to meet their respective market objectives. This helps the Nation by expanding clean, sustainable energy supplies while also improving the Nation's energy infrastructure and reducing our dependence on foreign oil.
- Program Goal 04.11.00.00: Intergovernmental Activities. Accelerate the adoption of clean, efficient and domestic energy technologies through efficient intergovernmental demonstration and delivery of cost-effective energy technologies which will benefit the public through improved energy productivity and reduced demand and particularly reduce the burden of energy cost on the disadvantaged.
- Program Goal 04.13.00.00: DEMP. The Federal Energy Management Program's goal is to provide the efficiency and renewable energy-related technical assistance that Federal agencies need to lead the Nation by example through government's own actions, by reducing energy intensity in Federal buildings by 35 percent by 2010 (relative to the 1985 statutory baseline level of 138,610 Btus per gross square foot).

Contribution to General Goal

Hydrogen Technology, Solar Energy, Wind Energy, Hydropower Technologies, Geothermal Technologies, Biomass and Biorefinery Systems R&D, Intergovernmental Activities, and Departmental Energy Management Program contribute to General Goal 4 by working together and with efficiency and load management programs to reduce the probability and potential magnitude of energy based disruptions and to improve the Nation's mix of affordable energy options.

These integrated programs directly contribute to the departmental goal by: (1) reducing demand-side pressure (mitigates costs) on our energy markets; (2) reducing energy imports; (3) diversifying the mix of domestic energy production; (4) providing smaller and decentralized, non-fuel based sources of electricity generation that are inherently less susceptible to interruption or attack; and (5) increasing our ability to adjust demand loads as needed, particularly those that can help reduce peaks and shift power readily during energy emergencies.

EIA/EERE expectations, assumptions, and caveats about future energy technologies and markets, are described briefly in the Benefits and in greater detail in the Expected Integrated Program Outcomes that follows. EERE's modeling of the benefits of its integrated portfolio, including activities funded by the Energy Supply and Energy Conservation Appropriations, which incorporates those elements, indicates the portfolio can be expected to contribute directly to the DOE Strategic Plan energy security goal for 2025 and beyond. Specifically, our modeling estimates the integrated portfolio is expected to: (1) reduce future demand for traditional energy sources by approximately 12 Quads in 2025 and over 30 Quads in 2050 (beyond the efficiency and renewable improvements expected in the absence of these programs); and (2) reduce the need for new electricity capacity by nearly 140 gigawatts (GW) in 2025. Oil savings would be roughly 2.3 million barrels per day (mbpd) in 2025 and over 10 mbpd in 2050.

Individual program activities planned for and funded by this appropriation would contribute to these improvements in the following ways under these business-as-usual conditions:[a]

- Hydrogen Technology would contribute to this goal by developing lower-cost means of producing and delivering hydrogen in large quantities from natural gas and renewable resources and developing fuel cell and hydrogen delivery infrastructure technologies. Specific targets include reducing the cost of producing hydrogen from renewables to achieve $2.85/gge untaxed at the station (5000 psi) and developing storage technology that enables greater than 300-mile vehicle driving range by 2010. Collectively these technologies could displace 0.2 million barrels per day (mbpd) of oil in 2025 and as technologies enter the market in significant numbers will approach 3 mbpd in 2050 under business-as-usual conditions. Additionally, they provide the option for substantially faster growth in hydrogen use if energy markets demand more rapid change.
- Solar Energy would contribute to this goal by developing: advanced, increasingly-efficient, lower-cost solar photovoltaic modules and grid application technologies; concentrating solar power technologies to centrally produce electricity from solar energy at a competitive cost; lightweight polymer materials for solar heating; and solar lighting systems. The Solar Program's technical objectives are to increase the efficiencies of each of its core technologies, which will contribute to lowering the costs of solar power. The target for solar power costs are $0.14 - $0.19/kWh for PV electric energy in 2010; $0.07/kWh for large-scale CSP power in 2012; and $0.05/kWh for solar water heating in freezing climates in 2012. If all of these targets were met, collectively, they could enable the development of 13 GW of solar electric capacity additions by 2025 and over 60 GW in 2050, while affording the country a source of clean, fuel-free, and portable electricity.
- Wind Energy would contribute to this goal by developing wind technologies that will provide large scale wind production in Class-4 conditions of 3 cents/kWh onshore and 5 cents/kWh offshore by 2012; distributed wind production at 10-15 cents/kWh by 2007; and the market systems and services that would extend wind production to most of the United States, which collectively could result in additional wind capacity of more than 90 GW by 2025 and more than 110 GW by 2050 beyond what is expected to be developed without these program efforts.
- Geothermal Technology would contribute to this goal by reducing the cost of geothermal energy production from flash and binary power to 4.3 and 6.1 cents/kWh (in year 2001 dollars) respectively by 2010, and by developing commercial Enhanced Geothermal Systems (EGS) technology, which would expand the amount of geothermal resources that can be competitively developed in the United States by 2040. Together, these activities could result in an increase in geothermal electricity capacity of 5 GW by 2025 and approach 40 GW by 2050.
- Biomass and Biorefinery Systems R&D would contribute to this goal by developing, by 2010, advanced technologies for producing fuels, chemicals, materials, and power from biomass via biochemical and thermochemical processes. This could reduce nonrenewable energy consumption by at least 1 Quad by 2050, and potentially more with integrated approaches.
- Intergovernmental Activities key contribution would be through accelerating the adoption and broadening the markets of energy efficiency R&D technologies developed by EERE programs, expanding and accelerating the direct reduction of demand for oil, natural gas, and electricity, and leading to the building of 1000 MW of renewable generation globally by 2015 and 100 MW of generation on American Indian lands by 2010.

[a] Individual program contributions are not strictly additive because of overlap in the markets addressed.

- Departmental Energy Management Program would contribute to this goal by providing project financing, technical assistance, and evaluation which will demonstrate methods to reduce energy intensity in Federal buildings. DEMP's target is to continue to reduce energy intensity by 1 percent each year (using FY 2003 as a baseline) through 2010.
- EERE is also working to implement the PMA through management efficiencies. The first phase of the EERE 2002 reorganization realigned and consolidated Headquarters organizational and business management structures to improve how EERE programs are managed at Headquarters. In the fall of 2003, EERE began the second phase of the reorganization – designing and implementing common project management practices across EERE field organizations. In October 2004, EERE implemented the Project Management Center (PMC) which provides improved and more cost effective project management, procurement, and financial management services to EERE programs engaged in financial assistance and formal contracts activities.

These technology and market improvements also help prepare the Nation for future energy, environmental and security needs by providing options for additional fuel savings, air emission reductions and electricity reliability improvements beyond those expected under business-as-usual scenarios.

Funding by General and Program Goal

	(dollars in thousands)		
	FY 2004	FY 2005	FY 2006
General Goal 4, Energy Security			
Program Goal 04.01.00.00, Hydrogen Technology	60,327	72,586	99,094
Program Goal 04.03.00.00, Solar Energy	79,603	74,878	83,953
Program Goal 04.05.00.00, Wind Energy	38,377	36,245	44,249
Program Goal 04.06.00.00, Hydropower	4,673	4,862	500
Program Goal 04.07.00.00, Geothermal Technology	23,644	23,394	23,299
Program Goal 04.08.00.00, Biomass and Biorefinery Systems R&D	43,374	45,512	50,359
Program Goal 04.11.00.00, Intergovernmental Activities	8,738	12,610	11,910
Program Goal 04.13.00.00, Departmental Energy Management Program	1,963	1,921	2,019
Total General Goal 4, Energy Security	260,699	266,056	315,383
All Other			
Hydrogen Technology/Congressionally Directed Activities	20,085	21,420	0
Solar Energy/Congressionally Directed Activities	1,128	10,196	0
Wind Energy/Congressionally Directed Activities	1,426	4,559	0
Geothermal Technology/ Congressionally Directed Activities	981	1,876	0
Biomass and Biorefinery Systems R&D/Congressionally Directed Activities	41,234	35,334	0

	(dollars in thousands)		
	FY 2004	FY 2005	FY 2006
Intergovernmental Activities/ Congressionally Directed Activities	5,935	4,166	0
Departmental Energy Management Program/ Congressionally Directed Activities	0	30	0
Renewable Program Support	8,493	5,954	2,901
Facilities and Infrastructure	12,950	11,389	16,315
Program Direction	16,490	19,064	19,043
Total, All Other	108,722	119,940	38,259
Total, General Goal 4 (Energy Supply)	369,421	385,996	353,642

Major FY 2004 Achievements

EERE works closely with industry, National Laboratories, Federal agencies, State energy offices, universities, non-government organizations and other stakeholders in conducting its R&D, demonstration and deployment activities. In addition to the 10 R&D awards EERE received in FY 2004 for applied technology. FY 2004 investment and collaboration achieved the following:

- Biomass and Biorefinery Systems R&D. Cost-shared research with two of the world's largest enzyme manufacturers has led to a 12-fold reduction since 2000 in the cost of the enzymes needed to convert cellulose to sugars for producing ethanol from lignocellulosic biomass. Achieving the program's cost and technical targets over the next decade will contribute significantly to the establishment of a strong bio-industry.
- Facilities and Infrastructure. Formal groundbreaking on a new Science and Technology Facility (S&TF) at NREL took place in July 2004, and with completion expected to be completed in 2006, is the first new facility in more than a decade. The landmark S&TF will provide significant advantages for state-of-the-art research, technology integration and collaboration. The facility will enable the expansion of research capabilities in photovoltaics, hydrogen, solid-state lighting, distributed energy, superconductivity, electrochromic windows and nanotechnologies. The S&TF will enable increased collaboration among researchers and was specifically designed to reduce barriers and time delays associated with transferring technology from research and development to industry.

Program Assessment Rating Tool (PART)

The Department implemented a tool to evaluate selected programs. PART was developed by the Office of Management and Budget (OMB) to provide a standardized way to assess the effectiveness of the Federal Government's portfolio of programs. The structured framework of the PART provides a means through which programs can assess their activities differently than through traditional reviews.

The current focus is to establish outcome- and output-oriented goals, the successful completion of which will lead to benefits to the public, such as increased national security and energy security, and improved environmental conditions. DOE has incorporated feedback from OMB into the FY 2006 Budget, and the Department will take the necessary steps to continue to improve performance.

No new Energy Supply appropriation programs were reviewed by OMB this year; the Department has initiated or completed addressing all prior year recommendations.

EERE's FY 2006 performance targets are consistent with PART measures and targets this year than in previous years, and work continues to make them as uniform as possible. EERE has corporately addressed a recommendation common to all DOE applied R&D PARTs, which is to improve consistency of methods and assumptions used to estimate benefits. Although benefits estimates calculated to support this budget are not yet comparable, DOE continues to improve consistency of various programs' methods and assumptions. EERE is addressing this challenge through the consolidation of planning, budget and analysis into one organization whose mission is: To support sound and effective EERE strategic, programmatic and fiscal decision-making through efficient processes that result in high quality representation, reporting, plans, analyses, budgets, performance management and program evaluations. The Department has used the existing R&D investment criteria to inform the development of the FY 2006 budget.

EERE is addressing the findings outside of EERE's direct program control such as Departmental allocation of costs by providing full internal accounting allocation of program direction, and is working with Departmental and OMB staff to incorporate R&D Investment Criteria as appropriate, expand the lessons learned in EERE benefits framework methodology to the applied Energy R&D programs. We also continue to interactively improve PART processes, systems and scoring consistency to enable our performance to be more accurately portrayed by PART. The individual program responses are provided in their respective budgets.

Significant Program Shifts

These program shifts and resulting budget prioritization decisions were guided by the R&D Investment Criteria (RDIC). Key RDIC are noted in the individual program discussions.

- Hydropower. The Department plans to effect closeout of the Hydropower Program in FY 2006, transferring results of its turbine research and development and water management techniques to the industry. This closeout decision was based upon a review of EERE program funding priorities, which include a broad spectrum of considerations. Important criteria for R&D investment include how close the work is to commercialization (RDIC 2g – Years to Commercialization) and potential public benefits (RDIC Section 3 – Performance) relative to other options. Hydropower technology R&D has advanced to the state that it is now adoptable by industry. Additionally, the program's water management strategy to increase generation and efficiency has been successfully demonstrated (RDIC 2e - Off-ramps). We will work to ensure transfer of these capabilities to industry during this final year.

- Hydrogen Technology. To support the 2010 technical targets planned in the DOE Hydrogen Posture Plan and Multi-Year RD&D Plan, the program will accelerate hydrogen technology development in the areas of production and delivery R&D and systems analysis. Production and delivery activities will also be accelerated on advanced electrolysis systems (consistent with National Academy of Sciences recommendations, RDIC 2f – External Review) as well as the development of high temperature thermochemical, photoelectrochemical, hydrogen separation, and delivery technologies (RDIC 2a – Building on Existing Technology). Systems Analysis increases will initiate the development of critical hydrogen transition scenarios, the evaluation of integration issues with other national energy systems and infrastructures, and expansion of the Macro-System Model to support the analysis recommendations of the National Academy of Sciences. The program will use external review and competitive merit-based process to select performers (RDIC 2f – Competitive Merit-based Selection).

- Wind Energy. The Wind Energy Program will expand its R&D portfolio to include exploration of both high-risk deep water offshore technology applications and increase the available/affordable wind resource bases near "hard to serve" population centers, the NE and Mid-Atlantic significantly expanding the population receiving program benefits (consistent with RDIC 1b and 1c – Investment Barriers Public Benefits). System integration issues unique to offshore applications will also be examined. The decision to move offshore was based on industry input through peer review (RDIC 2b & f – Industry Involvement and External Review), and a February 2003 planning meeting with industry involvement. Significantly larger wind generated electricity is possible with this technology application.

Expected Integrated Program Outcomes

The program pursues its mission through an integrated portfolio of research, development, demonstration and deployment activities. Figure 1 below depicts the related potential shift in nonrenewable energy consumption. We expect the energy efficiency and renewable energy components of these energy savings to result in lower energy bills and reduced susceptibility to energy price fluctuations; reduced EPA criteria and other pollutants; enhanced energy security as petroleum and natural gas dependence is reduced and domestic fuel supplies increase; and greater energy security and reliability from improvements in energy infrastructure. Indicators of some of these program benefits are provided in the tables below. The results shown in the long-term benefits tables are preliminary estimates based on initial modeling of some of the possible program production technologies and the estimates generated by the model have been rounded to reduce the implied precision.

The assumptions and methods underlying the modeling efforts have significant impact on the estimated benefits. Results could vary significantly if external factors, such as future energy prices, differ from the baseline case assumed for this analysis (essentially the EIA business as usual outlook for components of the economy affecting energy use -- this modeling includes competing technologies). In addition, possible changes in public policy and disruptions in the energy system which may affect estimated benefits are not modeled. The external factors such as unexpected changes in competing technology costs, identified in the Means and Strategies sections in each of the individual contributing programs, could also affect EERE's ability to achieve its strategic goals as could persistent directed funding. Projections of future benefits also depend on assumptions relating to how the economy will evolve over time and how rapidly energy efficient technologies will be developed and adopted among other variables. The estimated benefits presented here are predicated on the assumptions included in EIA's Annual Energy Outlook 2004 Reference Case projections.

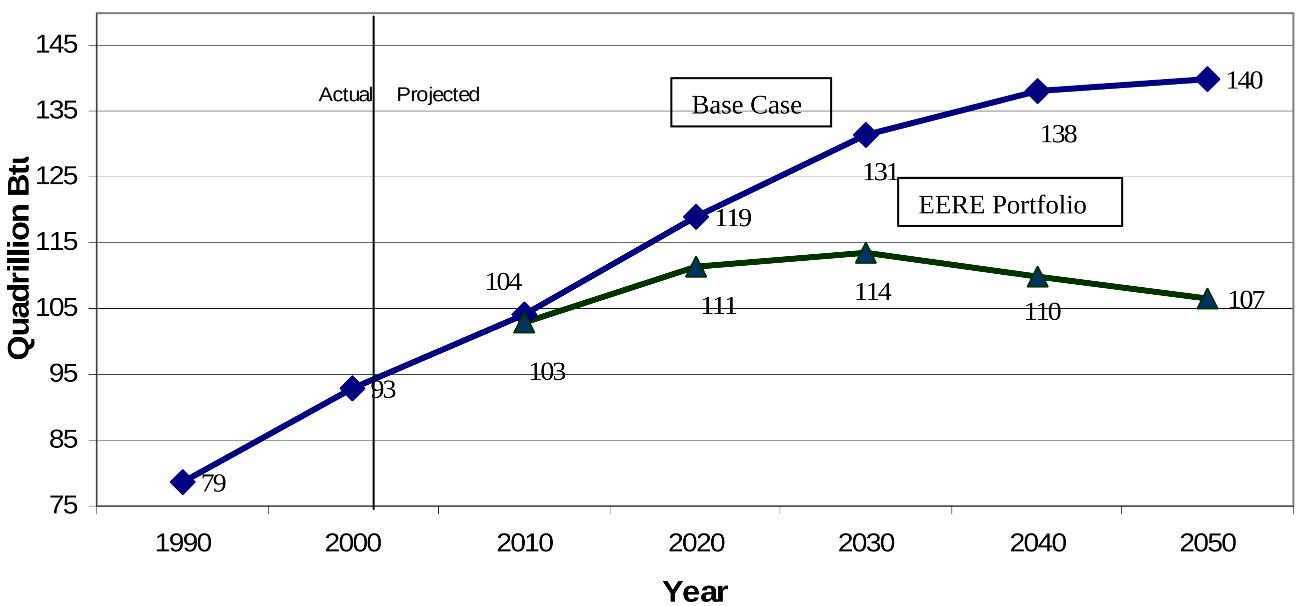
Some key assumptions about macroeconomic activity, energy demand, and technology results include the following "business-as-usual" outputs:

- Economic growth of 3.1 percent annually;
- Price per barrel of oil of about $28 (2003 dollars) in 2003, rising to $35 in 2004, then dropping to $25 in 2010, then rising slowly to $30 in 2025. In nominal dollars, the price of oil in 2025 would be $52; and
- Price per thousand cubic feed of natural gas of $4.98 (2003 dollars) in 2003, dropping to $3.64 in 2010, then rising slowly to $4.79 by 2025. In nominal dollars, the price of natural gas in 2025 would be about $8.20.

EIA also provides projections under alternative economic assumptions ranging from 2.4 to 3.5 percent annual growth between 2002 and 2025. Across this range, total energy consumption may grow by anywhere from 29 to 49 percent between 2002 and 2025. EIA also offers a range of technology assumptions. Across these cases total energy consumption may grow by anywhere from 46 percent between 2002 and 2025 if technology does not improve at all to 32 percent if technology improves rapidly. Changing assumptions on important variables such as these would likely affect the estimated benefits in this budget.

The results shown in the long term benefits tables are preliminary estimates based on initial modeling of some of the possible program production technologies; uncertainties are larger for longer term estimates, nonetheless, they provide a useful picture of the potential change in national benefits over time if the technology, infrastructure and markets evolve as expected. Estimated benefits which follow assume that individual technology plans and market assumptions obtain. A summary of the methods, assumptions, and models used in developing these benefit estimates that are important for understanding these results are provided at www.eere.energy.gov/office_eere/budget_gpra.html. Final documentation is estimated to be completed and posted by March 31, 2005.

Figure 1. U.S. Nonrenewable Energy Consumption, 1990-2000, and Projections to 2050



EERE's portfolio includes a mix of efforts intended to produce short-, mid-, and long-term benefits. The size of these benefits depends not only on the success of the EERE program efforts funded in this budget request, but on how future energy markets and policies evolve. EERE estimates a sub-set of these benefits assuming a continuation of current policies and business-as-usual development of energy markets. These estimates do not include the underlying, basecase improvements in energy efficiency and renewable energy use that could be expected in the absence of continued funding of EERE's programs.[a]

Mid-term Benefits[b]		2010	2015	2020	2025
		(calendar year)			
Energy Displaced	Primary nonrenewable energy savings (Quads)	1	3	8	12
Economic	Energy bill savings (billion 2002$)	12	37	87	123
Environment	Carbon emissions reductions (MMTCE)	22	67	160	262
Security	Oil savings (mbpd)	0.1	0.6	1.3	2.3
	Natural gas savings (Quads)	0.5	1.1	1.9	1.8
	Reduced need for additions to central conventional power (GW)	5	49	96	137

The table shows, that if successful and the assumptions play out as expected, EERE's programs could provide mid-term benefits in 2025 of over $120 billion in energy bill savings; a reduction of about 250 million metric tons of annual carbon emissions (MMTCE); a savings of over 2 million barrels of oil per day; and a reduction of nearly 2 Quads of natural gas consumption. A combination of reduced peak demand for electricity and additional renewable and distributed generation capacity eliminated the need for more than 130 GW of additional conventional central power generation, increasing the flexibility and diversity of our electricity system while reducing the potential for a shortage of new generating capacity.

EERE's portfolio includes a number of efforts to develop fundamental breakthroughs in technologies that promise major changes in how the U.S. will produce and use energy in the decades to come. If these breakthroughs succeed, benefits could continue to grow in the long term. By 2050, benefits may include reductions in the overall annual cost of our energy systems approaching $300 billion; reductions in annual carbon dioxide emissions of nearly 700 MMTCE; reductions in oil demand of over 10 million barrels per day; and annual savings in natural gas demand of over 2 Quads.

---

[a] Benefits reported are annual, not cumulative, for the year given. Estimates reflect the benefits that may be possible if all of the program's technical targets are met and funding continues at levels consistent with assumptions in the FY 2006 Budget through the program completion year, which varies by program.

[b] Mid-term program benefits, assuming technological success of the entire EERE portfolio, were estimated utilizing the GPRA06-NEMS model, based on the Energy Information Administration's (EIA) National Energy Modeling System (NEMS) and utilizing the EIA's Annual Energy Outlook (AEO) 2004 Reference Case.

Long-Term Benefits[a]		(calendar year) 2030	2040	2050
Energy Displaced	Primary nonrenewable energy savings (Quads)	18	28	34
Economic	Overall energy cost savings (billion 2002$)	102	188	282
Environment	Carbon emission reductions (MMTCE)	364	568	699
Security	Oil savings (mbpd)	4.6	9.0	11.0
	Natural gas savings (Quads)	2.8	3.6	2.4

Note: Mid-term energy-expenditure savings only include reductions in consumer energy bills, while long-term energy system cost savings also include the incremental cost of the advanced energy technology purchased by the consumer.

These mid and long term estimates are derived utilizing a similar baseline case, but different modeling techniques and, as a result, are not directly comparable. While point estimates are presented, both mid-term and long-term modeling are dependent upon the methodology and assumptions used. Many of the key variables affecting the benefits estimates are listed as the external factors that could affect expected results in the means and strategy sections of the individual programs and include variables such as market and policy interactions and the future price of oil, natural gas and electricity generation. Long term estimates should be considered preliminary as EERE refines its analytical approaches for the 2030-2050 timeframe.

These benefits result from the mix of interrelated investments supported by EERE's budget request. More efficient buildings and factories, for instance, provide the basis for distributed energy resources, such as building integrated solar photovoltaic systems and combined heat and power cogeneration. In addition to these "business-as-usual" benefits, EERE's portfolio would provide the technical potential to reduce conventional energy use even further if warranted by future energy needs. The development of wide-spread sources of wind, solar, geothermal, biomass, and hydropower energy sources; new ways of using energy through hydrogen and distributed power; and technologies that would fundamentally improve the basic efficiency of our homes, businesses, factories, and vehicles could facilitate substantial reductions in our oil use and convert a larger portion of our electricity system to decentralized capacity and renewable energy sources to improve security and reliability.

The following table shows expected benefits by program. The results are not additive, integrated results are shown in the tables above. The estimates are not directly comparable because of some differences in methodology and assumptions. Nevertheless, the table provides relative "order-of-magnitude" estimates while the Department continues to refine and standardize its methodology.

[a] Long-term benefits, assuming technological success of the entire EERE portfolio, were estimated utilizing the GPRA06 - MARKAL developed by Brookhaven National Laboratory (BNL). Results can differ among models due to differences in their structure. In particular, the two models estimate economic benefits in different ways, with the MARKAL model reflecting the cost of additional investments required to achieve reductions in energy bills.

GPRA 2006 Estimate of Potential Benefits by Program

	Primary Non-Renewable Energy Savings (Quads)		Energy Bill Savings (Billion 2002$)	Energy System Cost Savings (Billion 2002$)	Carbon Emission Reductions (MMTCE)		Oil Savings (mbpd)	
	2025	2050	2025	2050	2025	2050	2025	2050
Energy Supply (EWD):								
Hydrogen, Fuel Cells & Infrastructure Program (1)	0.2	4.3	2	26	5	60	0.2	2.7
Solar Energy Program	0.3	1.7	2	2	8	36	ns	ns
Wind Energy Program	3.3	3.7	4	4	81	87	0.1	ns
Geothermal Technologies Program	0.3	2.4	ns	5	8	59	ns	ns
Biomass & Biorefinery Systems R&D Program (2)	0.1	1.1	ns	1	3	19	0.0	0.4
Intergovernmental Activities Program (3)								
Federal Energy Management Program (4)	0.1	--	0	--	1	--	0.0	--
Energy Conservation (INT)								
Vehicle Technologies Program	4.0	18.9	61	177	76	365	1.8	8.8
Hydrogen, Fuel Cells & Infrastructure Program (1)	0.2	4.3	2	26	5	60	0.2	2.7
Weatherization & Intergovernmental Activities Program	1.2	--	10	--	27	--	0.1	--
Distributed Energy Program	0.3	--	2	--	11	--	ns	--
Building Technologies Program	1.2	4.2	12	62	28	92	0.0	0.1
Industrial Technologies Program	2.2	0.5	13	3	44	8	0.2	0.0
Biomass & Biorefinery Systems R&D Program (2)	0.1	1.1	ns	1	3	19	0.0	0.4
Federal Energy Management Program (4)	0.1	--	0	--	1	--	0.0	--

EERE's portfolio approach to RD&D affects benefits and the way they are calculated. The total benefits reported for EERE's entire portfolio are usually less that the sum of the individual programs due to competition between these technologies and the resulting tradeoffs. For instance, efficiency improvements reduce the future need for new electricity generating capacity, including the potential size of the renewable electric market. In addition, a research failure in one area will not necessarily reduce the technology's overall benefits, as the lack of market penetration by the failed technology may create a market opportunity elsewhere in the EERE portfolio. An integrated benefit total may be higher than the individual sums because of the additive impact of multiple EERE programs.

(1) Benefits were estimated jointly for the Hydrogen Technology (Energy Supply) and Fuel Cell Technologies (Energy Conservation) Programs. The estimates are repeated under each appropriation and are not additive.

(2) Benefits were estimated jointly for the Energy Supply and Energy Conservation components of the Biomass & Biorefinery Systems R&D Program. The estimates are repeated under each appropriation and are not additive.
(3) An estimate of renewable electricity generation stimulated by the Renewable Energy Production Incentive is included in the section for Intergovernmental Activities. Because this is not one of the common benefits estimated for all programs, it is not included in this table.
(4) Benefits were estimated jointly for the Departmental Energy Management (Energy Supply) and the Federal Energy Management (Energy Conservation) Programs. The estimates are repeated under each appropriation and are not additive.
ns = not significant; -- long-term benefits were not estimated for the Distributed Energy, Federal Energy Management, and Weatherization & Intergovernmental Programs

Funding Summary by Program

(dollars in thousands)

	FY 2004 Comparable Appropriation	FY 2005 Comparable Appropriation	FY 2006 Request	FY 2006 vs FY 2005	
				$ Change	% Change
Biomass Program					
Biomass and Biorefinery Systems R&D (EWD)	84,608	80,846	50,359	-30,487	-37.7%
Biomass and Biorefinery Systems R&D (INT)	6,966	7,253	21,805	+14,552	+200.6%
Total, Biomass Program	91,574	88,099	72,164	-15,935	-18.1%
Building Technologies (INT)	57,799	65,464	57,966	-7,498	-11.5%
Distributed Energy Resources (INT)	59,684	60,416	56,629	-3,787	-6.3%
Facilities and Infrastructure (EWD)	12,950	11,389	16,315	+4,926	+43.3%
Federal Energy Management Program					
Departmental Energy Management Program (EWD)	1,963	1,951	2,019	+68	+3.5%
Federal Energy Management Program (INT)	19,420	17,931	17,147	-784	-4.4%
Total, Federal Energy Management Program	21,383	19,882	19,166	-716	-3.6%
Geothermal Technology (EWD)	24,625	25,270	23,299	-1,971	-7.8%
Industrial Technologies (INT)	90,450	74,801	56,489	-18,312	-24.5%

	(dollars in thousands)				
	FY 2004 Comparable Appropriation	FY 2005 Comparable Appropriation	FY 2006 Request	FY 2006 vs FY 2005	
				$ Change	% Change
Hydrogen, Fuel Cells, and Infrastructure Program					
Hydrogen Technology (EWD)	80,412	94,006	99,094	+5,088	+5.4%
Fuel Cell Technologies (INT)	63,782	74,944	83,600	+8,656	+11.5%
Total, Hydrogen, Fuel Cells, and Infrastructure Program	144,194	168,950	182,694	+13,744	+8.1%
Renewable Program Support (EWD)	8,493	5,954	2,901	-3,053	-51.3%
Solar Energy (EWD)	80,731	85,074	83,953	-1,121	-1.3%
Vehicle Technologies (INT)	172,395	165,409	165,943	+534	+0.3%
Weatherization and Intergovernmental Activities					
Intergovernmental Activities (EWD)	14,673	16,776	11,910	-4,866	-29.0%
Weatherization and Intergovernmental Activities (INT)	307,932	309,005	298,157	-10,848	-3.5%
Total, Weatherization and Intergovernmental Activities	322,605	325,781	310,067	-15,714	-4.8%
Wind Energy and Hydropower					
Wind Energy (EWD)	39,803	40,804	44,249	+3,445	+8.4%
Hydropower (EWD)	4,673	4,862	500	-4,362	-89.7%
Total, Wind Energy and Hydropower	44,476	45,666	44,749	-917	-2.0%
Program Direction					
Program Direction (EWD)	16,490	19,064	19,043	-21	-0.1%
Program Management (INT)	92,362	93,011	89,036	-3,975	-4.3%
Total, Program Direction	108,852	112,075	108,079	-3,996	-3.6%
Subtotal, Energy Supply and Energy Conservation	1,240,211	1,254,230	1,200,414	-53,816	-4.3%
Use of prior year balances (EWD)	-17,126	-5,648	0	+5,648	+100.0%
Use of prior year balances (INT)	-2,823	0	0	0	0.0%
Total, Energy Supply and Energy Conservation	1,220,262	1,248,582	1,200,414	-48,168	-3.9%

Energy Supply
Office of Energy Efficiency and Renewable Energy

Funding by Site by Program

	(dollars in thousands)				
	FY 2004	FY 2005	FY 2006	$ Change	% Change
Central Regional Office					
Biomass and Biorefinery Systems R&D	150	0	0	0	0.0%
Wind Energy	66	700	250	-450	-64.3%
Program Direction	0	0	148	+148	NA
Solar Energy	50	50	50	0	0.0%
Total, Central Regional Office	266	750	448	-302	-40.3%
Chicago Operations Office					
Argonne National Laboratory					
Biomass and Biorefinery Systems R&D	515	190	0	-190	-100.0%
Wind Energy	200	20	0	-20	-100.0%
Hydrogen Technology	985	1,846	2,930	+1,084	+58.7%
Intergovernmental Activities	150	300	300	0	0.0%
Total, Argonne National Laboratory	1,850	2,356	3,230	+874	+37.1%
Brookhaven National Laboratory					
Geothermal Technology	440	322	0	-322	-100.0%
Hydrogen Technology	0	282	1,000	+718	+254.6%
Solar Energy	440	400	500	+100	+25.0%
Total, Brookhaven National Laboratory	880	1,004	1,500	+496	+49.4%

	(dollars in thousands)				
	FY 2004	FY 2005	FY 2006	$ Change	% Change
Lawrence Berkeley National Laboratory					
Biomass and Biorefinery Systems R&D	29	0	0	0	0.0%
Wind Energy	285	250	250	0	0.0%
Geothermal Technology	980	1,130	1,000	-130	-11.5%
Intergovernmental Activities	170	230	300	+70	+30.4%
Total, Lawrence Berkeley National Laboratory	1,464	1,610	1,550	-60	-3.7%
National Renewable Energy Laboratory					
Biomass and Biorefinery Systems R&D	27,123	22,585	20,000	-2,585	-11.4%
Wind Energy	31,479	25,342	29,600	+4,258	+16.8%
Facilities and Infrastructure	12,950	11,389	16,315	+4,926	+43.3%
Geothermal Technology	3,071	2,073	2,110	+37	+1.8%
Hydropower	149	210	150	-60	-28.6%
Hydrogen Technology	9,189	9,346	10,794	+1,448	+15.5%
Solar Enegy	61,926	55,315	62,400	+7,085	+12.8%
Intergovernmental Activities	1,500	1,700	1,700	0	0.0%
Total, National Renewable Energy Laboratory	147,387	127,960	143,069	+15,109	+11.8%
Pacific Northwest National Laboratory					
Biomass and Biorefinery Systems R&D	4,091	1,015	1,000	-15	-1.5%
Wind Energy	70	0	0	0	0.0%
Hydropower	875	940	75	-865	-92.0%
Hydrogen Technology	1,645	2,767	3,045	+278	+10.0%
Intergovernmental Activities	270	300	300	0	0.0%
Total, Pacific Northwest National Laboratory	6,951	5,022	4,420	-602	-12.0%
Total, Chicago Operations Office	158,532	137,952	153,769	+15,817	+11.5%
Golden Field Office					
Program Direction	3,386	4,671	5,027	+356	+7.6%

(dollars in thousands)

	FY 2004	FY 2005	FY 2006	$ Change	% Change
Idaho Operations Office					
Idaho National Engineering and Environment Laboratory					
Biomass and Biorefinery Systems R&D	1,520	1,810	1,400	-410	-22.7%
Wind Energy	100	75	75	0	0.0%
Geothermal Technology	2,332	2,596	2,000	-596	-23.0%
Hydropower	791	930	50	-880	-94.6%
Hydrogen Technology	182	0	0	0	0.0%
Total, Idaho National Engineering and Environment Laboratory	4,925	5,411	3,525	-1,886	-34.9%
Total, Idaho Operations Office	4,925	5,411	3,525	-1,886	-34.9%
Livermore Site Office					
Lawrence Livermore National Laboratory					
Geothermal Technology	781	865	500	-365	-42.2%
Hydrogen Technology	640	965	727	-238	-24.7%
Total, Lawrence Livermore National Laboratory	1,421	1,830	1,227	-603	-33.0%
Total, Livermore Site Office	1,421	1,830	1,227	-603	-33.0%
Los Alamos Site Office					
Los Alamos National Laboratory					
Hydrogen Technology	1,520	2,075	2,240	+165	+8.0%
Mid-Atlantic Regional Office					
Wind Energy	222	85	85	0	0.0%
Program Direction	0	0	147	+147	NA
Solar Energy	50	50	50	0	0.0%
Total, Mid-Atlantic Regional Office	272	135	282	+147	+108.9%
Midwest Regional Office					
Solar Energy	50	50	50	0	0.0%
Wind Energy	342	580	75	-505	-87.1%
Program Direction	0	0	148	+148	NA

	(dollars in thousands)				
	FY 2004	FY 2005	FY 2006	$ Change	% Change
Total, Midwest Regional Office	392	630	273	-357	-56.7%
National Energy Technology Laboratory					
Biomass and Biorefinery Systems R&D	145	0	0	0	0.0%
Wind Energy	50	0	0	0	0.0%
Geothermal Technology	500	1,000	3,000	+2,000	+200.0%
Hydrogen Technology	400	0	50	+50	NA
Total, National Energy Technology Laboratory	1,095	1,000	3,050	+2,050	+205.0%
National Nuclear Security Administration's (NNSA) Service Center					
NNSA Service Center					
Solar Energy	0	2,000	2,000	0	0.0%
Northeast Regional Office					
Wind Energy	100	185	185	0	0.0%
Program Direction	0	0	148	+148	NA
Solar Energy	442	50	50	0	0.0%
Total, Northeast Regional Office	542	235	383	+148	+63.0%
Oak Ridge Operations Office					
Oak Ridge National Laboratory					
Biomass and Biorefinery Systems R&D	961	970	800	-170	-17.5%
Wind Energy	218	150	150	0	0.0%
Hydropower	960	940	75	-865	-92.0%
Hydrogen Technology	2,180	2,385	3,107	+722	+30.3%
Solar Energy	280	465	300	-165	-35.5%
Intergovernmental Activities	904	1,000	1,000	0	0.0%
Total, Oak Ridge National Laboratory	5,503	5,910	5,432	-478	-8.1%
Total, Oak Ridge Operations Office	5,503	5,910	5,432	-478	-8.1%

	(dollars in thousands)				
	FY 2004	FY 2005	FY 2006	$ Change	% Change
Sandia Site Office					
Sandia National Laboratories					
Wind Energy	3,900	5,528	6,700	+1,172	+21.2%
Geothermal Technology	5,020	3,405	3,500	+95	+2.8%
Hydrogen Tehcnology	3,965	4,347	4,847	+500	+11.5%
Solar Energy	9,809	7,878	9,431	+1,553	+19.7%
Intergovernmental Activities	400	615	700	+85	+13.8%
Total, Sandia National Laboratories	23,094	21,773	25,178	+3,405	+15.6%
Total, Sandia Site Office	23,094	21,773	25,178	+3,405	+15.6%
Savannah River National Laboratory					
Hydrogen Technology	0	450	763	+313	+69.6%
Southeast Regional Office					
Wind Energy	85	85	85	0	0.0%
Program Direction	0	0	148	+148	NA
Solar Energy	50	50	50	0	0.0%
Total, Southeast Regional Office	135	135	283	+148	+109.6%
Washington Headquarters					
Office of Scientific and Technical Information					
Wind Energy	12	15	10	-5	-33.3%
Geothermal Technology	10	10	10	0	0.0%
Hydropower	11	11	0	-11	-100.0%
Total, Office of Scientific and Technical Information	33	36	20	-16	-44.4%
Washington Headquarters					
Biomass and Biorefinery Systems R&D	50,074	54,276	27,159	-27,117	-50.0%
Wind Energy	2424	7,504	6,509	-995	-13.3%
Program Direction	13,104	14,393	13,130	-1,263	-8.8%
Geothermal Technology	11,491	13,869	11,179	-2,690	-19.4%
Hydropower	1,887	1,831	150	-1,681	-91.8%

	FY 2004	FY 2005	FY 2006	$ Change	% Change
Hydrogen Technology	59,706	69,543	69,591	+48	+0.1%
Departmental Energy Management Program	1,963	1,951	2,019	+68	+3.5%
Solar Energy	7,634	18,716	9,022	-9,694	-51.8%
Intergovernmental Activities	11,279	12,631	7,610	-5,021	-39.8%
Renewable Program Support	8,493	5,954	2,901	-3,053	-51.3%
Total, Washington Headquarters	168,055	200,668	149,270	-51,398	-25.6%
Total, Washington Headquarters	168,088	200,704	149,290	-51,414	-25.6%
Western Area Power Administration					
Wind Energy	150	125	125	0	0.0%
Western Regional Office					
Wind Energy	100	160	150	-10	-6.3%
Program Direction	0	0	147	+147	NA
Solar Energy	0	50	50	0	0.0%
Total, Western Regional Office	100	210	347	+137	+65.2%
Total, Energy Supply	369,421	385,996	353,642	-32,354	-8.4%

(dollars in thousands)

Site Description

Central Regional Office

Introduction

The Central Regional Office is located in Golden, Colorado. The Central Regional Office provides (1) global analytical support to EERE programs; (2) support to the R&D programs by administering grants and cooperative agreements to regional, State, and local organizations, both public and private; and (3) provides direction, guidance, and support deployment and outreach programs on a local and regional level. It provides support to Biomass and Biorefinery Systems R&D, Wind Energy, Program Direction, and Solar Energy.

Biomass and Biorefinery Systems R&D

The Central Regional Office previously provided support to outreach activities on a local and regional level.

Wind Energy

The Central Regional Office provides support deployment and outreach programs on a local and regional level.

Program Direction

Program Direction funds the salary, benefits, and travel costs for 1 FTE in each Regional Office in order to support: (1) promotion of EERE renewable energy and hydrogen programs at the local and regional levels; (2) administration of grants to, and cooperative agreements with, States and local governments; and (3) administration and implementation of locally- and regionally-focused deployment activities, such as Million Solar Roofs, Wind Powering America, etc.

Solar Energy

The Central Regional Office helps to administer the Million Solar Roofs Initiative.

Chicago Operations Office

Argonne National Laboratory

Introduction

Argonne National Laboratory (ANL) is located in Argonne, Illinois. It is a multi-discipline laboratory providing support to Biomass and Biorefinery Systems R&D, Wind Energy, Hydrogen Technology, and Intergovernmental Activities.

Biomass and Biorefinery Systems R&D

ANL conducts research on biomass conversion processes and environmental benefits analysis for several EERE programs, including energy balance and emissions for biofuels in conventional and advanced vehicles with and without fuel cells.

Wind Energy

ANL is preparing a programmatic environmental impact statement for wind energy development on Federal Land.

Hydrogen Technology

ANL is conducting research and development of advanced hydrogen storage concepts including modeling of storage systems and life cycle analyses.

Intergovernmental Activities

Funding to ANL supports international activities, primarily in the Asia-Pacific Economic Cooperation (APEC) area by providing technical assistance and support to the program's APEC related projects.

Brookhaven National Laboratory

Introduction

Brookhaven National Laboratory (BNL) is located in Upton, New York. It is a multi-disciplinary research laboratory and is dedicated to basic, non-defense scientific research. It provides support for Geothermal Technology, Hydrogen Technology, and Solar Energy.

Geothermal Technology

BNL supports System Development research activities in advanced drilling and energy conversion research, including drilling materials, high temperature elastomers, and silica recovery from geothermal brines.

Hydrogen Technology

Brookhaven is providing support to Hydrogen Technology; specifically, development of advanced metal hydride hydrogen storage concepts.

Solar Energy

BNL performs research and development for the Photovoltaic Energy Systems efforts. BNL has the responsibility for environmental, health, and safety (ES&H) impacts associated with photovoltaic energy production, delivery, and use. BNL conducts ES&H audits, safety reviews, and incident investigations and assists industry to identify and examine potential ES&H barriers and hazard control strategies for new photovoltaic materials, processes, and application options before their large-scale commercialization.

Lawrence Berkeley National Laboratory

Introduction

Lawrence Berkeley National Laboratory (LBNL) is located in Berkeley, California. It is a multi-discipline laboratory providing support to Biomass and Biorefinery Systems R&D, Wind Energy, Geothermal Technology, and Intergovernmental Activities.

Biomass and Biorefinery Systems R&D

LBNL previously provided analytical support to the program.

Wind Energy

LBNL performs analyses of opportunities for Wind Energy applications in the restructured electricity market and administers various utility restructuring activities under the new electricity reliability office. In support of utility restructuring, LBNL conducts policy and technical analyses on utility regulatory policies at the State and Federal levels. LBNL provides technical support to State organizations such as the public utility commissions and state energy offices on utility restructuring issues. LBNL provides guidance and support to the private and public market components of the utility industry, including the energy services industry, regional market transformation consortia, and public and private utilities.

Geothermal Technology

LBNL performs research on Enhanced Geothermal Systems and exploration technology including studies of reservoir dynamics and seismic, isotopic, and electromagnetic exploration techniques.

Intergovernmental Activities

LBNL performs on-going research and technical assistance for the International Renewable Energy Program, including technical assistance for U.S.-China energy cooperation, and support for Collaborative Labeling and Appliance Standards Projects (CLASP).

National Renewable Energy Laboratory

Introduction

The National Renewable Energy Laboratory (NREL) is located in Golden, Colorado. It is a multi-discipline laboratory providing support to Biomass and Biorefinery Systems R&D, Wind Energy, Facilities and Infrastructure, Geothermal Technology, Hydropower, Hydrogen Technology, Solar Energy, and Intergovernmental Activities.

Biomass and Biorefinery Systems R&D

NREL is the lead laboratory for biomass R&D. NREL also develops analytical methodologies (chemical and life-cycle) that are used to facilitate industry's commercialization efforts, including economic assessment of technologies. NREL operates two user facilities, the Thermochemical Users Facility (TCUF) for syngas technologies, and the Alternative Fuels Users Facility (AFUF) for bioconversion technologies. Private sector participants may use the facilities after appropriate arrangements are made.

Wind Energy

NREL is the lead laboratory for national wind R&D, performing research in aerodynamics, structural dynamics, and advanced components and control systems related to wind energy. The National Wind Technology Center (NWTC), located at NREL, provides research and testing facilities for fatigue testing of turbine blades, dynamometer testing of wind turbine drive trains and generators, atmospheric testing of turbines, and certification testing which are required for sales and operation in many overseas markets. NWTC staff also conducts the Department's cost-shared Wind Turbine Research partnerships with industry.

Facilities and Infrastructure

The Facilities and Infrastructure Program provides funding for plant and capital equipment (PCE) which provides routine upgrades of the laboratory's office, research and user facilities. The program also supports major construction projects, such as the Science Technology Facility that began construction in FY 2004.

Geothermal Technology

NREL serves as the lead laboratory for Advanced Power System under Systems Development. The laboratory also supports in the Deployment areas of education, outreach and Technical Analysis.

Hydropower

NREL conducts hydropower/renewable energy integration studies and hydropower outreach activities.

Hydrogen Technology

NREL serves as the lead laboratory in research and development of technologies using renewable resources that will offer longer-term solutions to the production and storage of hydrogen. NREL is conducting research and development on material systems for the storage of hydrogen using carbon nanotubes and the photoelectrochemical production of hydrogen using semiconductors. NREL is also conducting research and development to engineer biological organisms and photoelectrochemical systems to split water into hydrogen and oxygen and the conversion of biomass to hydrogen. Additionally, NREL designs new processes and facilities to produce and use hydrogen through engineering calculations and cost evaluations, and provides key technical expertise for codes and standards development.

Solar Energy

NREL is the lead laboratory for the Solar Energy Technology Program. NREL conducts fundamental and applied materials research on photovoltaic devices, photovoltaic module reliability and systems development, data collection and evaluation on solar radiation, and implementation of cost-shared government/industry partnerships. Basic research teams investigate a variety of photovoltaic materials, such as amorphous silicon, polycrystalline thin films, high-efficiency materials and concepts, and high-purity silicon and compound semiconductors. NREL conducts simulated and actual outdoor tests on photovoltaic cells, modules, and arrays. The test results are used in developing standards and performance criteria for industry and to improve reliability. NREL serves as the lead laboratory for the Solar Heating and Lighting activity and has a major role in the Concentrating Solar Power activity. NREL supports this by conducting technical analyses and design, experimentation, and managing technical tasks and subcontracts to universities and industry. NREL's technical responsibilities include the development of low-cost solar collectors for water or space heating, trough R&D, parabolic dish reliability, concentrating photovoltaic system R&D, and materials research. In addition, NREL coordinates related technical activities with the Sandia National Laboratories.

Intergovernmental Activities

NREL provides technical assistance to the transfer of renewable energy and energy efficiency technologies to Native American tribal lands and to the international deployment of renewable energy technologies. NREL is also the lead laboratory for the International Renewable Energy Programs (e.g., Global Village Energy Partnership (GVEP), Climate Energy Technology Export Initiative (CETE) seeking to mobilize private investment in clean energy technologies identified as climate change and development priorities by key developing and transition countries. NREL participates in providing technical assistance in identifying and developing energy policies that will reduce greenhouse gas emissions and contribute to development goals through accelerated deployment of renewable energy and energy efficiency technologies. In addition, NREL works cooperatively with the private sector.

Pacific Northwest National Laboratory

Introduction

Pacific Northwest National Laboratory (PNNL) is located in Richland, Washington. It is a multi-discipline laboratory providing support to Biomass and Biorefinery Systems R&D, Wind Energy, Hydropower, Hydrogen Technology, and Intergovernmental Activities.

Biomass and Biorefinery Systems R&D

PNNL provides thermochemical research and development in support of the syngas platform and related products.

Wind Energy

PNNL supported cross-cutting analysis.

Hydropower

PNNL provides biological, environmental analysis and testing support for the Hydropower Technology Program. PNNL has designed and fabricated test equipment to simulate turbine-induced physical stresses on fish, and will be using this test equipment for assessing the environmental performance of fish-friendly turbines.

Hydrogen Technology

PNNL is the lead laboratory in the development of safety materials and systems for various end use applications. PNNL performs research and development tasks such as hydrogen storage and other technical support to address safety issues involved with various technologies, including underground storage, pipeline transmission and hydrogen sensing.

Intergovernmental Activities

PNNL performs on-going research and technical assistance for the International Renewable Energy Program (IREP), including technical assistance for international renewable energy activities in Africa, China, and Russia.

Golden Field Office

Introduction

The Golden Field Office (GO) is located in Golden, Colorado. It provides project management and procurement support for Wind Energy, Program Direction, and Hydropower.

Program Direction

Enables GO to provide program direction, guidance, and support. GO serves as a central Project Management Office (PMO) to EERE. Activities previously performed at other Operations Offices are being consolidated at GO.

Idaho Operations Office

Idaho National Engineering and Environmental Laboratory

Introduction

Idaho National Engineering Laboratory (INEEL) is located in Idaho Falls, Idaho. It is a multi-discipline laboratory providing support to Biomass and Biorefinery Systems R&D, Wind Energy, Geothermal Technology, Hydropower, and Hydrogen Technology.

Biomass and Biorefinery Systems R&D

INEEL provides biomass-related R&D services and support for the feedstock infrastructure development effort. This work is performed in close collaboration with ORNL and NREL.

Wind Energy

INEEL provides technical support to the program on government and military applications of wind energy.

Geothermal Technology

INEEL serves as the lead laboratory for research and development in geosciences. INEEL conducts research in exploration technologies, Enhanced Geothermal Systems, and advanced heat and power systems.

Hydropower

INEEL provides engineering and technical support to the Hydropower Program. INEEL serves as the engineering technical monitor for the Advanced Hydro Turbine Technology Subprogram and the Tribal Energy hydropower projects located in Alaska, and conducts hydropower resource and economic assessments.

Hydrogen Technology

INEEL performed research in the area of high temperature steam electrolysis using high temperature waste heat from next generation nuclear reactor technology. (This technology can achieve significantly higher efficiencies than standard water electrolysis for the production of hydrogen).

Livermore Site Office

Lawrence Livermore National Laboratory

Introduction

Lawrence Livermore National Laboratory (LLNL) is located in Livermore, California. It is a multi-discipline laboratory providing support to Geothermal Technology and Hydrogen Technology.

Geothermal Technology

LLNL conducts research and development in Enhanced Geothermal Systems and exploration technology, including isotope and geochemical studies.

Hydrogen Technology

LLNL serves as the lead laboratory in research and development of a high temperature solid oxide electrolyzer and two different systems for pressurized gas storage of hydrogen. LLNL is capable of producing composite storage tanks for environmental testing to verify the advantages of various engineering concepts to increase the storage capacity while reducing the cost of manufacturing.

Los Alamos Site Office

Los Alamos National Laboratory

Introduction

Los Alamos National Laboratory (LANL) is located in Los Alamos, New Mexico. It is a multi-discipline laboratory providing support to Hydrogen Technology.

Hydrogen Technology

LANL is conducting research and development of advanced hydrogen storage concepts supporting chemical hydrogen storage.

Mid-Atlantic Regional Office

Introduction

The Mid-Atlantic Regional Office provides (1) global analytical support to EERE programs; (2) support to the R&D programs by administering grants and cooperative agreements to regional, State, and local organizations, both public and private; and (3) provides direction, guidance, and support deployment and outreach programs on a local and regional level. They are located in Philadelphia, Pennsylvania. It provides support to Wind Energy, Program Direction, and Solar Energy.

Wind Energy

The Mid-Atlantic Regional Office provides support deployment and outreach programs on a local and regional level.

Program Direction

Program Direction funds the salary, benefits, and travel costs for 1 FTE in each Regional Office in order to support: (1) promotion of EERE renewable energy and hydrogen programs at the local and regional levels; (2) administration of grants to, and cooperative agreements with, States and local governments; and (3) administration and implementation of locally- and regionally-focused deployment activities, such as Million Solar Roofs, Wind Powering America, etc.

Solar Energy

The Mid-Atlantic Regional Office helps to administer the Million Solar Roofs Initiative.

Midwest Regional Office

Introduction

The Midwest Regional Office provides (1) global analytical support to EERE programs; (2) support to the R&D programs by administering grants and cooperative agreements to regional, State, and local organizations, both public and private; and (3) provides direction, guidance, and support deployment and outreach programs on a local and regional level. Chicago Regional Office is located in Chicago, Illinois. It supports Solar Energy, Wind Energy, and Program Direction.

Solar Energy

The Midwest Regional Office helps to administer the Million Solar Roofs Initiative.

Wind Energy

The Midwest Regional Office provides support deployment and outreach programs on a local and regional level.

Program Direction

Program Direction funds the salary, benefits, and travel costs for 1 FTE in each Regional Office in order to support: (1) promotion of EERE renewable energy and hydrogen programs at the local and regional levels; (2) administration of grants to, and cooperative agreements with, States and local governments; and (3) administration and implementation of locally- and regionally-focused deployment activities, such as Million Solar Roofs, Wind Powering America, etc.

National Energy Technology Laboratory

Introduction

The National Energy Technology Laboratory (NETL) is located in Morgantown, West Virginia. It provides procurement support to Biomass and Biorefinery Systems R&D, Wind Energy, Geothermal Technology, Hydrogen Technology.

Biomass and Biorefinery Systems R&D

NETL assisted the program in outreach activities related to biomass technologies.

Wind Energy

NETL administers financial assistance agreements for wind energy technical assistance and outreach efforts.

Geothermal Technology

The State Energy Program Special Project funding goes through the Regional Office (RO), and the contracting for the RO is being conducted by NETL.

Hydrogen Technology

In accordance with a Memorandum of Agreement with the Office of Fossil Energy, NETL co-manages hydrogen research and development efforts to improve the efficiency and lower the cost of fossil-based hydrogen production processes. Collaboration also occurs with the Office of Fossil Energy and NETL for producing hydrogen from coal. Specifically, NETL researchers will be developing separation and purification methods critical to producing high quality hydrogen used in fuel cells.

National Nuclear Security Administration's (NNSA) Service Center

Introduction

The NNSA Service Center is located in Albuquerque, New Mexico. It is a multi-discipline Service Center providing support to Solar Energy.

Solar Energy

The NNSA Service Center administers the cooperative agreements for the Southeast and Southwest Regional Experiment Stations for Solar Energy. The NNSA Service Center is responsible for funding solar research and analysis activities performed at the Southwest and Southeast Regional Energy Stations.

Northeast Regional Office

Introduction

The Northeast Regional Office provides (1) global analytical support to EERE programs; (2) support to the R&D programs by administering grants and cooperative agreements to regional, State, and local organizations, both public and private; and (3) provides direction, guidance, and support deployment and outreach programs on a local and regional level. It is located in Boston, Massachusetts and supports Wind Energy, Program Direction, and Solar Energy.

Oak Ridge Operations Office

Oak Ridge National Laboratory

Introduction

Oak Ridge National Laboratory (ORNL) is located in Oak Ridge, Tennessee. It is a multi-disciplinary laboratory providing support to Biomass and Biorefinery Systems R&D, Wind Energy, Hydropower, Hydrogen Technology, Solar Energy, and Intergovernmental Activities.

Biomass and Biorefinery Systems R&D

ORNL conducts biomass technologies R&D, evaluates harvesting technology for biomass, and conducts environmental research, residue and forests research, and resource and market analysis. These efforts are closely coordinated with INEEL and NREL.

Wind Energy

ORNL provides analysis and support to wind integration studies and applications.

Hydropower

ORNL provides biological and environmental analysis and testing support for the DOE Hydropower Program. ORNL has the primary responsibility for environmental mitigation studies and for developing the large hydropower turbine testing protocol.

Hydrogen Technology

ORNL performs research and development activities in photobiology and storage in support of the lead labs, NREL and Sandia National Laboratories. ORNL has collaborated with NREL and UC Berkeley to develop a microalgae system for the production of hydrogen. ORNL is using their expertise to integrate engineered biological systems from NREL and UC Berkeley into a base organism that directly produces hydrogen.

Solar Energy

ORNL is the primary laboratory responsible for conducting hybrid solar lighting R&D for the Solar Program. This includes conducting research into sunlight transmission through fiber optics; designing and testing systems that collect the sunlight, transfer it into fiber optics, and then distribute the sunlight into rooms; and coordinating industrial partners interested in commercializing the technology.

Intergovernmental Activities

In the International Renewable Energy Program, ORNL has senior responsibility for providing technical assistance to developing countries in the Asia-Pacific region. This assistance includes training in the use of various models for analyzing various options for mitigating and sequestering greenhouse gas emissions.

Sandia Site Office

Sandia National Laboratories

Introduction

Sandia National Laboratories (SNL) is located in Albuquerque, New Mexico and in Livermore, California. It is a multi-discipline laboratory providing support to Wind Energy, Geothermal Technology, Hydrogen Technology, Solar Energy, and Intergovernmental Activities.

Wind Energy

SNL Wind Energy Department staff work closely with counterparts at the National Renewable Energy Laboratory to provide the program and the U.S. wind industry with engineering expertise to further the program's knowledge and goals.

Geothermal Technology

SNL serves as the lead laboratory for research and development in drilling under Systems Development. SNL conducts research on diagnostics-while-drilling, drilling measurement and control, drilling hardware development, and design and testing of high-temperature wellbore instrumentation. SNL also manages cost-shared exploration with industry partners under Technology Verification and supports outreach activities under Technology Deployment.

Hydrogen Technology

SNL in California serves as the lead laboratory in the research and development of metal hydride storage materials and systems for various end use applications. SNL is capable of producing metal hydride materials for use in research and validation projects. SNL also serves as the lead for the design, implementation, and testing of hydrogen systems to verify building codes and equipment standards for many applications.

Solar Energy

SNL supports the Photovoltaic Energy Systems efforts with the principal responsibility for systems and balance-of-systems technology development and reliability. Indoor and outdoor measurement and evaluation facilities provide support to industry for cell, module, and systems measurement, evaluation, and analysis. Systems-level work concentrates on application engineering reliability, database development, and technology transfer. SNL is the lead laboratory for the Concentrating Solar Power activity. SNL's technical responsibilities include power tower R&D, dish R&D, and the management of technical tasks and subcontracts to industry and universities. SNL also has responsibilities within the Solar Heating and Lighting activity, providing technical support to the solar industry and homebuilders.

Intergovernmental Activities

SNL provides technical assistance to the transfer of renewable energy and energy efficiency technologies to Native American tribal lands and to the international deployment of renewable energy technologies. Sandia also supports International Renewable Energy activities in Latin America seeking to mobilize private investment in clean energy technologies.

Savannah River National Laboratory

Introduction

Savannah River National Laboratory is located in Aiken, South Carolina. It is a multidisciplinary research laboratory that provides support to Hydrogen Technology.

Hydrogen Technology

Savannah River is leveraging its history and expertise in understanding the properties of hydrogen and its effects on materials. It is a key element of DOE's metal hydride hydrogen storage research program. Savannah River is capable of producing metal hydride materials for use in research and validation projects.

Southeast Regional Office

Introduction

The Southeast Regional Office provides (1) global analytical support to EERE programs; (2) support to the R&D programs by administering grants and cooperative agreements to regional, State, and local organizations, both public and private; and (3) provides direction, guidance, and support deployment and outreach programs on a local and regional level. It is located in Atlanta, Georgia. It supports Wind Energy, Program Direction, and Solar Energy.

Wind Energy

The Southeast Regional Office provides support deployment and outreach programs on a local and regional level.

Program Direction

Program Direction funds the salary, benefits, and travel costs for 1 FTE in each Regional Office in order to support: (1) promotion of EERE renewable energy and hydrogen programs at the local and regional levels; (2) administration of grants to, and cooperative agreements with, States and local governments; and (3) administration and implementation of locally- and regionally-focused deployment activities, such as Million Solar Roofs, Wind Powering America, etc.

Solar Energy

The Southeast Regional Office helps to administer the Million Solar Roofs Initiative.

Washington Headquarters

Office of Scientific and Technical Information

Introduction

Office of Scientific and Technical Information (OSTI) is located in Oak Ridge, Tennessee. It provides technical support for Wind Energy, Geothermal Technology, and Hydropower.

Wind Energy

OSTI distributes technical information for the program, including publishing and maintaining on-line full text of electronic current awareness publications.

Geothermal Technology

OSTI distributes information for the Geothermal Technology Program including publishing, digitizing of legacy documents, and maintaining on-line full text of electronic publications.

Hydropower

OSTI distributes information for the Hydropower Program, including publishing and maintaining on-line full text of electronic current awareness publications.

Washington Headquarters

Introduction

Washington, D.C. is the headquarters for the Office of Energy Efficiency and Renewable Energy operations. The Headquarters operations provides specialized, technical expertise in planning, formulation, execution, and evaluation, in order to support the responsible guidance and management of the budget. In addition, competitive Program Announcements and solicitations are planned and implemented through Headquarters. It provides support to Biomass and Biorefinery Systems R&D, Wind Energy, Program Direction, Geothermal Technology, Hydropower, Hydrogen Technology, Departmental Energy Management Program, Solar Energy, Intergovernmental Activities, and Renewable Program Support.

Western Area Power Administration

Introduction

Western Area Power Administration (WAPA) is located in Lakewood, Colorado. It is a multi-region power-making agency that is providing support to Wind Energy.

Wind Energy

WAPA is conducting analysis of integrating wind into its power system, including assessment of opportunities for coordinating operation with its hydropower assets.

Western Regional Office

Introduction

The Western Regional Office provides (1) global analytical support to EERE programs; (2) support to the R&D programs by administering grants and cooperative agreements to regional, State, and local organizations, both public and private; and (3) provides direction, guidance, and support deployment and outreach programs on a local and regional level. Western Regional Office is located in Seattle, Washington and provides support to Wind Energy, Program Direction, and Solar Energy.

Wind Energy

The Western Regional Office provides support deployment and outreach programs on a local and regional level.

Program Direction

Program Direction funds the salary, benefits, and travel costs for 1 FTE in each Regional Office in order to support: (1) promotion of EERE renewable energy and hydrogen programs at the local and regional levels; (2) administration of grants to, and cooperative agreements with, States and local governments; and (3) administration and implementation of locally- and regionally-focused deployment activities, such as Million Solar Roofs, Wind Powering America, etc.

Solar Energy

The Western Regional Office helps to administer the Million Solar Roofs Initiative.

Hydrogen Technology

Funding Profile by Subprogram[a]

(dollars in thousands)

	FY 2004 Comparable Appropriation	FY 2005 Original Appropriation	FY 2005 Adjustments	FY 2005 Comparable Appropriation	FY 2006 Request
Hydrogen Technology					
Production and Delivery R&D	10,083	14,333	-115[b]	14,218	32,173
Storage	13,174	23,845	-191[c]	23,654	29,890
Infrastructure Validation	5,784	9,560	-76[d]	9,484	14,945
Safety and Codes and Standards	5,615	6,002	-48[e]	5,954	13,121
Education[f]	2,417	0	0	0	1,881
Systems Analysis[f]	1,372	3,993	-589[g]	3,404	7,084
Congressionally Directed Activities	41,967	37,592	-300[h]	37,292	0
Total, Hydrogen Technology	80,412	95,325	-1,319	94,006	99,094

Public Law Authorizations:

P.L. 95-91, "Department of Energy Organization Act" (1977)
P.L. 96-294, "Energy Security Act" (1980)
P.L. 101-566, "Spark M. Matsunaga, Hydrogen Research, Development, and Demonstration Act of 1990" (1990)
P.L. 102-486, "Energy Policy Act of 1992, Section 2026" (1992)
P.L. 104-271, "Hydrogen Future Act of 1996" (1996)

[a] SBIR/STTR funding in the amount of $892,000 was transferred to the Science Appropriation in FY 2004. Estimates for SBIR/STTR budgeted in FY 2005 and FY 2006 are $1,219,000 and $1,986,000 respectively.
[b] Reflects the 0.80% rescission of -$115,000.
[c] Reflects the 0.80% rescission of -$191,000.
[d] Reflects the 0.80% rescission of -$76,000.
[e] Reflects the 0.80% rescission of -$48,000.
[f] In the FY04 and FY05 budgets, Education and Cross-cutting (now Systems Analysis) were grouped into one key activity. The activities have been separated in the FY06 budget.
[g] Reflects the 0.80% rescission of -$23,000 and comparability adjustment for Cross-cutting Planning, Analysis and Evaluation of -$566,000.
[h] Reflects the 0.80% rescission of -$300,000.

Mission

Hydrogen Technology is part of the overall integrated Hydrogen, Fuel Cells and Infrastructure Technologies Program (HFCIT) in DOE's Office of Energy Efficiency and Renewable Energy.[a] The mission of the integrated HFCIT Program is to research, develop, and validate fuel cell and hydrogen production, delivery, and storage technologies. The program aims to have hydrogen from diverse domestic resources used in a clean, safe, reliable, and affordable manner in fuel cell vehicles and stationary power applications.

Benefits

Hydrogen Technology is a key component of the President's Hydrogen Fuel Initiative and contributes to the goals of DOE's FreedomCAR budget crosscut. In turn, both FreedomCAR and the Hydrogen Fuel Initiative support the Nation moving forward to achieve the vision of a diverse, secure, and emissions-free energy future. Together, the Hydrogen Fuel Initiative and FreedomCAR will facilitate a decision by industry to commercialize hydrogen-powered fuel cell vehicles in the year 2015. Widespread commercialization of hydrogen-powered vehicles will support our national security interests by significantly reducing our reliance on foreign oil. To the extent that hydrogen is produced from domestic resources in an environmentally sound manner, Hydrogen Technology will provide a significant environmental benefit for the Nation. Research undertaken by Hydrogen Technology is targeted to enable cost competitive hydrogen production from renewables and natural gas and to provide storage technology that enables greater than 300 mile driving range for vehicles.

In November of 2003, the DOE launched the International Partnership for the Hydrogen Economy agreed to by 15 nations and the European Union, in pursuit of hydrogen as a transportation system reality by 2020. In February 2004, the Department released its DOE Hydrogen Posture Plan, which outlines the Department's role in hydrogen energy research and development. When hydrogen-powered fuel cell vehicles are introduced in substantial numbers, the oil savings and other benefits to the Nation are expected to be significant.

Strategic and Program Goals

The Department's Strategic Plan identifies four strategic goals (one each for defense, energy, science, and environmental aspects of the mission) plus seven general goals that tie to the strategic goals. The Hydrogen Technology Program supports the following goal:

Energy Strategic Goal

General Goal 4, Energy Security: Improve energy security by developing technologies that foster a diverse supply of reliable, affordable, and environmentally sound energy by providing for reliable delivery of energy, guarding against energy emergencies, exploring advanced technologies that make a fundamental improvement in our mix of energy options, and improving energy efficiency.

The Hydrogen Technology Program has one program goal which contributes to General Goal 4 in the "goal cascade:"

---

[a] The integrated HFCIT Program receives funding from the Energy Supply (for Hydrogen Technology) and Energy Conservation (for Fuel Cell Technologies) appropriations. This budget description is for the Hydrogen Technology portion of the integrated HFCIT Program.

Program Goal 04.01.00.00: Hydrogen Technology: Develop hydrogen production, delivery and storage technologies to the point that they are cost and performance competitive and are being used by the Nation's transportation, energy, and power industries. Development of these technologies will also make our clean domestic energy supplies more flexible, dramatically reducing or even ending dependence on foreign oil.

Contribution to Program Goal 04.01.00.00 (Hydrogen Technology)

The key Hydrogen Technology contribution to General Goal 4, Energy Security, is production of domestic supplies through:

- Production and delivery R&D for market-based technologies that will reduce the cost of producing hydrogen from renewables from $6.20/gge in 2003 to $2.85/gge untaxed at the station (5000 psi) by 2010;[a]

- Production and delivery R&D for market-based technologies that will reduce the cost of producing hydrogen from natural gas (distributed) from $5.00/gallon of gasoline equivalent (gge) in FY 2003 to $1.50/gge (at 5,000 psi) in FY 2010 untaxed at the station with high equipment manufacturing volumes (e.g. hundreds of units/year);

- Storage R&D to develop and demonstrate commercially-viable hydrogen storage technology that enables greater than 300-mile vehicle driving range. Specifically, develop and demonstrate by 2010 a hydrogen storage technology with capacity of 2.0 kWh/kg (6 weight percent), compared to 0.5-1.3 kWh/kg in 2003, and 1.5 kWh/l (kilowatt-hours per liter), compared to 0.5-0.6 kWh/l in 2003;

- Education activities that will significantly increase the number of students, teachers, and local and state government representatives, and large scale end-users who understand the concept of a hydrogen economy. The program expects to achieve a four-fold increase in the number of students, teachers, and local and state government representatives, and a two-fold increase in the number of large scale end users, who understand the concept of a hydrogen economy and how it may affect them by 2011 (relative to 2004 survey results), thus accelerating the market adoption of hydrogen-based technology;

- Validation of infrastructure technology at full scale to achieve the target cost of hydrogen production and delivery at the station. Specifically, to validate infrastructure and vehicle interface technologies in 2009 at full scale with a cost of $3.00 per gallon gasoline equivalent with 68 percent well-to-pump efficiency; and

- Underlying research for safety and codes and standards that will enable preparation of a global technical regulation (GTR) for hydrogen fuel cell vehicles and infrastructure (GTR expected to be submitted in draft in 2008; approval anticipated in 2010). Global consistency in standards will ensure that different technologies need not be developed for each region of the world.

---

[a] Basis of renewable hydrogen production target changed from biomass to electrolysis in response to the National Research Council's recommendation to increase emphasis on electrolysis technology development.

Annual Performance Results and Targets

FY 2001 Results	FY 2002 Results	FY 2003 Results	FY 2004 Results	FY 2005 Targets	FY 2006 Targets
Program Goal 04.01.00.00 (Hydrogen Technology)					
Hydrogen Technology/Production and Delivery R&D: Renewables					
			Complete research for biomass syngas reforming catalysts to improve durability and reduce cost towards achieving 5,000 psi hydrogen produced for $5.70/gallon of gasoline equivalent (untaxed, modeled cost) at the station by 2005. [MET]	Model cost of hydrogen produced from renewables and assess versus the 2010 target of $2.85/gge, untaxed at the station at 5000 psi.	Complete fabrication of lab-scale electrolyzer, and test whether it achieves 64% energy efficiency and meets the 2006 system-level targets of $5.50/gge hydrogen cost.
Hydrogen Technology/Production and Delivery R&D: Non-Renewables					
	Complete construction of a prototype hydrogen generator with ceramic membrane for production and purification of hydrogen from natural gas.		Complete research for natural gas-to-hydrogen production and dispensing component development and fabrication towards achieving 5,000 psi hydrogen for $3.00/gge (untaxed and without co-production of electricity) at the station in 2006. [MET]	Complete the research for a distributed natural gas-to-hydrogen production and dispensing system that can produce 5,000 psi hydrogen for $3.00/gge (untaxed and without coproducing electricity) at the station in 2006.	Complete the development of a laboratory scale distributed natural gas-to-hydrogen production and dispensing system that can produce 5,000 psi hydrogen for $3.00/gge.
Hydrogen Technology/Storage: Solid State					
			Complete draft of standard test protocol and construction of test facility for solid-state hydrogen storage materials in support of the targets of 1.2 kWh/l and 4.5 wt. percent and the 2010 targets of 2.0kWh/kg (6 wt. percent), 1.5 kWh/l at $4/kWh. [MET]	Identify materials with the potential to meet 2010 targets of 2.0 kWh/kg (6 wt percent), 1.5 kWh/l, at $4/kWh.	Complete fabrication and testing of prototype metal hydride system, evaluate against target of 1.2 kWh/kg (3.5 wt.%), and complete preliminary design of system with potential to meet 2010 targets (2.0 kWh/kg [6 wt.%], 1.5 kWh/l).
Hydrogen Technology /Storage: Tanks					
		Complete design of the 5,000 psi cryogenic-gas tank and 10,000 psi compressed gas tank to achieve 1.3 kWh/kg and 0.6 kWh/l. [Met]	Complete development of 5,000 psi cryo-gas tank and 10,000 psi compressed gas tank achieving 1.3 kWh/kg and 0.8 kWh/l. [MET]	Complete testing of 10,000 psi hydrogen storage tanks evaluating against the hydrogen storage system target of 1.5 kWh/kg (4.5 weight percent), and identify approaches to meet the cost target of $6/KWh.	
Hydrogen Technology/Infrastructure and Validation					
		Verify low electricity and	Identify and complete feasibility	Complete validation of an	Complete installation and 1,000

FY 2001 Results	FY 2002 Results	FY 2003 Results	FY 2004 Results	FY 2005 Targets	FY 2006 Targets
		hydrogen production cost (<$.08/kWh and <$3.60/gal equivalent untaxed when produced in quantity) through cost shared operation of a 50kWe stationary fuel cell and hydrogen co-production facility for six months. [Met]	and system design of an isothermal compressor to be incorporated in hydrogen refueling stations to produce hydrogen at $3.00/gge by 2009. [MET]	energy station that can produce 5,000 psi hydrogen from natural gas for $3.60 per gallon of gasoline equivalent (including co-production of electricity) untaxed at the station with mature equipment production volumes (e.g., 100 units/year).	hours of testing a refueling station; determine system performance, fuel quality and availability; and demonstrate the ability to produce 5,000 psi hydrogen from natural gas for $3.00 per gallon of gasoline equivalent, untaxed at the station, and with large equipment production volumes [e.g., 100 units/year]) by 2009.
Hydrogen Technology: Education					
			Determine the baseline level of knowledge and develop a plan for educating target audiences (students and teachers, state and local governments, and large-scale end-users nationwide). [MET]		
Hydrogen Technology: Systems Analysis					
			Define requirements for system analysis and integration to link the program's technical objectives to cost and schedule. [MET]		Develop, peer review and issue Hydrogen Systems Analysis Plan.
Hydrogen Technology/Safety and Codes and Standards					
			Complete the harmonized technical standard for high pressure vehicle storage that can be incorporated into a regulation (i.e. incorporating the various standards of different countries into a single regulation) for hydrogen storage. Complete the draft technical standard for vehicular safety. [MET]		Characterize large-leak releases of hydrogen and develop model to validate experiments to within 25 % of expected value.
Hydrogen Technology/Efficiency					

FY 2001 Results	FY 2002 Results	FY 2003 Results	FY 2004 Results	FY 2005 Targets	FY 2006 Targets
			Contribute proportionately to EERE's corporate goal of reducing corporate and program uncosteds to a range of 20-25 percent by reducing program annual uncosteds by 10 percent in 2004 relative to the program uncosted baseline (2003) until the target range is met.	*Contribute proportionately to EERE's corporate goal of reducing corporate and program adjusted uncosted obligated balances to a range of 20-25 percent by reducing program annual adjusted uncosteds by 10 percent in 2005 relative to the Hydrogen/Fuel Cell Program FY 2004 end of year adjusted uncosted baseline ($29,283K) until the target range is met.*	*Contribute proportionately to EERE's corporate goal of reducing corporate and program adjusted uncosteds to a range of 20-25 percent by reducing program annual uncosteds by 10 percent in 2006 relative to the program uncosted baseline (2005) until the target range is met.* *Maintain total program management costs in relation to total Program costs in the range of 8% - 12% to demonstrate efficient and effective EERE-wide business and technical support to mission direct programs.*

Means and Strategies

Hydrogen Technology will use various means and strategies to achieve its program goals as described below. "Means" include operational processes, resources, information, and the development of technologies, and "strategies" include program, policy, management and legislative initiatives and approaches. Various external factors, as listed below, may impact the ability to achieve the program's goals. Collaborations are integral to the planned investments, means and strategies, and to addressing external factors.

Hydrogen Technology will implement the program through the following means:

- Conduct long-term research, development, and technology validation activities, which are aimed at reducing oil consumption across a range of energy applications and sectors of the economy;
- Develop hydrogen production, delivery and storage technologies to achieve cost, efficiency, and other required targets to meet program goals;
- Conduct infrastructure validation activities in partnership with industry to develop and validate the feasibility of hydrogen generation stations that derive hydrogen from both renewable and fossil fuels for stationary and transportation fuel cell systems;
- Conduct research for safety and codes and standards, focused on ensuring the safety aspects of hydrogen technologies and enabling widely accepted codes and standards. Enabling effective codes and standards requires a substantial and verified database of scientific information on hydrogen properties. DOE will coordinate with and assist DOT and other code developing entities by providing this experimental database from research projects and the DOE "learning" demonstration project;
- Develop systems models and make trade-off analyses to direct effective technology decisions; and
- Develop and distribute educational materials and training to facilitate the transition to a hydrogen economy.

Hydrogen Technology will implement the program through the following strategies:

- Implement the Department's planning documents including the DOE Hydrogen Posture Plan (which outlines the Department's role in hydrogen energy research and development), the HFCIT Multi-year Research, Development and Demonstration Plan (which establishes technical targets and schedules to address key technology barriers) and the National Hydrogen Energy Roadmap (which lays out research and development pathways to guide hydrogen and fuel cell R&D.);
- Perform formal merit reviews across the Department's portfolio of Hydrogen activities (this process includes the merit review of EERE, Nuclear Energy, Science and Technology (NE), Fossil Energy (FE) and Science (SC) hydrogen and related technologies). The Merit Review evaluation incorporates the principles of the Administration's R&D investment criteria and is conducted in compliance with the Department's Merit Review Guidelines. Additionally, field project managers and technology development managers evaluate progress formally on a quarterly basis;

- Participate in the development of research data to enable uniform codes and standards at the international level to ensure that the U.S. industry can compete globally;
- Use Centers of Excellence for R&D on chemical hydrides, metal hydrides and carbon-based materials to support the solid state storage goal;
- Conduct cross-cutting analyses and focus on life cycle cost, emissions, and efficiency of a broad array of options for hydrogen infrastructure in the near (2015), mid (2030), and long term (post 2050); and
- Conduct research, development and demonstration activities through competitive, cost-shared cooperative agreements with industry and universities.

These means and strategies will result in improving energy security by increasing the generation of reliable, affordable, and environmentally sound hydrogen, adding to the diversity and security of the Nation's energy supply - thus putting the taxpayers' dollars to more productive use.

The following external factors could affect Hydrogen Technology's ability to achieve its strategic goal:

- Congressionally Directed projects that do not contribute to the program's goals;
- Price, performance and availability of alternative technologies and conventional fuels that will compete with hydrogen fueled vehicles will affect the market outcomes;
- Decisions on the nature and timing of supporting policy instruments to help stimulate end-use markets; and
- Public acceptance and concerns regarding the safe use of hydrogen.

In carrying out the program's mission, Hydrogen Technology performs the following collaborative activities:

- Coordinate across four Departmental elements, EERE, NE, FE and SC and the Department of Transportation (DOT) to update the DOE Hydrogen Posture Plan annually to support and coordinate the Department's Hydrogen Fuel Initiative budget request. EERE is the Departmental lead and coordinates research, development and demonstration planning, budget formulation and budget execution activities under the Hydrogen Fuel Initiative.

(dollars in thousands)

Hydrogen Fuel Initiative	FY 2006 Request
Energy Efficiency and Renewable Energy (EERE)	$182,694
Nuclear Energy (NE)	$20,000
Fossil Energy (FE)	$22,000
Office of Science (SC)	$32,500
Subtotal, Department of Energy	$257,194
Department of Transportation (DOT)	$2,350
Total Hydrogen Fuel Initiative	$259,544

- Participate in the Hydrogen R&D Interagency Task Force. The Task Force involves Federal agencies that have hydrogen and fuel cell related activities to leverage and coordinate Federal resources;
- Participate in the International Partnership for a Hydrogen Economy to leverage R&D capabilities globally;
- Coordinate infrastructure validation with vehicle technology validation funded under the Energy Conservation appropriation;
- Work with the DOT, the Environmental Protection Agency (EPA) and the National Institute for Standards and Technology (NIST) on research for safety and codes and standards. Develop an annual coordination plan with DOT that outlines cooperative activities and establishes roles and responsibilities; and
- For activities that support transportation applications, cooperate with the EERE Office of FreedomCAR and Vehicle Technologies. The President's Hydrogen Fuel Initiative and activities in the FreedomCAR budget crosscut are implemented through technical teams, which provide a mechanism for developing requirements and, industry consensus (see Technology goals below), evaluating R&D activities, and providing recommendations for program direction. These technical teams are composed of government and industry experts that meet regularly. The interdependency is depicted in the table that follows.

2010 Hydrogen Fuel Initiative and FreedomCAR Coordinated Technology Goals

The Office of FreedomCAR and Vehicle Technologies has responsibility for these goals:

- Electric Propulsion Systems with a 15-year life capable of delivering at least 55 kW for 18 seconds and 30 kW continuous at a system cost of $12/kW peak.
- Internal Combustion Engine Powertrain Systems costing $30/kW, having a peak brake engine efficiency of 45 percent, and that meet or exceed emissions standards.
- Electric Drive train Energy Storage with 15-year life at 300 Wh with discharge power of 25 kW for 18 seconds and $20/kW.
- Material and Manufacturing Technologies for high volume production vehicles which enable/support the simultaneous attainment of: 50 percent reduction in the weight of vehicle structure and subsystems, affordability, and increased use of recyclable/renewable materials.
- Internal Combustion Engine Powertrain Systems operating on hydrogen with cost target of $45/kW by 2010 and $30/kW in 2015, having a peak brake engine efficiency of 45 percent, and that meet or exceed emissions standards. *(Shared responsibility with HFCIT)*

The Office of Hydrogen, Fuel Cells, and Infrastructure Technologies has responsibility for these goals:

- 60 percent peak energy-efficient, durable direct hydrogen Fuel Cell Power Systems (including hydrogen storage) with 325 W/kg specific power and 220 W/l power density operating on hydrogen. Cost targets are $45/kW by 2010 and $30/kW by 2015.
- Fuel Cell Systems (including an on-board fuel processor) having a peak brake engine efficiency of 45 percent, and that meet or exceed emissions standards with a cost target of $45/kW by 2010 and $30/kW by 2015. This goal is no longer being pursued due to "no-go" decision on the on-board reformer technology pathway.
- Hydrogen Refueling Systems demonstrated with developed commercial codes and standards and diverse renewable and non-renewable energy sources. Targets: 70 percent energy efficiency well-to-pump; cost of energy from hydrogen equivalent to gasoline at market price, assumed to be $1.50 per gallon (2001 dollars).
- Hydrogen Storage Systems demonstrating an available capacity of 6 wt. percent hydrogen, specific energy of 2.0 kWh/kg and energy density of 1.5 kWh/l at a cost of $4/kWh.
- Internal Combustion Engine Powertrain Systems operating on hydrogen with cost target of $45/kW by 2010 and $30/kW in 2015, having a peak brake engine efficiency of 45 percent, and that meet or exceed emissions standards. *(Shared responsibility with FCVT)*

Validation and Verification

To validate and verify program performance, Hydrogen Technology will conduct internal and external reviews and audits. These programmatic activities are subject to continuing review by, for example, the Congress, the General Accounting Office, the Department's Inspector General, the U.S. Environmental Protection Agency, and state environmental agencies. Specific milestones, go/no-go decision points, and technical progress are systematically reviewed through the program's merit review process. The table below summarizes validation and verification activities.

Data Sources: Merit Review and Peer Evaluation of R&D, and Program Peer Reviews are conducted. Engineering models and quarterly reports are used to validate technical targets. Summary program plans are used to evaluate progress towards technical targets.

Baselines: The following are the key baselines used in Hydrogen Technology:

- renewable production (delivered) (2003): $6.20/gge
- non-renewable production (delivered) (2003): $5.00/gge
- electrolysis production efficiency (2003): 62 percent
- compressed hydrogen tank-only storage (2003): 1.3 kWh/kg (3.9% by weight) and 0.6 kWh/l
- solid state materials for storage systems (2003): 0.5 kWh/kg (1.5% by weight) and 0.5 kWh/l
- validated production (delivered) (2004): $3.60/gge
- education (2004): Survey[a]
- Uncosted balance of research resources (2003): $15.6M (out of $31.1M appropriation, subtracting $7M of earmarks) or 50 percent

Frequency: GPRA Benefits are estimated annually, Merit Review and Peer Evaluation of R&D projects are evaluated annually, and Program Peer Review is conducted biennially. Quarterly reports are submitted to DOE Technology Development Managers. Summary program plans are submitted annually.

Data Storage: EERE Corporate Planning System

---

[a] Analysis of a 2004 survey is currently underway to determine the 2004 baseline for number of stakeholders in target audiences educated about hydrogen energy systems.

Evaluation: In carrying out the program’s mission, the HFCIT Program uses several forms of evaluation to assess progress and to promote program improvement.

- Technology validation and operational field measurement, as appropriate
- Peer review by independent outside experts of both the program and subprogram portfolios
- Annual internal Technical Program Review of the HFCIT Program
- Specialized program evaluation studies to examine process, impacts, or market baseline and effects, as appropriate
- Quarterly and annual assessment of program and management results based performance through Joule (the DOE quarterly performance progress review of budget targets), R&DIC (annual internal review of performance planning and management of R&D programs against specific criteria), PMA (the Presidents Management Agenda -- annual departmental and PSO based goals whose milestones are planned, reported and reviewed quarterly) and PART (common government wide program/OMB reviews of management and results).
- Annual review of methods, and recomputations of potential benefits for the Government Performance and Results Act (GPRA)

The National Academies (National Research Council, National Academy of Engineering) have performed an extensive review of the Hydrogen Program and has published a report “Hydrogen Economy: Opportunities, Costs, Barriers and R&D Needs.” The committee’s report indicated the four most fundamental technological and economic challenges are: 1) to develop and introduce cost-effective, durable, safe and environmentally desirable fuel cell systems and hydrogen storage systems; 2) to develop the infrastructure to provide hydrogen for the light-duty vehicle user; 3) to reduce sharply the costs of hydrogen production from renewable energy sources over a time frame of decades; and 4) to capture and store the carbon dioxide byproduct of hydrogen production from coal.

Merit reviews and peer evaluations conducted by energy, hydrogen, and fuel cell experts from outside of the U.S. Department of Energy are held to evaluate the research, development and demonstration projects to ensure that they address the priorities and key technology barriers identified in the HFCIT planning documents.

The HFCIT Program develops and implements planning documents and supports the development of technology roadmaps with industry.[a] These efforts are used to focus the program’s investments on activities that are within the Federal Government’s role and that address top priority needs.

[a] See the following documents: Fuel Cell Report to Congress, Feb. 2003; A National Vision of America’s Transition to a Hydrogen Economy, March 2002; National Hydrogen Energy Roadmap, November 2002; FreedomCAR Fuel Cell Technical Roadmap; HFCITP Multi-Year Research, Development and Demonstration Plan ; Hydrogen Posture Plan; and the National Academies’ Report, “The Hydrogen Economy: Opportunities, Costs, Barriers, and R&D Needs” 2004.

The National Laboratories can receive direct funds to overcome high-risk hydrogen and fuel cell technology research and development barriers, based on their capabilities and performance. In the future, the program plans to evaluate competition issues related to the national laboratories. Industry and universities already receive funding through a competitive process that leads to cost-shared cooperative agreements. Hydrogen and fuel cell industry experts review each university, laboratory and industry project at the annual Merit Review and Peer Evaluation. Consistent with the principles of the Administration's R&D Investment Criteria, project peer reviews include: 1) Relevance to overall DOE and Hydrogen Fuel Initiative objectives; 2) Approach to performing the research and development; 3) Technical accomplishments and progress toward project and DOE goals; 4) Technology transfer/collaborations with industry/universities/laboratories; and 5) Approach and relevance of proposed future research. The panel also evaluates the strengths and weaknesses of each project, and recommends additions to or deletions from the scope of work.

Some projects are also evaluated by the FreedomCAR joint technical teams each year. The program facilitates supplier-customer relationships to ensure that R&D results from national laboratories and universities are transferred to industry suppliers and that industry supplier developments are made available to automakers, energy industry and stationary power producers.

Reviews conducted by the Hydrogen Safety Panel to monitor the safety of procedures and facilities throughout the HFCIT Program.

Verification: Quarterly reports from DOE funded industry, university and National Laboratory partners document the status of quarterly targets and milestones. An Annual Report is used to evaluate progress towards meeting program goals and technical targets. Data from Technology Validation projects will be used to assess technology status. Independent Systems Integration function will evaluate research results.

Program Assessment Rating Tool (PART)

The Department implemented a tool to evaluate selected programs. PART was developed by OMB to provide a standardized way to assess the effectiveness of the Federal Government's portfolio of programs. The structured framework of the PART provides a means through which programs can assess their activities differently than through traditional reviews. Hydrogen Technology has incorporated feedback from OMB into the FY 2006 Budget Request and has taken or will take the necessary steps to continue to improve performance.

Most PART recommendations within program control have been addressed and results-based planning continues to improve. The FY 2004 PART review of Hydrogen Technology contained a recommendation to establish a partnership with the energy industry to complement the DOE's FreedomCAR budget. To fulfill this recommendation, FreedomCAR (the partnership between DOE and USCAR) was expanded to include energy industry partners and the expanded partnership was launched to coordinate hydrogen research activities with both automotive and energy industry partners. Many activities funded through the President's Hydrogen Fuel Initiative and FreedomCAR are now implemented through the government-industry FreedomCAR and Fuel Partnership.

The FY 2004 PART recommendation to expand high-risk R&D on hydrogen production from renewable resources and on hydrogen storage technologies was addressed with two solicitations for proposals that led to cooperative agreements with universities and industry, and work agreements with National Laboratories to develop high-risk hydrogen production from renewables and hydrogen storage technologies. EERE and SC have coordinated extensively in developing a FY 2004 solicitation for basic research to support hydrogen production, storage and use.

Another FY 2004 PART recommendation suggested the development of adequate annual performance measures. Annual performance measures that correlate with multi-year program plan technical targets have been included in budget requests. These improvements in planning and accountability were reflected in the Hydrogen Program's improved FY 2005 score in those areas, resulting in an overall score improvement and a “moderately effective” rating, the second highest rating possible.

The FY 2005 PART also found that the program has coordinated well with other DOE programs (i.e. in developing the DOE Hydrogen Posture Plan) and with industry (i.e. in developing technology roadmaps) in establishing a plan to achieve the goals of President’s Hydrogen Fuel Initiative. The PART noted that a significant level of congressionally directed activities in FY 2004 − nearly half of the program’s budget − jeopardizes progress on the President’s initiative by reducing program funding available to address the most important barriers to the hydrogen economy.

The PART also recommended that the program participate in the development of a consistent framework for the Department to analyze the costs and benefits of its R&D investments, and apply this guidance to development of the FY 2006 budget. The program has provided input the Department needs to improve consistency in the methods and assumptions used to estimate potential benefits. The Department is employing the data in its effort to produce comparable estimates within its energy R&D programs to inform budget decision. EERE is working with OMB, the other applied R & D programs, and the PMA Budget and Performance Integration principals in the department to establish an increasingly integrated and consistent framework to inform the budget process.

Funding by General and Program Goal

	(dollars in thousands)		
	FY 2004	FY 2005	FY 2006
General Goal 4, Energy Security			
Program Goal 04.01.00.00, Hydrogen Technology			
Production and Delivery R&D	10,083	14,218	32,173
Storage R&D	13,174	23,654	29,890
Infrastructure Validation	5,784	9,484	14,945
Safety and Codes and Standards	5,615	5,954	13,121
Education	2,417	0	1,881
Systems Analysis	1,372	3,404	7,084
Congressionally Directed Activities			
Competitive Solicitation for Solid Oxide Fuel Cells	2,453	4,960	0
HI-Way Initiative in New York State (partially supports Goal)	981	0	0
Fuel Cell Development for Distributed Generation and Carbon Sequestration in Northwest Indiana	1,962	0	0
EVermont Hydrogen Electrolyzer Project	937	0	0
Evaluation of Solar-Powered Thermo-Chemical Production of Hydrogen from Water	2,943	0	0
National Center for Manufacturing Science to Develop Advanced Manufacturing Technologies for Renewable Energy Applications	2,943	0	0
Fuel Cell Research by the University of South Florida (partially supports Goal)	981	1,488	0
Hydrogen Future Park at the University of Montana	736	0	0
Renewable Hydrogen Fueling Station System, University of Nevada at Las Vegas	2,943	4,960	0
Expanding Clean Energy Research and Education Program at the University of South Carolina (partially supports Goal)	1,079	992	0
Hydrogen Fuel Cell Project Washoe County, Nevada	1,962	992	0
Lansing Community College Alternative Energy Center	981	0	0
California Hydrogen Infrastructure (partially supports Goal)	0	2,480	0
Total, Congressionally Directed Activities	20,901	15,872	0
Total, Program Goal 04.01.00.00, Hydrogen Technology	60,327	72,586	99,094

	(dollars in thousands)		
	FY 2004	FY 2005	FY 2006
All Other			
Congressionally Directed Activities[a]			
HI-Way Initiative in New York State (partial $)[b]	981	0	0
Shared Technology Transfer Program by Nicholls State University	981	0	0
Startech Hydrogen Production Project	491	497	0
Hawaii Hydrogen Center for Development and Deployment of Distributed Energy Systems: Gateway Project on Island of Hawaii	2,982	992	0
Hawaii Hydrogen Center for Development and Deployment of Distributed Energy Systems: Power Park on the Island of Oahu	491		0
Edison Materials Technology Center	2,943	2,976	0
Florida Hydrogen Partnership/Initiative	1,962	1,984	0
Fuel Cell Research by the University of South Florida (partial $)[b]	981	1,488	0
Fuel Cell Mine Loader and Prototype Locomotive	1,962	1,984	0
Hydrogen Regional Infrastructure Program in Pennsylvania	2,943	1,984	0
Expanding Clean Energy Research and Education Univ. South Carolina (partial $)[b]	1,079	992	0
Enterprise Center for Chattanooga Fuel Cell Demo	2,485	0	0
Residential Fuel Cell Demo by the Delaware County Electric Coop	294	0	0
Smart Energy Management Control Systems	491	0	0
Hydrogen Storage and Fuel Cells, Univ of Las Vegas	0	2,976	0
Zero Emission Bus Demo Program	0	99	0
Ohio Distributed Hydrogen Project	0	1,091	0
Bowling Green Fuel Cell, Univ. of Toledo	0	992	0
California Hydrogen Infrastructure (partial $)[b]	0	2,480	0
National Center for Energy Management and Building Technologies	0	885	0
Total, All Other	21,066	21,420	0
Total, General Goal 4 (Hydrogen Technology)	80,412	94,006	99,094

[a] Hydrogen Technology worked with the recipients of the Congressionally Directed funding in an attempt to develop statements of work that address technology barriers and support program goal.
[b] Projects marked as "partial $" are judged to be partially supportive of the program goals, so half of their funding is included in the first section of the table and half is shown here in the second section.

Expected Program Outcomes

Hydrogen Technology pursues its mission through integrated activities designed to improve the energy efficiency, flexibility, and productivity of our energy economy. We expect these improvements to reduce susceptibility to energy price fluctuations; reduce greenhouse gas emissions; reduce EPA criteria and other pollutants; and enhance energy security by increasing the production and diversity of domestic fuel supplies. Realization of the Hydrogen Technology goals would provide the technical potential to reduce conventional energy use.

Estimates for energy savings, energy expenditure savings, carbon emission reductions, oil savings, and natural gas savings that result from the realization of the integrated HFCIT Program goals are shown in the tables below through 2050, reflecting the increasing availability of commercial fuel cells and hydrogen sources. When hydrogen-powered fuel cell vehicles are introduced in substantial numbers and fuel cells reach the mass consumer market for electronics and other stationary applications, the oil savings and other benefits to the Nation are expected to be significant. Early estimates of potential long-term benefits that could be achieved by the entire Hydrogen Fuel Initiative (not just EERE's activities) were 11 million barrels per day (mbpd) in 2040. Achievement of the Hydrogen and Fuel Cell program goals could result in mid-term oil savings of 0.2 mbpd in 2025 as the program technologies begin to enter the market (based on the GPRA06-NEMS model) and in the long term ramp up to savings of 2.7 mbpd in 2050 (based on preliminary estimates using the GPRA06–MARKAL model).[a] Additional contributions towards the Hydrogen Fuel Initiative-wide goal of 11 mbpd will come from the Nuclear Energy, Science, and Fossil Energy activities in the Initiative, and also from the Vehicle Technologies program's emerging work on hydrogen-fueled internal combustion engines.

The assumptions and methods underlying the modeling efforts have significant impact on the estimated benefits, and results could vary significantly if external factors, such as future energy prices, differ from the "baseline case" assumed for this analysis. EERE's baseline case is essentially the same as the EIA "business-as-usual" case presented in its Annual Energy Outlook. In addition, possible changes in public policy and disruptions in the energy system which may affect estimated benefits are not modeled. The external factors such as unexpected changes in competing technology costs, identified in the Means and Strategies section above, could also affect the Program's ability to achieve its goals.

The results shown in the long term benefits tables are preliminary estimates based on initial modeling of some of the possible program production technologies; nonetheless, they provide a useful picture of the potential change in national benefits over time if the technology, infrastructure and markets evolve as expected. Estimated benefits that follow assume that individual technology plans are followed and current market assumptions obtain. Final documentation is estimated to be completed and posted by March 31, 2005. Uncertainties are larger for longer term estimates. A summary of the methods, assumptions, and models used in developing these benefit estimates that are important for understanding these results are provided at: http://www.eere.energy.gov/office_eere/budget_gpra.html.

---

[a] In the FY 2006 projections, the HFCIT Program's estimated benefits for 2025 to 2050 are roughly half of those presented in the FY 2005 Budget Request. This is primarily due to a reduction in the model's relative efficiency advantage of a hydrogen fuel cell vehicle over a gasoline hybrid vehicle. This reduction was the result of adopting common assumptions for vehicle weight reductions, aerodynamic improvements, and tire rolling resistance in both vehicle types. Another cause for the reduction in estimated benefits is that the natural gas prices projected for this period are more than 10 percent higher than in last year's analysis.

The full long-term potential for renewable-based hydrogen is not reflected in this FY 2006 benefits analysis. Further improvements in the analysis for renewable-based hydrogen technology are underway. In addition, these estimates do not include an assessment of the role of policy measures in facilitating the development of the infrastructure necessary to provide hydrogen at refueling stations nationwide, or in stimulating consumer demand for hydrogen fuel cell vehicles.

FY 2006 GPRA Benefits Estimates for Hydrogen, Fuel Cells and Infrastructure Technologies Program[a]

Mid-term benefits[b]	2010	2015	2020	2025
Primary nonrenewable energy savings (Quads)	ns	ns	ns	0.2
Energy bill savings (Billion 2002$)	ns	ns	ns	2
Carbon emission reductions (MMTCE)	ns	ns	ns	5
Oil savings (mbpd)	ns	ns	ns	0.2
Natural gas savings (Quads)[c]	ns	ns	ns	-0.30

Long-term benefits[d]	2030	2040	2050
Primary nonrenewable energy savings (Quads)	1.0	3.0	4.3
Energy system cost savings (Billion 2001$)	1	11	26
Carbon emission reductions (MMTCE)	21	43	60
Oil savings (mbpd)	0.7	2.0	2.7
Natural gas savings (Quads)	-0.27	0.29	0.71

[a] Benefits reported are annual, not cumulative, for the year given. Estimates reflect the benefits that may be possible if all of the program's technical targets are met and funding continues at levels consistent with assumptions in the FY 2006 Budget.
[b] Mid-term program benefits were estimated utilizing the GPRA06-NEMS model, based on the Energy Information Administration's (EIA) National Energy Modeling System (NEMS) and utilizing the EIA's Annual Energy Outlook (AEO) 2004 Reference Case.
[c] Although these results show a small negative impact on natural gas demand in the short and mid-term, an analysis by the Office of Energy Efficiency and Renewable Energy (EERE) of its entire research and deployment portfolio indicates that by 2020 the industrial, buildings, and other portions of this EERE portfolio will be freeing up significant natural gas demand to more than offset the estimated small impacts on natural gas of the HFCIT Program during the early phases of the transition to a hydrogen economy. In the long term, the program is targeting more renewable-based hydrogen.
[d] Long-term benefits were estimated utilizing the GPRA06 - MARKAL developed by Brookhaven National Laboratory (BNL). Results can differ among models due to differences in their structure. In particular, the two models estimate economic benefits in different ways, with the MARKAL model reflecting the cost of additional investments required to achieve reductions in energy bills.

Production and Delivery R&D

Funding Schedule by Activity

(dollars in thousands)

	FY 2004	FY 2005	FY 2006	$ Change	% Change
Production and Delivery R&D	10,083	14,218	32,173	+17,955	+126.3%
Total, Production and Delivery R&D	10,083	14,218	32,173	+17,955	+126.3%

Description

Production and Delivery R&D encompasses a diversity of renewable feedstocks and energy sources including biomass, wind, and solar, to convert to hydrogen. Work involving other feedstocks are largely funded by, and coordinated with, other offices (i.e. FE and NE). Technology areas include an array of processes and techniques such as reforming, separating, purifying, compressing, and delivering hydrogen.

Benefits

Production and Delivery R&D supports the mission of the HFCIT Program by developing new and advanced technologies to produce hydrogen from diverse domestic resources. The benefits of the R&D support the achievement of fuel costs on a cents/mile basis which is less than for existing gasoline vehicles. The research will enable the projected cost of hydrogen produced in large quantities by renewable and non-renewable fuel sources to be reduced as indicated. Note, targets are based on hydrogen quantities of approximately 1,500 kg/day for distributed production of hydrogen.

Hydrogen Production Costs (modeled)[a]: Renewable delivered at 5000 psi

($/gge)

	2003	2004	2005	2006	2007	2008	2009	2010
Hydrogen[b]	6.20		5.70	5.50		4.50		2.85

[a] Hydrogen production cost estimates use laboratory data and assume high equipment manufacturing volumes, e.g. approximately 1000 units/year.

[b] Hydrogen production costs are based on distributed refueling station scale (500-1500 gge/day) electrolyzing water at $6/gge in 2004 ($700/kW, 62 percent LHV using electricity with 30-40 percent wind power, $5.50/gge in 2006 ($600/kW, 64 percent LHV using electricity with 30-40 percent renewable power; $4.50/gge in 2008 ($400/kW, 65 percent LHV using electricity with 30-40 percent renewable power; and $2.85/gge in 2010 ($250/kW, 75 percent LHV using electricity with 40 percent wind power).

Hydrogen Production Costs (modeled)[a]: Non-renewable delivered at 5000 psi, untaxed, at 5000 psi, based on natural gas at $4.40/MBtu.

	($/gge) (2001 dollars)							
	2003	2004	2005	2006	2007	2008	2009	2010
Hydrogen from natural gas (distributed)..	5.00		4.50	3.00			2.50	1.50

Detailed Justification

	(dollars in thousands)		
	FY 2004	FY 2005	FY 2006
Production and Delivery R&D..	**10,083**	**14,218**	**32,173**

Expand research on renewable feedstocks and energy sources. Develop advanced electrolyzer systems that address cost, efficiency, durability and integration with wind based electricity to achieve a projected hydrogen cost as low as $2.85 per gasoline gallon equivalent (untaxed) at 5000 psi by 2010. Conduct research using biomass feedstock to combine reforming, water-gas shift, separations and purification with gasification/pyrolysis processes toward achieving a cost of $3.50/gge at the station by 2009. Research will be coordinated with gasification technology developed by the EERE Biomass Program and DOE's Fossil Energy Program. Develop separation technologies to reduce energy use and capital costs associated with purifying hydrogen streams from renewable sources such as biomass. In photoelectrochemical water splitting production and in collaboration with the Office of Science, complete development of a semiconductor material that achieves a projected 8 percent solar-to-hydrogen efficiency with 1000-hour durability by the end of 2010. Conduct research for advanced semiconductor materials to achieve 10 percent solar-to-hydrogen efficiency and 5,000 hour durability by 2015. In collaboration with the Office of Science, research biological micro-organism systems to improve efficiency for water splitting production. Additionally, conduct research in solar based high temperature water splitting chemical cycles using solar concentrators aimed at demonstrating the feasibility of $4.00 per gasoline gallon equivalent at the plant gate by 2010.

Conduct research to reduce capital costs and increase energy efficiency of delivery systems from central production facilities including lower pipeline material and construction costs, more energy efficient and lower cost liquefaction technology, more reliable and durable compression technology, and novel, cost effective solid or liquid delivery systems.

Continue production and delivery research cooperative agreement projects selected in 2004. These projects included 16 universities and over 80 industry partners with national laboratories serving in technical assistance role in specific areas of their expertise.

[a] Hydrogen production cost estimates use laboratory data and assume high equipment manufacturing volumes, e.g. hundreds of units/year.

	(dollars in thousands)		
	FY 2004	FY 2005	FY 2006

In FY 2004, this activity was reduced by $261,000 for SBIR/STTR and transferred to the Science Appropriation.

Total, Production and Delivery R&D	**10,083**	**14,218**	**32,173**

Explanation of Funding Changes

	FY 2006 vs. FY 2005 ($000)
Production and Delivery R&D The significant increase is consistent with the National Research Council's recommendations in their *Hydrogen Economy Report.* Reflects Research and Development Investment Criteria (RDIC) section 2f – External Peer Review, and 2b, Industry Involvement.) The increased funding is to accelerate distributed reforming and electrolyzer development. Research will also be increased in carbon-free, renewable solar based high temperature thermochemical, photoelectrochemical and photobiological, production and delivery technologies to complement existing technologies in support of the 2010 technical targets planned in the DOE Hydrogen Posture Plan and the HFCIT Program Multi-Year Research, Development and Demonstration Plan. (RDIC section 2a - Builds on or Complements Existing R&D.) The majority of the increase will support competitive, merit-reviewed, cost-shared R&D with industry. (RDIC section 2c - Industry Cost-sharing and RDIC section 2f – Competitive Awards and Peer Review.)	+17,955
Total Funding Change, Production and Delivery R&D	**+17,955**

Storage

Funding Schedule by Activity

(dollars in thousands)

	FY 2004	FY 2005	FY 2006	$ Change	% Change
Storage	13,174	23,654	29,890	+6,236	+26.4%
Total, Storage	13,174	23,654	29,890	+6,236	+26.4%

Description

Hydrogen Storage will focus primarily on the research and development of on-board vehicular storage systems that allow for a driving range of greater than 300 miles within the constraints of weight, volume, durability, refueling time, efficiency, and total cost. Storage will develop and demonstrate solid and liquid materials and explore conformable tank technologies for hydrogen storage systems to meet 2010 and 2015 on-board system targets. In addition, hydrogen storage systems for off-board applications will be developed.

Benefits

Hydrogen storage is a key enabling technology for the advancement of hydrogen and fuel cell technologies for transportation, stationary power, and portable power applications. Current hydrogen storage systems for vehicles are inadequate to meet customer driving range expectations without intrusion into vehicle cargo or passenger space. The Hydrogen Storage activity supports the mission of the HFCIT Program by focusing on the development of compact, light-weight, low-cost, durable, and efficient storage systems to achieve a driving range of greater than 300 miles.

The research will enable the system volumetric (kWh/l) and gravimetric (kWh/kg or weight percent)[a] storage capacities (while meeting cost targets) to be improved as indicated below.

	Actuals		Targets					
Materials-Based	2003	2004	2005	2006	2007	2008	2009	2010
Volumetric (kWh/l)	0.6	0.8			1.2			1.5
Gravimetric (kWh/kg)	0.8	1.0	1.0		1.5			2.0
Gravimetric (wt percent)	2.4	3.0	3.0		4.5			6.0

[a] 2 kWh/kg = 6 weight percent. A 6 wt. percent hydrogen storage system contains 6 kg of hydrogen in a system weighing 100 kg. 1 kg of hydrogen contains 33.3kWh, so, 6 kg contains approximately 200kWh. A 200 kWh Hydrogen/100 kg system = 2kWh/kg.

Detailed Justification

	(dollars in thousands)		
	FY 2004	FY 2005	FY 2006
Storage..	**13,174**	**23,654**	**29,890**

Conduct research and development directed at meeting the 2010 system targets of 2.0 kWh/kg (6 weight percent), 1.5 kWh/l, and $4/kWh, and identifying scientific/technological paths to meet the 2015 system targets of 3.0 kWh/kg (9 weight percent), 2.7 kWh/l, and $2/kWh. This work is based on the "Grand Challenge" solicitation issued in 2003 to establish a "*National Hydrogen Storage Project*," with $150 million over 5 years, subject to congressional appropriations. Although awards from the "Grand Challenge" could not be started in 2004 due to congressionally directed projects, FY 2006 would be the second year of the effort. These awards include projects at 30 universities and 10 companies that will receive 65 percent of the funding, and projects at 10 Federal laboratories to receive approximately 35 percent of the funding.

Conduct hydrogen storage research and development at Centers of Excellence that include teams of university, industry and National Laboratory partners, with a focus on metal hydrides, chemical hydrogen storage, and carbon-based materials. Full and open competition for the "Grand Challenge" included universities, industry and National Laboratories eligible for awards. For the first time, national laboratories competed for hydrogen storage awards through a separate category in the solicitation. This ensured that the most viable approaches and best teams capable of solving the critical challenge of hydrogen storage were selected. University and industry participants were eligible to submit proposals as team members within the Centers of Excellence or as leads under a separate category, or both. The DOE will continue to work with Congress to ensure that the storage effort is competed to the maximum extent possible and that National Laboratories are utilized appropriately.

Focus on chemical hydrogen storage research to reduce the cost and improve efficiencies of off-board regeneration. Focus carbon-based materials research on reproducibility, contributing to a go/no-go decision in the 4th quarter of FY 2006 on continuation of carbon nanotube R&D based on reproducibly attaining a 6 wt. percent materials-based hydrogen storage capacity. Focus metal hydride research on designing and developing complex metal hydrides that have the potential of meeting the 2010 system targets and offering pathways to meet the 2015 system targets.

Conduct research and development on exploratory approaches, novel materials and concepts not covered under the Centers of Excellence. Work in this area will be continued through the 15 university and industry awards made in FY 2005 from the "Grand Challenge" solicitation. This is consistent with the National Academies' recommendation that "there should be a shift in the hydrogen program away from some development areas and toward exploratory work- as has been done in the area of hydrogen storage." The continued shift in hydrogen storage activity will focus on innovative chemistries and novel materials approaches in collaboration with the DOE Office of Science - through university, National Laboratory, and industry R&D. Advanced concepts include novel carbon nanostructures (other than nanotubes), metal-organic materials, clathrates and polymers. The shift away from compressed tank development will continue by focusing on advanced concepts, rather than

	(dollars in thousands)		
	FY 2004	FY 2005	FY 2006

on technologies near commercialization.

Complete analysis of hybrid approaches that combine compressed gas storage with reversible materials to reduce pressure requirements and increase vehicle range.

Utilize standard test protocols and an independent test capability to validate and to compare the capacities of hydrogen storage materials under development at partner laboratories at universities, industry and National Laboratories.

Focus analysis activities on advanced storage options with special attention to life cycle energy efficiencies, cost and environmental impact.

In FY 2004, this activity was reduced by $353,000 for SBIR/STTR and transferred to the Science Appropriation.

	FY 2004	FY 2005	FY 2006
Total, Storage	**13,174**	**23,654**	**29,890**

Explanation of Funding Changes

	FY 2006 vs. FY 2005 ($000)
Storage An increase in research and development of materials-based hydrogen storage technologies is consistent with the National Research Council's recommendations in their *Hydrogen Economy* report. (Consistent with RDIC 2f – external peer review, and RDIC 2b – industry input to planning.) Increased emphasis will be on exploratory research and development with potential to meet long term targets for on-board vehicular hydrogen storage. Focused, collaborative efforts in the three key areas of metal hydrides, chemical hydrogen storage and carbon-based materials will be continued through multiple university, industry and national laboratory partners within centers of excellence. The planned increases in metal hydrides, chemical hydrogen storage, carbon-based and high surface area sorbents, and novel materials research and development are in support of the 2010 and 2015 technical targets planned in the DOE Hydrogen Posture Plan and the HFCIT Program Multi-Year Research, Development and Demonstration Plan**.** The majority of the increase will support competitive, merit-reviewed, cost-shared R&D through independent projects led by industry and universities in the area of novel materials and concepts. (Consistent with RDIC 2c – industry cost-sharing, and RDIC 2f – competitive awards and peer review.)	+6,236
Total Funding Change, Storage	**+6,236**

Infrastructure Validation

Funding Schedule by Activity

(dollars in thousands)

	FY 2004	FY 2005	FY 2006	$ Change	% Change
Infrastructure Validation	5,784	9,484	14,945	+5,461	+57.6%
Total, Infrastructure Validation	5,784	9,484	14,945	+5,461	+57.6%

Description

Infrastructure Validation includes the validation of advanced hydrogen technologies using full-scale demonstrations. Validation of hydrogen technology targets under real world conditions typically occurs three years after the research demonstrates potential to achieve the targets. Hydrogen technology R&D are then verified at commercial scale for performance against established R&D goals which include high pressure storage tanks, production and delivery processes, and hydrogen refueling station technologies.

Benefits

Infrastructure Validation will provide the most accurate assessment of the readiness of the technology and the risk of continued government and industry investment. In order for the automotive, utility, and fuel industries to make commercialization decisions by 2015, integrated vehicle and infrastructure systems need to be validated and individual component targets need to be met under real-world operating conditions. This activity supports HFCIT's mission by providing critical statistical data that fuel cell vehicles can meet efficiency and durability targets, storage systems can efficiently meet 300+ mile range requirements and fuel costs are less than for existing gasoline vehicles. Infrastructure Validation also provides information so that research in support of technical standards can be performed and vehicle and infrastructure safety can be demonstrated.

The research will enable commercial scale validation of the projected cost of hydrogen produced in larger quantities by non-renewables (in $/gge, untaxed) as indicated below.

($/gge)

	2003	2004	2005	2006	2007	2008	2009
Validate cost of hydrogen production[a]		3.60					3.00

[a] The validation activity validates the 2006 laboratory data for estimated hydrogen production costs for non-renewables in real world conditions. Hydrogen production cost estimates use real world data and assume high equipment manufacturing volumes, e.g. hundreds of units/year.

Detailed Justification

	(dollars in thousands)		
	FY 2004	FY 2005	FY 2006
Infrastructure Validation	**5,784**	**9,484**	**14,945**

Two competitive solicitations were issued previously for 50/50 cost-share partnerships to demonstrate: 1) hydrogen fuel cell vehicles and the correspondent refueling infrastructure with automobile manufacturers and energy companies (Controlled Hydrogen Fleet and Infrastructure Technology Demonstration and Validation Project); and 2) integrated renewable and fossil fuel distributed generation systems with hydrogen storage (Power Parks) in partnership with utilities.

Five automobile manufacturers and energy company partnerships were selected in April, 2004 as part of The Controlled Hydrogen Fleet and Infrastructure Technology Demonstration and Validation Project. The partnerships will design and construct hydrogen refueling stations and associated infrastructure to support "learning" demonstrations of new hydrogen production technology to validate reaching the 2009 target of $3.00/gge (untaxed).

The initial infrastructure efforts through FY 2006 will include installing and operating stations in Northern and Southern California, Michigan, Washington, D.C., and Florida. Hydrogen production concepts being demonstrated will explore options that will span viable candidates for the early transition period (i.e., 2018 to 2025) as well as later transition candidates (i.e., 2026 to 2035). The early stations will be deployed by FY 2006 and include concepts with local distributed natural gas reformation plants, renewable systems, and mid-size natural gas reformation plants with pipelines and mobile refueling systems to local distributed stations. At least four stations will incorporate renewable systems, including an option that will be part of a power park. Data relevant to key vehicle and refueling interface issues will be produced and published on refueling times, hydrogen purity impacts, energy efficiency of the hydrogen generation plant, plant availability, reliability, etc. to provide a data base for system modelers.

The goal of the demonstration effort is to validate hydrogen production technology at $3.00/gallon gasoline equivalent (untaxed) by 2009 with 68 percent natural gas-based well-to-pump efficiency. Two distributed natural gas reformation systems will be operated through 2006 to demonstrate the ability to produce hydrogen for $3.00/gallon gasoline equivalent (untaxed) at 5000 psi hydrogen (with high capital equipment manufacturing volumes, e.g. hundreds of units/year). If possible these units will be incorporated into real world operating systems that could validate their economic performance by 2006. The Energy Station at Las Vegas, Nevada, will be operated as part the Controlled Fleet and Infrastructure Demonstration Project. Three power park projects were awarded for the integration of renewable energy systems into distributed electric generation systems in September, 2002 as part of the State Energy Special Projects Program. One project will be completed in FY 2006 and the other two will be completed in FY 2007. These three power park projects will be operated and maintained (including the one referenced above that may incorporate renewable systems). They will demonstrate the ability to use both distributed electric generation from natural gas and renewable energy in a synergistic and efficient manner. Two of the power park projects will demonstrate the practicality and

	(dollars in thousands)		
	FY 2004	FY 2005	FY 2006

the feasibility of utilizing power from vehicles during peak or brownout periods on the grid. Issues on grid interconnects, reliability and safety will be addressed.

In FY 2004, this activity was reduced by $29,000 for SBIR/STTR and transferred to the Science Appropriation.

Total, Infrastructure Validation	**5,784**	**9,484**	**14,945**

Explanation of Funding Changes

	FY 2006 vs. FY 2005 ($000)
Infrastructure Validation	
The increased budget for Infrastructure Validation will allow industry to test, demonstrate and validate new system solutions and use the results to refocus the hydrogen research and development program. (Consistent with RDIC 2a – build on or complement existing R&D, and RDIC 2b – industry involvement in planning.) This effort was initiated through a competitive solicitation that was well-responded to by major automobile and energy company consortia. Selections were made that included over seven automobile manufacturers and four energy companies to participate in 50/50 cost-share projects. (Consistent with RDIC 2b – industry involvement in planning, and RDIC 2f – competitive awards and peer review.) Three performance indicators were included in the solicitation: fuel cell durability and performance under real world operating conditions, vehicle range and cost of hydrogen production. (Consistent with RDIC 2e – which asks how well an activity incorporates "off-ramps" and clear end-points for R&D.) At the end of FY 2006, there is to be go/no go decision on whether to proceed with second generation vehicles based on first generation vehicle performance and second generation designs. (Consistent with RDIC 2e – which asks how well an activity incorporates "off-ramps" and clear end-points for R&D.)	+5,461
Total Funding Change, Infrastructure Validation	**+5,461**

Safety and Codes and Standards

Funding Schedule by Activity

(dollars in thousands)

	FY 2004	FY 2005	FY 2006	$ Change	% Change
Safety and Codes and Standards.......	5,615	5,954	13,121	+7,167	+120.4%
Total, Safety and Codes and Standards	5,615	5,954	13,121	+7,167	+120.4%

Description

Safety and Codes and Standards include fundamental studies to determine the flammability, explosive, reactive, and dispersion properties of hydrogen. Components, subsystems, and systems will be subjected to environmental conditions that could result in failure to verify design practice and failure mode prediction analysis. Once the identification of critical failure modes and safety issues for hydrogen and fuel cell technologies are developed, this technical data will be provided to appropriate Standards Developing Organizations (i.e., International Code Council, National Fire Protection Association) to write and publish applicable codes and standards for hydrogen production and delivery processes as well as for hydrogen storage and fuel cell systems for both transportation and stationary applications. The DOE will not be involved directly in writing codes and standards, but instead will facilitate the development of these standards through R&D and support for appropriate technical representation in working groups. Activities also include the development of passive and active safety systems based on new sensor technologies, comprehensive safety analysis and compilation of a defensible database on safety.

Benefits

In order for industry to make commercialization decisions the technologies must meet safety standards. This requires a comprehensive and defensible database on component reliability and safety to enable publishing of performance-based domestic standards and international standards or regulations that will allow the technologies to compete in a global market. This activity supports HFCIT's mission by providing the critical data needed to write and adopt standards, the safety criteria and systems that meet or exceed current technologies and will eventually lead to new Federal Motor Vehicle Safety Standards for fuel cell vehicles by the DOT.

Activities under Safety and Codes and Standards will facilitate and provide data to support the establishment of a global technical regulation for hydrogen and fuel cell vehicles and infrastructure.

	2006	2007	2008	2009	2010
Facilitate global technical regulation	Characterize large-leak releases of hydrogen and develop model to validate experiments to within 25 % of expected value.		Provide preliminary data for draft U.S. technical standards for preparation of draft regulation.		Data and testing completed to finalize U.S. technical standards for preparation of a Global Technical Regulation.

Detailed Justification

	(dollars in thousands)		
	FY 2004	FY 2005	FY 2006
Safety and Codes and Standards	**5,615**	**5,954**	**13,121**

Develop data to enable standards to be established for fuel cell power plant systems that include performance verification of efficiency and emissions. Collaborate with DOT, EPA, NIST and other agencies to implement a comprehensive safety research, testing and evaluation program for hydrogen fuel cell technologies that will facilitate the safe use of hydrogen, the establishment required codes and standards, and result in a performance and certification specification for the National Highway Traffic Safety Administration. Work with these agencies will be conducted utilizing inter-agency agreements. Define failure mode tests in each subsystem within the vehicle and identify design requirements to support FreedomCAR goals. Conduct a solicitation that consolidates safety, codes and standards stakeholder support under a limited number of contract teams. Coordinate testing and data developed for new building codes and equipment standards for hydrogen technologies. Assist code developers by providing experimental data from hydrogen refueling demonstration sites.

Initiate construction of devices for training facility to simulate bulk storage, fuel dispensing and distribution piping systems at the Volpentest Hammer Training and Education Center. Revise plan for safety tests and analysis to validate the performance of the systems for new standards and review with the technical team. Produce training modules on hydrogen safety and design for Fire Marshals and Building Inspectors. In collaboration with hydrogen education activities, initiate safety and code official training by developing modules and facilities in partnership with National Laboratories, code developers, fire marshals and other stakeholders.

Provide system safety requirements which have to be demonstrated for production, storage and utilization program elements. Initiate the development of sensor technology to detect and measure hydrogen leaks. Prepare draft materials compatibility guide for hydrogen systems, identify material needs, and establish research program to develop them.

In FY 2004, this activity was reduced by $149,000 for SBIR/STTR and transferred to the Science Appropriation.

Total, Safety and Codes and Standards	**5,615**	**5,954**	**13,121**

Explanation of Funding Changes

	FY 2006 vs. FY 2005 ($000)
Safety and Codes and Standards	
The requested increase is to accelerate development of Codes and Standards and underlying hydrogen safety research. This is consistent with the National Research Council's recommendations in their *Hydrogen Economy* report. (Consistent with RDIC 2f – external review.) The R&D will be developed in cooperation with the government-industry partnership Codes and Standards Tech Team. (Consistent with RDIC 2b – industry involvement.) R&D will also be increased in the development of hydrogen sensors and component testing to complement existing technologies in support of the 2010 technical targets planned in the DOE Hydrogen Posture Plan and the HFCIT Program Multi-Year Research, Development and Demonstration Plan. (Consistent with RDIC 2a – build on or complement existing R&D.)	+7,167
Total Funding Change, Safety and Codes and Standards	**+7,167**

Education

Funding Schedule by Activity

(dollars in thousands)

	FY 2004	FY 2005	FY 2006	$ Change	% Change
Education	2,417	0	1,881	+1,881	NA
Total, Education	2,417	0	1,881	+1,881	NA

Description

Education activities are designed to increase understanding of the benefits and challenges to achieving a hydrogen economy, the facts about hydrogen safety, and the role that target audiences can play in the transition to a hydrogen economy. Target audiences, identified by key government and industry stakeholders in the National Hydrogen Energy Roadmap, include state and local governments, including safety and code officials; potential end-users; and the public. Over the long term, education of teachers and students will also be required.

Benefits

Education aids in overcoming institutional barriers to a hydrogen economy.

The education activity responds to the President's National Energy Policy recommendation to the Secretary of Energy to develop an education campaign that communicates the benefits of alternative energy, including hydrogen. With an emphasis on hydrogen safety, near-term education activities focused on key target audiences are critical to enabling not only the successful implementation of early hydrogen demonstration projects, but also longer-term market adoption and acceptance that are required to realize the benefits of a hydrogen economy.

State and local governments lay the foundation for long-term change and, with safety and code officials, enable the adoption of appropriate codes and approve hydrogen project installations. Public misunderstanding and false perceptions about the safe use of hydrogen threaten the implementation of hydrogen demonstrations and the success of a future hydrogen economy – education is required to overcome this significant challenge and ensure public confidence in hydrogen. In addition, education activities focused on students and teachers will foster development of a trained workforce, including engineers and technicians to maintain hydrogen fuel cell equipment and ensure safe use. Over the long term, hydrogen education should also engage younger students in the study of science and technology and ensures an informed first-generation of hydrogen technology users.

Hydrogen Technology Education Knowledge Assessment Targets

		2004	2005	2006	2007	2008	2009	2011
Students, and teachers (state/local government officials)	Survey[a]						two-fold increase[b]	four-fold increase[b]
End users................................	Survey[a]						one-fold increase[c]	two-fold increase[c]

Detailed Justification

	(dollars in thousands)		
	FY 2004	FY 2005	FY 2006
Education	**2,417**	**0**	**1,881**

In FY 2004, Education was grouped with Analysis activities under the key activity entitled, "Systems Analysis and Education." It is now presented as a separate activity. In response to the President's National Energy Policy recommendation, implement the following education activities:

Work in partnership with DOE Regional Offices, state energy offices, and local partners, to offer training to state and local government officials and potential end-users to help ensure an understanding of hydrogen technologies, hydrogen safety issues, and opportunities for facilitating the transition to a new energy economy. Building on efforts initiated in FY 2004, further develop and expand networks to provide information exchange, facilitate collaboration, and seek solutions to local hydrogen implementation barriers.

In collaboration with Safety, Codes and Standards, develop and implement training modules for safety and code official training in partnership with National Laboratories, code developers, fire marshals, and other stakeholders.

In cooperation with automotive and energy industry partners, conduct activities to educate the public and key target audiences in communities where new hydrogen fueling stations will be implemented as part of Technology Validation projects. Using public education materials developed through competitively awarded solicitations in FY 2004, conduct training and outreach to raise awareness of the hydrogen economy and build public familiarity and confidence with the safe use of hydrogen as an energy carrier.

To support all Education efforts serving multiple target audiences, develop and maintain information

---

[a] Analysis is currently underway of a 2004 survey to determine the FY 2004 baseline.
[b] Measures of numbers of students, teachers, and end users who understand the concept of a hydrogen economy and how it may affect them.
[c] Measures of numbers of potential end-users who understand the concept of a hydrogen economy with how it may affect turn, as compared to a 2004 baseline.

	(dollars in thousands)		
	FY 2004	FY 2005	FY 2006

clearinghouse services launched in FY 2004 to provide interested stakeholders, including the public, with greater access to current and objective information about hydrogen technology.

Implement multi-year teacher professional development projects awarded through a competitive solicitation in FY 2004. Distribute materials to a broader teacher audience, beyond those participating in the initial pilot and trial sessions, to raise awareness and recruit interested teachers to participate in the full-scale pilot curriculum testing as a National Field Test Center in phase three of the project the following year.

Implement Hydrogen Technology Learning Center projects initiated through a competitive solicitation in FY 2004. Develop and begin offering short courses to the community and key regional stakeholders in an effort to raise awareness of the hydrogen economy.

In FY 2004, the Education activity was reduced by $64,000 for SBIR/STTR, which was transferred to the Science Appropriation.

Total, Education	**2,417**	**0**	**1,881**

Explanation of Funding Changes

	FY 2006 vs. FY 2005 ($000)
Education	
The increase in the education activity responds to the President's National Energy Policy recommendation to the Secretary of Energy to develop an education campaign that communicates the benefits of alternative energy, including hydrogen. The appropriation was zero in FY 2005 and the requested increase is necessary to create market awareness where no market currently exists. A major part of the effort will be to educate key stakeholders, including collaborating with Safety, Codes and Standards to develop and implement safety and code official training in partnership with National Laboratories, code developers, fire marshals, and other stakeholders. Additionally, in cooperation with automotive and energy industry partners, activities will be conducted to educate the public and key target audiences in communities where new hydrogen fueling stations will be implemented as part of Technology Validation projects. Using public education materials developed through competitively awarded solicitations in FY 2004, training and outreach will be conducted to raise awareness of the hydrogen economy and build public familiarity and confidence with the safe use of hydrogen as an energy carrier. (Consistent with RDIC 1b – Market Barriers, RDIC 2b – industry involvement, and RDIC 1d – supports federal policy. (A market solution is preferable to mandates for hydrogen use, and markets only function well when buyers have good information.))	+1,881
Total Funding Change, Education	**+1,881**

Systems Analysis

Funding Schedule by Activity

(dollars in thousands)

	FY 2004	FY 2005	FY 2006	$ Change	% Change
Systems Analysis	1,372	3,404	7,084	+3,680	+108.1%
Total, Systems Analysis	1,372	3,404	7,084	+3,680	+108.1%

Description

Systems Analysis includes development of independent systems analysis and independent evaluation functions consistent with the recommendations of the National Research Council (NRC). One of the findings of the NRC's report on hydrogen states, "The effective management of the Department of Energy Hydrogen Program will be far more challenging than any activity previously undertaken on the civilian energy side of the DOE." The NRC goes on to recommend that a systems analysis capability be established to identify the impacts of various hydrogen technology pathways, assess associated cost elements and drivers, identify key costs and technological gaps, evaluate the significance of actual research results, and assist in the prioritization of research and development directions. Systems Analysis provides the analytical and technical basis for understanding the hydrogen economy and supports informed decision-making with regard to research and development direction and prioritization.

Benefits

Systems Analysis is one of the keys to the hydrogen program in terms of understanding and assessing the technology needs and progress, the potential environmental impacts, and the energy-related economic benefits of the various hydrogen supply and demand pathways. This analysis is done to directly support program decision-making, planning and budgeting, and interactions with other energy domains. In addition, the results support the annual updates to key planning documents, including the Hydrogen Posture Plan, which describes the current direction and the planned milestones for the DOE Hydrogen Program.

Detailed Justification

	(dollars in thousands)		
	FY 2004	FY 2005	FY 2006
Systems Analysis	**1,372**	**3,404**	**7,084**

In FY 2004, Systems Analysis was grouped with Education activities under the key activity entitled, "Systems Analysis and Education." It is now presented as a separate activity.

In Systems Analysis, conduct independent analyses to minimize both the existence and the appearance of technological or programmatic biases. Update the Integrated Baseline by continuing well-to-wheels analyses of baseline performance of current technologies and targets to track program progress and to help identify most critical R&D needs. Conduct environmental impact analyses for hydrogen and fuel cell technologies being developed to determine potential environmental effects of wide scale commercialization and to ensure regulatory compliance. Expand systems modeling of the hydrogen supply evolution and hydrogen infrastructure transition pathways, and validate models. Complete the Baseline Macro-System Model by integrating existing and emerging models for the hydrogen infrastructure (production, distribution, storage, and use) and make available to the hydrogen community. Update the Systems Analysis Plan, Technical Requirements Document, and Posture Plan. Provide support and input for program element go/no-go decisions, e.g., carbon nanotubes for hydrogen storage.

In FY 2004, the Systems Analysis activity was reduced by $36,000 for SBIR/STTR, which was transferred to the Science Appropriation.

Total, Systems Analysis	**1,372**	**3,404**	**7,084**

Explanation of Funding Changes

	FY 2006 vs. FY 2005 ($000)
Systems Analysis	
The increased funding is to evaluate a transition plan consistent with developing the infrastructure and hydrogen resources necessary to support vehicle market penetration and demand scenarios, which is consistent with the National Research Council's recommendations in their *Hydrogen Economy* report. Competitive solicitations planned for FY 2005 will be implemented for model development of the Hydrogen Economy in 2006. (Consistent with RDIC 2f – competitive selection and external review.) Research will also be increased for the development of the Macro Model (RDIC 2a – technically feasible R&D) in support of the 2010 technical targets planned in the DOE Hydrogen Posture Plan and the HFCIT Program Multi-Year Research, Development and Demonstration Plan**.** The majority of the increase will support competitive, merit-reviewed, cost-shared analysis with industry (RDIC 2b, 2f – incorporate industry and competitive merit-based review). The planned increases are consistent with the program's plan to establish an independent systems analysis capability to identify the impacts of various hydrogen technology pathways, to assess associated cost elements and drivers, to identify key cost and technological gaps, to evaluate the significance of actual research results, and to assist in the prioritization of research and development directions. (Consistent with RDIC 1b – market barriers to private investment, RDIC 2a – building on existing R&D, and RDIC 2b – industry involvement.)	+3,680
Total Funding Change, Systems Analysis	**+3,680**

Congressionally Directed Activities

Funding Schedule by Activity

(dollars in thousands)

	FY 2004	FY 2005	FY 2006	$ Change	% Change
Congressionally Directed Activities....	41,967	37,292	0	-37,292	-100.0%
Total, Congressionally Directed Activities..	41,967	37,292	0	-37,292	-100.0%

Description

The content of this section reflects 23 separate Congressionally Directed activities ("earmarks") within Hydrogen Technology in FY 2004 and 17 earmarked projects in FY 2005. In general, such activities do not support program goals because they are not well-aligned with established research pathways or focused on overcoming the technical barriers as identified in the program's detailed planning documents.

Detailed Justification

(dollars in thousands)

	FY 2004	FY 2005	FY 2006
There were a total of 23 Congressionally Directed activities funded in FY 2004, and 18 were funded in FY 2005. Most of the projects will be conducted over 2-3 years. The program does not request further funding for these projects. The following projects were directed by Congress to be included in this program:			
Competitive Solicitation for Solid Oxide Fuel Cells	**2,453**	**4,960**	**0**
A solicitation was issued and awards have been made to General Electric for the development of a lab-scale solid oxide fuel cell and to Materials and Systems Research for an integrated fuel cell/electrolysis system.			
HI-Way Initiative in New York State...............................	**1,962**	**0**	**0**
A team consisting of GE/SUNY of Albany plans to investigate the use of engineered plastics to reduce the cost of electrolysis systems.			

	(dollars in thousands) FY 2004	FY 2005	FY 2006
Shared Technology Transfer Program by Nicholls State University	**981**	**0**	**0**

Plans include developing a catalog of NAVSEA-Carderock hydrogen related activities, implementation of an education outreach program and identification of hydrogen related businesses.

Fuel Cell Development for Distributed Generation and Carbon Sequestration in Northwest Indiana	**1,962**	**0**	**0**

Plan includes the development and testing of solid oxide fuel cells and the evaluation of a natural gas infrastructure capability for transporting hydrogen.

EVermont Hydrogen Electrolyzer Project	**937**	**0**	**0**

This project includes the development of a hydrogen vehicle and deployment of an electrolysis refueling station with grid connections to wind generators.

Evaluation of Solar-Powered Thermo-Chemical Production of Hydrogen from Water	**2,943**	**0**	**0**

This project plans to evaluate and conduct laboratory research on the most promising 4-6 thermochemical cycles that are capable of splitting water utilizing solar power.

Startech Hydrogen Production Project	**491**	**497**	**0**

This project plans to examine the merits of plasma driven gasification with hydrogen membrane separation technology to process medical wastes, municipal solid waste, scrap plastic and coal. Pilot scale equipment will be utilized.

Hawaii Hydrogen Center for Development and Deployment of Distributed Energy Systems: Gateway Project on Island of Hawaii	**2,982**	**992**	**0**

This funds the Gateway project on the island of Hawaii, and is preparing a business case for biomass and wind systems.

Hawaii Hydrogen Center for Development and Deployment of Distributed Energy Systems: Power Park on the Island of Oahu [FY 2004: $490,540 from the original EWD Appropriation Bill. FY 2005: $1,984,000]	**491**	**0**	**0**

This funds the development and deployment of a power park on the island of Oahu.

	(dollars in thousands)		
	FY 2004	FY 2005	FY 2006
Edison Materials Technology Center to Develop Improved Materials to Support the Hydrogen Economy	**2,943**	**2,976**	**0**

A solicitation was issued and eight projects are being negotiated that include a range of topics from hydrogen sensor development to photoelectrochemical hydrogen production. A second round of project selection is underway.

National Center for Manufacturing Science to Develop Advanced Manufacturing Technologies for Renewable Energy Applications	**2,943**	**0**	**0**

Plans include holding workshops, solicitations and managing projects, with a focus on identifying and developing manufacturing processes applicable to fuel cell and hydrogen technologies.

Florida Hydrogen Partnership/Initiative	**1,962**	**1,984**	**0**

Plans include issuing two solicitations for renewable and hydrogen research projects that are yet to be selected.

Fuel Cell Research by the University of South Florida	**1,962**	**2,976**	**0**

The project objectives are to explore materials and concepts that may be applicable to fuel cells and hydrogen storage.

Hydrogen Future Park at the University of Montana	**736**	**0**	**0**

Plans include development of a Hydrogen Futures website, creation of an alternative energy curriculum and establishment of a hydrogen safety training center.

Fuel Cell Mine Loader and Prototype Locomotive	**1,962**	**1,984**	**0**

Plans include the development and the deployment of a mine front-end loader and mine locomotive at operating mines for tests.

Renewable Hydrogen Filling Station System, University of Nevada at Las Vegas	**2,943**	**4,960**	**0**

Plans include the construction and deployment of a photovoltaic/electrolysis refueling station in Las Vegas and research tasks on photoelectrochemical conversion from water to hydrogen.

Hydrogen Regional Infrastructure Program in Pennsylvania	**2,943**	**1,984**	**0**

This project plans to survey available technologies for hydrogen pipeline delivery, off-board storage, hydrogen sensors and development of improved hydrogen delivery technology for pipelines.

	(dollars in thousands)		
	FY 2004	FY 2005	FY 2006
Bowling Green Fuel Cell, Univ. of Toledo	**0**	**992**	**0**

This project is anticipated to include fuel cell related activities affiliated with the University of Toledo.

California Hydrogen Infrastructure	**0**	**4,960**	**0**

This project will develop several technological approaches to deploy refueling stations that will include mobil platforms, stations at pipelines and electrolysis systems.

National Center for Energy Management and Building Technologies...	**0**	**885**	**0**

Activities funded under this Congressionally-directed project were to address HVAC research needs and improve the efficiency, productivity, and security of the U.S. building stock by developing and disseminating synergistic and complementary solutions to energy management, indoor environment quality, and security concerns in new and existing buildings.

Total, Congressionally Directed Activities......................	**41,967**	**37,292**	**0**

Explanation of Funding Changes

	FY 2006 vs. FY 2005 ($000)
Congressionally Directed Activities	
No further funding is requested for the 18 Congressionally-Directed projects that received funding in FY 2005.	-37,292
Total Funding Change, Congressionally Directed Activities	**-37,292**

	(dollars in thousands)		
	FY 2004	FY 2005	FY 2006
Expanding Clean Energy Research and Education Program at the University of South Carolina	**2,158**	**1,984**	**0**

The project objectives include materials development applicable to hydrogen storage and fuel cell technologies.

Hydrogen Fuel Cell Project Washoe County, Nevada....	**1,962**	**992**	**0**

This project plans to develop and deploy a geothermal/electrolysis hydrogen production refueling station and provide for the conversion of county buses to operate on hydrogen and hydrogen mixture fuels.

Chattanooga Fuel Cell Demonstration Project (FY 2004 $2,485,250 included in the Omnibus Appropriation Bill.)..	**2,485**	**0**	**0**

Plans include the development and test of a 5 kw solid oxide fuel cell that can co-produce hydrogen as a fuel and generate electricity.

Lansing Community College Alternative Energy Center..	**981**	**0**	**0**

Plans include creation of an alternative energy laboratory including hydrogen and fuel cell subsystems, professional development materials and an alternative energy curriculum.

Residential Fuel Cell Demonstration by the Delaware County Electric Cooperative...........................	**294**	**0**	**0**

This demonstration proposes to assess propane-fed fuel cells for off-grid and edge-of-grid residential combined heat and power applications.

Smart Energy Management Control System..................	**491**	**0**	**0**

This project plans to evaluate and develop fuel cell-powered micro-grid connected neighborhoods. An economic assessment will be made of the concept.

Hydrogen Storage and Fuel Cells, University of Las Vegas	**0**	**2,976**	**0**

This project is anticipated to include materials development for hydrogen storage and fuel cell technologies.

Zero Emission Bus Demo Program	**0**	**99**	**0**

This project is anticipated to include activities related to a zero emissions bus demonstration.

Ohio Distributed Hydrogen Project	**0**	**1,091**	**0**

This project is anticipated to include activities in Ohio related to distributed hydrogen technologies.

Solar Energy

Funding Profile by Subprogram[a]

(dollars in thousands)

	FY 2004 Comparable Appropriation	FY 2005 Original Appropriation	FY 2005 Adjustments	FY 2005 Comparable Appropriation	FY 2006 Request
Solar Energy					
Photovoltaic Energy Systems................................	72,537	77,663	-1,386[b]	76,277	74,973
Concentrating Solar Power...	5,331	6,000	-49[c]	5,951	6,000
Solar Heating and Lighting...	2,863	2,870	-24[d]	2,846	2,980
Total, Solar Energy	80,731	86,533	-1,459	85,074	83,953

Public Law Authorizations:

P.L. 93-409, "Solar Heating and Cooling Demonstration Act" (1974)
P.L. 94-163, "Energy Policy and Conservation Act" (EPCA) (1975)
P.L. 94-385, "Energy Conservation and Production Act" (ECPA) (1976)
P.L. 95-91, "Department of Energy Organization Act" (1977)
P.L. 95-619, "National Energy Conservation Policy Act" (NECPA) (1978)
P.L. 96-294, "Energy Security Act" (1980)
P.L. 95-590, "Solar Photovoltaic Energy Research, Development and Demonstration Act" (1984)
P.L. 101-218, "Renewable Energy and Energy Efficiency Technology Competitiveness Act of 1989" (1989)
P.L. 101-575, "Solar, Wind, Waste, and Geothermal Power Production Incentives Act of 1990" (1990)
P.L. 102-46, "Solar, Wind, Waste, and Geothermal Power Production Incentives Technical Amendments Act" (1991)
P.L. 102-1018, "Energy Policy Act (EPACT)" (1992)

Mission

The mission of the Solar Energy Program ("Solar Program") is to improve America's security, environmental quality, and economic prosperity through public/private partnerships that bring reliable and affordable solar energy technologies to the marketplace.

Benefits

Through its research and development activities, the Solar Program develops solar energy technologies – such as photovoltaics (PV), concentrating solar power (CSP), and solar heating and lighting systems (SHL) – that are reliable, affordable, and environmentally sound. Transforming our Nation's vast

---

[a] SBIR/STTR funding in the amount of $1,684,000 was transferred to the Science Appropriation in FY 2004. Estimates for SBIR/STTR budgeted in FY 2005 and FY 2006 are $2,199,000 and $2,091,000 respectively.
[b] Reflects the 0.80% rescission of -$612,000 and comparability adjustment for Cross-cutting Planning, Analysis and Evaluation of -$774,000.
[c] Reflects the 0.80% rescission of -$49,000.
[d] Reflects the 0.80% rescission of -$24,000.

supply of free and available solar energy into a widely available, fuel-free energy resource will increase energy security both by increasing electricity production and diversifying domestic energy supply, as well as provide energy options in both normal market conditions and emergency situations.

The Solar Program provides additional types of non-quantifiable public benefits in the areas of reliability, security, and environment.[a] PV systems can either be integrated with the electricity grid or work independently as distributed systems, a flexibility which increases our national energy security by providing a widely available and flexible source of power not dependent on our aging and vulnerable electricity grid system. CSP systems use dishes for smaller, decentralized systems or troughs and towers for larger, centralized power applications. SHL systems provide hot water and solar lighting for residential and commercial buildings.

Solar energy is particularly valuable in reducing the need for new generating and transmission capacity because its availability matches daily and seasonal electricity peaks. Solar energy provides additional energy security during emergencies in the form of local power and hot water availability that is not dependent on fuel deliveries or overhead wires (subject to disruption) and which will not contribute to local air pollution during a protracted emergency. Solar energy displaces electricity demand most during the hottest, sunniest days of the year when demand for space cooling peaks, helping to avoid blackouts; this also reduces Clean Air Act criteria pollutant emissions from generation plants when air pollution levels are at their highest and non-attainment status is most at risk.

More detailed, integrated and comprehensive economic, energy and energy security benefits estimates are provided in the Expected Program Outcomes section at the end of the program level budget narrative.

Strategic and Program Goals

The Department's Strategic Plan identifies four strategic goals (one each for defense, energy, science, and environmental aspects of the mission) plus seven general goals that tie to the strategic goals. The Solar Program supports the following goal:

Energy Strategic Goal

General Goal 4, Energy Security: Improve energy security by developing technologies that foster a diverse supply of reliable, affordable, and environmentally sound energy by providing for reliable delivery of energy, guarding against energy emergencies, exploring advanced technologies that make a fundamental improvement in our mix of energy options, and improving energy efficiency.

The Solar Program has one program goal which contributes to General Goal 4 in the "goal cascade":

Program Goal 04.03.00.00: Solar Energy. The Solar Program goal is to improve performance of solar energy systems and reduce development, production, and installation costs to competitive levels, thereby accelerating large-scale usage across the Nation and making a significant contribution to a clean, reliable and flexible U.S. energy supply.

Contribution to Program Goal 04.03.00.00 (Solar Energy)

The key Solar Program contribution to the Department's General Goal 4, Energy Security, is increased production of electricity and diversification of energy supply. The Solar Program works to improve the

[a] Not reflected in the quantified benefits reported in the Expected Program Outcomes section.

performance of next-generation solar energy technologies which reduce system, manufacturing, and installation costs to levels competitive with conventional energy sources. When Federal solar energy research began in the 1970s in response to oil price shocks, the cost of electricity from solar resources was about $2.00 per kilowatt-hour (kWh). Technological advances over the last two decades have significantly reduced solar electricity costs. Today, the cost of solar electricity ranges from as low as $0.12/kWh for CSP to $0.23/kWh for certain PV applications. The long-term cost goal for electricity from these systems is in the range of $0.035/kWh - $0.062/kWh for centralized CSP systems and $0.06/kWh for residential PV applications, based on technology and market assessments.

Key technology pathways to the goal include (detailed annual performance progress indicators are presented in their respective benefits sections):

- By 2010, reduce the 30-year user cost for PV electric energy to $0.14 - $0.19/kWh from $0.18 - $0.23/kWh in 2004 (baseline to be validated in FY 2005).
- By 2010, reduce the cost of large-scale CSP power plants in the Southwest to $0.09 - $0.11/kWh from $0.12 - $0.14/kWh in 2004.
- By 2010, reduce the cost of solar water heating in freezing climates to $0.05 - $0.06/kWh from $0.11 - $0.12/kWh in 2004.

Annual Performance Results and Targets

FY 2001 Results	FY 2002 Results	FY 2003 Results	FY 2004 Results	FY 2005 Targets	FY 2006 Targets
Program Goal 04.03.00.00 (Solar Energy)					
Photovoltaic Energy Systems					
Develop a 14-percent-efficient stable prototype thin-film photovoltaic cell.	Reduce the manufacturing cost of PV modules to $2.25 per Watt (equivalent to a range of $0.20 to $0.25 per kWh price of electricity for an installed solar system).	Reduce manufacturing cost of PV modules to $2.10 per Watt (equivalent to a range of $0.19 to $0.24 per kWh price of electricity for an installed solar system). [MET]	Verify, with standard laboratory measurements, U.S.-made commercial production crystalline silicon PV modules with 12.5 percent conversion efficiency. Verify, with standard laboratory measurements, U.S.-made commercial production thin-film PV modules with 10 percent conversion efficiency. [MET]	Verify, using standard laboratory measurements, a conversion efficiency of 13.5 percent of U.S.-made, commercial crystalline silicon PV modules. Production cost of such modules is expected to be $1.95 per Watt.	Verify, using standard laboratory measurements, a conversion efficiency of 14.0 percent of U.S.-made, commercial crystalline silicon PV modules. Production cost of such modules is expected to be $1.85 per Watt.
				Develop thin-film PV modules with an 11.0-percent conversion efficiency that are capable of commercial production in the U.S.	Develop thin-film PV modules with an 11.5-percent conversion efficiency that are capable of commercial production in the U.S.
Concentrating Solar Power					
					Conduct advanced research on trough collectors and receivers that will lead to a reduction in the modeled cost of energy from CSP troughs to $0.12-$0.14/kWh.
Solar Heating and Lighting					
			Developed conceptual designs of a low-cost polymer solar water heater capable of operation in freezing climates.	Achieve 5.0 cents per kilowatt-hour modeled cost of energy from solar water heater capable of operating in non-freezing climates.	Achieve 4.5 cents per kilowatt-hour modeled cost of energy from solar water heater capable of operating in non-freezing climates.
			Contributed proportionately to EERE's corporate goal of reducing corporate and program uncosteds to a range of 20-25 percent by reducing program annual uncosteds by 10 percent in 2004 relative to	*Contribute proportionately to EERE's corporate goal of reducing corporate and program adjusted uncosted obligated balances to a range of 20-25 percent by reducing program annual adjusted*	*Contribute proportionately to EERE's corporate goal of reducing corporate and program adjusted uncosted obligated balances to a range of 20-25 percent by reducing program annual adjusted*

FY 2001 Results	FY 2002 Results	FY 2003 Results	FY 2004 Results	FY 2005 Targets	FY 2006 Targets
			the program uncosted baseline (in 2003) until the target range is met.	*uncosteds by 10 percent in 2005 relative to the program FY 2004 end of year adjusted uncosted baseline($19,342K) until the target range is met.*	*uncosteds by 10 percent in 2006 relative to the program FY 2005 end of year adjusted uncosted baseline until the target range is met.* *Maintain total Program Direction costs in relation to total Program costs in the range of 8% - 12% to demonstrate efficient and effective EERE-wide business and technical support to mission direct programs.*

Means and Strategies

The Solar Program will use various means and strategies to achieve its program goals as described below. "Means" include operational processes, resources, information, and the development of technologies, and "strategies" include program, policy, management and legislative initiatives and approaches. Various external factors, as listed below, may impact the ability to achieve the program's goals. Collaborations are integral to the planned investments, means and strategies, and to addressing external factors.

The Solar Program will implement these goals using the following means:

- Perform scientific research, development, deployment and demonstration activities in partnership with industry, universities and National Laboratories.
- Increase photovoltaic module efficiency, system reliability, and manufacturing capability and efficiency; and
- Reduce the production cost of all solar energy technology systems.

The Solar Program will achieve these goals using the following strategies:

- Investing in collaborative research with both National Laboratories and universities to achieve technology breakthroughs along pathways toward "leap-frog" materials and technology improvements;
- Leveraging Federal resources by cost-sharing the development of next generation technologies with industry and other partners; and
- Working with States, industry, and other organizations to communicate technology advances and opportunities effectively, reduce barriers, and accelerate market penetration of technology applications.

These strategies will significantly reduce the cost of solar technologies, which will improve energy security by increasing the amount, availability and diversity of the domestic energy supply.

The following external factors could affect the Solar Program's ability to achieve its strategic goal:

- material costs;
- labor costs;
- currency exchange rates;
- the price and availability of alternative technologies and conventional fuels;
- international R&D and deployment efforts;
- financial incentives and other policies;
- interest rates and inflation;
- State and local regulation; and

- market participant withdrawal or entry.

In carrying out the mission, the Solar Program performs the following collaborative activities:

- research, development, demonstration and deployment activities, as well as information sharing, with industrial manufacturers, National Laboratories, and universities;
- work with solar energy experts outside of the Department to:
  - ensure that the Solar Program's research directions and priorities address the needs of manufacturers, utilities, state agencies, consumers, and other stakeholders;
  - ensure that program activities are within the realm of technical feasibility and properly aligned with market forces; and
  - develop technology roadmaps and peer reviews, versions of which have been completed within the last three years for each of the primary solar subprograms.

Validation and Verification

To validate and verify program performance, the Solar Program will conduct internal and external reviews and audits. The table below summarizes validation and verification activities.

Data Sources:	Annual Energy Review (EIA); Renewable Energy Annual (EIA); Annual Energy Outlook (EIA); Solar Electric Power: The U.S. Photovoltaic Industry Roadmap, (2001); Photovoltaics, Energy for the New Millennium: The National Photovoltaics Program Plan 2000-2004 (2000); Zero Energy Homes Roadmap (2002); Peer Review of the U.S. Department of Energy's Solar Buildings Technology Research Program (2001); National Research Council, Critique of the Sargent and Lundy Draft Assessment of Cost and Performance Forecasts for Concentrating Solar Power (2002); Sargent and Lundy, Assessment of Parabolic Trough and Power Tower Solar Technology Cost and Performance Forecasts (2003); Peer Review of the DOE Photovoltaic Program (2003).
Baselines:	The Solar Program's 2004 baselines for system production cost reduction goals are as follows: \$0.18 – \$0.23/kWh for PV electric energy (to be verified in FY 2005); \$0.12 - \$0.14/kWh for electricity from CSP technologies; \$0.07/kWh equivalent for solar water heating in non-freezing climates; \$0.11 - \$0.12/kWh equivalent for solar water heating in freezing climates (see the Solar Program Multi-Year Technical Plan (rev. 2004) and the CSP Technology Transition Plan (2004)).
Frequency:	Annual.
Evaluation:	In carrying out the program's mission, the Solar Program uses several forms of evaluation to assess progress and to promote program improvement. ▪ Technology validation and operational field measurement ▪ Critical peer review of both the program and subprogram portfolios and activities by independent outside experts

- Annual internal Technical Program Review of the Solar Program
- Specialized program evaluation studies to examine process, impacts, or market baseline and effects, as appropriate
- Quarterly and annual assessment of program and management results based performance through Joule (the DOE quarterly performance progress review of budget targets), R&DIC (annual internal review of performance planning and management of R&D programs against specific criteria), PMA (the Presidents Management Agenda -- annual departmental and PSO based goals whose milestones are planned, reported and reviewed quarterly) and PART (common government wide program/OMB reviews of management and results).
- Annual review of methods, and re-computation of potential benefits for the Government Performance and Results Act (GPRA)

Data Storage: EIA and other organizations, such as National Laboratories (including the National Renewable Energy Laboratory (NREL), Sandia National Laboratories (Sandia) and Oak Ridge National Laboratory (ORNL)), store data on computer servers.

Verification: Peer reviews; National Laboratory system and component test data; trade association reviews; National Laboratory survey of PV manufacturing cost/capacity data from U.S. industry; EIA survey of solar manufacturers; literature reviews.

Program Assessment Rating Tool (PART)

The Department implemented a tool to evaluate selected programs. PART was developed by OMB to provide a standardized way to access the effectiveness of the Federal Government's portfolio of programs. The structured framework of the PART provides a means through which programs can assess their activities differently than through traditional reviews. The Solar Program has incorporated feedback from OMB into the FY 2006 Budget Request and has taken or will take necessary steps to continue to improve performance.

In response to the FY 2004 PART review, the Solar Program is attempting to adhere to the specific direction of congressional appropriation earmark language while increasing the contribution to program goals to the maximum extent possible.

One specific FY 2004 PART recommendation was to terminate the Concentrating Solar Power (CSP) subprogram, in alignment with a recommendation from a peer review by the National Research Council (NRC), a branch of the National Academy of Sciences (NAS).[a] At the Department's request, an independent engineering company, Sargent and Lundy (S&L), evaluated CSP technology and found that the potential exists to lower the cost of power from CSP plants to between \$0.035/kWh and \$0.062/kWh by 2020, assuming sufficient market incentives.[b] To verify its credibility, the Department asked the

---

[a] National Research Council, "Renewable Power Pathways: A Review of the U.S. Department of Energy's Renewable Energy Programs" (2000).
[b] Sargent and Lundy, "Assessment of Parabolic Trough and Power Tower Solar Technology Cost and Performance Forecasts" (draft version, 2002); final version: SL-5641 (May 2003).

NRC to review the draft version of the S&L evaluation. The NRC agreed with the S&L review that there was significant potential for cost reduction in CSP technologies and determined that "since 1999, significant progress has been made in understanding the potential impacts of thermal storage technologies, thin film glass mirrors, improved heat collection units, improved trough support structures, and other technical opportunities to improve CSP technology."[a] During FY 2004, the Solar Program developed a comprehensive technology transition plan for the CSP subprogram,[b] including its R&D potential and program pathways. The technology transition plan is critical for understanding how best to use the funds appropriated for CSP in FY 2005, and informed the CSP budget request in FY 2006.

The FY 2004 PART review and score, and subsequent follow-up activities by the program last year, provided suggestions that resulted in refined long-term and annual measures incorporated in this FY 2006 budget request. The FY 2005 PART showed Solar Program improvement in accountability and the PART findings reflect recognition of that improvement. In the FY 2005 PART, the Solar Program maintained its rating of "moderately effective," the second highest rating category. The PART review also recognized that the Solar Program has implemented a new "systems driven" approach to help prioritize activities in its portfolio by analyzing present and potential markets, technology trade-off studies, and research and development reviews, and recognized that the program had developed a Multi-Year Technical Plan to guide its research efforts. In addition, the PART review also recognized that congressionally-directed activities reduce the program funding available for competitive solicitations and core National Laboratory research designed to support program goals.

In response to the lessons learned from the DOE FY 2003 performance audit by KPMG and consistent with production cost measures developed for the FY 2005 PART, the Solar Program is transitioning its annual performance targets from external outcomes to program outputs. Annual technical targets, such as solar module efficiency, reflect the actual technical work conducted by the program, allow for improved validation and verification of program performance, and minimize the potential for target achievement disruption caused by market factors beyond the program's control.[c] Cost measures are useful indicators that show market trends and assist the program in responding to a changing marketplace. Therefore, the Solar Program is using "hybrid" targets for its activities that emphasize technical outputs, but maintain a strong connection to relevant costs.

The PART also recommended that the program participate in the development of a consistent framework for the Department to analyze the costs and benefits of its R&D investments, and apply this guidance to development of the FY 2006 budget. The program has provided input the Department needs to improve consistency in the methods and assumptions used to estimate potential benefits. The Department is employing the data in its effort to produce comparable estimates within its energy R&D programs to inform budget decision. EERE is working with OMB, the other applied R & D programs, and the PMA Budget and Performance Integration principals in the department to establish an increasingly integrated and consistent framework to inform the budget process.

---

[a] National Academy of Sciences, "Letter Report: Critique of the Sargent and Lundy Assessment of Concentrating Solar Power Cost and Performance Forecasts" (2002).
[b] Solar Energy Program, U.S. Department of Energy, "Concentrating Solar Power: Technology Transition Plan, FY 2006 – FY 2010" (2004).
[c] Market factors outside the program's control that could affect the achievement of cost goals include, but are not limited to, raw material costs, labor costs, interest rates, currency exchange rates, inflation, foreign competition, state and local regulations, and market participant withdrawals or entries.

Funding by General and Program Goal

(dollars in thousands)

	FY 2004	FY 2005	FY 2006
General Goal 4, Energy Security			
Program Goal 04.03.00.00, Solar Energy			
Photovoltaic Energy Systems	71,409	66,478	74,973
Concentrating Solar Power	5,331	5,951	6,000
Solar Heating and Lighting	2,863	2,449	2,980
Total, Program Goal 04.03.00.00, Solar Energy	79,603	74,878	83,953
All Other - Congressionally Directed Activities			
Evaluation of Solar-Powered Thermo-Chemical Hydrogen Project, UNLV	0	4,464	0
Photonics Research and Development, UNLV	0	1,488	0
Conductive Coatings for Solar Cells	0	1,488	0
Yucca Valley Project	245	248	0
Center for Ecological Technology	392	0	0
Hackensack University Green Building Medical Center	491	0	0
Photovoltaic Panels for Mark Twain House and Museum	0	198	0
Solar Technology Center, UNLV	0	744	0
National Center on Energy Management and Building Technologies	0	1,169	0
University of Louisville Sustainable Buildings Project	0	397	0
Total, All Other	1,128	10,196	0
Total, General Goal 4 (Solar Energy)	80,731	85,074	83,953

Expected Program Outcomes

The Solar Program pursues its mission through integrated activities designed to increase the use of domestic renewable resources. We expect these improvements to reduce susceptibility to energy price fluctuations and potentially lower energy bills; reduce EPA criteria and other air pollutants; enhance energy security by increasing the production and diversity of domestic fuel supplies; and provide greater energy security and reliability by improving our energy infrastructure.

Of particular importance to national security, solar energy technologies can produce emergency power without fuel. Fuel-free generation obviates the need to transport fuel during emergency situations in which critical fuel and transportation infrastructure may be damaged or incapacitated. In addition to these "EERE business-as-usual" benefits, realizing the Solar Program goals would provide the technical potential to reduce conventional energy use even further. In particular, estimated benefits would be sensitive to assumptions about the structure of future electricity prices and markets, particularly in the areas of peak pricing and load management market opportunities. If technology targets and market expectations are met, Solar Program activities are expected to result in an estimated 13 gigawatts (GW) of electric capacity additions and $1.8 billion in energy expenditure savings annually by 2025, rising to 62 GW of electric capacity additions and $2.3 billion in energy system cost savings annually by 2050. Adding 62 GW of capacity is roughly equivalent to avoiding the construction of nearly 400 new conventional power plants, based on the current average U.S. power plant size of 160 MW.

Estimates of annual non-renewable energy savings, energy expenditure savings, carbon emission reductions, natural gas savings, and solar electricity capacity additions that result from the realization of Solar Program goals are shown in the table below through 2050. Benefits are expected to grow beyond 2050 as research advances, market penetration grows, and capital stock turns over.

The estimates reported here also do not reflect additional consumer demand for solar energy because it provides increased reliability of service, an emergency source of power, and/or an improvement in load management capabilities. As a result, the benefits reported here likely understate the demand for solar energy.

The assumptions and methods underlying the modeling efforts have significant impact on the estimated benefits, and results could vary significantly if external factors, such as future energy prices, differ from the "baseline case" assumed for this analysis. EERE's baseline case is essentially the same as the EIA "business-as-usual" case presented in its Annual Energy Outlook. In addition, possible changes in public policy and disruptions in the energy system which may affect estimated benefits are not modeled. The external factors such as unexpected changes in competing technology costs, identified in the Means and Strategies section above, could also affect the Program's ability to achieve its goals. Also note that the modeling long term benefits assumes that funding levels will be consistent with the President's commitment and assumptions in the 2006 Budget, and that funding will be applied to the core program. If the pattern of substantial congressionally directed projects persists over several years, the GPRA benefits estimates will need to be reduced.

The results shown in the long term benefits tables are preliminary estimates based on initial modeling of some of the possible program production technologies; nonetheless, they provide a useful picture of the potential change in national benefits over time if the technology, infrastructure and markets evolve as expected. Estimated benefits which follow assume that individual technology plans and market assumptions obtain. Final documentation is estimated to be completed and posted by March 31, 2005. Uncertainties are larger for longer term estimates. A summary of the methods, assumptions, and models used in developing these benefit estimates that are important for understanding these results are provided at www.eere.energy.gov/office_eere/budget_gpra.html.

FY 2006 GPRA Benefits Estimates for Solar Energy Program[a]

Mid-Term Benefits[b]	2010	2015	2020	2025
Primary nonrenewable energy savings (Quads)	0.01	0.05	0.12	0.30
Energy bill savings (Billion 2002$)	ns	1.1	2.7	1.8
Carbon emission reductions (MMTCE)	0	1	2	8
Natural gas savings (Quads)	0.01	0.03	0.03	0.01
Program specific electric capacity additions (GW)	1	3	6	13

Long-Term Benefits[c]	2030	2040	2050
Primary nonrenewable energy savings (Quads)	0.6	1.2	1.7
Energy system cost savings (Billion 2001$)	1.7	2.5	2.3
Carbon emission reductions (MMTCE)	11	23	36
Natural gas savings (Quads)	0.3	0.7	0.6
Program specific electric capacity additions (GW)	11	30	62

[a] Benefits reported are annual, not cumulative, for the year given. Estimates reflect the benefits that may be possible if all of the program's technical targets are achieved and funding continues at levels consistent with assumptions in the FY 2006 Budget.
[b] Mid-term program benefits were estimated utilizing the GPRA06-NEMS model, based on the Energy Information Administration's (EIA) National Energy Modeling System (NEMS) and utilizing the EIA's Annual Energy Outlook (AEO) 2004 Reference Case.
[c] Long-term benefits were estimated utilizing the GPRA06 - MARKAL developed by Brookhaven National Laboratory (BNL). Results can differ among models due to differences in their structure. In particular, the two models estimate economic benefits in different ways, with the MARKAL model reflecting the cost of additional investments required to achieve reductions in energy bills.

Photovoltaic Energy Systems

Funding Schedule by Activity

(dollars in thousands)

	FY 2004	FY 2005	FY 2006	$ Change	% Change
Photovoltaic Energy Systems					
Fundamental Research	28,224	26,878	31,373	+4,495	+16.7%
Advanced Materials and Devices	28,441	24,600	28,600	+4,000	+16.3%
Technology Development	14,744	15,000	15,000	0	0.0%
Congressionally Directed Activities	1,128	9,799	0	-9,799	-100.0%
Total, Photovoltaic Energy Systems	72,537	76,277	74,973	-1,304	-1.7%

Description

Photovoltaic (PV) technologies utilize semi-conducting materials that directly convert sunlight into electricity. Modular by nature with no moving parts, they can be sized to every need and placed almost anywhere sunlight is available.

Benefits

The Solar Program focuses on achieving the Department's long-term goal of making solar energy an important part of the national energy supply portfolio through the development of highly-reliable PV systems with user lifetime energy costs competitive with electricity from conventional resources. The PV subprogram attempts to achieve this goal by: 1) increasing their sunlight-to-electricity conversion efficiency (performance); 2) increasing system operating lifetime and reliability; and 3) reducing the manufacturing cost of cells, modules, and systems.

The basic building block of a PV system is a power module, which is typically one square meter in size and produces 120 Watts of power. The power module comprises 50-70 percent of the cost of an installed system and presents the greatest opportunity for cost savings. Current (2004) crystalline silicon (c-Si) power modules are approximately 13 percent efficient and produce electricity at 18 to 23 cents/kWh (lifetime system user cost over 30 years), to be verified in FY 2005. To lower costs and improve performance, the program is developing next-generation PV technologies such as "thin-film" PV cells and "leap-frog" technologies such as polymers and nanostructures, while conducting systems engineering efforts to increase the durability of fielded systems and developing technologies to improve system interconnections with the electric grid.

For FY 2006, the PV subprogram's priorities are:

- Cell and module development efforts, i.e., advanced crystalline silicon modules, thin-film modules, and super high-efficiency concentrator solar cells.
- Advanced module manufacturing technologies for high throughput and low-cost products.
- Systems reliability technologies, which increase the lifetime of thin-film modules and the mean time to failure of DC-to-AC current for low-cost, grid-tied distributed PV systems.

The Photovoltaic Energy Systems subprogram contributes to the overall program goal by developing PV technologies that are reliable and affordable. PV technologies transform our Nation's vast supply of free and available solar energy into a significant usable supply of electricity for use in homes, commercial buildings, industry, government facilities, and many other applications. Diversifying our national electricity generation fuel portfolio will increase national security by providing domestically available energy supply options for use both in normal and emergency situations. In addition, photovoltaic systems can either be integrated with the electricity grid or work independently, further increasing our national energy security by decreasing reliance on our vulnerable, aging electricity grid.

In response to the lessons learned from the DOE FY 2003 performance audit by KPMG and consistent with production cost measures developed for the FY 2005 PART, the solar PV subprogram is transitioning its performance targets from actual manufacturer production costs (external outcomes) to PV module efficiency measures (program outputs), based on the impacts of annual R&D progress. Efficiency measures better reflect the actual technical work conducted by the program, allow for improved validation, verification, and transparency, and minimize the potential for target achievement disruption caused by market factors beyond the program's control.[a] Cost measures are useful indicators, however, that show market trends and assist the program in responding to a changing marketplace. Therefore, the program is using a "hybrid" target for its crystalline silicon work that emphasizes efficiency, but maintains a strong connection to manufacturer production costs. Cost targets for thin film are not feasible because of the inability to validate cost of power from this new technology in the market.

Increasing module efficiency is a critical component to lowered system production costs (per Watt) and successful entry of PV systems into energy markets. Efficiency levels differ for the two main types of PV modules. Crystalline silicon is the dominant PV technology, while thin films are a family of promising PV technologies that have recently entered commercial production. Accordingly, the projected efficiencies in the table below address both technologies for systems in domestic commercial production.

[a] Market factors outside the program's control that could affect the achievement of cost goals include, but are not limited to, raw material costs, labor costs, currency exchange rates, interest rates, inflation, foreign competition, state and local regulations, and market participant withdrawals or entries.

U.S.-Produced PV Module Efficiency Targets

(Conversion Efficiency (%))

Efficiency	Historic		Planned						
	2003	2004	2005	2006	2007	2008	2009	2010	2020
Crystalline Silicon (c-Si)									
Target	12.5	13.0	13.5	14.0	14.5	15.0	15.5	16.0	20.0
Actual	12.5	13.0	-	-	-	-	-	-	-
Thin Film									
Target	10.0	10.5	11.0	11.5	12.0	12.5	13.0	13.5	18.0
Actual	10.0	10.5	-	-	-	-	-	-	-

The Solar Program uses the following PV module manufacturing cost data and projections as helpful indicators of progress toward achieving program benefits:

Historic and Projected Solar Energy Costs

	Historic					Planned					
	2000	2001	2002	2003	2004	2005	2006	2007	2008	2009	2010
Manufacturing Cost of Crystalline Silicon PV Modules ($/Watt)											
Target	2.50	2.35	2.25	2.10	1.95	1.95[a]	1.85	1.75	1.65	1.60	1.55
Actual	2.50	2.35	2.25	2.10	n/a						
Cost of Power from Crystalline Silicon PV Modules ($/kWh)											
Target	0.22-0.27	0.21-0.26	0.20-0.25	0.19-0.24	0.18-0.23	0.18-0.23	0.17-0.22	0.16-0.21	0.15-0.20	0.14-0.19	0.14-0.19
Actual	0.22-0.27	0.21-0.26	0.20-0.25	0.19-0.24	n/a						

During FY 2005, the PV subprogram conducted a review of its technical and cost targets using literature and field reviews as well as a more detailed analysis of individual PV technology pathways and targets. This effort is being conducted by university and National Laboratory personnel and is intended to help identify critical technological barriers, develop risk profiles, and evaluate PV targets and goals.

To implement the budget and performance integration portion of the President's Management Agenda, the Solar Program participated in the Administration's R&D Investment Criteria (R&DIC) evaluation process, the OMB Program Assessment Rating Tool (PART) process, and a multi-year program planning process. These exercises guided program budget planning, management decisions, and

[a] PV cost targets were adjusted for 2005 and outward due to verification processes. All technical targets remain on track but the target verification process causes the target completion dates to slip one year due to availability of market data.

performance goals and targets. As a result, this budget request for this subprogram redirects requested funding from congressionally directed activities in FY 2005 to R&D that better supports the program's performance goals.

Detailed Justification

(dollars in thousands)

	FY 2004	FY 2005	FY 2006
Fundamental Research	**28,224**	**26,878**	**31,373**

Fundamental research is critical to continued advancement of photovoltaic technology to meet the Solar Program's long-term goal of making solar electricity cost-competitive with electricity from traditional sources by 2020. There are four focus areas within Fundamental Research: Measurements and Characterization, the University Research Project (formerly the "Basic Research and University Project"), the High Performance Initiative, and the Collaborative Crystalline Silicon Initiative.

Under the Measurements and Characterization activity, researchers work in partnership with universities, industry and the National Laboratories to improve the efficiency of cell materials and devices by investigating their fundamental properties and operating mechanisms. This teamed research approach identifies efficiency-limiting defects in cell materials and analyzes their electrical and optical properties. In FY 2006, the Measurements and Characterization activity will focus its efforts on identifying degradation mechanisms and intrinsic instabilities in thin-film materials and devices that affect reliability.

The University Research Project investigates innovative ideas and leap-frog technologies through university and collaborative laboratory research. This high-risk research opens the door to non-conventional concepts that could dramatically improve cost effectiveness in the long term. Research is also conducted on crystalline silicon (c-Si) and thin-film materials to improve performance by better understanding material defects. Specific to thin films, research in FY 2006 will focus on processing methods to improve large-area deposition techniques and growth mechanisms that can achieve better uniformity, fewer defects, and faster throughput.

In support of this research, $1,590,000 from this subactivity will be used in FY 2006 to purchase laboratory instrumentation to equip the new Science and Technology Facility (STF) at the National Renewable Energy Laboratory (NREL). [The remainder of the $790,000 anticipated for equipment expenditures at the STF will be funded by the Solar Program in this and other sub-activities in FY 2007.]

The third focus area, the High Performance Initiative, supports research to substantially increase the efficiency of two key technologies: 1) large-area, monolithically interconnected multi-junction thin films; and 2) super high-efficiency, multi-junction concentrating cells. Both approaches have the potential to substantially reduce the costs of photovoltaic cells. Fundamental research in FY 2006 is aimed at making progress toward increasing the conversion efficiency of thin films from 11 percent (2005) to 13.5 percent (2010) and multi-junction concentrating cell efficiency from 30 percent (2005) to 40 percent (2010).

(dollars in thousands)

The fourth focus area, the Collaborative Crystalline Silicon Initiative, is a new effort designed to strengthen the position of the U.S. in international c-Si photovoltaic system markets. This initiative will feature cost-shared collaboration with a wide array of industry members and universities to improve U.S. c-Si technologies, which should improve the U.S. position in international markets and contribute to a significant reduction in cost of power from c-Si photovoltaic systems. In FY 2006, the Solar Program will develop a roadmap for this initiative and issue and complete initial solicitations.

Important to all research activities, the subprogram will conduct necessary analysis activities to help insure performance measures and goals are attained.

In FY 2004, this activity was reduced by $770,224 for SBIR/STTR and transferred to the Science Appropriation.

	FY 2004	FY 2005	FY 2006
Advanced Materials and Devices.....................................	**28,441**	**24,600**	**28,600**

The Advanced Materials and Devices activity has three focus areas: the Thin Film Partnership, Advanced Manufacturing R&D, and Module Reliability.

Development of thin films is a major thrust of the program and receives strong industry support. The Thin Film Partnership has formed strong research teams to focus R&D on promising thin-film candidates, such as amorphous silicon, copper indium diselenide, cadmium telluride and thin-film silicon. These research teams comprise university, industry, and laboratory researchers who work to solve generic issues as well as industry specific problems. In FY 2006, the program will fund the second year of three-year cost-shared contracts under the Thin Film Partnership solicitation issued in FY 2004. In support of this research, $1,000,000 from this subactivity will be used in FY 2006 to purchase laboratory instrumentation to equip the STF at NREL. [The remainder of the $790,000 anticipated for equipment expenditures at the STF will be funded by the Solar Program in this and other sub-activities in FY 2007.]

In Advanced Manufacturing R&D, strong partnerships with the domestic PV industry have been formed with the goal of reducing costs, increasing efficiency, and increasing capacity to help enhance the industry's competitiveness in the development and manufacture of PV modules. Many areas of manufacturing R&D are critical to further reduce the cost of PV systems. University, industry, and National Laboratory researchers will apply fundamental physics and chemistry principles to identify deficiencies and develop solutions that will improve sunlight-to-electricity conversion efficiencies, while lowering manufacturing costs. Three of the most important barriers are yield, throughput rate, and module efficiency. Better, more reliable, and faster processes are required, and these in turn require improvements such as more intelligent processing, in-situ diagnostics, and less expensive methods of assembly. In FY 2006, the PV Manufacturing R&D three-year, 50-50 cost-shared subcontracts will focus on large-scale module and component yield, durability, and reliability issues related to crystalline silicon. Additional subcontracts will be issued to address areas of work such as improvement of module manufacturing processes to increase module reliability; system and system component packaging, system integration, manufacturing and assembly; product manufacturing flexibility; and balance-of-system quality control. The primary focus is the enhancement of module, system component, and complete system reliability.

(dollars in thousands)

In Module Reliability, the new thin-film module reliability team will continue to address degradation mechanisms and intrinsic instabilities of pre-commercial modules. Thirty-year product life is necessary for photovoltaic modules and systems in order to reach the program's levelized energy cost goals.

In addition, necessary analysis and communication activities will be conducted to help ensure performance measures and goals are attained.

In FY 2004, this activity was reduced by $259,477 for SBIR/STTR and transferred to the Science Appropriation.

	FY 2004	FY 2005	FY 2006
Technology Development	**14,744**	**15,000**	**15,000**

The Technology Development activity has three focus areas: Systems Engineering and Reliability; Building Integrated PV R&D; and Outreach and Analysis.

Systems Engineering and Reliability research focuses on the critical need to improve reliability of the entire PV system, including balance-of-system components such as DC-to-AC power inverters and battery charge controllers. This work is led by Sandia and is implemented in close partnership with industry and the Southeast and Southwest Regional Experiment Stations[a] (Funding for the Southwest Regional Experiment Station: FY 2004 - $1.1 million; FY 2005 - $1.0 million; FY 2006 request - $1.0 million. Funding for the Southwest Regional Experiment Station: FY 2004 - $1.1 million; FY 2005 - $1.0 million; FY 2006 request - $1.0 million). Emphasis is placed on four technical objectives: 1) reducing life-cycle costs; 2) improving reliability of systems and system components; 3) increasing and assuring the performance of fielded systems; and 4) removing barriers to the use of the technology. To help remove barriers, the engineering and reliability activity supports development of codes and standards, as well as procedures for certifying performance of commercial systems.

In FY 2006, performance evaluation of thin-film systems will be conducted in the field to establish benchmark data in both hot, humid climates representative of the southeastern U.S. and hot, dry climates representative of the southwestern U.S. Accelerated lifetime testing in the laboratory will be conducted in parallel of the field testing. Any failures found in the field or in the laboratory will be analyzed to determine the degradation mechanisms. Work will continue with the Southeast and

---

[a] FY 2006 activities at the Southeast and Southwest Regional Experiment Stations include gathering and analyzing data from fielded PV systems to provide insight on the levelized cost of energy from PV, studying the issues that affect the durability of photovoltaic modules, establishing procedures and processes to certify PV hardware and systems, and assessing the performance and reliability of utility interactive inverters for small systems.

(dollars in thousands)

Southwest Regional Experiment Stations to improve the reliability of distributed grid-tied systems, especially in the buildings sector.

Building Integrated Photovoltaics (BIPV) is a promising solar application in which PV modules serve the dual purpose of replacing conventional building materials and generating electricity. (Funding for BIPV: FY 2004 - $500,000; FY 2005 - $100,000; FY 2006 request - $1,000,000). While traditional applications such as remote telecommunications and rural infrastructure will continue to grow, the solar industry has recently increased their emphasis on BIPV. By offering more than one functionality, BIPV systems will help cross the profit threshold that holds the key to significant growth in distributed, grid-connected electricity markets. This effort will be coordinated with the Building Technologies Program to develop zero energy buildings. In FY 2006, the program will continue BIPV research to more fully integrate PV into buildings.

The Million Solar Roofs initiative (MSRI) is designed to support States and local communities as they develop a strong commitment to the sustained deployment of solar energy technologies (Funding for Million Solar Roofs: FY 2004 - $2.6 million; FY 2005 - $2.0 million; FY 2006 request - $2.0 million). The target of MSRI is to facilitate through partnerships the installation of solar energy systems on one million U.S. buildings by 2010. By 2003, estimated cumulative installations totaled 180,000, the majority of which were solar hot water installations. MSRI partners include builders, energy service providers, utilities, non-governmental organizations, and State and local governments.

Outreach and Analysis activities are necessary for a national R&D program to remain viable in a rapidly changing energy sector. Such activities include testing, verification, and deployment activities for grid-connected applications and analyzing private sector commercialization options to better target R&D pathways. In FY 2006, core technology analysis and outreach activities will continue, as well as the systems-driven approach activity to help identify research priorities. The Solar Decathlon promotes awareness of solar energy technologies through a high-profile university competition.

In FY 2004 this activity was reduced by $609,769 for SBIR/STTR and transferred to the Science Appropriation.

	FY 2004	FY 2005	FY 2006
Congressionally Directed Activities.................................	**1,128**	**9,799**	**0**
▪ **Congressionally Directed Activity, Evaluation of Solar-Powered Thermo-Chemical Project of Hydrogen, UNLV**……………………………………..	**0**	**4,464**	**0**

In FY 2005, the U.S. Congress directed funds to assist the University of Nevada – Las Vegas with solar-powered thermo-chemical hydrogen activities.

	(dollars in thousands)		
	FY 2004	FY 2005	FY 2006
▪ **Congressionally Directed Activity, Photonics Research and Development, UNLV**.....................	**0**	**1,488**	**0**

In FY 2005, the U.S. Congress directed funds to assist the University of Nevada – Las Vegas with photonics research and development activities.

▪ **Congressionally Directed Activity, Conductive Coatings for Solar Cells**...	**0**	**1,488**	**0**

In FY 2005, the U.S. Congress directed funds to assist with conductive coatings for solar cells activities.

▪ **Congressionally Directed Activity, Yucca Valley Project**...	**245**	**248**	**0**

In FY 2004 and FY 2005, the U.S. Congress directed funds to assist the Yucca Valley Project (Yucca Valley, California) with solar energy activities.

▪ **Congressionally Directed Activity, Center for Ecological Technology**...	**392**	**0**	**0**

In FY 2004, the U.S. Congress directed funds to assist the Center for Ecological Technology (Pittsfield, Massachusetts) with solar energy activities.

▪ **Congressionally Directed Activity, Photovoltaic Panels for Mark Twain House and Museum**.............	**0**	**198**	**0**

In FY 2005, the U.S. Congress directed funds to assist the Mark Twain House and Museum (Hartford, Connecticut) with solar energy activities.

▪ **Congressionally Directed Activity, Hackensack University Green Building Medical Center**...............	**491**	**0**	**0**

In FY 2004, the U.S. Congress directed funds to assist the Hackensack University Green Building Medical Center (Hackensack, New Jersey) with solar energy activities.

▪ **Congressionally Directed Activity, Solar Technology Center, UNLV**...	**0**	**744**	**0**

In FY 2005, the U.S. Congress directed funds to assist the Solar Technology Center, UNLV with solar energy activities.

▪ **Congressionally Directed Activity, National Center on Energy Management and Building Technologies**...	**0**	**1,169**	**0**

In FY 2005, activities funded under this Congressionally-directed project were to address HVAC research needs and improve the efficiency, productivity, and security of the U.S. building stock by developing and disseminating synergistic and complementary solutions to energy

	(dollars in thousands)		
	FY 2004	FY 2005	FY 2006
management, indoor environment quality, and security concerns in new and existing buildings.			
Total, Congressionally Directed Activities	**1,128**	**9,799**	**0**
Total, Photovoltaic Energy Systems	**72,537**	**76,277**	**74,973**

Explanation of Funding Changes

	FY 2006 vs. FY 2005 ($000)
Fundamental Research	
Increase funding to the High Performance Initiative by awarding an additional industry or university contract that shows potential and scientific merit. This activity will support the High Performance Initiative's technical objective, to increase PV cell and module efficiency, and its goal, to reduce the cost of energy from PV systems to a level competitive with energy from conventional resources. Initiate funding of the Collaborative Crystalline Silicon Initiative (CCSI), including support of research and development in the areas of cell and module performance and component cost reduction. The funding increase will enable significant cost-sharing and strong industry involvement in CCSI planning functions (RDIC 2b, industry involvement and 2c, industry cost sharing). Consistent with the program's multi-year technical plan, this funding increase will support long-term, high-risk research that industry is unlikely to conduct itself due to market barriers such as corporate unwillingness to undertake high-risk, long-term R&D due to short-term profit pressures and the inability of the market to value externalities such as environmental and security benefits (RDIC 1b, Market Barriers)	+4,495

	FY 2006 vs. FY 2005 ($000)
Advanced Materials and Devices	
Increase funding to support the awarding of 2-4 new contracts for crystalline silicon manufacturing processes. These 50/50 cost-shared industry contracts will help to accelerate cost reductions in crystalline modules and systems through technical improvements. Increase thin-film module and system reliability research at the National Laboratories that addresses industry's needs. Outdoor lifetime testing of pre-commercial modules provided by industry will be conducted on fielded modules to assess their durability and identify degradation mechanisms. This funding increase for mid-term research and development takes advantage of significant industry cost-sharing opportunities that do not exist in other subprogram areas. (RDIC 2c, industry cost sharing) This reliability research will contribute to the goal of reducing the cost of energy from PV systems to a level competitive with energy from conventional resources. This increase reflects the benefits from cost sharing and consultation with industry to build complementary and feasible technology unlikely to be generated independently by industry (RDIC sections 2a - Complementary R&D and 2b - Industry Involvement)	+4,000
Congressionally Directed Activities	
▪ **Congressionally Directed Activity, Evaluation of Solar-Powered Thermo-Chemical Hydrogen, UNLV**	
This activity does not support the program goal..	-4,464
▪ **Congressionally Directed Activity, Photonics Research and Development, UNLV**	
This activity does not support the program goal..	-1,488
▪ **Congressionally Directed Activity, Conductive Coatings for Solar Cells**	
This activity does not support the program goal..	-1,488
▪ **Congressionally Directed Activity, Yucca Valley Project**	
This activity does not support the program goal..	-248
▪ **Congressionally Directed Activity, Photovoltaic Panels for Mark Twain House and Museum**	
This activity does not support the program goal	-198
▪ **Congressionally Directed Activity, Solar Technology Center, UNLV**	
This activity does not support the program goal..	-744

	FY 2006 vs. FY 2005 ($000)
▪ **Congressionally Directed Activity, National Center on Energy Management and Building Technologies**	
This activity does not support the program goal	-1,169
Total, Congressionally Directed Activities	**-9,799**
Total Funding Change, Photovoltaic Energy Systems	**-1,304**

Concentrating Solar Power

Funding Schedule by Activity

	(dollars in thousands)				
	FY 2004	FY 2005	FY 2006	$ Change	% Change
Concentrating Solar Power	5,331	5,951	6,000	+49	+0.8%
Total, Concentrating Solar Power	5,331	5,951	6,000	+49	+0.8%

Description

Concentrating solar power (CSP) systems utilize the heat generated by concentrating and absorbing the sun's energy to drive a heat engine/generator to produce electric power. The concentrated sunlight produces temperatures ranging from 600°F to over 1500°F which is used to run heat engines or steam turbines for generating power or producing clean fuels such as hydrogen.

There are currently three types of solar thermal systems – parabolic trough, power tower and dish-engine systems – that are capable of producing power using the sun's heat. Trough systems use linear parabolic concentrators to focus sunlight along the focal lines of the collectors. In a power tower system, a field of two-axis tracking mirrors, called heliostats, reflects sunlight onto a receiver that is mounted on top of a centrally-located tower. Dish-engine systems comprise a parabolic dish concentrator, a thermal receiver, and a heat engine/generator located at the focus of the dish to generate power.

Trough and tower systems are best suited for large-scale power applications (30 - 200 MW plants) and have the valuable attribute of dispatchability due to their use of thermal storage. Dish-engine systems are best suited for distributed mini-grid applications ranging in size from 2 - 25 kW, but can also be configured to work off-grid for remote power applications.

Benefits

The CSP subprogram contributes to the overall program goal by developing energy supply technologies that are reliable, affordable, and environmentally sound. Expanding our national electricity generation fuel portfolio will increase energy security by diversifying our domestic energy supply options for use both in normal and emergency situations.

As noted in the FY 2005 PART submission, the CSP subprogram is following recommendations from several merit review panels and an independent engineering study, which established benchmark technology costs and achievable long-term cost goals and detailed the highest priority R&D activities to achieve those goals. During FY 2005, the CSP subprogram is developing an integrated system efficiency model to track technical progress across several R&D areas that contribute to increasing overall CSP system efficiency and decreasing the cost of energy from CSP. The model will be peer reviewed in FY 2005. By FY 2006, the model is expected to help generate targets for use in current and subsequent years.

Similar to the other solar subprograms, the CSP subprogram is moving from measuring outcomes to outputs in its metrics. The new CSP model focuses on system efficiency to better reflect the actual technical work conducted by the program, allow for improved verification and validation of results, and minimize the potential for target achievement disruption caused by market factors beyond the program's control.[a] System efficiency measures, as developed, will have a direct correlation to the cost of electricity from CSP. In addition, the program will continue to track cost data, as cost measures remain useful indicators of market trends and assist the program in responding to a changing marketplace. Therefore, the program is using a "hybrid" target for its work that emphasizes technical accomplishments, but maintains a strong connection to modeled, or projected, cost of energy from CSP.

The Solar Program uses the below historical cost data and projections as indicators of progress toward achieving program benefits. Outyear projections beyond FY 2006 assume a level of funding commensurate with the CSP Technology Transition Plan.

Historic and Projected CSP Solar Energy Costs[b]

($/kWh)

Levelized Electricity Cost from CSP	2003	2004	2005	2006	2007	2008	2009	2010	2011	2012
Target	0.12-0.14	0.12-0.14	0.12-0.14	0.12-0.14	0.11-0.13	0.11-0.13	0.10-0.12	0.09-0.11	0.08-0.10	0.07-0.09
Actual	0.12-0.14	0.12-0.14								

[a] Market factors outside the program's control that could affect the achievement of cost goals include, but are not limited to, raw material costs, labor costs, currency exchange rates, interest rates, inflation, foreign competition, state and local regulations, and market participant withdrawals or entries.
[b] In this table, years indicate the years in which field verification of modeled cost occurs.

Detailed Justification

	(dollars in thousands)		
	FY 2004	FY 2005	FY 2006
Concentrating Solar Power	**5,331**	**5,951**	**6,000**

As described earlier in the PART section, one specific FY 2004 PART recommendation was to terminate the CSP subprogram, in alignment with a recommendation from a peer review by the National Research Council (NRC), a branch of the National Academy of Sciences (NAS).[a] At the Department's request, an independent engineering company, Sargent and Lundy, evaluated CSP technology and found that the potential exists to lower the cost of power from CSP plants to between $0.035/kWh and $0.062/kWh by 2020, assuming sufficient market incentives.[b] To verify its credibility, the Department asked the NRC to review the draft version of the evaluation. The NRC agreed with the Sargent and Lundy review that there was potential for cost reduction and determined that "since 1999, significant progress has been made in understanding the potential impacts of thermal storage technologies, thin film glass mirrors, improved heat collection units, improved trough support structures, and other technical opportunities to improve CSP technology."[c]

In FY 2006, parabolic trough technology activities will be expanded on the development of next-generation concentrators and receivers. Development of advanced thermal energy storage technologies will continue and new collector and storage technologies being deployed in commercial projects will be evaluated. Field validation will be conducted on new collector technologies being deployed in trough projects in Arizona and Nevada.

For distributed applications, research in FY 2006 will focus on improving the reliability of dish systems through the operation and testing of multiple units at Sandia National Laboratory test facilities.

Applied research at the National Laboratories on advanced receiver and concentrator concepts will be combined with a competitive solicitation to initiate the development of these parabolic trough components. In order to increase the net efficiency of trough systems, their operating temperatures must be increased. Organic salts offer the potential for high-temperature operation (500^{o} C vs. 390^{o} C today) with the benefit of being liquid at ambient temperatures. The research challenge in FY 2006 will be to formulate an inexpensive organic salt that allows for high-temperature operation.

---

[a] National Research Council, "Renewable Power Pathways: A Review of the U.S. Department of Energy's Renewable Energy Programs," National Academy Press, 2000.
[b] R. Charles, et al., "Assessment of Parabolic Trough and Power Tower Solar Technology Cost and Performance Forecasts," Sargent & Lundy Consulting Group, SL-5641, May 2003.
[c] G. Kulcinski, et al., "Critique of the Sargent & Lundy Assessment of Cost and Performance Forecasts for Concentrating Solar Power," National Academy of Sciences, National Research Council Board on Energy and Environmental Systems, November 2002.

	(dollars in thousands)		
	FY 2004	FY 2005	FY 2006

Analytical support will be provided to the Western Governors' Association (WGA) to assist CSP deployment activities already underway in California, New Mexico, Arizona, and Nevada. Funding levels for the WGA depend on the relevant analyses requested by member States. (Funding for WGA: FY 2004 - $200,000; FY 2005 - $150,000; FY 2006 request - $200,000).

Total, Concentrating Solar Power	**5,331**	**5,951**	**6,000**

Explanation of Funding Changes

	FY 2006 vs. FY 2005 ($000)
Concentrating Solar Power	
No significant change	+49
Total Funding Change, Concentrating Solar Power	**+49**

Solar Heating and Lighting

Funding Schedule by Activity

(dollars in thousands)

	FY 2004	FY 2005	FY 2006	$ Change	% Change
Solar Heating and Lighting					
Solar Heating and Lighting	2,863	2,449	2,980	+531	+21.7%
Congressionally Directed Activity, University of Louisville Sustainable Buildings Project...........	0	397	0	-397	-100.0%
Total, Solar Heating and Lighting	2,863	2,846	2,980	+134	+4.7%

Description

The Solar Heating and Lighting (SHL) subprogram develops solar technologies that provide hot water and hybrid solar lighting for residential and/or commercial buildings in collaboration with industry partners.

Benefits

The glass-and-copper configuration of current solar water heaters makes them costly to manufacture, difficult to install and maintain, and inflexible in their applications. The SHL subprogram develops new formulations of lightweight polymer materials to modernize solar water heaters, which simplify installation and decrease the heating cost. The initial emphasis on systems designed for non-freezing climates is expected to help select polymeric materials able to withstand twenty years of use also in freezing climates. SHL also provides technical support to the building industry and manufacturers in designing solar water heaters. In addition, SHL develops a hybrid solar lighting systems that displace electric lighting and could increase the productivity and/or performance of workers and students by bringing sunlight into interior rooms of office buildings, industrial and government facilities, hospitals, and schools.

The SHL subprogram contributes to the overall Solar Program goal by developing energy supply technologies that are reliable and affordable. Using solar energy to provide heat increases our national security by reducing our reliance on imported fossil fuel, diversifying our energy portfolio for both normal and emergency situations, and alleviating pressure on both the natural gas supply and the aging electricity grid.

In an effort to move from measuring outcomes to outputs, along with the rest of the Solar Program, the SHL subprogram in FY 2005 is working to develop a technical output metric for water heaters with a direct correlation to cost outcomes. Such a metric will allow for improved validation and verification and minimize the potential for target achievement disruption caused by market factors beyond the program's control.[a] In the meantime, SHL will continue to measure its progress using modeled cost targets.

The table below shows presents historic energy cost figures as well as future estimates, which predict that the cost of energy from solar water heating in non-freezing climates is expected to decrease from an equivalent of $0.07/kWh in 2004 to $0.045/kWh in 2006, a drop that is expected to expand the market for solar water heaters. The cost of energy trend from technical improvements to solar water heaters will be discussed in greater detail in the upcoming revision to the Solar Program Multi-Year Technical Plan (2005).

Historic and Expected Cost of Energy from Solar Water Heaters

($/kWh equivalent)

	2000	2003	2004	2005	2006	2007	2008	2009	2010
Non-Freezing Climates									
Target..........................	0.07	0.08	0.07	0.05	0.045[b]	--	--	--	--
Actual	0.08	0.08	0.07						
Freezing Climates									
Target..........................	--	--	-- [c]	--	--	--	0.09-0.10	0.07-0.08	0.05-0.06
Actual	--	--	0.11-0.12						

Detailed Justification

(dollars in thousands)

	FY 2004	FY 2005	FY 2006
Solar Heating and Lighting..	**2,863**	**2,449**	**2,980**

During FY 2006, prototype non-freezing water heaters units being field tested will undergo evaluation and any final design changes implemented. By the end of FY 2006, SHL should be able to close out Federal involvement in non-freezing solar water heater development, including the appropriate transfer of intellectual property rights and completion of contractual obligations. At that time, SHL will shift all its solar water heater R&D efforts to freezing-climate technologies.

In FY 2004, the SHL subprogram began conducting research and development (R&D) of low-cost,

[a] Market factors outside the program's control that could affect the achievement of cost goals include, but are not limited to, raw material costs, labor costs, currency exchange rates, interest rates, inflation, foreign competition, state and local regulations, and market participant withdrawals or entries.
[b] Conclude research on solar water heaters suitable for non-freezing climates.
[c] Begin research on solar water heaters suitable for freezing climates. No cost targets are set for FY 2004 and FY 2005 because funds previously designated for issuance of freezing climate water heater solicitations in FY 2005 have been redirected to fund a congressional earmark.

	(dollars in thousands)		
	FY 2004	FY 2005	FY 2006

polymer-based solar water heating systems suited for freezing climates. During FY 2005, the Solar Program is refining the conceptual design developed in FY 2004. A freezing-climate water heater solicitation originally planned for FY 2005 was postponed because of a lack of funds created by the University of Louisville Sustainable Buildings Project earmark. In FY 2006, the solicitation will be released and proposals selected. The winning teams will develop prototype freezing-climate systems.

In the area of solar lighting systems, the subprogram is currently developing the second generation of Hybrid Solar Lighting (HSL) systems in conjunction with Oak Ridge National Laboratory. The HSL system concentrates sunlight, through a dish and tracking system, onto optical fibers that transfer sunlight into interior rooms, displacing artificial lights and improving lighting quality. Data from an HSL system installed at a commercial site during FY 2005 will be evaluated in FY 2006 and appropriate system modifications will be made. Completion of the commercial installation(s) by the end of FY 2006 will enable a decision on future Federal involvement in hybrid solar lighting systems.

In FY 2004, this subprogram was reduced by $44,530 for SBIR/STTR and transferred to the Science Appropriation.

	FY 2004	FY 2005	FY 2006
Congressionally Directed Activity, University of Louisville Sustainable Buildings Project..........................	**0**	**397**	**0**

In FY 2005, the U.S. Congress directed funds to assist the University of Louisville (Louisville, Kentucky) with solar energy activities.

	FY 2004	FY 2005	FY 2006
Total, Solar Heating and Lighting....................................	**2,863**	**2,846**	**2,980**

Explanation of Funding Changes

	FY 2006 vs. FY 2005 ($000)
Solar Heating and Lighting	
The increased funding will fund industry teams with winning proposals from a freezing-climate water heater solicitation to be issued in FY 2006. The teams will complete the first phase of an effort to develop a low-cost solar water heater suitable for freezing climates: developing conceptual designs. The next phase will include the development of prototype systems. These systems will lead to products that will reduce emissions, increase domestic energy supply, reduce energy consumption, and reduce peak demand for electricity from the centralized grid. All of these results are identified as high priority items by the President as detailed in the National Energy Policy (RDIC 1a, Presidential priority)...	+531
Congressionally Directed Activity, University of Louisville Sustainable Buildings Project	
This activity does not support the program goal..	-397
Total Funding Change, Solar Heating and Lighting	**+134**

Wind Energy

Funding Profile by Subprogram[a]

(dollars in thousands)

	FY 2004 Comparable Appropriation	FY 2005 Original Appropriation	FY 2005 Adjustments	FY 2005 Comparable Appropriation	FY 2006 Request
Wind Energy					
Technology Viability...........	28,150	26,813	-212[b]	26,601	32,600
Technology Application......	10,227	10,188	-544[c]	9,644	11,649
Congressionally Directed Activities...............	1,426	4,599	-40[d]	4,559	0
Total, Wind Energy	39,803	41,600	-796	40,804	44,249

Public Law Authorizations:

P.L. 94-163, "Energy Policy and Conservation Act (EPCA)" (1975)
P.L. 101-218, "Renewable Energy and Energy Efficiency Technology Competitiveness Act" (1989)
P.L. 101-575, "Solar, Wind, Waste, and Geothermal Power Production Incentives Act" (1990)
P.L. 102-1018, "Energy Policy Act (EPACT)" (1992)

Mission

The mission of the Wind Energy Program is to lead the Nation's research and development efforts to improve wind energy technology through public/private partnerships that enhance domestic economic benefit from development, and to address barriers to the use of wind energy in coordination with stakeholders, resulting in greater energy security through more diverse, clean, reliable, affordable and secure domestic supply.

Benefits

The Wind Program's mission and activities contribute directly to EERE's and DOE's mission of improving national, energy and economic security and address the President's National Energy Policy call for increasing the diversity of our Nation's energy resources. The Wind Program has successfully graduated its high speed wind effort, meeting its cost of energy goal of 3 cents/kWh in Class 6 winds in 2004. Since 2002, the program has focused most of its efforts on low wind speed technologies, and through its public/private partnerships, has improved the cost of energy for large systems in Class 4 onshore winds from 5.5 cents in 2002 to 4.4 cents in 2004, based on modeling of a composite turbine that includes improved and new technology. Based on recent emergence of U.S. offshore wind power development prospects and assessment of potential National benefits, the program is also supporting R&D for reducing the cost of offshore systems. Achieving the Wind Program's mission will enhance

[a] SBIR/STTR funding in the amount of $924,000 was transferred to the Science Appropriation in FY 2004. Estimates for SBIR/STTR budgeted in FY 2005 and FY 2006 are $622,000 and $737,000 respectively.
[b] Reflects the 0.80% rescission of -$212,000.
[c] Reflects the 0.80% rescission of -$77,000 and comparability adjustment for Cross-cutting Planning, Analysis and Evaluation of -$467,000.
[d] Reflects the 0.80% rescission of -$40,000.

the competitiveness of wind energy in conventional electricity markets, growing the domestic energy supply resource, yielding environmental benefits by avoiding pollutant emissions and benefiting the Nation's infrastructure posture by reducing economic effects of fuel price or supply disruptions and increasing system reliability.

More detailed, integrated and comprehensive economic, energy and energy security benefits estimates are provided in the Expected Program Outcomes section at the end of the program level budget narrative.

Strategic and Program Goals

The Department's Strategic Plan identifies four strategic goals (one each for defense, energy, science, and environmental aspects of the mission) plus seven general goals that tie to the strategic goals. The Wind Program supports the following goal:

Energy Strategic Goal

General Goal 4, Energy Security: Improve energy security by developing technologies that foster a diverse supply of reliable, affordable and environmentally sound energy by providing for reliable delivery of energy, guarding against energy emergencies, exploring advanced technologies that make a fundamental improvement in our mix of energy options, and improving energy efficiency.

The Wind Program has one program goal which contributes to General Goal 4 in the "goal cascade":

Program Goal 04.05.00.00: Wind Energy. By 2012, complete program technology research and development, collaborative efforts, and provide the technical support and outreach needed to overcome barriers – energy cost, energy market rules and infrastructure, and energy sector acceptance –to enable wind energy to compete with conventional fuels throughout the Nation in serving and meeting the Nation's energy needs.

Contribution to Program Goal 04.05.00.00 (Wind Energy)

The Wind Energy Programs' key contribution to General Goal 4, Energy Security, is through supply growth and diversification. The Wind Program focuses on developing new, cost-effective technologies through research and development with competitively selected public/private partnerships and by facilitating the installation of wind systems by providing supporting research in power systems integration, technology acceptance and other analytical and engineering support. Key technology pathways that contribute to achievement of these benefits include (annual performance indicators are provided in the individual technology benefits narrative):

- Low Wind Speed Technology (LWST): By 2012, reduce the cost of electricity from large wind systems in Class 4 winds to 3 cents/kWh for onshore systems (from a baseline of 5.5 cents/kWh in 2002) and 5 cents/kWh for offshore systems (from a baseline of 9 cents in FY 2005).
- Distributed Wind Technology (DWT): By 2007, reduce the cost of electricity from distributed wind systems to 10-15 cents/kWh in Class 3 wind resources, from a baseline of 17-22 cents/kWh in 2002. [Note: a range of cost performance targets are most appropriate for distributed wind systems, which require an approach based on relative improvement within scale, application, and market segments. The 10 cent/kWh target corresponds to a 50-100 kW turbine that is typical for large farms, small to mid-size commercial and/or remote village applications. The 15 cent/kWh target corresponds to a 3-10 kW turbine for residential applications.]
- Technology Acceptance: By 2010, facilitate the installation of at least 100 MW of wind in at least 30 States from a baseline of 8 States in 2002.

Annual Performance Results and Targets

FY 2001 Results	FY 2002 Results	FY 2003 Results	FY 2004 Results	FY 2005 Targets	FY 2006 Targets
Program Goal 04.05.00.00 (Wind Energy)					
Technology Viability					
Advance wind hybrid control system technology developed jointly with USDA Agricultural Research Center became commercially available.		Complete low wind speed turbine conceptual design studies, and fabricate and begin testing advanced wind turbine components optimized for low wind speed application initiated under industry partnership projects. [MET]	Complete testing of prototypes of first advanced low wind speed technology components, and complete detailed design under first public-private partnership project for full system low wind speed turbine development. [MET]	Low Wind Speed Technology (LWST): Complete fabrication and begin testing advanced variable speed power converter. Test first advanced blade, incorporating improved materials and manufacturing techniques. Field test the first full-scale Low Wind Speed Technology prototype turbine. This contributes to the Annual LWST COE Target: 4.3 cents per kWh in Class 4 winds.	Low Wind Speed Technology (LWST): Complete designs for first components developed under the second round of LWST, and complete testing of the first commercial prototype from the Phase I LWST. Annual LWST COE Target: 4.0 cents per kWh in onshore Class 4 winds, and 8.7 cents per kWh for offshore systems.
				Distributed Wind Technology (DWT): Complete prototype testing of 1.8 kW Small Wind Turbine, finishing the International Electrotechnical Commission suite of tests for acoustics, power, durability, and safety. This contributes to the Annual DWT COE Target: 12-18 cents per kWh in Class 3 winds.	Distributed Wind Technology (DWT): Award grants/cooperative agreements for second round of DWT solicitations; and complete all of the grants for DWT round one conceptual design work. DWT COE Target: 11-16 cents per kWh in Class 3 winds.
				Technology Acceptance: 32 States with over 20 MW installed; 16 States with over 100 MW installed.	Technology Acceptance: 19 States with over 100 MW wind installed.
			Contribute proportionately to EERE's corporate goal of reducing corporate and program uncosteds to a range of 20-25 percent by reducing program annual uncosteds by 10 percent in 2004 relative to the program uncosted baseline (in 2003) until the target range is met.	*Contribute proportionately to EERE's corporate goal of reducing corporate and program adjusted uncosted obligated balances to a range of 20-25 percent by reducing program annual adjusted uncosteds by 10 percent in 2005 relative to the program FY 2004 end of year adjusted uncosted baseline ($18,371K) until the target range is met.*	*Contribute proportionately to EERE's corporate goal of reducing corporate and program adjusted uncosteds to a range of 20-25 percent by reducing program annual uncosteds by 10 percent in 2006 relative to the program uncosted baseline (2005) until the target range is met.*

FY 2001 Results	FY 2002 Results	FY 2003 Results	FY 2004 Results	FY 2005 Targets	FY 2006 Targets
					Maintain total Program Direction costs in relation to total Program costs in the range of 8% - 12% to demonstrate efficient and effective EERE-wide business and technical support to mission direct programs.

Means and Strategies

The Wind Program will use various means and strategies to achieve its program goals as described below. "Means" include operational processes, resources, information, and the development of technologies, and "strategies" include program, policy, management and legislative initiatives and approaches. Various external factors, as listed below, may impact the ability to achieve the program's goals. Collaborations are integral to the planned investments, means and strategies, and to addressing external factors.

The Wind Program will implement the following means:

- Supporting public/private partnerships for multiple large wind system technology pathways (> 100 kilowatts) to achieve the goal of 3 cents/kWh for onshore systems and 5 cents/kWh for offshore systems in Class 4 winds by 2012.
- Under the Distributed Wind Technology (DWT) activity, the program supports cost-shared public/private R&D partnerships for developing cost effective Small Wind Turbine Systems for Class 3 wind speed areas.
- Use of Systems Integration to enhance the compatibility of wind energy technologies with the electric power system, and to develop information to assure fair treatment of wind energy by power system operators, transmission owners and regulators and to mitigate barriers.

The Wind Program will implement the following strategies:

- The Program's current R&D focus is on the development of wind turbines that can operate economically in lower wind resource areas, which would significantly expand opportunities for wind energy use in the United States. Cost effective turbine technology for areas of the country with Class 4[a] wind resources would increase the total amount of economically viable wind energy resource in the Nation by a factor of twenty, and reduce the average distance to load centers by a factor of five.
- In FY 2005, the program began including offshore system technology development in its Low Wind Speed Technology (LWST) activities. Offshore wind technology could enable harnessing abundant wind resources near major hard-to-serve load centers, such as in the Northeastern and Mid-Atlantic U.S.
- The Department also supports development of Small Wind Turbines (100 kilowatts or less) that can serve a range of high-valued, distributed power applications. These applications include supplemental on-site power generation for grid-connected suburban and rural residences, farms, and businesses; stand-alone power supply in conjunction with hybrid system technologies to serve remote or island energy needs; and dedicated power for applications such as water pumping and ice

[a] The following table defines wind classes and their relative significance to energy production potential.

	(Wind Class) 6	5	4	3
Wind speed (annual average wind speed in miles per hour at 33 feet above the ground)	15	14	13	12
Relative Energy Content at Different Wind Classes (percent)..	100	81	66	49

making. Substantial markets for residential and small business applications in the United States are expected to open with emerging state incentive programs, reduced institutional barriers, and improved technology, as detailed in the U.S. Small Wind Turbine Industry's Roadmap.[a]

The Program expects that these strategies will result in significant cost savings and a significant reduction in the cost of wind technology, improving energy security by increasing the generation of reliable, affordable and environmentally sound wind energy, adding to the diversity of the Nation's energy supply and reducing the demand for natural gas.

The following external factors could affect Wind Energy's ability to achieve its strategic goal:

- the availability of conventional energy supplies;
- the cost of competing technologies;
- state and international efforts to support wind energy;
- Federal, state and regional regulatory actions affecting offshore wind installations;
- continuation of Federal tax incentives; and
- Implementation of other policies at the national level, including Federal efforts to reduce carbon and criteria emissions.

In carrying out the program's mission, the Wind Energy Program collaborates in several important activities including:

- program activities dependent upon outputs from academia, manufacturers, developers, and National Laboratories;
- systems integration with the electric transmission and distribution system industry on policy and R&D issues;
- improvements in the capability of the Distributed Energy Resources Program (within DOE) and industry to develop distributed wind and other energy sources;
- industry and R&D directions for the production of hydrogen for energy use;
- cooperative research and development with the International Energy Agency (IEA); and
- peer review of the Wind Program's overall strategies and its activities by academia, manufacturers and National Laboratories and with independent experts.

[a] The U.S. Small Wind Turbine Industry Roadmap: A 20-year Industry Plan for Small Wind Turbine Technology. American Wind Energy Association Small Wind Turbine Committee, June 2002.

Validation and Verification

To validate and verify program performance, the Wind Program will conduct internal and external reviews and audits. The table below summarizes validation and verification activities.

Data Sources:	"Assessment of Potential Improvements in Large-Scale Low Wind Speed Technology," J. Cohen, Proceedings of Global Wind Power 2004, Chicago, Illinois, March 28-31, 2004, published by American Wind Energy Association. Low Wind Speed Turbine Technology Characterization, Migliore and Cohen, presented at Wind Power 2003; Wind Energy Technology Characterization, 1997, published by EPRI. Low Wind Speed Turbine Technology Benefits, internal analysis for the FY 2002 request, peer reviewed by A.D. Little. FY 2001, FY 2002, FY 2003 and FY 2004 Wind Program Peer Reviews. American Wind Energy Association (AWEA)/Global Energy Concepts Wind Plant Database, reviewed by EIA, contain proprietary data. Various published and confidential data on wind projects economics. AWEA Small Wind Turbine Industry Roadmap.
Baselines:	Low Wind Speed Technology: 5.5 cents/kWh in FY 2002 for onshore applications, and 9 cents/kWh in FY 2005 for offshore applications; Distributed Wind Technology: 17-22 cents/kWh in FY 2002; and Technology Application: 8 States with at least 100 MW installed wind in FY 2002.
Frequency:	Annual.
Data Storage:	Web, paper publications and on-line storage
Evaluation:	In carrying out the program's mission, the Wind Energy Program uses several forms of evaluation to assess progress and to promote program improvement.

- Technology validation and operational field measurement, as appropriate
- Peer review by independent outside experts of both the program and subprogram portfolios
- Annual internal Technical Program Review of the Wind Energy Program
- Specialized program evaluation studies to examine process, impacts, or market baseline and effects, as appropriate
- Quarterly and annual assessment of program and management results based performance through Joule (the DOE quarterly performance progress review of budget targets), R&DIC (annual internal review of performance planning and management of R&D programs against specific criteria), PMA (the Presidents Management Agenda -- annual departmental and PSO based goals whose milestones are planned, reported and reviewed quarterly) and PART (common government wide program/OMB reviews of management and results).
- Annual review of methods, and recomputation of potential benefits for the Government Performance and Results Act (GPRA)

Verification: Activities and accomplishments will be verified by monthly reports from contractor/National Laboratories, including NREL, and from lead program field elements. Determining the cost of energy (COE) for LWST and DWT goals will be derived from the impact of improvements in individual components and subsystems based on comparisons against a baseline turbine composite with a well-understood cost of energy. Determining the number of States with over 100 MW of wind for the Technology Acceptance goal will come from U.S. capacity statistics regularly collected by the National Energy Renewable Laboratory through subcontract. Reporting will be done on a quarterly basis to DOE from NREL.

Program Assessment Rating Tool (PART)

The Department implemented a tool to evaluate selected programs. PART was developed by OMB to provide a standardized way to assess the effectiveness of the Federal Government's portfolio of programs. The structured framework of the PART provides a means through which programs can assess their activities differently than through traditional reviews. The Wind Program has incorporated feedback from OMB into the FY 2006 Budget Request and has taken or will take the necessary steps to continue to improve performance.

The FY 2004 PART review of the Wind Energy Program contained a recommendation to continue emphasis on wind technology development for low wind speed areas; Low Wind Speed Technologies are the FY 2006 Wind Program's budget focus. Another PART recommendation suggested the development of practical but meaningful annual performance measures; the Wind Energy Program has developed annual performance targets for its three PART goals and Budget technology pathways (see the section Contribution to Program Goals), covering about 85 percent of its budget request. The Wind Program is also attempting to adhere to the specific direction of Congressional appropriation language while increasing the contribution to program goals to the extent possible. These improvements in accountability were reflected in the Wind Program's significantly improved FY 2005 score in the results/accountability area, resulting in a modest overall score improvement, and a "moderately effective" rating, the second highest rating possible.

The FY 2005 PART found that the program has a clear purpose, strong planning and management. The PART acknowledged the role of the program in commercial success of high wind speed technologies and transition to greater focus on low wind speed technologies, reflected in the budget priorities.

The PART also recommended that the program participate in the development of a consistent framework for the Department to analyze the costs and benefits of its R&D investments, and apply this guidance to development of the FY 2006 budget. The program has provided input the Department needs to improve consistency in the methods and assumptions used to estimate potential benefits. The Department is employing the data in its effort to produce comparable estimates within its energy R&D programs to inform budget decision. EERE is working with OMB, the other applied R & D programs, and the PMA Budget and Performance Integration principals in the department to establish an increasingly integrated and consistent framework to inform the budget process.

Funding by General and Program Goal

	(dollars in thousands)		
	FY 2004	FY 2005	FY 2006
General Goal 4, Energy Security			
Program Goal 04.05.00.00, Wind Energy			
Technology Viability	28,150	26,601	32,600
Technology Application	10,227	9,644	11,649
Total, Program Goal 04.05.00.00, Wind Energy	38,377	36,245	44,249
All Other			
Congressionally Directed Activity, Wind Energy Transmission Study (Omnibus Bill)	497	0	0
Congressionally Directed Activity, Vermont Department of Public Service	491	0	0
Congressionally Directed Activity, St. Francis, Pennsylvania Wind Farm Feasibility Study	144	521	0
Congressionally Directed Activity, Saginaw, Michigan Chippewa Wind Project	294	0	0
Congressionally Directed Activity, North Dakota Wind Pilot Project	0	496	0
Congressionally Directed Activity, Great Plains Wind Energy Transmission Development Project	0	496	0
Congressionally Directed Activity, Alaska Wind Energy Project	0	1,488	0
Congressionally Directed Activity, Renewable Energy for Rural Economic Development Program, Utah State University	0	496	0
Congressionally Directed Activity, Iowa Lakes Community College Wind Turbine Project	0	496	0
Congressionally Directed Activity, National Center for Energy Management and Building Technologies	0	566	0
Total, All Other	1,426	4,559	0
Total, General Goal 4 (Wind Energy)	39,803	40,804	44,249

Expected Program Outcomes

The Wind Program pursues its mission through integrated activities designed to increase the use of domestic renewable resources. We expect these improvements to reduce susceptibility to energy price fluctuations and potentially lower energy bills; reduce EPA criteria and other pollutants; enhance energy security by increasing the production and diversity of domestic energy supplies; and provide greater energy security and reliability by improving our energy infrastructure. In addition to these “EERE business-as-usual” benefits, realizing the Wind Program goals would provide the technical potential to reduce conventional energy use even further if warranted by future energy needs.

Estimates of non-renewable annual energy savings, energy expenditure savings, carbon emission reductions, natural gas savings, and wind electricity capacity additions that result from the realization of Wind Program goals are shown in the tables below through 2050.

The assumptions and methods underlying the modeling efforts have significant impact on the estimated benefits, and results could vary significantly if external factors, such as future energy prices, differ from the "baseline case" assumed for this analysis. EERE's baseline case is essentially the same as the EIA "business-as-usual" case presented in its Annual Energy Outlook. In addition, possible changes in public policy and disruptions in the energy system which may affect estimated benefits are not modeled. The external factors such as unexpected changes in competing technology costs, identified in the Means and Strategies section above, could also affect the Program's ability to achieve its goals. Also note that the modeling long term benefits assumes that funding levels will be consistent with the President's commitment and assumptions in the 2006 Budget, and that funding will be applied to the core program. If the pattern of substantial congressionally directed projects persists over several years, the GPRA benefits estimates will need to be reduced.

The results shown in the long term benefits tables are preliminary estimates based on initial modeling of some of the possible program production technologies; nonetheless, they provide a useful picture of the potential change in national benefits over time if the technology, infrastructure and markets evolve as expected. Final documentation is estimated to be completed and posted by March 31, 2005. Uncertainties are larger for longer term estimates. A summary of the methods, assumptions, and models used in developing these benefit estimates that are important for understanding these results are provided at www.eere.energy.gov/office_eere/budget_gpra.html.

FY 2006 GPRA Benefits Estimates for Wind Program[a]

Mid-Term Benefits[b]	2010	2015	2020	2025
Primary nonrenewable energy savings (Quads)	0.04	0.84	2.29	3.32
Energy bill savings (Billion 2002$)..	ns	5	7	4
Carbon emission reductions (MMTCE)	1	18	52	81
Natural gas savings (Quads)...	0.01	0.24	0.52	0.39
Program specific electric capacity additions (GW)	3	30	70	93

Long-Term Benefits[c]	2030	2040	2050
Primary nonrenewable energy savings (Quads)	2.8	3.7	3.7
Energy system cost savings (Billion 2001$)	1	3	4
Carbon emission reductions (MMTCE)	60	73	87
Natural gas savings (Quads)..	1.09	1.99	0.50
Program specific electric capacity additions (GW)	68	96	111

[a] Benefits reported are annual, not cumulative, for the year given. Estimates reflect the benefits that may be possible if all of the program's technical targets are achieved and funding continues at levels consistent with assumptions in the FY 2006 Budget.
[b] Mid-term program benefits were estimated utilizing the GPRA06-NEMS model, based on the Energy Information Administration's (EIA) National Energy Modeling System (NEMS) and utilizing the EIA's Annual Energy Outlook (AEO) 2004 Reference Case.
[c] Long-term benefits were estimated utilizing the GPRA06 - MARKAL developed by Brookhaven National Laboratory (BNL). Results can differ among models due to differences in their structure. In particular, the two models estimate economic benefits in different ways, with the MARKAL model reflecting the cost of additional investments required to achieve reductions in energy bills.

Technology Viability
Funding Schedule by Activity

(dollars in thousands)

	FY 2004	FY 2005	FY 2006	$ Change	% Change
Technology Viability					
Low Wind Speed Technology (Large Systems)	11,611	10,494	15,600	+5,106	+48.7%
Distributed Wind Technology (DWT – Small Systems)	1,962	1,908	2,000	+92	+4.8%
Supporting Research and Testing (SR&T)	14,577	14,199	15,000	+801	+5.6%
Total, Technology Viability..............	28,150	26,601	32,600	+5,999	+22.6%

Description

Technology Viability focuses on developing new, cost-effective technologies through research and development using competitively selected public/private partnerships (Low Wind Speed Technology and Distributed Wind Technology projects) closely coordinated with Supporting Research and Testing conducted by National Laboratories.

Benefits

The Technology Viability key activities focus on research and development for improving the cost effectiveness of large and small wind energy systems, which is a primary barrier to wind energy competing without disadvantage to serve the Nation's energy needs. Reducing the cost of energy of large and small wind systems will help meet the Wind Energy Program's goals and, in turn help wind energy compete without disadvantage in energy markets.

The following table provides expected annual indicators of progress for the LWST and DWT activities cents/kilowatt-hour in Class 4 Wind Regimes:

(fiscal year)

	02	03	04	05	06	07	08	09	10	11	12
Low Wind Speed Technology – onshore											
Target……………….	5.5	5.0	4.6	4.3	4.0	3.7	3.5	3.3	3.2	3.1	3.0
Actual ………………	5.5	5.0	4.4								
Low Wind Speed Technology – Offshore											
Target………..………				9	8.7	8.3	7.8	7.2	6.5	5.7	5.0
Actual …………..………											

	(fiscal year)										
	02	03	04	05	06	07	08	09	10	11	12
Distributed Wind Technology[a]											
Target	17-22	14-20	13-19	12-18	11-16	10-15					
Actual		14-20	13-19								

The Wind Program also has developed a methodology for measuring and tracking program performance. Levelized COE, in constant dollars, is the primary performance indicator for the LWST and DWT efforts. Achieving the planned COE target will be possible through the Technology Improvement Opportunities being addressed by the portfolio of LWST, DWT, and Supporting Research and Testing (SR&T) efforts. Cost of energy estimates for full-scale prototypes will be based on industry experience in maturation of technologies and manufacturing processes. Determining the COE impact of improvements in individual components and subsystems will be based on comparisons against a baseline turbine composite with a well-understood cost of energy. On a yearly basis throughout the course of the LWST and DWT projects, the impact of technology improvements will be assessed and the results will be peer-reviewed. Forecasts of COE impact will be based on progress of existing subcontracts and results of research efforts at the time of the assessment, thereby allowing a clear picture of the impact of improvements against the overall goals and objectives. The methodology is available in the *Wind Energy Program Multi Year Technical Plan for 2004 – 2010* at www.eere.energy.gov/windandhydro/.

Detailed Justification

	(dollars in thousands)		
	FY 2004	FY 2005	FY 2006
Low Wind Speed Technology (LWST - Large Systems) . .	**11,611**	**10,494**	**15,600**

The Low Wind Speed Technology (LWST) project supports public/private partnerships for multiple large wind system technology pathways (turbines over 100 kilowatts) to achieve the goal of 3 cents/kWh for onshore systems and 5 cents/kWh for offshore systems in Class 4 winds by 2012. New partnerships to catalyze industry adoption of component technology developments and emerging innovation are supported through a series of three LWST competitive solicitations - Phase I was initiated in FY 2002, Phase II began in FY 2004, and Phase III is planned to commence in FY 2007. These concentrate on three technical areas: 1) conceptual design studies, 2) component development and testing; and 3) full turbine prototype development and testing. The Phase II LWST solicitation was expanded to include offshore wind energy system technology development, beginning in FY 2005. The LWST portfolio and related Supporting Research and Testing activities are continuously coordinated to facilitate technology transfer and transition conceptual design and component projects into full system development. LWST projects will be periodically reviewed against analytically established performance measures to provide

---

[a] Cents/kilowatt-hour in Class 3

(dollars in thousands)

the basis for funding and planning adjustments needed to optimize the portfolio for success.

In 2006, two major milestones are expected under this effort: 1) Fabrication of the first components developed under the second round of LWST will be completed and testing will begin; and 2) Testing of the first commercial prototype from the Phase I LWST will be completed. The program will also examine options for further offshore technology development.

Distributed Wind Technology (DWT - Small Systems).....	**1,962**	**1,908**	**2,000**

The Distributed Wind Technology (DWT) project supports public-private partnerships for multiple small wind system technology pathways (turbines less than or equal to 100 kilowatts) to achieve the program goal of 10-15 cents per kilowatt-hour in Class 3 resources by 2007.

New partnerships to catalyze industry adoption of component technology developments and emerging innovation are supported through a series of three technical areas: 1) conceptual design studies; 2) component development and testing; and 3) full turbine prototype development and testing.

FY 2006 activities will expand the number of DWT public/private partnerships using a competitive solicitation. The DWT portfolio and related Supporting Research and Testing activities are continuously coordinated to facilitate technology transfer and transition conceptual design and component projects into full system development. These SR&T efforts will support not only the new grantees from the FY 2006 solicitation but also will provide ongoing technical support to the current DWT financial assistance projects.

In FY 2006, major milestones expected under this effort are: 1) Award grants/cooperative agreements from a second round DWT solicitation; and 2) Complete all of the grants for DWT round one conceptual design work.

Supporting Research and Testing (SR&T)	**14,577**	**14,199**	**15,000**

Supporting Research and Testing (SR&T) is composed of three key program elements that directly support development of Low Wind Speed Technology (LWST) and Distributed Wind Technology (DWT): Design Review and Analysis, Enabling Research, and Testing Support. SR&T provides technical support essential to the LWST and DWT public/private partnerships by engaging the capabilities of the National Labs, universities and other technical support available in private industry.

The Design Review and Analysis task ensures that improved products resulting from advances in R&D are developed in a logical and safe manner and in compliance with the applicable international certification standards - a vital step in mitigating the risk of market acceptance for LWST and DWT output technology.

Enabling Research activities in advanced rotor development, drive train and power systems, inflow and site characterization, and systems and controls provide the technical improvements in components and integrated systems needed to support LWST and DWT projects. Characterization of the design environment, improved computer simulation codes, advanced components, and integrated systems and controls are the main product outputs.

The third program element, Testing Support, includes both facility and field tests of all newly developed

	(dollars in thousands)		
	FY 2004	FY 2005	FY 2006

LWST and DWT components and systems to ensure design and performance compliance. Structural testing of blades up to 45 meters in length and fully integrated power drive train tests, up to 2.5 MW, are accomplished in the controlled environments of the Industrial User Facility (IUF) and Dynamometer Test Facility (DTF). Field testing of fully integrated prototypes in actual wind farms and distributed power applications provides the final validation of the LWST and DWT designs.

SR&T also includes funding required for operation of the National Wind Technology Center (NWTC) at the National Renewable Energy Laboratory (NREL) for specialized engineering test facilities and equipment that directly support LWST and DWT public-private technology development partnerships. (Of the $2.0 million for NWTC in FY 2006, $350,000 falls under SR&T.) Capital equipment expenditures of approximately $750,000 are expected by the National Renewable Energy Laboratory in FY 2006. Performance is measured for R&D activities using analytically-established targets linking contributions from each activity to meeting LWST and DWT Program goals. Outputs of this activity include periodic design reviews and conduct of tests at industry and laboratory locations.

SR&T activities in FY 2006 include, for the Distributed Wind Technology Program, completing fabrication and beginning testing of a composite blade made from new manufacturing techniques and complete preliminary design of a DWT (less than 100 kW) prototype system. For the Low Wind Speed Technology Program, SR&T activities in FY 2006 include continuing Great Plains long-term inflow and structural dynamics test of a 1.5 MW machine in a joint public/private partnership with industry; beginning testing of an advanced twist/flap coupled blade using carbon fiber design elements; and supporting offshore and Great Plains deployment with advanced atmospheric monitoring technology, analysis, and simulation enhancements. In FY 2004, funding for this activity was reduced by $924,000 for SBIR/STTR which was and transferred to the Science Appropriation.

Total, Technology Viability	**28,150**	**26,601**	**32,600**

Explanation of Funding Changes

	FY 2006 vs. FY 2005 ($000)
Low Wind Speed Technology (Large Systems)	
Increase accelerates hardware development and testing activities under ongoing LWST component and system development projects with industry partners, with emphasis on accelerating offshore wind power technology projects. Majority of increase will support competitive, merit-reviewed, cost-shared R&D with industry (RDIC 2b and 2f), build on existing technology, and complement related R&D (RDIC 2a) underway in industry, universities, and national laboratories	+5,106
Distributed Wind Technology (DWT – Small Systems)	
Increase accelerates hardware development and testing activities under ongoing industry partner DWT turbine system projects. Increase will support competitive, merit-reviewed, cost-shared R&D with industry (RDIC 2b, 2f)	+92
Supporting Research and Testing (SR&T)	
Increases laboratory testing activities required to support hardware development stage of LWST and DWT industry partner projects	+801
Total Funding Change, Technology Viability	**+5,999**

Technology Application

Funding Schedule by Activity

(dollars in thousands)

	FY 2004	FY 2005	FY 2006	$ Change	% Change
Technology Application					
Systems Integration	3,140	2,665	4,349	+1,684	+63.2%
Resource Assessment	981	0	0	0	0
Technology Acceptance	3,449	3,815	4,100	+285	+7.5%
Supporting Engineering and Analysis	2,657	3,164	3,200	+36	+1.1%
Total, Technology Application	10,227	9,644	11,649	+2,005	+20.8%

Description

The Technology Application subprogram addresses opportunities and barriers other than turbine cost of energy concerning use of wind energy systems. Activities include Systems Integration which requires applied technical efforts, and Technology Acceptance, which focuses on resolving institutional issues and providing energy sector outreach. Technology Application also includes cross-cutting Supporting Engineering and Analysis activities that accelerate the appropriate introduction of wind energy systems in the energy sector through opportunities such as field verification projects, support for industry certification testing and standards development, and near-term technical support for emerging industry issues.

Benefits

Technology Application helps the program achieve its mission by focusing on the non-energy cost barriers that impede wind energy use in the United States. Helping stakeholders and officials within States understand wind energy technologies and how wind can be integrated into their state energy systems will in turn reduce institutional and regulatory barriers, helping wind to compete without disadvantage.

The following table provides expected annual indicators of progress for Technology Application:

(fiscal year)

	00	01	02	03	04	05	06	07	08	09	10
Technology Acceptance											
# of States with 100 MW Target			--	10	12	16	19	22	25	27	30
# of States with 100 MW Actual	4	7	8	10	12						

The Technology Application performance targets above are used as a way to measure the success of the Wind Energy Program's outreach activities. Since each State is a unique regulatory, policy and economic entity, reaching 100 MW installed capacity threshold is an important indicator that wind is being accepted as a large-scale generating option by the State's utilities, regulators, and investors.

Detailed Justification

	(dollars in thousands)		
	FY 2004	FY 2005	FY 2006
Systems Integration	**3,140**	**2,665**	**4,349**

Systems Integration is comprised of efforts to enhance the compatibility of wind energy technologies with the electric power system, and to develop information to assure fair treatment of wind energy by power system operators, transmission owners and regulators and to mitigate barriers. System integration includes development of data on wind turbine and wind plant performance from onshore and offshore applications of interest to the power industry; analytical techniques to represent the wind plant in planning and operating tools used by the electric power industry; investigation of transmission tariffs and policies to ensure that wind projects are treated fairly, and transfer of this information and techniques to stakeholders in the power industry, including regional transmission operators, state and Federal regulators, wind plant operators and wind turbine manufacturers. The geographical scope of the activity ranges from distributed application, such as a 10 kW turbine interconnected with a rural cooperative farm, to isolated village power systems using wind and diesel power plants, to large wind plants covering several tens of square kilometers. The issues to be considered are largely the same for each scale of the wind project – issues arising from the compatibility of wind generation with the needs of the load for well-controlled voltage and stable electric power. Recent studies have shown that the additional cost to interconnect wind plants at low penetrations are on the order of 0.2 cents per kWh. These ancillary service costs are thought to increase slowly with increasing wind plant penetration, i.e., as wind supplies a greater fraction of the instantaneous demand.

Systems Integration also includes consideration of how wind energy competes in the competitive marketplace and new applications such as wind-hydrogen production, desalination, purification and delivery of water, and wind/hydropower coordination to develop operating strategies to create improved economics and benefits for both technologies.

In FY 2006, improved operating techniques, including wind plant output forecasting; will be investigated to reduce the impact of ancillary service costs. Projects include improved resolution of wind plant hourly output for typical months needed for transmission studies and economic evaluations, investigations of improved transmission tariffs for low capacity factors, and variable output wind projects such as flexible-firm tariffs. Simulation tools to represent geographical diversity of several wind plants connected to the same power system will be developed in conjunction with industry and verified to provide an analytical basis for integration of larger amounts of wind energy. The geographic diversity and integration of offshore wind plants will also be investigated. The results of all of these investigations will be transferred to power industry regulators and stakeholders. Staff from at least two Regional Transmission Organizations and Federal regulators will be engaged to transfer results of these activities and to provide feedback on their usefulness. In addition, regional transmission consortia will be encouraged to explore wind energy development and develop scenarios for deployment to be used in RTO planning studies.

Resource Assessment	**981**	**0**	**0**

The program has employed the best scientific knowledge and regional and local experience to collect wind resource data and prepare detailed maps as an essential tool in identifying promising areas for development. In the last 10 years, efforts have focused on refinement of initial resource maps by adding

	(dollars in thousands)		
	FY 2004	FY 2005	FY 2006

measurements, finer scale surface and terrain data through geographic information systems, and large-scale weather modeling. The program has largely transferred this level of mapping technology to the private sector where a small number of companies can provide mapping services. Core resource assessment and mapping efforts were completed in FY 2004. The program transferred state and local mapping capability completed in previous years to industry, and remaining needs for resource assessment-related activities to other parts of the program.

Technology Acceptance	**3,449**	**3,815**	**4,100**

Technology Acceptance includes activities to build on the national R&D investment in wind technology through work with national stakeholder groups to move the technology into the power generation market. The Wind Powering America (FY04, FY05 and FY06 at $3.1 million each) component of Technology Acceptance addresses barriers to wind development at the national, state, and local levels. The focus is on facilitating the deployment of wind technology to bring economic benefits to the country, enhancing the use of domestic energy resources, supporting Federal sector compliance with renewable energy use goals, and stimulating sustainable tribal energy sectors. Activities are conducted in partnership with utility generators, equipment manufacturers, project financiers and developers, public and private officials, regulators, industrial and public sector consumers, other Federal and state agencies, and citizen stakeholder groups to provide technical support, guidance, and information on national, regional, state, and local efforts to explore and develop their wind energy resources. Technology Acceptance also supports cooperative activities with utility-based and other key stakeholder organizations to expand access to wind resource data and to provide information on technical and institutional barriers to development. Performance for this activity is measured by tracking the number of States that have installations of 100 MW indicating that there is a considerable level of acceptance of in these States.

In FY 2006, activities will focus on continuing support for existing and emerging state wind working groups, expanding tribal wind technical assistance on wind resources and project planning and development; continuing partnership activities with agriculture-sector national and state organizations; continuing collaboration with public power national and state-based organizations; expanding the community and rural schools project concepts; and expanding small wind system support activities. FY 2006 performance targets for this activity: 19 States with at least 100 MW of wind installed.

	(dollars in thousands)		
	FY 2004	FY 2005	FY 2006
Supporting Engineering and Analysis	**2,657**	**3,164**	**3,200**

The Supporting Engineering and Analysis (SE&A) activity provides a number of cross-cutting functions for supporting the achievement of the program's goals. These include systems analysis to track improvements in wind technology in diverse applications; assessment of future improvements in cost performance of wind technology (i.e., technology characterization); investigation of technical, environmental, and institutional issues to address near-term barriers for industry; participation in development of domestic and international design standards for wind turbine design and testing, design review and testing support for the Underwriters Laboratories wind turbine certification program; and operation and management of the National Wind Technology Center (NWTC) to support staff, facilities and Technology Application activities. [Of the $2.0 million planned for the NWTC, $1.656 million falls under SE&A.]

In FY 2006, the program will continue programmatic analyses and data collection required to update wind technology characterization and projections, wind project database, and to support program benefits assessment required by GPRA; transition turbine certification testing program activities to UL; coordinate the production and publication of technical papers and reports (such as the *IEA Wind Energy Annual Report* and *Wind Power Today & Tomorrow*) outreach brochures and materials, journal articles, websites, and conference papers and exhibits.

	FY 2004	FY 2005	FY 2006
Total, Technology Application..	**10,227**	**9,644**	**11,649**

Explanation of Funding Changes

	FY 2006 vs. FY 2005 ($000)
Systems Integration	
Increase due to higher priority for addressing grid systems integration impacts as a result of increasing wind energy penetration levels, and to address new challenges with integrating offshore, consistent with the (RDIC 1b) focusing on addressing critical market barriers..	+1,684
Resource Assessment	
No significant change	0
Technology Acceptance	
Increases technology acceptance support for emerging opportunities, including offshore wind power...	+285
Supporting Engineering and Analysis	
No significant change	+36
Total Funding Change, Technology Application...	**+2,005**

Congressionally Directed Activities

Funding Schedule by Activity

(dollars in thousands)

	FY 2004	FY 2005	FY 2006	$ Change	% Change
Congressionally Directed Activities	1,426	4,559	0	-4,559	-100%
Total, Congressionally Directed Activities..	1,426	4,559	0	-4,559	-100%

Description

In general, Congressionally Directed activities do not support program goals because such activities were not a result of the program's planning effort which is focused on overcoming technical barriers.

Detailed Justification

(dollars in thousands)

	FY 2004	FY 2005	FY 2006

There were a total of 9 Congressionally Directed activities in FY 2004. The program does not plan to request any in future years. The following projects were directed by Congress to be included in this program:

Wind Energy Transmission Study (Omnibus Bill)........	**497**	**0**	**0**

To explore dynamic scheduling of wind power through the grid to supply electrolysis-based hydrogen production

Vermont Department of Public Service...................	**491**	**0**	**0**

Public education and outreach project to reduce barriers to wind energy use in the State.

St. Francis, Pennsylvania Wind Farm Feasibility Study ..	**144**	**521**	**0**

Continuation of wind turbine feasibility study for St. Francis University.

Saginaw, Michigan Chippewa Wind Project	**294**	**0**	**0**

Feasibility study for a wind farm located on tribal lands.

North Dakota Wind Pilot Project.........................	**0**	**496**	**0**

Continuation of project to explore dynamic scheduling of wind power through the grid to supply electrolysis-based hydrogen production.

	(dollars in thousands)		
	FY 2004	FY 2005	FY 2006
Great Plains Wind Energy Transmission Development Project	**0**	**496**	**0**
To support project at University of North Dakota Energy and Environmental Research Center for analysis of transmission requirements for wind power development in the Great Plains region.			
Alaska Wind Energy Project	**0**	**1,488**	**0**
To support competitively selected wind projects in the state of Alaska.			
Renewable Energy for Rural Economic Development Program, Utah State University	**0**	**496**	**0**
To support the Rural Economic Development Program at the university.			
Iowa Lakes Community College Wind Turbine Project	**0**	**496**	**0**
For installation of a wind turbine for the College which will be used for educating and training students about wind power.			
National Center for Energy Management and Building Technologies	**0**	**566**	**0**
In FY 2005, activities funded under this Congressionally-directed project were to address HVAC research needs and improve the efficiency, productivity, and security of the U.S. building stock by developing and disseminating synergistic and complementary solutions to energy management, indoor environment quality, and security concerns in new and existing buildings.			
Total, Congressionally Directed Activities	**1,426**	**4,559**	**0**

Explanation of Funding Changes

	FY 2006 vs. FY 2005 ($000)
Congressionally Directed Activities	
No funds are being requested in FY 2006	-4,559
Total Funding Change, Congressionally Directed Activities	**-4,559**

Hydropower

Funding Profile by Subprogram[a]

(dollars in thousands)

	FY 2004 Comparable Appropriation	FY 2005 Original Appropriation	FY 2005 Adjustments	FY 2005 Comparable Appropriation	FY 2006 Request
Hydropower					
Technology Viability	3,293	3,401	-28[b]	3,373	150
Technology Application	1,380	1,599	-110[c]	1,489	350
Total, Hydropower	4,673	5,000	-138	4,862	500

Public Law Authorizations:

P.L. 93-577, "Federal Non-Nuclear Energy Research and Development Act" (1974)
P.L. 94-163, "Energy Policy and Conservation Act (EPCA)" (1975)
P.L. 94-385, "Energy Conservation and Production Act (ECPA)" (1976)
P.L. 95-91, "Department of Energy Organization Act" (1977)
P.L. 95-238, "Department of Energy Act – Civilian Applications" (1978)
P.L. 95-619, "National Energy Conservation Policy Act (NECPA)" (1978)
P.L. 96-294, "Energy Security Act" (1980)
P.L. 101-218, "Renewable Energy and Energy Efficiency Technology Competitiveness Act" (1989)
P.L. 104-303, "Water Resources Development Act" (1996)

Mission

The mission of the Hydropower Program ("Hydropower Program") has been to lead the Nation's efforts to improve the technical, societal, and environmental benefits of hydropower, and develop cost-competitive technologies that enable the development of new and incremental hydropower capacity, adding to the diversity of the Nation's energy supply. The Department plans to closeout the Hydropower Program in FY 2006 and transfer results of its research and development related to testing of fish-friendly large turbines to industry.

Benefits

The Hydropower Program's mission and activities have contributed directly to EERE's and DOE's mission of improving National, Energy, and Economic security by increasing supply and diversity.

---

[a] SBIR/STTR funding in the amount of $133,000 was transferred to the Science Appropriation in FY 2004. Estimates for SBIR/STTR budgeted in FY 2005 and FY 2006 are $98,000 and $10,000 respectively.
[b] Reflects the 0.80% rescission of -$28,000.
[c] Reflects the 0.80% rescission of -$12,000 and comparability adjustment for Cross-cutting Planning, Analysis and Evaluation of -$98,000.

Strategic and Program Goals

The Department's Strategic Plan identifies four strategic goals (one each for defense, energy, science, and environmental aspects of the mission) plus seven general goals that tie to the strategic goals. The Hydropower Program supports the following goal:

Energy Strategic Goal

General Goal 4, Energy Security: Improve energy security by developing technologies that foster a diverse supply of reliable, affordable and environmentally sound energy by providing for reliable delivery of energy, guarding against energy emergencies, exploring advanced technologies that make a fundamental improvement in our mix of energy options, and improving energy efficiency.

The Hydropower Program has had one program goal which contributes to General Goal 4 in the "goal cascade":

Program Goal 04.06.00.00: Hydropower. With the completion of testing on new turbine technologies and consistent with previous congressional direction, the Hydropower Program's goal is to closeout this program and effectively transition remaining program activities and information (e.g., R&D results, technical data and findings) to private/public sector programs.

Contribution to Program Goal 04.06.00.00 (Hydropower)

The Hydropower Program will effectively transition remaining program activities and information to industry and the public sector.

Annual Performance Results and Targets

FY 2001 Results	FY 2002 Results	FY 2003 Results	FY 2004 Results	FY 2005 Targets	FY 2006 Targets
Program Goal 04.06.00.00 (Hydropower)					
Technology Validation, Technology Application					
		Complete the pilot-scale testing of a fish friendly turbine, providing the basis for future full-scale testing at an operational site. Successful testing will provide industry with a proven design, helping attain the 2 percent mortality goal. [MET]	Complete report comparing field tests and model results for the effects of blade strike on turbine-passed fish. [MET]	Complete prototype testing at the Osage project that demonstrates 2 mg/liter improvement in oxygen content of water downstream of the hydropower plant.	Complete final report for operations and maintenance monitoring of large turbine test sites.
			Contribute proportionately to EERE's corporate goal of reducing corporate and program uncosteds to a range of 20-25 percent by reducing program annual uncosteds by 10 percent in 2004 relative to the program uncosted baseline (in 2003) until the target range is met.	*Contribute proportionately to EERE's corporate goal of reducing corporate and program adjusted uncosted obligated balances to a range of 20-25 percent by reducing program annual adjusted uncosteds by 10 percent in 2005 relative to the program FY 2004 end of year adjusted uncosted baseline ($3,022K) until the target range is met.*	*Contribute proportionately to EERE's corporate goal of reducing corporate and program adjusted uncosteds to a range of 20-25 percent by reducing program annual uncosteds by 10 percent in 2006 relative to the program uncosted baseline (2005) until the target range is met.* *Maintain total Program Direction costs in relation to total Program costs in the range of 8% - 12% to demonstrate efficient and effective EERE-wide business and technical support to mission direct programs.*

Means and Strategies

The Hydropower Program has used various means and strategies to achieve its program goals in the past. "Means" include operational processes, resources, information, and the development of technologies, and "strategies" include program, policy, management and legislative initiatives and approaches. Means and strategies in FY 2006 will focus on closing out remaining program elements such as completing documentation of technology partnerships and transferring to industry, and archiving legacy documents.

Validation and Verification

To validate and verify program performance, the Hydropower Program has conducted internal and external reviews and audits. The table below summarizes past validation and verification activities.

Data Sources:	DOE Final Report, US Hydropower Resource Assessment (1998); DOE Low Head/Low Power Hydropower Resource Assessment (2003); FY 2003 Peer Review; Energy Information Administration Annual Energy Outlook; Annual Energy Review.
Evaluation:	In carrying out the program's mission, the Hydropower Program used several forms of evaluation to assess progress and to promote program improvement. ▪ Technology validation and operational field measurement, as appropriate ▪ Peer review by independent outside experts of both the program and subprogram portfolios ▪ Annual internal Technical Program Review of the Hydropower Program ▪ Specialized program evaluation studies to examine process, impacts, or market baseline and effects, as appropriate ▪ Quarterly and annual assessment of program and management results based performance through Joule (the DOE quarterly performance progress review of budget targets), R&DIC (annual internal review of performance planning and management of R&D programs against specific criteria), PMA (the Presidents Management Agenda -- annual departmental and PSO based goals whose milestones are planned, reported and reviewed quarterly) and PART (common government wide program/OMB reviews of management and results). ▪ Annual review of methods, and recomputation of benefits for the Government Performance and Results Act (GPRA).
Baselines:	Dissolved Oxygen: 1.8 mg/l in 2002, Fish survivability: 95 percent for the best existing turbines.
Frequency:	Annual.
Data Storage:	Computer storage and available on DOE/EERE and EIA websites.
Verification:	To validate the development of environmentally improved hydropower turbines, the program had been conducting field testing at four hydropower sites. The tests were expected to measure the progress made toward improving the environmental and operational performance of this technology. FY 2006 activities will focus on closing out these projects.

Funding by General and Program Goal

	(dollars in thousands)		
	FY 2004	FY 2005	FY 2006
General Goal 4, Energy Security			
Program Goal 04.06.00.00, Hydropower			
Technology Viability	3,293	3,373	150
Technology Application	1,380	1,489	350
Total, Program Goal 04.06.00.00, Hydropower	4,673	4,862	500
Total, General Goal 4 (Hydropower)	4,673	4,862	500

Expected Program Outcomes

Since the Hydropower Program will be terminated in FY 2006, benefits to the market are from past research and development, not from research conducted in FY 2006. Therefore, expected program outcomes will not be reported.

Technology Viability

Funding Schedule by Activity

(dollars in thousands)

	FY 2004	FY 2005	FY 2006	$ Change	% Change
Technology Viability					
Advanced Hydropower Technology ..	1,911	2,208	150	-2,058	-93.2%
Supporting Research and Testing.......	1,382	1,165	0	-1,165	-100.0%
Total, Technology Viability........................	3,293	3,373	150	-3,223	-95.6%

Description

The Technology Viability key activity has focused on development of advanced technologies to enhance environmental performance and greater energy efficiencies. In 2003, the Program could not find a partner willing to cost share in the full-scale testing of a new, innovative turbine, indicating a lack of interest and/or need by the industry. The Program shifted focus in 2004 and 2005 to R&D on existing commercial designs with potential for efficiency gains and/or increased fish survivability. Market barriers to private sector investment in this R&D are minimal. Consistent with R&D investment criterion on the necessity of market barriers to justify Federal investment, the Hydropower Program will be closed out in FY 2006 (RDIC 1b, market barriers).

Benefits

Efforts in FY 2006 will focus on closing out contracts at sites where technology has been implemented.

Detailed Justification

(dollars in thousands)

	FY 2004	FY 2005	FY 2006
Advanced Hydropower Technology	**1,911**	**2,208**	**150**

In FY 2005, the Program will complete testing of fish-friendly turbines at Wanapum and Osage hydropower plants; complete work with the U.S. Army Corps of Engineers on laboratory scale modeling tests of the Ice Harbor hydropower plant; and complete studies to evaluate the effectiveness of environmental mitigation practice. Because of completion of these fish-friendly turbine testing in FY 2005, the Department plans to close-out the Hydropower Program and transfer results to industry. FY 2006 activities will focus on completing monitoring of plant operation and maintenance, and documenting of previous Advanced Hydropower Technology activities. Outstanding contracts under this key activity will be closed out in FY 2006.

Supporting Research and Testing	**1,382**	**1,165**	**0**

	FY 2004	FY 2005	FY 2006

(dollars in thousands)

In FY 2005, the Program will complete a number of studies regarding fish injury mechanisms from hydropower turbine systems. Also includes funding of $74,400 for the National Center on Energy Management and Building Technologies. Because work will be completed in FY 2005, no funds are requested in FY 2006. In FY 2004, this activity was reduced by $57,000 for SBIR/STTR and transferred to the Science Appropriation.

Total, Technology Viability	**3,293**	**3,373**	**150**

Explanation of Funding Changes

	FY 2006 vs. FY 2005 ($000)
Technology Viability	
▪ **Advanced Hydropower Technology**	
The Hydropower Program has completed its fish-friendly large turbine testing and plans to close out the program. The $150,000 requested will be used to complete monitoring of plant operation and maintenance, and preparation of final documentation of Advanced Hydropower Technology activities (RDIC 2e, off ramps).	-2,058
▪ **Supporting Research and Testing**	
No funds are being requested because studies of fish injury mechanisms were completed	-1,165
Total Funding Change, Technology Viability	**-3,223**

Technology Application

Funding Schedule by Activity

	(dollars in thousands)				
	FY 2004	FY 2005	FY 2006	$ Change	% Change
Technology Application					
Systems Integration and Technology Acceptance	1,025	1,191	350	-841	-70.6%
Supporting Engineering and Analysis	355	298	0	-298	-100.0%
Total, Technology Application	1,380	1,489	350	-1,139	-76.5%

Description

The Technology Application Subprogram has included Systems Integration and Technology Acceptance, and Supporting Engineering and Analysis. As part of the close out of the Hydropower Program, funds will be used in FY 2006 to complete hydropower/wind integration studies and close out activities in this area.

Benefits

FY 2006 activities will focus on closing out remaining contracts.

Detailed Justification

	(dollars in thousands)		
	FY 2004	FY 2005	FY 2006
Systems Integration and Technology Acceptance	**1,025**	**1,191**	**350**

This activity has included the determination of technical, economic, and institutional opportunities to integrate hydropower with wind technology and maintain a dialogue among key stakeholders that will aid in developing and maintaining sustainable hydropower markets. In FY 2006, the funding will be used to complete integration studies and close out activities in this area.

Supporting Engineering and Analysis	**355**	**298**	**0**

In FY 2005, the Program will complete characterization of the low head hydropower technology available in the market. Because this activity will be completed in FY 2005, no funds are requested in FY 2006.

Total, Technology Application	**1,380**	**1,489**	**350**

Explanation of Funding Changes

	FY 2006 vs. FY 2005 ($000)
Systems Integration and Technology Acceptance	
Technology R&D has advanced to the state that it is now adoptable by industry. Consistent with R&D investment criterion on the necessity of market barriers to justify Federal investment, funds being requested will be used to complete integration studies (RDIC 1b, market barriers)	-841
Supporting Engineering and Analysis	
No funds are being requested because technology characterization work will have been completed	-298
Total Funding Change, Technology Application	**-1,139**

Geothermal Technology

Funding Profile by Subprogram[a]

(dollars in thousands)

	FY 2004 Comparable Appropriation	FY 2005 Original Appropriation	FY 2005 Adjustments	FY 2005 Comparable Appropriation	FY 2006 Request
Geothermal Technology					
Technology Development............	16,425	15,603	-123[b]	15,480	19,799
Technology Application	6,238	6,610	-378[c]	6,232	3,500
Congressionally Directed Activities......................................	1,962	3,587	-29[d]	3,558	0
Total, Geothermal Technology....	24,625	25,800	-530	25,270	23,299

Public Law Authorizations:

P.L 93-410, "Geothermal Energy Research, Development, and Demonstration Act of 1976"
P.L 95-91, "Department of Energy Organization Act (1977)"
P.L 95-618, "Energy Tax Act of 1978"
P.L 96-294, "Energy Security Act (1980)"
P.L 101-218, "Renewable Energy and Energy Efficiency Technology Competitiveness Act of 1989"
P.L 101-575, "Solar, Wind, Waste, and Geothermal Power Production Incentives Act of 1990"
P.L 102-486, "Energy Policy Act of 1992"

Mission

The mission of the Geothermal Technology Program ("Geothermal Program") is to work in partnership with U.S. industry to establish geothermal energy as an economically competitive contributor to the U.S. energy supply.

Benefits

The Geothermal Program's mission and activities directly support DOE's mission to promote scientific and technological innovation in support of advancing the national, economic and energy security of the United States. The technologies developed by this program could provide the Nation with new sources of electricity that are highly reliable and cost competitive and do not add to America's air pollution or the emission of greenhouse gases. Since geothermal energy systems use a domestic and renewable

[a] SBIR/STTR funding in the amount of $499,000 was transferred to the Science Appropriation in FY 2004. Estimates for SBIR/STTR budgeted in FY 2005 and FY 2006 are $341,000 and $384,000 respectively.
[b] Reflects the 0.80% rescission of -$123,000.
[c] Reflects the 0.80% rescission of -$51,000 and comparability adjustment for Cross-cutting Planning, Analysis and Evaluation of -$327,000.
[d] Reflects the 0.80% rescission of -$29,000.

source of energy, geothermal electricity generation is not subject to price volatility and supply disruptions from changes in global energy markets.

Over the past decade the program has yielded technological advances to binary cycle technology that have reduced the cost of low temperature conversion technology by as much as 2 cents/kWh (based on model estimates). These benefit not only geothermal technology but other related low-temperature conversion technology such as solar thermal and distributed energy. More detailed energy and energy security benefits estimates are provided in the Expected Program Outcomes section at the end of the program level budget narrative.

Strategic and Program Goals

The Department's Strategic Plan identifies four strategic goals (one each for defense, energy, science, and environmental aspects of the mission) plus seven general goals that tie to the strategic goals. The Geothermal Program supports the following goal:

Energy Strategic Goal

General Goal 4, Energy Security: Improve energy security by developing technologies that foster a diverse supply of reliable, affordable, and environmentally sound energy by providing for reliable delivery of energy, guarding against energy emergencies, exploring advanced technologies that make a fundamental improvement in our mix of energy options, and improving energy efficiency.

The Geothermal Program has one goal which contributes to General Goal 4 in the "goal cascade":

Program Goal 04.07.00.00: Geothermal. The Geothermal Program goal is to improve technology performance and reduce market entry costs of geothermal energy to competitive levels, thereby making the large geothermal resource available to the Nation.

Contribution to Program Goal 04.07.00.00 (Geothermal Technology)

The Geothermal Program's key contribution to General Goal 4, Energy Security, is through supply growth and diversification. Energy Security focuses on developing new and more cost-effective technologies through research and development. Key technology pathways that contribute to achievement of the program goal are described in the bullets below.

- The Geothermal Program's short-term goal is to reduce the levelized cost of power generated by conventional geothermal resources from 6.1 to 8.7 cents per kWh (kilowatt-hour) in 2000 to 4.3 to 6.1 cents per kWh (in year 2001 dollars) for flash power and binary power, respectively, by 2010.

The Geothermal Program also contributes to General Goal 4, Energy Security, by developing technology to enhance geothermal systems, thereby improving their productivity and increasing their economic lifetime.

Annual Performance Results and Targets

FY 2001 Results	FY 2002 Results	FY 2003 Results	FY 2004 Results	FY 2005 Targets	FY 2006 Targets
Program Goal 04.07.00.00: (Geothermal Technology)					
Technology Development/Systems Development					
Selected industrial partners to increase reservoir productivity at three sites using Enhanced Geothermal System (EGS) technology.	Completed design and environmental assessment of a small-scale (300 kW to 1MW) geothermal power plant for field verification.	Support industry opening and initial operation of a 1 MW small-scale geothermal plant in the state of New Mexico. [MET]	Create an Enhanced Geothermal System (EGS) with an industry partner and test associated technology needed to operate and monitor the system.	Field test a fully integrated Diagnostics-While-Drilling (DWD) advanced drilling system in a high-temperature geothermal well, verifying control of drilling operations in real time, thereby reducing costs. If successful, DWD will reduce drilling costs by one half of the total cost reduction target for drilling.	Reduce the cost of power for flash systems to 5.3 cents/KWh from 5.5 cents/KWh in 2005. Reduce the cost of power for binary systems to 7.7 cents/KWh from 8.1 cents/KWh in 2005.
			Contribute proportionately to EERE's corporate goal of reducing corporate and program uncosteds to a range of 20-25 percent by reducing program annual uncosteds by 10 percent in 2004 relative to the program uncosted baseline (in 2003) until the target range is met.	*Contribute proportionately to EERE's corporate goal of reducing corporate and program adjusted uncosted obligated balances to a range of 20-25 percent by reducing program annual adjusted uncosteds by 10 percent in 2005 relative to the program FY 2004 end of year adjusted uncosted baseline ($21,644K) until the target is met.*	*Contribute proportionately to EERE's corporate goal of reducing corporate and program adjusted uncosteds to a range of 20-25 percent by reducing program annual uncosteds by 10 percent in 2006 relative to the program uncosted baseline (2005) until the target range is met.* *Maintain total Program Direction costs in relation to total Program costs in the range of 8% - 12% to demonstrate efficient and effective EERE-wide business and technical support to mission direct programs.*

Means and Strategies

The Geothermal Program has adopted a two-fold strategy to achieve its goal: (1) provide selected, but aggressive, technology improvements that have the greatest impacts on performance and cost; and (2) mitigate non-technical barriers that can influence or affect performance and costs. However, various external factors may impact the ability to achieve these goals. The program also performs collaborative activities with industry and government agencies to help meet its goals.

The program will implement the following means:

- To ensure the best value for the taxpayer dollar, a coherent core of research will be conducted at National Laboratories having unique expertise in the subject areas; the balance of research projects will be performed through cost-shared awards to private companies and academic institutions selected via competitive solicitations.
- To reduce or eliminate institutional, regulatory, and other non-technical barriers that hamper the expanded use of geothermal energy in the United States, the program will provide comprehensive and timely information about geothermal resources and technology to interested stakeholders from the public and private sector.
- In order to make the most of appropriated funds, the program will strive to maintain uncosted obligations at the minimum levels required to maintain program continuity from one fiscal year to the next, estimated to be in the range of 20-25 percent of the current funding level.

The program will implement the following strategies:

- Improve exploration tools while collaborating with stakeholders to expand the useful amounts of geothermal resources.
- Reduce well costs and expand drilling capabilities by encouraging industry adoption of a down hole diagnostic system and development of innovative means of rock penetration.
- Expand the resource base by improving the productivity of marginal resources (e.g. low permeability, low temperature, low water content).
- Improve conversion technologies to increase efficiencies and decrease costs of generating electricity from resources with temperatures lower than 280 degrees F.

These means and strategies could result in a significant reduction in geothermal costs. This in turn may improve energy security by increasing the generation of reliable, affordable, and environmentally sound geothermal energy, adding to the diversity and economic security of the Nation’s energy supply.

The following external factors could affect the Geothermal Program’s ability to achieve its strategic goal:

- Demand for electricity;
- Availability of conventional energy supplies;
- Regulatory requirements;

- Market incentives;
- Cost of competing technologies;
- Federal tax incentives and implementation of other policies at the national level; and
- Proximity of transmission grid.

In carrying out the program's mission, the Geothermal Program performs the following collaborative activities:

- Seek new geothermal resources or expand existing resources through teaming efforts involving a variety of public and private organizations such as industrial concerns, universities and government agencies;
- Plan future work and review current activities, in concert with academia, National Laboratories, Federal and state government agencies, industry, and other stakeholder organizations through forums, working groups, and oversight committees; and
- Conduct collaborative activities with programs in other countries on selected topics of common interest under the auspices of the International Energy Agency.

Validation and Verification

To validate and verify program performance, the Geothermal Program conducts internal and external reviews and audits with the assistance of experts from a variety of stakeholder organizations. These programmatic activities are subject to continuing review by, for example, the Congress, the General Accounting Office, the Department's Inspector General, the U.S. Environmental Protection Agency, and state environmental agencies. Research is coordinated closely with the geothermal community to ensure that the program's research directions and priorities address the needs of power producers, consumers, and other interested parties and to ensure that these activities are within the realm of technical feasibility and properly aligned with market forces. Peer reviews are performed using expert independent reviewers from geothermal and related fields. As the major stakeholder organizations, the Geothermal Resources Council and the Geothermal Energy Association provide comments and recommendations on the current and future direction of the Geothermal Program (Geothermal Resources Council Bulletin, Vol. 32/Number 2, March/April 2003, p. 63, www.geothermal.org/articles). The table below summarizes validation and verification activities.

Data Sources: Geothermal Resources Council Bulletin; Geothermal Energy Association Update; Energy Information Administration's Annual Energy Review, Renewable Energy Annual, and Annual Energy Outlook; Geothermal Resources Council Transactions; Stanford Geothermal Program Workshop Proceedings; various system analyses by NREL and other contractors; International Energy Agency's Geothermal Implementing Agreement Annual Report; Peer Reviews of the U. S. Department of Energy's Geothermal Technology Program: August 23-24, 2001, March 25-27, 2002, July 29-August 1, 2003, and June 7-8, 2004; Geothermal Program Briefings: March 20, 2003, March 16, 2004.

Baselines:	The Geothermal Program's baselines for cost reduction goals are contained in its Strategic Plan, August 2004, and the draft Multi-Year Technical Program Plan, December 2004. The cost of geothermal power in 2000 was 5.8 cents/kWh for flash power and 8.6 cents/kWh for binary power.
Evaluation:	Quarterly and annual assessment of program and management results based performance through Joule (the DOE quarterly performance progress review of budget targets), R&DIC (annual internal review of performance planning and management of R&D programs against specific criteria), PMA (the Presidents Management Agenda -- annual departmental and PSO based goals whose milestones are planned, reported and reviewed quarterly) and PART (common government wide program/OMB reviews of management and results).
Frequency:	Annual
Data Storage:	Corporate Planning System
Verification:	Trade association and educational association reviews; open bids on electric power purchase agreements; Federal leasing applications; filings with state and Federal regulatory agencies; commercial sales of new technology.

Program Assessment Rating Tool (PART)

The Department implemented a tool to evaluate selected programs. PART was developed by OMB to provide a standardized way to assess the effectiveness of the Federal Government's portfolio of programs. The structured framework of the PART provides a means through which programs can assess their activities differently than through traditional reviews. The program has incorporated feedback from OMB into the FY 2006 Budget Request and has taken or will take the necessary steps to continue to improve performance.

The Geothermal Program has taken action to address all of the PART recommendations. A strategic plan has been prepared that specifies program goals and the means to achieve them, while a multi-year program plan has been drafted that describes the technical pathways the program will follow to achieve the performance measures derived from the programmatic goals. In response to one of the FY 2004 PART recommendations, the Geothermal Program developed a set of annual performance measures dealing with the cost of drilling wells and the cost of building geothermal surface systems. In addition, the program developed performance measures for the number of new geothermal fields expected to be discovered in the United States, and the amount of developable geothermal resources confirmed by resource assessment.

In response to one of the FY 2005 PART recommendations, the program continues to emphasize the Enhanced Geothermal Systems R&D that focuses on applying engineering techniques to improve the productivity of geothermal systems. These improvements in planning, management and accountability were reflected in the program's improved FY 2005 PART score in those three areas, resulting in a "moderately effective" rating.

The FY 2005 PART found that the program has a very clear purpose and strong planning and management. The PART acknowledged the role of the program in cost reduction and subsequent growth of competitive power production from expanded geothermal resources and implementation of the recommendation to shift resources to Enhanced Geothermal Systems. The PART also found that Congressionally Directed Activities reduced program funding available for competitive solicitations designed to contribute toward program goals.

The PART also recommended that the program participate in the development of a consistent framework for the Department to analyze the costs and benefits of its R&D investments, and apply this guidance to development of the FY 2006 budget. The program has provided input the Department needs to improve consistency in the methods and assumptions used to estimate potential benefits. The Department is employing the data in its effort to produce comparable estimates within its energy R&D programs to inform budget decision. EERE is working with OMB, the other applied R & D programs, and the PMA Budget and Performance Integration principals in the department to establish an increasingly integrated and consistent framework to inform the budget process.

Funding by General and Program Goal

(dollars in thousands)

	FY 2004	FY 2005	FY 2006
General Goal 4, Energy Security			
Program Goal 04.07.00.00, Geothermal Technology			
Technology Development	16,425	15,480	19,799
Technology Application	6,238	6,232	3,500
Congressionally Directed Activity, Geothermal Research at the University of Nevada-Reno	981	992	0
Congressionally Directed Activity, Tuscarora Geothermal	0	496	0
Congressionally Directed Activity, University of Texas Permian Basin Center for Energy Economic Diversification	0	194	0
Total, Program Goal 04.07.00.00, Geothermal Technology	23,644	23,394	23,299
All Other			
Congressionally Directed Activity, Technology Application/ Technology Deployment/Lake County Full Circle Effluent Pipeline Project	981	496	0
Congressionally Directed Activity, Technology Application/Technology Deployment/Klamath and Lake Counties Geothermal Agricultural Ind. Park, Oregon	0	298	0
Congressionally Directed Activity, Technology Application/ Technology Deployment/Geothermal Mill Redevelopment, Massachusetts	0	744	0
Congressionally Directed Activity, National Center for Energy Management and Building Technologies	0	338	0
Total, All Other	981	1,876	0
Total, General Goal 4 (Geothermal Technology)	24,625	25,270	23,299

Expected Program Outcomes

The Geothermal Program pursues its mission through integrated activities designed to increase the use of domestic renewable resources and contribute towards improved energy productivity of our economy. These improvements will reduce susceptibility to energy price fluctuations and potentially lower energy bills; reduce EPA criteria and other pollutants; enhance energy security by increasing the production and diversity of domestic fuel supplies; and provide greater energy security and reliability by improving our energy infrastructure. In addition to these “EERE business-as-usual” benefits, realizing the Geothermal Program goals would provide the technical potential to reduce non-renewable energy use even further if warranted by future energy needs.

Estimates of annual non-renewable energy savings, geothermal energy expenditure savings, carbon emission reductions, natural gas savings, and electricity capacity additions that result from the realization of Geothermal Program goals through 2050 are shown in the following table.

The assumptions and methods underlying the modeling efforts have significant impact on the estimated benefits, and results could vary significantly if external factors, such as future energy prices, differ from the “baseline case” assumed for this analysis. EERE’s baseline case is essentially the same as the EIA “business-as-usual” case presented in its Annual Energy Outlook. In addition, possible changes in public policy and disruptions in the energy system which may affect estimated benefits are not modeled. The external factors such as unexpected changes in competing technology costs, identified in the Means and Strategies section above, could also affect the Program’s ability to achieve its goals. Also note that the modeling long term benefits assumes that funding levels will be consistent with the President’s commitment and assumptions in the 2006 Budget, and that funding will be applied to the core program. If the pattern of substantial congressionally directed projects persists over several years, the GPRA benefits estimates will need to be reduced.

The results shown in the long term benefits tables are preliminary estimates based on initial modeling of some of the possible program production technologies; nonetheless, they provide a useful picture of the potential change in national benefits over time if the technology, infrastructure and markets evolve as expected. Estimated benefits that follow assume that individual technology plans and market assumptions obtain. Final documentation is estimated to be completed and posted by March 31, 2005. Uncertainties are larger for longer term estimates. A summary of the methods, assumptions, and models used in developing these benefit estimates that are important for understanding these results are provided at www.eere.energy.gov/office_eere/budget_gpra.html. The Geothermal Technology Program estimates that there will be a 25GW of geothermal electric equivalent capacity installed by 2040. However, the Geothermal Energy Association (1999), projects that the economically viable resource will be increased to 40 GW by 2040.

FY 2005 GPRA Benefits Estimates for Geothermal Technology Program[a]

Mid-Term Benefits[b]	2010	2015	2020	2025
Primary nonrenewable energy savings (Quads)	0.01	0.09	0.16	0.33
Energy bill savings (Billion 2002$)	ns	ns	ns	ns
Carbon emission reductions (MMTCE)	0	2	4	8
Natural gas savings (Quads)	0.02	0.04	0.02	ns
Program specific electric capacity additions (GW)	1	2	3	5

Long-Term Benefits[c]	2030	2040	2050
Primary nonrenewable energy savings (Quads)	0.82	1.89	2.36
Energy system cost savings (Billion 2001$)	1	4	5
Carbon emission reductions (MMTCE)	16	38	59
Program specific electric capacity additions (GW)	11	25	38

[a] Benefits reported are annual, not cumulative, for the year given. Estimates reflect the benefits that may be possible if all of the program's technical targets are met and funding continues at levels consistent with assumptions the FY 2006 Budget.
[b] Mid-term program benefits were estimated utilizing the GPRA06-NEMS model, based on the Energy Information Administration's (EIA) National Energy Modeling System (NEMS) and utilizing the EIA's Annual Energy Outlook (AEO) 2004 Reference Case.
[c] Long-term benefits were estimated utilizing the GPRA06 - MARKAL developed by Brookhaven National Laboratory (BNL). Results can differ among models due to differences in their structure. In particular, the two models estimate economic benefits in different ways, with the MARKAL model reflecting the cost of additional investments required to achieve reductions in energy bills.

Technology Development

Funding Schedule by Activity

(dollars in thousands)

	FY 2004	FY 2005	FY 2006	$ Change	% Change
Technology Development					
Resource Development	2,019	2,501	3,655	+1,154	+46.1%
Enhanced Geothermal Systems	6,680	6,687	7,898	+1,211	+18.1%
Systems Development	7,726	6,292	8,246	+1,954	+31.1%
Total, Technology Development	16,425	15,480	19,799	+4,319	+27.9%

Description

This subprogram examines processes affecting the economical production of geothermal systems with the intent of providing technology to increase productivity substantially. The three components of this activity involve: (1) finding resources; (2) creating new techniques for increasing the productivity of geothermal reservoirs; and (3) developing advanced technology in wellfield construction and energy conversion, the two major cost elements of geothermal electric power production and direct use.

Benefits

Technology Development serves the program's mission through the design, construction, and testing of innovative technologies that reduce the cost of geothermal energy to competitive levels or makes more geothermal resources available for production. This work is accomplished in close collaboration with industry as cost-sharing partners.

Historical and expected contributions within Technology Development include:

	2000	2001	2002	2003	2004	2005	2010
Drilling ($/ft)							
Target	300	291	282	273	268	255	225
Actual	300	288	282	273	252	--	--
Surface Systems ($/kW)							
Target	2000	1960	1920	1880	--	1875	1575
Actual	2000	1960	1920	1880	--	--	--

	2005	2010	2020
Enhanced Geothermal Systems (EGS) (cents per kWh)			
Target	12	11	8
Actual	12	-	-

Detailed Justification

	(dollars in thousands)		
	FY 2004	FY 2005	FY 2006
Resource Development	**2,019**	**2,501**	**3,655**

Resource Development deals with finding, characterizing, and assessing the geothermal resource through understanding the formation and evolution of geothermal systems. The work builds on continuing research that investigates seismicity, isotope geochemistry, 3-D magnetotellurics, remote sensing, and other techniques as exploration tools. Available exploration technology from related industries (e.g., petroleum, mining, waste management) is evaluated for adaptation to geothermal environments. The objective is to double the exploration success rate, as determined by wildcat wells, from 20 percent in 2000 to 40 percent by 2015.

In FY 2006, the program will conduct extensive field tests of technologies for exploration, such as remote sensing, geophysical, and geochemical techniques to locate hidden geothermal resources. Cost-shared investigations of promising new sites will be conducted to verify the presence of resources. By providing data, equipment, and personnel, the program will expand and accelerate the geothermal resource assessment being conducted in collaboration with the U.S. Geological Survey (USGS) and state agencies.

Enhanced Geothermal Systems	**6,680**	**6,687**	**7,898**

Natural geothermal systems depend on three factors to produce energy: heat, water, and permeability. Heat is present virtually everywhere at depth; water and permeability are more problematic. Enhanced Geothermal Systems (EGS) are engineered reservoirs created to produce energy from geothermal resources deficient in economical amounts of water and/or permeability. EGS technology will increase the productivity and lifetime of those reservoirs. The program will use performance-based decision criteria to determine whether to proceed with EGS by 2010. Assuming viability of the technology is proven, subsequent research is expected to enable economic access to some of the resource base to begin by 2020.

During FY 2006, the program will continue to broaden understanding of natural geothermal processes, such as fluid flow, fracture dynamics, and rock-water interaction, through cooperative research projects with universities, private companies, and National Laboratories. EGS field projects with cost-sharing industry partners will continue at three sites including the completion of long-term testing of the enhanced reservoir at the Coso (CA) geothermal field. Conduct feasibility studies of a field test site for

	(dollars in thousands)		
	FY 2004	FY 2005	FY 2006

EGS technology. A comprehensive analysis of reservoir testing in the U.S. and abroad will be performed.

Systems Development	**7,726**	**6,292**	**8,246**

Drilling and completion of wells account for 30 - 50 percent of the cost of a geothermal power project. High up-front costs and the chance of unsuccessful drilling can drive financial risk to unacceptable levels relative to anticipated project return on investment. Drilling research aims to produce new technologies for reducing the cost of geothermal wells through an integrated systems approach that focuses on improvements to key subsystems. The research effort draws on advancements from the petroleum, mining, and related industries, wherever new technology can be adapted for geothermal applications. The objective is to reduce the cost of drilling by 28 percent by 2010 compared to year 2000 costs. Systems Development also covers improving energy conversion technologies. These include better heat exchangers and condensers, which reduce capital and operating costs. Use of advanced materials and innovative energy conversion technologies can substantially improve the economics of geothermal electric power generation. The objective is to reduce both the capital costs of geothermal surface systems and operating and maintenance costs by 25 percent by 2010 compared to year 2000 costs.

In FY 2006, the program will demonstrate an integrated Diagnostics-While-Drilling data management system with user-selected displays; verify the field-worthiness of advanced primary cementing technology such as nitrified, high-temperature, reverse-circulated cements; complete field demonstrations of hydraulically augmented drag bits and high-strength drill pipe; field-test enhanced air-cooled condensers; complete development of American Society for Testing and Materials (ASTM) standards for thermally sprayed metallic coatings, and complete development of a laser-based instrument for real-time detection of hydrogen sulfide in cooling towers. The electrical power systems projects selected in FY 2005 will be advanced to the design and construction phase.

In FY 2004, funding for this activity was reduced by $499,000 for SBIR/STTR which was transferred to the Science Appropriation.

Total, Technology Development	**16,425**	**15,480**	**19,799**

Explanation of Funding Changes

	FY 2006 vs. FY 2005 ($000)
Resource Development	
Increased funding for resource assessment expanding from a regional to a national scale. This change responds in part to the NEP recommendation to increase renewable energy production on Federal lands	+1,154
Enhanced Geothermal Systems	
The increase responds to FY 2005 PART recommendations and RDIC criteria 3a, prioritizing program investment based upon potential for public benefit. It continues emphasis on EGS R&D by expanding field testing of EGS reservoirs to include a dedicated technology test site. The program will conduct initial feasibility studies for the test site	+1,211
Systems Development	
The increase will support development and operation of a Drilling Dynamics Simulator, an example of program application of R&D to cost effectively address technological risk (RDIC 2i). It will dynamically simulate performance of drilling equipment in a controlled laboratory setting representative of actual geothermal drilling conditions and a detailed analysis of the potential improvements in performance and cost of energy conversion systems associated with generation of electricity from 150 ºC hydrothermal resources using binary cycle technology	+1,954
Total Funding Change, Technology Development	**+4,319**

Technology Application

Funding Schedule by Activity

(dollars in thousands)

	FY 2004	FY 2005	FY 2006	$ Change	% Change
Technology Application					
Technology Verification.....................	3,500	3,130	2,000	-1,130	-36.1%
Technology Deployment	2,738	3,102	1,500	-1,602	-51.6%
Total, Technology Application................	6,238	6,232	3,500	-2,732	-43.8%

Description

This subprogram concerns the practical application of advancements made under the Technology Development subprogram. The focus involves the field verification of new technology, deployment of that technology, and its transfer to commercial applications. In addition, the activity examines barriers to the transfer and use of geothermal technology within the U.S. The success of this transfer effort depends upon involvement by industry partners and other interested parties. The extent of cost sharing by the private sector is an important measure of that success.

Benefits

By providing a pathway for transferring geothermal technology into the business arena, Technology Application supports the program mission of working in partnership with U.S. industry to establish geothermal as an economically competitive contributor to the U.S. energy supply. The pathway consists of verifying technology and deploying technology with industry at U.S. geothermal sites. Working with geothermal stakeholders to reduce non-technical barriers that inhibit geothermal expansion also assists in establishing geothermal as an important source of energy supply.

Detailed Justification

	(dollars in thousands)		
	FY 2004	FY 2005	FY 2006
Technology Verification	**3,500**	**3,130**	**2,000**

Technology Verification includes cost-shared resource verification projects and demonstration of near-term commercial research products. Technology Verification moves technologies from research and development to a level where the technologies are accepted and actively used and applied by the U.S. geothermal industry and other stakeholders. All development components of exploration, EGS, drilling, and energy conversion should eventually be field tested to demonstrate improvements in technology performance at a commercial scale. Such verifications of improved technology are done in collaboration with cost-sharing industry partners, who will adopt the technology.

In FY 2006, the program will continue to collaborate with industry partners to find and evaluate new geothermal resources using DOE-sponsored technology improvements. This activity builds on prior exploration and will directly contribute to the addition of new resources in the western United States. One competitively selected power system project will advance to the design and construction phase.

Technology Deployment	**2,738**	**3,102**	**1,500**

Institutional issues, such as complex regulations, can often prevent the transition from a prototype of new technology to a commercial product. This activity addresses the factors affecting the deployment of geothermal systems. Education, outreach, technical support, and systems analysis are used to encourage greater deployment. Interested parties come from the public and private sectors working in concert to raise awareness levels and solve problems of common interest.

Under this activity, the program will facilitate partnerships with the geothermal industry, power companies, energy consumers, and public officials at all levels, with the goal of removing barriers to geothermal deployment.

In FY 2006, the program will conduct outreach activities focused on key state and regional development issues and work with Native Americans from New Mexico (NM) and Nevada (NV) to use geothermal energy for heat and electricity. Analyses will be performed on the economic impacts of geothermal technologies and future market opportunities as well as continuing systems analysis to help guide the program.

Total, Technology Application	**6,238**	**6,232**	**3,500**

Explanation of Funding Changes

	FY 2006 vs. FY 2005 ($000)
Technology Verification	
The decrease reflects more emphasis on technology development (such as EGS) that will contribute to achieving program goals.	-1,130
Technology Deployment	
The decrease reflects more emphasis on technology development (such as EGS) that will contribute to achieving program goals.	-1,602
Total Funding Change, Technology Application	**-2,732**

Congressionally Directed Activities

Funding Schedule by Activity

	(dollars in thousands)				
	FY 2004	FY 2005	FY 2006	$ Change	% Change
Congressionally Directed Activities....	1,962	3,558	0	-3,558	-100.0%
Total, Congressionally Directed Activities...	1,962	3,588	0	-3,558	-100.0%

Description

The content of this section reflects 7 separate Congressionally Directed activities ("earmarks") within Geothermal Technology. In general, such activities do not support program goals because they are not well-aligned with established research pathways or focused on overcoming the technical barriers as identified in the program's detailed planning documents.

Detailed Justification

	(dollars in thousands)		
	FY 2004	FY 2005	FY 2006

There were a total of 2 Congressionally Directed activities in FY 2004 and 7 in FY 2005. Most of the projects will be conducted over 2-3 years. The program does not request further funding for these projects. The following projects were directed by Congress to be included in this program:

Geothermal Research at the University of Nevada-Reno...	**981**	**992**	**0**

Geothermal resource assessment and exploration of the Great Basin.

Lake County Basin (Full Circle) Geothermal Project in California...	**981**	**496**	**0**

Final design and procurement for construction of Phase III Full Circle pipeline.

Tuscarora Geothermal	**0**	**496**	**0**

Drilling of a geothermal production well in northern Nevada.

Klamath and Lake Counties Geothermal-Agricultural Ind. Park, Oregon.......................................	**0**	**298**	**0**

Promotion of the use of geothermal energy for agriculture in south central Oregon.

	(dollars in thousands)		
	FY 2004	FY 2005	FY 2006
Geothermal Mill Redevelopment, Mass.	**0**	**744**	**0**

Installation of a geothermal heat pump system for space heating.

University of Texas Permian Basin Center for Energy Economic Diversification	**0**	**194**	**0**

Assessment of feasibility of heat extraction from the Permian Basin in Texas.

National Center for Energy Management and Building Technologies	**0**	**338**	**0**

Activities funded under this Congressionally-directed project were to address HVAC research needs and improve the efficiency, productivity, and security of the U.S. building stock by developing and disseminating synergistic and complementary solutions to energy management, indoor environment quality, and security concerns in new and existing buildings.

Total, Congressionally Directed Activities	**1,962**	**3,558**	**0**

Explanation of Funding Changes

	FY 2006 vs. FY 2005 ($000)
Congressionally Directed Activities	
No funds are requested, as recommended by PART funds are being allocated to other activities more closely aligned with the Program's goals	-3,558
Total Funding Change, Congressionally Directed Activities	**-3,558**

Biomass and Biorefinery Systems R&D

Funding Profile by Subprogram[a]

(dollars in thousands)

	FY 2004 Comparable Appropriation	FY 2005 Original Appropriation	FY 2005 Adjustments[b]	FY 2005 Comparable Appropriation	FY 2006 Request
Biomass and Biorefinery					
Feedstock Infrastructure	982	2,000	-16[c]	1,984	1,000
Platforms Research and Development	28,874	30,969	-896[d]	30,073	43,360
Utilization of Platform Outputs	13,518	13,562	-107[e]	13,455	5,999
Congressionally Directed Activities	41,234	35,616	-282[f]	35,334	0
Total, Biomass and Biorefinery Systems R&D	84,608	82,147	-1,301	80,846	50,359

Public Law Authorizations:

P.L. 93-577, "Federal Non-Nuclear Energy Research and Development Act" (1974)
P.L. 94-163, “Energy Policy and Conservation Act” (EPCA) (1975)
P.L. 94-385, “Energy Conservation and Production Act” (ECPA) (1976)
P.L. 95-91, “Department of Energy Organization Act” (1977)
P.L. 95-618, “Energy Tax Act" (1978)
P.L. 95-619, “National Energy Conservation Policy Act” (NECPA) (1978)
P.L. 95-620, “Powerplant and Industrial Fuel Use Act" (1978)
P.L. 96-294, “Energy Security Act” (1980)
P.L. 100-12, “National Appliance Energy Conservation Act" (1987)
P.L. 100-615, “Federal Energy Management Improvement Act" (1988)
P.L. 101-218, “Renewable Energy and Energy Efficiency Technology Competitiveness Act" (1989)
P.L. 101-549, “Clean Air Act Amendments" (1990)
P.L. 101-575, “Solar, Wind, Waste, and Geothermal Power Production Incentives Act" (1990)
P.L. 102-486, "Energy Policy Act" (1992)
P.L. 106-224, “Biomass Research and Development Act" (2000)
P.L. 108-148, “Healthy Forest Restoration Act” (2003)

[a] SBIR/STTR funding in the amount of $1,067,000 was transferred to the Science Appropriation in FY 2004. Estimates for SBIR/STTR budgeted in FY 2005 and FY 2006 are $873,000 and $920,000 respectively.
[b] Programs were reduced by 0.80 percent as required by the Omnibus Appropriation Bill.
[c] Reflects the 0.80% rescission of -$16,000.
[d] Reflects the 0.80% rescission of -$241,000 and comparability adjustment for Cross-cutting Planning, Analysis and Evaluation of -$655,000.
[e] Reflects the 0.80% rescission of -$107,000.
[f] Reflects the 0.80% rescission of -$282,000.

Mission

The mission of the Biomass and Biorefinery Systems R&D Program ("Biomass Program") is to partner with U.S. industry to foster research and development on advanced technologies that will convert our Nation's biomass resources into affordable industrial products (including energy and higher valued chemicals and materials) through the development of biorefineries.[a] An analogy to this approach is the petroleum refinery that refines crude oil into a broad range of industrial products. The Biomass Program receives funds from both the Energy Supply and the Energy Conservation appropriations. Energy Supply-funded activities focus primarily on developing advanced technologies for producing intermediate feedstocks such as sugars, synthesis gas (syngas), and pyrolysis oils for use in biorefineries. Energy Conservation-funded activities focus on developing advanced technologies for more energy efficient industrial processes and co-production of high-value industrial products.

Benefits

The program's research focus covers three areas: Feedstock Infrastructure for reducing the cost of collecting and preparing raw biomass;[b] Platforms Research and Development for reducing the cost of outputs and byproducts from biochemical and thermochemical processes (i.e., reducing the cost of biomass sugars, syngas, and pyrolysis oil); and Utilization of Platform Outputs for developing technologies and processes that co-produce liquid and gaseous fuels, chemicals and materials, and heat and power--and integrating those technologies and processes in biorefinery configurations (i.e., converting sugars, syngas or pyrolysis oil to useable fuels, chemicals, materials, heat for steam generation, etc.).

Examples of existing biorefineries include wet and dry mill ethanol plants, and paper mills. The program partners with these industries to develop the next generation of biorefinery that will produce value-added chemicals and materials together with fuels and/or power from non-conventional, lower cost feedstocks such as agricultural and forest residues. Next generation biorefineries built on this partnership model will be more efficient and use more diverse biomass resources to accelerate economic development of the bio-industry and increase domestic energy supply production and diversity, increasing energy security. One of the program's recent achievements was reducing the cost of enzymes needed for cellulosic ethanol production from over $5 per gallon of ethanol produced (1999 estimate) to between 30 and 50 cents per gallon (2004 estimate). The National Renewable Energy Laboratory (NREL) independently verified the industry partners' experiments and used DOE's latest modeling tools to estimate these costs.

---

[a] Biorefineries are processing facilities that extract carbohydrates, oils, lignin, and other materials from biomass, convert them into multiple products such as transportation fuels, power, and products.

[b] Biomass means any organic matter that is available on a renewable or recurring basis, including agricultural crops and trees, wood and wood wastes and residues, plants, grasses, residues, fibers, and animal wastes, municipal solid wastes, and other waste materials.

Strategic and Program Goals

The Department's Strategic Plan identifies four strategic goals (one each for defense, energy, science, and environmental aspects of the mission) plus seven general goals that tie to the strategic goals. The Biomass Program supports the following goal:

Energy Strategic Goal

General Goal 4, Energy Security: Improve energy security by developing technologies that foster a diverse supply of reliable, affordable and environmentally sound energy by providing for reliable delivery of energy, guarding against energy emergencies, exploring advanced technologies that make a fundamental improvement in our mix of energy options, and improving energy efficiency.

The Biomass Program has one program goal which contributes to General Goal 4 in the "goal cascade":

Program Goal 04.08.00.00: Biomass. Develop biorefinery-related technologies to the point that they can compete in terms of cost and performance and are used by the Nation's transportation, energy, chemical, agriculture, forestry, and power industries to meet their respective market objectives. This helps the Nation by expanding clean, sustainable energy supplies while also improving the Nation's energy infrastructure and reducing our dependence on foreign oil.

Contribution to Program Goal 04.08.00.00 (Biomass)

The program directly supports General Goal 4, Energy Security principally by increasing production of oil substitutes and diversifying supply. It also directly addresses the goals and recommendations of the President's National Energy Policy, the Biomass R&D Act of 2000 and the Farm Security and Rural Investment Act of 2002.

Key technology pathways that contribute to the achievement of these benefits include:

Platforms Research and Development contribution:

- Reduce the estimated cost for production of a cleaned and reformed biomass-derived synthesis gas produced from $6.48 per million Btu in 2003 (equivalent to electricity at 7.52 cents per kWh) to $5.28 per million Btu by 2012 (equivalent to electricity at 5.97 cents per kWh)[a]. For comparison, EIA projected wellhead natural gas prices at $4.19 per million Btu in 2015. Indicators of progress will be bench-scale data (2007) and pilot-scale data (2012) that support the modeled cost. In the FY 2005 Congressional budget request, pilot-scale testing was anticipated to be accomplished in 2010. However, the magnitude of Congressionally-directed projects in FY 2004 necessitated a delay of the projected date to 2012.
- Reduce the estimated cost for production of a mixed, dilute sugar stream suitable for fermentation to ethanol, from 15 cents/lb in 2003 (corresponding to $2.75 per gallon of ethanol at $53 per dry ton of corn stover) to 10 cents/lb by 2012 (corresponding to $1.75 per gallon of ethanol at $45 per dry ton of corn stover). Indicators of progress will be bench-scale data (2007) and pilot-scale data (2012)

[a] The previous baseline and target costs in the FY 2005 Congressional budget was too conservative - $9.80 per million Btu in 2003 and $7.58 per million Btu in 2010. A software error has been corrected, resulting in the current baseline and target costs.

that support the modeled cost. The magnitude of Congressionally-directed projects in FY 2004 necessitated a delay of the projected date from 2010 to 2102.

Utilization of Platform Outputs R&D contribution:

- Measure Under Development

In view of the integrated biorefinery emphasis, the current budget request focuses on sugars and syngas, the biorefinery intermediate products from which transportation fuels (including ethanol from residual starch and cellulose), heat, power, and various chemicals would be produced. For the sugars-based biorefinery, near term technology efforts consist of pursuing the conversion of fiber (containing residual starch, cellulose and hemi-cellulose) from corn kernels and distiller dried grains to transportation fuels (such as ethanol) and higher valued co-products.

Annual Performance Results and Targets

FY 2001 Results	FY 2002 Results	FY 2003 Results	FY 2004 Results	FY 2005 Targets	FY 2006 Targets
Program Goal 04.08.00.00 (Biomass and Biorefinery Systems R&D)					
Utilization of Platform Outputs					
		Establish testing program at three existing gasifiers at partners' sites for the development and application of technology components (e.g. gas clean-up, gas engines, fuel cells, etc.) that needed to be integrated with the gasification components to produce power, fuels, and chemicals. [MET: Greater than 80 percent but less than 100 percent – Completion was delayed by 5 months]	Demonstrate clean syngas production in three thermochemical conversion systems. [MET] Complete testing of ethanol production from corn fiber in partnership with industry in order to achieve a 3 percent increase in ethanol production from each corn ethanol plant that successfully implements the technology without requiring additional corn feedstock. [MET]		Complete experimental plan for pilot scale testing aimed at producing additional ethanol and enhancing co-product value using the existing plant feed for either a wet or dry mill. This is one of the key steps necessary for transitioning from starch to corn fiber and eventually to corn stover, achieving the FY 2012 cost targets for sugars and ethanol.
Platforms Research and Development					
Conducted a competitive solicitation and selected at least one partner for demonstrating the conversion of cellulosic feedstock at a corn ethanol plant.	DOE waited for responses associated with the biomass solicitation issued in FY 2002, and delayed to 2004 the development of prototype yeasts capable of fermenting multiple biomass-derived sugars to meet cost goals for the ethanol/gasoline blend markets.	Complete the thermochemical options analysis to assess various process pathways to fuels (e.g., F-T, gasoline, diesel, alcohols). Develop an improved enzyme preparation for reducing the cost of producing ethanol from biomass. Evaluate its impact on production costs using an updated computer model of the production process. [MET]		Complete a technical and economic evaluation of integrated biomass to fuels systems to validate the sugar cost of $0.135 per pound and syngas cost of $6.13 per million Btu.	Complete laboratory and economic assessment of 2 different feedstocks, identifying operating conditions that link pretreatment with enzymes that could be scaled-up and have the potential of achieving the goal of $0.13 per pound sugar by 2007. Develop a fluidizable tar-reforming catalyst for synthesis gas production.
			Contribute proportionately to EERE's corporate goal of reducing corporate and program uncosteds to a range of 20-25 percent by reducing program annual uncosteds by 10 percent in 2004 relative to the program uncosted baseline (in 2003) until the target range met.	*Contribute proportionately to EERE's corporate goal of reducing corporate and program adjusted uncosted obligated balances to a range of 20-25 percent by reducing program annual adjusted uncosteds by 10 percent in 2005 relative to the Biomass & Biomass Refinery Systems Program FY 2004 end of year adjusted uncosted baseline*	*Contribute proportionately to EERE's corporate goal of reducing corporate and program adjusted uncosteds to a range of 20-25 percent by reducing program annual uncosteds by 10 percent in 2006 relative to the program uncosted baseline (2005) until the target range is met.* *Maintain total Program Direction costs in relation to*

FY 2001 Results	FY 2002 Results	FY 2003 Results	FY 2004 Results	FY 2005 Targets	FY 2006 Targets
				($62,235K) until the target range is met.	*total Program costs in the range of 8% - 12% to demonstrate efficient and effective EERE-wide business and technical support to mission direct programs.*

Means and Strategies

The Biomass Program will use various means and strategies to achieve its program goals as described below. "Means" include operational processes, resources, information, and the development of technologies, and "strategies" include program, policy, management and legislative initiatives and approaches. Various external factors, as listed below, may impact the ability to achieve the program's goals. Collaborations are integral to achieving the planned investments, means and strategies, and to addressing external factors.

The Biomass Program will implement the following means in order to improve the cost-competitiveness of biomass technologies (including feedstock collection and storage):

- R&D through competitive solicitations for industrial partnerships with appropriate cost sharing to attract innovation and ensure investment value for industry and university contracts;
- Management of R&D by a series of objectives and milestones; tracked by the Project Management Center[a] and verified with reviews from industry and university experts.
- Input from peer reviews.[b] Peer reviews of program plans and activities are aimed at obtaining expert, independent opinion on the program's goals and objectives; feasibility of reaching the goals; appropriateness of technical barriers being addressed; appropriateness of the Federal role, and whether the level of Federal funding for projects is commensurate with technical objectives.

The Biomass Program will implement the following strategies:

- Guidance by the Biomass Technical Advisory Committee and the Biomass R&D Board established under the Biomass R&D Act of 2000. Evaluation and analysis results are also input to the decision process as required by the Government Performance & Results Act (GPRA) and the President's Management Agenda (PMA).
- The Administration's R&D Investment Criteria and DOE's internal assessment modeled after the Administration's Program Assessment Rating Tool (PART). These are overlaid on the various inputs provided by external and internal entities so that program decisions will result in the highest possible return on Federal investments.
- Using a stepwise progression to gain industry cost-share and commitment to program goals, the program is pursuing the biorefinery approach beginning with existing biorefineries. These are based on wood in the case of the forest biorefinery and starch in the case of the sugars-based biorefinery (corn dry mills, in particular). Biorefineries will logically follow a progression moving from the lowest cost feedstock with the least technology and market risk through a series of steps where research will be needed to bring more feedstocks and more products under the biorefinery umbrella. This progression is expected to develop along two pathways, sugars-based and thermochemical.

---

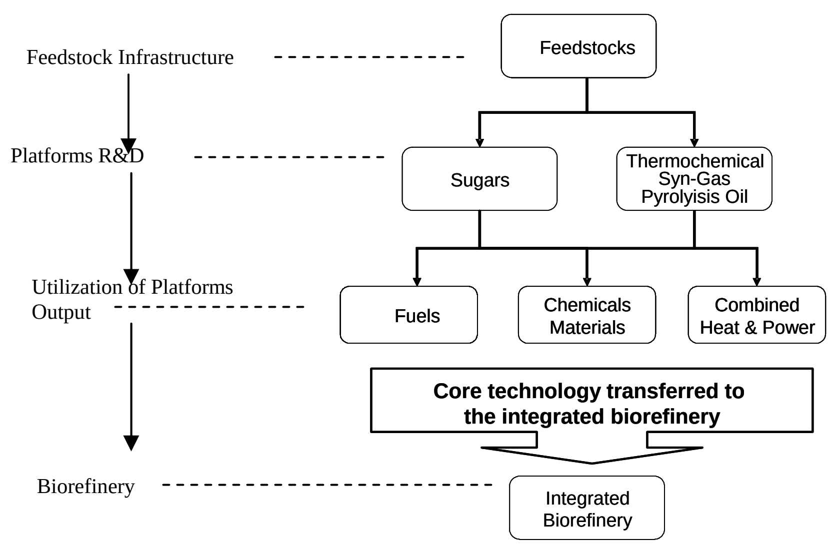
[a] EERE implemented the Project Management Center approach at the Golden Field Office and the National Energy Technology Laboratory to enhance the management of projects.

[b] As of December 2004, the most recent review was the November 2003 Biomass Program Review, Washington, DC.

- Under-utilized residues from existing recalcitrant biorefinery feedstock streams, i.e., residual starch, cellulose and hemi-cellulose, will be targeted first as feedstock in the near term. The sugars-based biorefinery might include the following step-wise progression: 1) starch based residuals in corn kernel; 2) cellulose in kernel; 3) kernel separation into products; 4) sugar-based biorefineries driven by expanding markets for additional products, starch-based residuals in the kernel and cellulose in agricultural residues such as corn stover and wheat straw; and 5) ultimately the sugars-based biorefinery utilizing cellulosic energy crops.

- The thermochemical-based biorefinery will also proceed in a step-wise progression: 1) laboratory scale utilizing a clean, dry, and uniform biomass feedstock to produce clean syngas or pyrolysis oil; 2) pilot test with industrial partners using a relatively clean feedstock to produce a "dirty" syngas or pyrolysis oil; 3) industrial partners produce a clean syngas or pyrolysis oil; 4) industrial partners produce a clean syngas or pyrolysis oil from a non-uniform feedstock (potentially wet or sulfur laden) at pilot scale; 5) at an industrial facility integrate various syngas or pyrolysis systems into a biorefinery configuration that produces fuel, power, or chemicals.

- In time it is likely that a biorefinery may emerge that combines elements of thermochemical-based and sugars-based biorefineries. One example of this dual approach could be a biorefinery that separates biomass's lignin fraction (for thermochemical conversion) from its carbohydrate fraction (for sugars conversion). These and similarly integrated biorefinery progressions should result in increasing benefits built along a continuum beginning with the initial stages of technology integration in about 2011 as the technology and infrastructure develop further. The figure below summarizes the program's approach.



These strategies could result in significant cost savings and reduction in imported oil dependency.

The following external factors could affect the program's ability to achieve its strategic goal:

- Cost and availability of conventional fossil energy sources;
- Consumer acceptance; and
- Cost of competing technologies.

The market penetration rate of bio-based technologies is a function of technical breakthrough, price trends of coal, oil and natural gas, and policy factors.

In carrying out its mission, the program performs the following collaborative activities:

- Annual USDA/DOE solicitation for biomass technologies R&D and other coordination under the Biomass Research and Development Act; and
- Partnerships with existing biorefineries to develop technologies resulting in more cost-effective use of current feedstock and/or utilization of additional, new feedstock such as cellulosic residues.

Validation and Verification

To validate and verify program performance, the Biomass and Biorefinery Systems R&D Program will conduct internal and external reviews and audits. For example, during peer reviews of the program, these programmatic activities have been reviewed by experts from universities, state agencies, industry, and the U.S. Department of Agriculture. The table below summarizes validation and verification activities.

Data Sources:	The Renewable Fuels Association's production statistics; the National Renewable Energy Laboratory's Renewable Electric Plant Information System (REPIS); the Energy Information Administration's (EIA) Annual Energy Review, Renewable Energy Annual and Annual Energy Outlook; the Gas Technology Institute Survey of Distributed Resources; EIA Form 860 data analyzed by the Resource Dynamics Corporation. Individual projects develop production cost and quantity estimates for sugar, syngas, ethanol, and other fuels and chemicals (these are reviewed and monitored by managers).
Baselines:	The following are the key baselines used in the Biomass Program: ▪ Biomass delivered cost (2003): \$53 per dry ton for wheat straw and corn stover ▪ Cleaned and reformed syngas (2003): \$6.48/million Btu (equivalent to 7.52 cents per kWh of electricity) ▪ Mixed, dilute, unfermented sugars (2003): 15 cents per pound (equivalent to \$2.75 per gallon of ethanol)
Evaluation:	In carrying out the program's mission, the Biomass Program uses several forms of evaluation to assess progress and to promote program improvement.

- Technology validation and operational field measurement, as appropriate
- Peer review by independent outside experts of both the program and subprogram portfolios
- Biennial internal Technical Program Review of the Biomass Program
- Specialized program evaluation studies to examine process, impacts, or market baseline and effects, as appropriate
- Quarterly and annual assessment of program and management results based performance through Joule (the DOE quarterly performance progress review of budget targets), R&DIC (annual internal review of performance planning and management of R&D programs against specific criteria), PMA (the Presidents Management Agenda -- annual departmental and PSO based goals whose milestones are planned, reported and reviewed quarterly) and PART (common government wide program/OMB reviews of management and results).
- Annual review of methods, and updated analysis of potential benefits for the Government Performance and Results Act (GPRA)

The National Laboratories receive direct funds for technology research and development, based on their capabilities and performance. Advisory panels consisting of non-Federal and industry experts review each laboratory and industry project at scheduled stage-gate reviews and peer evaluation of R&D. Projects are evaluated based on the following criteria: 1) Relevance to overall DOE objectives; 2) Approach to performing the research and development; 3) Technical accomplishments and progress toward project and DOE goals; 4) Technology transfer/collaborations with industry/universities/laboratories; and 5) Approach and relevance of proposed future research. The panels also evaluate the strengths and weaknesses of each project, and recommend additions to or deletions from the scope of work. The program organization facilitates relationships to ensure that Federal R&D results are transferred to industry.

Frequency: Potential benefits are estimated annually. Independent evaluation of R&D projects are performed according to schedule per the "stage-gate" process for moving each project through an independent review "gate", from a less costly stage (such as preliminary paper studies) to a more costly stage (such as bench scale experiments). Program Peer Reviews are conducted annually.

Data Storage: EERE Benefits website, Corporate Planning System, and other computer-based data systems.

Verification: DOE technology managers verify the achievement of targets through project reviews, including reviews of cost and performance modeling results. Project leaders in the field must provide to the technology managers documentation of experimental and/or analytic results as evidence of success. The evidence is listed in material supporting the DOE Joule performance tracking system.

Various trade associations review the data and the modeling processes (e.g. REPIS renewable), and the EIA verifies the REPIS database. Peer reviews are independently conducted by personnel from industry, academia and governmental agencies other than the U.S. Department of Energy.

Funding by General and Program Goal

	(dollars in thousands)		
	FY 2004	FY 2005	FY 2006
General Goal 4, Energy Security			
Program Goal 04.08.00.00, Biomass			
Feedstock Infrastructure	982	1,984	1,000
Platforms Research and Development	28,874	30,073	43,360
Utilization of Platform Outputs	13,518	13,455	5,999
Total, Program Goal 04.08.00.00, Biomass	43,374	45,512	50,359
All Other			
North Central Texas Dairy Waste Control Pilot Project	196	0	0
Biomass Cogeneration Project at North Country Hospital	245	0	0
Eastern Nevada Landscape Coalition	249	248	0
White Pine County Schools Heating	249	0	0
Ethanol Production from Biomass – University of Louisville	294	0	0
Missouri Soybean Association	294	0	0
Vermont Biomass Energy Center	392	496	0
Center for Biomass Utilization at University of North Dakota	491	992	0
Biorefinery at Louisiana State University	491	496	0
Research in Nebraska on Improved Soybean Oil for Biodiesel Fuel	491	0	0
Clean Energy from Gasification of Switchgrass - Iowa State University	736	0	0
On-Farm Small Scale Waste Energy Demonstration Project	736	0	0
Mount Wachusett Community College	942	0	0
University of Tennessee Switchgrass Demonstration Project	981	0	0
Oxygenated Diesel Emissions Testing in California and Nevada, AAE Technologies	981	496	0
New Uses Information and Entrepreneur Development Center	981	0	0
Ag-Based Industrial Lubricants Located at the University of Northern Iowa	981	496	0

	(dollars in thousands)		
	FY 2004	FY 2005	FY 2006
Mississippi State Biodiesel Production Project	981	1,489	0
McMinnville Biodiesel Project	981	0	0
Maine Forest Bio-Products R&D	981	0	0
Iowa State University Catalysis Research	981	0	0
E-Diesel Research with NCGA	981	0	0
Bio-Based Products and Energy with Midwest Consortium	1,962	0	0
Michigan Biotechnology Initiative	1,962	0	0
Regional Biomass Energy Program	1,962	3,969	0
Iowa Switchgrass Project - Chariton Valley	2,500	496	0
Consortium for Plant Biotechnology Research	2,943	2,977	0
Gridley Rice Straw Project	2,943	0	0
Fuels from Agricultural and Animal Wastes	12,327	0	0
Thermo-Energy Project at University of Nevada - Reno	0	496	0
Vermont Biofuels Initiative	0	496	0
Recycling for Energy Conservation in Wells, Nevada	0	248	0
Alternative Fuels Plant in Livingston Parish	0	496	0
Alaska Wood Biomass Project	0	198	0
Mississippi Technology Alliance – Alternative Energy Enterprise	0	2,977	0
Kentucky Rural Energy Supply	0	1,984	0
South-Eastern and North-Central Regional Sun Grant Centers	0	1,488	0
Purdue-Midwest Consortium for Sustainable Biofuels	0	496	0
Texas A&M – Renewable Energy from Animal Biowaste	0	992	0
Biotech-to-Ethanol Project	0	1,488	0
National Biofuel Energy Laboratory	0	1,984	0
Research Triangle Biomass, North Carolina	0	992	0
Sugar-Based Ethanol Biorefinery at Louisiana State University	0	1,984	0
SUNY-Morrisville Anaerobic Digester Project	0	198	0
NREL Demonstration for Small-Scale Biomass (BioMax)	0	2,976	0
Anaerobic Digestion – Ohio Agricultural Research Development Center	0	992	0
Alabama Alternative Fuel Source Study	0	496	0
Georgia Biorefinery and Hydrogen Fuel Cell Research	0	1,488	0

	(dollars in thousands)		
	FY 2004	FY 2005	FY 2006
National Center for Energy Management and Building Technologies	0	710	0
Total, All Other	41,234	35,334	0
Total, Biomass and Biorefinery Systems R&D	84,608	80,846	50,359

Expected Program Outcomes

The Biomass Program pursues its mission through integrated activities designed to increase the use of domestic renewable resources and contribute towards improved energy productivity of our economy. We expect these improvements to reduce national susceptibility to energy price fluctuations and potentially lower energy bills; reduce several EPA-criteria pollutants and other pollutants; enhance energy security by increasing the production and diversity of domestic fuel supplies; and provide greater energy security and reliability by improving our energy infrastructure. In addition to these "EERE business-as-usual" benefits, realizing the Biomass Program goals would provide the technical potential to reduce conventional energy use even further if warranted by future energy needs.

Estimates of annual non-renewable energy savings, energy expenditure savings, carbon emission reductions, oil savings, and natural gas savings that result from the realization of Biomass Program goals are shown in the table below through 2050. The level of Biorefinery Outputs (Btu basis) as a result of realizing the program goals is also reported through 2050.

These estimates do not include other benefits such as local air quality improvements and represent a conservative initial effort at assessing the benefits of the Biomass Program activities and likely significantly underestimate the benefits from integrated biorefinery production options that are yet to be modeled. In addition, these estimates do not yet address some of the more fundamental technologies being developed in the Integrated Biorefinery and Bio-based products processes.

The assumptions and methods underlying the modeling efforts have significant impact on the estimated benefits, and results could vary significantly if external factors, such as future energy prices, differ from the "baseline case" assumed for this analysis. EERE's baseline case is essentially the same as the EIA "business-as-usual" case presented in its Annual Energy Outlook. In addition, possible changes in public policy and disruptions in the energy system which may affect estimated benefits are not modeled. The external factors such as unexpected changes in competing technology costs, identified in the Means and Strategies section above, could also affect the Program's ability to achieve its goals. Also note that the modeling long term benefits assumes that funding levels will be consistent with the President's commitment and assumptions in the 2006 Budget, and that funding will be applied to the core program. If the pattern of substantial congressionally directed projects persists over several years, the GPRA benefits estimates will need to be reduced.

The results shown in the long term benefits tables are preliminary estimates based on initial modeling of some of the possible program production technologies; nonetheless, they provide a useful picture of the potential change in national benefits over time if the technology, infrastructure and markets evolve as expected. Estimated benefits which follow assume that individual technology plans and market assumptions obtain. Final documentation is estimated to be completed and posted by March 31, 2005. Uncertainties are larger for longer term estimates. A summary of the methods, assumptions, and models used in developing these benefit estimates that are important for understanding these results are provided at www.eere.energy.gov/office_eere/budget_gpra.html.

FY 2006 GPRA Benefits Estimates for Biomass Program[a]

Mid-Term Benefits[b]	2010	2015	2020	2025
Cellulosic ethanol production (million gallons)[c]	0	120	260	1,570
Primary nonrenewable energy savings (Quads)	0	0.02	0.06	0.12
Energy bill savings (Billion 2002$) (mmtce)	0	ns	ns	ns
Carbon emission reductions (mmtce)	0	ns	2	3
Oil savings (MBPD)	0	ns	0.01	0.01
Natural gas savings (Quads)	0	ns	ns	0.02

Long-Term Benefits[d]	2030	2040	2050
Cellulosic ethanol production (million gallons)[e]	1586	5598	8772
Primary nonrenewable energy savings (Quads)	0.2	0.7	1.1
Energy system cost savings (Billion 2002$)	0	0	1
Carbon emission reductions (MMTCE)	4	12	19
Oil savings (MBPD)	0.09	0.29	0.40
Natural gas savings (Quads)	0.02	0.06	0.16

[a] Benefits reported are annual, not cumulative, for the year given. Estimates reflect the benefits that may be possible if all of the program's technical targets are met and funding continues at levels consistent with assumptions in the FY 2006 Budget.
[b] Mid-term program benefits were estimated utilizing the GPRA06-NEMS model, based on the Energy Information Administration's (EIA) National Energy Modeling System (NEMS) and utilizing the EIA's Annual Energy Outlook (AEO) 2004 Reference Case. "ns" stands for "not significant."
[c] Includes ethanol from corn stover, other residues, and future energy crops, and ethanol from corn kernel fiber and associated residual starch. GPRA05 did not include ethanol from the residual starch bound to the fiber.
[d] Long-term benefits were estimated utilizing the GPRA06 - MARKAL developed by Brookhaven National Laboratory (BNL). Results can differ among models due to differences in their structure. In particular, the two models estimate economic benefits in different ways, with the MARKAL model reflecting the cost of additional investments required to achieve reductions in energy bills.
[e] Measured as incremental ethanol production over reference case.

Feedstock Infrastructure

Funding Schedule by Activity

	(dollars in thousands)				
	FY 2004	FY 2005	FY 2006	$ Change	% Change
Feedstock Infrastructure	982	1,984	1,000	-984	-49.6%
Total, Feedstock Infrastructure	982	1,984	1,000	-984	-49.6%

Description

Biomass is bulkier than fossil resources such as coal and oil, resulting in higher costs for transport and storage when compared to fossil fuels. The goal of this work is to develop novel harvesting equipment designs and storage and logistics systems for agricultural residues. The requested level of support also provides funds to conduct systems level design studies such as analysis of biomass feedstock systems (including sustainability requirements) and regional and national cost/supply relationships.

Benefits

Feedstock costs account for up to 30 percent the production costs of bio-based fuels and products. These activities will reduce biomass harvesting and storage costs for agricultural residues such as wheat straw and corn stover in order to facilitate the growth of the biomass industry. Indicators of progress toward that goal include developing a conceptual, novel harvesting system and testing a dry storage system by 2010. It is also anticipated that continued feedstock research will be conducted at the Department of Agriculture under the Agricultural Research Service, Forest Service, and funds provided by USDA through the Biomass Initiative.

Detailed Justification

	(dollars in thousands)		
	FY 2004	FY 2005	FY 2006
Feedstock Infrastructure	**982**	**1,984**	**1,000**

In FY 2006, feedstock infrastructure systems work continues for single-pass harvester development for wheat straw and corn stover collection, and storage and transportation options to minimize costs for delivering these agricultural feedstock residues to a conversion plant. Infrastructure systems analysis will also continue in order to integrate economic and environmental considerations.

Total, Feedstock Infrastructure	**982**	**1,984**	**1,000**

Explanation of Funding Changes

	FY 2006 vs. FY 2005 ($000)
Feedstock Infrastructure	
Reduced effort in feedstock resource evaluation because funding for this activity is more in alignment with other agency missions.	-984
Total Funding Change, Feedstock Infrastructure	**-984**

Platforms Research and Development

Funding Schedule by Activity

(dollars in thousands)

	FY 2004	FY 2005	FY 2006	$ Change	% Change
Platforms Research and Development					
Thermochemical Platform R&D	14,434	18,688	15,000	-3,688	-19.7%
Bioconversion Platform R&D for Sugars	14,440	11,385	28,360	+16,975	+149.1%
Total, Platforms Research and Development	28,874	30,073	43,360	+13,287	+44.2%

Description

The program is pursuing Thermochemical Platform Research and Development and Bioconversion Platform Research and Development for Sugars. Conversion of biomass via thermochemical and/or bioconversion processes is viewed as the best choice for the production of significant quantities of fuels, power, and chemicals and materials. The process intermediates are synthesis gas (syngas), pyrolysis oils, and sugars. One of the key goals of the Thermochemical Platform activity is to complete the development of gas cleanup technologies that allow biomass feedstocks to be converted to clean products that meet the stringent gas quality specifications for advanced systems that can produce fuels and chemicals. Bioconversion Platform R&D for Sugars will improve the performance and costs of enzymes, biomass pretreatment, and fermentation of multiple biomass sugars for the production of fuel ethanol and other bio-based products. The program provides information regarding the annual USDA/DOE solicitation of biomass technologies R&D to the Biomass Technical Research and Development Advisory Committee. This committee was established under the Biomass R&D Act of 2000 in order to provide guidance to USDA and DOE in the area of biomass technologies R&D.

Benefits

Integration and optimization of these processes will be necessary in order to:

- Reduce the estimated cost for production of a cleaned and reformed biomass-derived synthesis gas produced from $6.48 per million Btu in 2003 (equivalent to electricity at 7.52 cents per kWh) to $5.28 per million Btu by 2012 (equivalent to electricity at 5.97 cents per kWh)[a]. For comparison, EIA projected wellhead natural gas prices at $4.19 per million Btu in 2015. Indicators of progress will be bench-scale (2007) and pilot-scale data (2012) that support the modeled cost. In the FY 2005 Congressional budget request, pilot-scale testing was anticipated

[a] The previous baseline and target costs in the FY 2005 Congressional budget was too conservative - $9.80 per million Btu in 2003 and $7.58 per million Btu in 2010. A software error has been corrected, resulting in the current baseline and target costs.

to be accomplished in 2010. However, the magnitude of Congressionally-directed projects in FY 2004 necessitated a delay of the projected date to 2012 for both this syngas target and the sugar target discussed below.

- Reduce the estimated cost for production of a mixed, dilute sugar stream suitable for fermentation to ethanol, from 15 cents/lb in 2003 (corresponding to $2.75 per gallon of ethanol at $53 per dry ton of corn stover) to 10 cents/lb by 2012 (corresponding to $1.75 per gallon of ethanol at $45 per dry ton of corn stover). Indicators of progress will be bench-scale (2007) and pilot-scale data (2012) that support the modeled cost.

Detailed Justification

	(dollars in thousands)		
	FY 2004	FY 2005	FY 2006
Thermochemical Platform R&D	**14,434**	**18,688**	**15,000**

The Thermochemical Platform R&D Activity conducts research, testing, integration, and feasibility studies on thermochemical conversion of biomass to provide the foundation for advanced and integrated systems that focus on syngas. This area demonstrates advanced gasification system technologies (feeding, cleanup/conditioning, system integration) that are suitable for use in biorefineries, the conversion of syngas into fuels and chemicals, and for combined heat and power generation in both large-scale and distributed applications. Black liquor gasification is not part of this work.

The program decision to reduce funding for thermochemical R&D and increase funding for Bioconversion Platform R&D was guided by the logic of R&D Investment Criterion No. 2a which assesses the program's complementarity to ongoing RD&D. The thermochemical conversion efforts build on and complement existing catalytic synthesis technologies for liquid fuels production. Gasification development is tailored to biomass fuels, but complements public and private R&D funding of a number of other programs, including the Clean Coal Program. The Clean Coal Program has invested significantly in coal gasification technology development. The Biomass Program benefits from that work with respect to gas cleanup and conditioning for use in advanced power generation systems. Industry is largely focused on bioconversion at this time and therefore biorefinery development partnerships are focused on bioconversion. However, the program also supports thermochemical technologies for additional pathways to a bio-industry of the future.

Syngas cost reduction will be achieved as a result of increased process efficiency in syngas production and conversion of syngas to fuels, chemicals and materials through: (a) developing and verifying thermochemical technologies in production, clean-up and reforming, and (b) validating their integration into biorefinery configurations.

In FY 2006, the program will continue to develop technologies for the production, cleanup and conditioning of biomass syngas and pyrolysis oils suitable for conversion to fuels and chemicals. This will be done in collaboration with industrial partners selected under the Biomass Initiative Solicitation that was jointly conducted with the Department of Agriculture in FY 2004. Gas cleanup and conditioning efforts will focus on the syngas and pyrolysis stream for the removal of particulates and other inorganic materials, on the conversion of tars, improving syngas yields, and on shift reactions to adjust hydrogen ratios. These R&D partnerships will develop technologies compatible with the scale of biomass facilities, and that are compatible for integration into existing petroleum and chemical operations as well as forest biorefineries. The eventual outcome will be biorefinery configurations incorporated into these industries' current operations.

(dollars in thousands)

In FY 2004, this activity was reduced by $1,067,000 for SBIR/STTR and transferred to the Science Appropriation.

	FY 2004	FY 2005	FY 2006
Bioconversion Platform R&D for Sugars	**14,440**	**11,385**	**28,360**

The Bioconversion Platform for Sugars is defined by the work to convert the complex sugars of biomass to simple sugars and focuses on three major elements, (a) advanced pretreatment, (b) enzymatic hydrolysis, and (c) process integration. The Bioconversion Platform also supports integration activities with Feedstock Infrastructure and Utilization of Platform Outputs because processing biomass into sugars, syngas, or pyrolytic oils is affected by the properties and costs of the feedstock as delivered to the biorefinery, and the quality of the sugars, syngas, or pyrolytic oils has an effect on the subsequent conversion to fuels, chemicals, or steam and power.

Sugar cost reductions will reflect the results of work in the areas of feedstock, pretreatment, conversion of complex sugars to simple sugars, and process integration. Specific targets include: (a) reducing the severity (harshness) of thermochemical pretreatment while optimizing the digestibility of the pretreated material by selection of optimal pretreatment chemistry and determining the effectiveness of post-pretreatment; (b) reduction of enzyme costs; and (c) increasing the solids loading for the process to reduce equipment size, energy requirements, and reagent requirements.

Pretreatment activities include studies to identify the most cost effective thermochemical treatments that reduce the recalcitrance of lignocellulose through chemical or enzymatic de-polymerization. In addition to optimizing the best studied methodology, dilute acid pretreatment, alternative chemistries and configurations will be examined for efficacy and efficiency. In FY 2006, pilot-scale examination of one or more additional chemistries or configurations for thermochemical pretreatment will be initiated. Pretreated biomass will be reduced to simple sugars and residue by the action of hydrolytic enzymes. Further improvements are believed possible and appropriate and will be sought by work targeted to: (a) improving the specific activity of cellulases; (b) by improving the synergy between cellulase and non-cellulase hydrolases that attack the hemicellulose, protein, waxes, perhaps lignin, and other compounds that contribute to recalcitrance; and (c) by exploring optimization of the cellulase preparations to specific thermochemical pretreatment regimes. There is a solicitation planned for FY 2006 to address these issues.

Process integration focuses studies on developing interfaces between unit operations developed in

	(dollars in thousands)		
	FY 2004	FY 2005	FY 2006

thermochemical pretreatment and enzymatic hydrolysis projects. It further addresses the junctions with Feedstock and Products areas. On-going work addresses: (a) process intensification, the ability to run at high solids; (b) solid-liquid separations; and (c) the feedstock issues of carbohydrate composition variability and analytical methods. Demonstration of a model process at pilot-scale is expected to show successful integration of developed unit operations and to reveal any remaining generic stumbling blocks. The solicitation planned for FY 2006 will also include opportunities to support integration of thermochemical pretreatment technology into existing facilities.

Total, Platforms Research and Development...................	**28,874**	**30,073**	**43,360**

Explanation of Funding Changes

	FY 2006 vs. FY 2005 ($000)
Thermochemical Platform R&D	
Using R&D Investment Criteria No. 2a and 2b, the program prioritized an increased effort for Bioconversion Platform R&D that will support emerging and advanced sugar-based biorefineries by overcoming barriers in enzymes, pretreatment, and process integration. Section 2a of the RDIC addressed how well each plan builds on existing technology and complements related R&D and Section 2b of the RDIC addressed how well the R&D activity's planning and priorization incorporate industry involvement...	-3,688
Bioconversion Platform R&D for Sugars	
An increase in funding for Bioconversion Platform R&D is requested to solicit partnerships to overcome barriers in enzymes, pretreatment, and process integration. This increase will advance further the technological base for biorefinery projects..........	+16,975
Total Funding Change, Platforms Research and Development	**+13,287**

Utilization of Platform Outputs

Funding Schedule by Activity

(dollars in thousands)

	FY 2004	FY 2005	FY 2006	$ Change	% Change
Utilization of Platform Outputs					
Integration of Biorefinery Technologies	13,312	13,455	5,999	-7,456	- 55.4%
Products Development	206	0	0	0	0%
Total, Utilization of Platform Outputs	13,518	13,455	5,999	-7,456	-55.4%

Description

The Utilization of Platform Outputs R&D Subprogram consists of projects that are conducted with industrial partners and thus each project may be different in terms of the feedstock, details of the processes or the suite of co-products. However, the common thrust of the Integration of the Biorefinery Technologies component is to support the integration of residual starch and cellulosic conversion processes into existing starch-based ethanol plants.

Benefits

This subprogram will provide essential benefits in the following areas:

Detailed Justification

(dollars in thousands)

	FY 2004	FY 2005	FY 2006
Integration of Biorefinery Technologies	**13,312**	**13,455**	**5,999**

In FY 2006, in partnership with industry, the program will continue to integrate and test the handling, pretreatment, hydrolysis, and fermentation operations to allow for an evaluation of the performance and costs of converting biomass to fuels. Industry partners will conduct developmental work at the bench-scale and/or pilot-scale, refine engineering and economic evaluations, and develop commercialization plans. University and National Laboratory personnel will conduct research to support industrial partners in overcoming barriers identified by these high profile projects that will become the lead biorefineries deployed with program support.

	FY 2004	FY 2005	FY 2006
	(dollars in thousands)		
Products Development	**206**	**0**	**0**

Congressionally directed activities reduced the overall program budget in FY 2005, leaving no funds for investigating the use of platform outputs for the production of value-added products, and for state/regional partnership activities aimed at overcoming market barriers. No FY 2006 funds are requested for this activity.

	FY 2004	FY 2005	FY 2006
Total, Utilization of Platform Outputs	**13,518**	**13,455**	**5,999**

Explanation of Funding Changes

	FY 2006 vs. FY 2005 ($000)
Integration of Biorefinery Technologies	
The proposed funding strategy allows for increased funding of Bioconversion Platform R&D for Sugars needed for next generation of green field biorefineries. Also, funding for certain activities have reached a point of development in which they are better aligned with the jurisdiction of the Appropriations Subcommittee on Interior and Related Agencies. The FY 2006 requested funding for these is in the Energy Conservation account	-7,456
Products Development	
No change	0
Total Funding Change, Utilization of Platform Outputs	**-7,456**

Congressionally Directed Activities

Funding Schedule by Activity

(dollars in thousands)

	FY 2004	FY 2005	FY 2006	$ Change	% Change
Congressionally Directed Activities....	41,234	35,334	0	-35,334	-100.0%
Total, Congressionally Directed Activities..	41,234	35,334	0	-35,334	-100.0%

Description

In general, Congressionally Directed activities do not support program goals because such activities were not a result of the program's planning effort which is focused on overcoming technical barriers.

Detailed Justification

(dollars in thousands)

	FY 2004	FY 2005	FY 2006

In FY 2005, there were 29 Congressionally Directed activities funded out of the Biomass Program and a Congressionally Directed activity funded jointly with other EWD programs. The program does not request any funds to continue these projects as they do not further the achievement of DOE's goals. The following projects were directed by Congress to be included in this program:

North Central Texas Dairy Control Pilot Project.........	**196**	**0**	**0**

Anaerobic digestion of dairy waste for generating electricity and reducing discharged phosphorus

Biomass Cogeneration Project at North Country Hospital...	**245**	**0**	**0**

Vermont hospital switching to wood fuel system for electricity and heat

Biomass Restoration by Eastern Nevada Landscape Coalition	**249**	**248**	**0**

Improving vegetation via thinning and increasing more desirable species

Biomass Conversion in White Pine County, Nevada......	**249**	**0**	**0**

Conversion of school's fuel oil heating to wood-fired hot water heating.

(dollars in thousands)	FY 2004	FY 2005	FY 2006
Ethanol Production at University of Louisville	**294**	**0**	**0**
R&D to maximize ethanol production in viscous fermentations.			
Biodiesel Demonstration with Missouri Soybean Association	**294**	**0**	**0**
Evaluation of biodiesel use in school buses.			
Vermont Biomass Energy Center	**392**	**496**	**0**
Accelerating adaptation of near-term renewable biomass technologies.			
Center for Biomass Utilization, University of North Dakota	**491**	**992**	**0**
Development of technologies for biomass-based power and fuels and transfer of information to potential users.			
Biorefinery at Louisiana State University	**491**	**496**	**0**
Development of technology for converting sugar cane wastes and molasses into fuels and chemicals.			
Improved Soybean Oil for Biodiesel in Nebraska	**491**	**0**	**0**
Evaluation of diesel engine performance using biodiesel made from high oil-content soybean.			
Gasification of Switchgrass – Iowa	**736**	**0**	**0**
Development of switchgrass gasification technology for power application.			
On-Farm Small Scale Waste Energy Demonstration Project	**736**	**0**	**0**
Evaluation of grass straw conversion to power and fuels.			
Biomass Gasification at Mount Wachusett Community College	**942**	**0**	**0**
Feasibility of small modular bio-power systems.			
Switchgrass Demonstration Project	**981**	**0**	**0**
Evaluation of the potential of producing switchgrass on commercial agricultural land and as an energy feedstock.			
Oxygenated Diesel Emissions Testing in California and Nevada	**981**	**496**	**0**
Demonstration of diesel and ethanol mixture in heavy vehicles.			

	FY 2004	FY 2005	FY 2006
	(dollars in thousands)		
New Uses Information and Entrepreneur Development Center	**981**	**0**	**0**

Support for commercialization and entrepreneurship of agricultural research into alternative industrial use products.

Ag-Based Industrial Lubricants at the University of Northern Iowa	**981**	**496**	**0**

Development of bio-based lubricants meeting industry performance specifications.

Mississippi State Biodiesel Production Project	**981**	**1,489**	**0**

Development of new feedstock and technologies for bio-diesel production.

McMinnville Biodiesel Project	**981**	**0**	**0**

Evaluation of biodiesel used in a diesel generator.

Maine Forest Bio-Products R&D	**981**	**0**	**0**

Development of processes for converting forest biomass to bio-based products.

Center for Catalysis at Iowa State University	**981**	**0**	**0**

Development of new catalysts for commodity chemicals and processes for bio-based products.

E-Diesel Research with National Corngrowers Association	**981**	**0**	**0**

Testing ethanol diesel mixtures in the laboratory using engines and on site using actual farm vehicles.

Bio-Based Products and Energy with Midwest Consortium	**1,962**	**0**	**0**

Research on processes for increasing dry mills' output value with a focus on distillers dry grain solubles.

Michigan Biotechnology Initiative	**1,962**	**0**	**0**

Development of the ammonia fiber explosion pretreatment technology and fermentation production of succinic acid to enhance dry mill ethanol profitability.

Regional Biomass Energy Program	**1,962**	**3,969**	**0**

Dissemination of information to overcome market barriers and accelerate biomass utilization.

	(dollars in thousands)		
	FY 2004	FY 2005	FY 2006
Iowa Switchgrass Project - Chariton Valley	**2,500**	**496**	**0**

Testing of co-firing coal and switchgrass, conducting field research to enable the use of switchgrass for energy, and develop this market.

Consortium for Plant Biotechnology Research	**2,943**	**2,977**	**0**

Bringing together industry, academe, and Federal resources to conduct research in plant biotechnology and other bio-based technologies.

Gridley Rice Straw Project	**2,943**	**0**	**0**

Assessment of rice straw gasification for ethanol and electricity production, and rice straw supply potential.

Fuels from Agricultural/Animal Wastes	**12,327**	**0**	**0**

Development of thermal depolymerization technology for producing bio-based products and energy from bio-wastes.

ThermoEnergy Research Project at the University of Nevada-Reno	**0**	**496**	**0**

Scope to be negotiated.

Vermont Biofuels Initiative	**0**	**496**	**0**

Scope to be negotiated.

Recycling for Energy Conservation, City of Wells, Nevada	**0**	**248**	**0**

Scope to be negotiated.

Alternative Fuel Plant Construction, Livingston Parish	**0**	**496**	**0**

Scope to be negotiated.

Alaska Wood Biomass Project	**0**	**198**	**0**

Scope to be negotiated.

Mississippi Technology Alliance	**0**	**2,977**	**0**

Scope to be negotiated.

Kentucky Rural Energy Supply	**0**	**1,984**	**0**

Scope to be negotiated.

Southeastern and North Central Regional Sun Grant Centers	**0**	**1,488**	**0**

	(dollars in thousands)		
	FY 2004	FY 2005	FY 2006
Scope to be negotiated.			
Purdue – Midwest Consortium for Sustainable Biofuels	**0**	**496**	**0**
Scope to be negotiated.			
Texas A&M – Renewable Energy from Animal Biowaste	**0**	**992**	**0**
Scope to be negotiated.			
Biotech-to-Ethanol Project	**0**	**1,488**	**0**
Scope to be negotiated.			
National Biofuel Energy Laboratory	**0**	**1,984**	**0**
Scope to be negotiated.			
Research Triangle Biomass, North Carolina	**0**	**992**	**0**
Scope to be negotiated.			
Sugar-Based Ethanol Biorefinery at Louisiana State University	**0**	**1,984**	**0**
Bioconversion of sugars to ethanol and potential co-product.			
SUNY-Morrisville Anaerobic Digester Project	**0**	**198**	**0**
Anaerobic digestion technology for converting organic wastes to useful products.			
NREL Demonstration for Small-Scale Biomass (BioMax)	**0**	**2,976**	**0**
Demonstration of small, modular biopower production system that uses high bulk density biomass.			
Anaerobic Digestion – Ohio Agricultural Research Development Center	**0**	**992**	**0**
Anaerobic digestion technology for converting organic wastes to useful products.			
Alabama Alternative Fuel Source Study	**0**	**496**	**0**
Scope to be negotiated.			

	FY 2004	FY 2005	FY 2006
Biorefinery and Hydrogen Fuel Cell Research in Georgia	**0**	**1,488**	**0**

Scope to be negotiated.

	FY 2004	FY 2005	FY 2006
National Center for Energy Management and Building Technologies	**0**	**710**	**0**

Activities funded under this Congressionally-directed project were to address HVAC research needs and improve the efficiency, productivity, and security of the U.S. building stock by developing and disseminating synergistic and complementary solutions to energy management, indoor environment quality, and security concerns in new and existing buildings.

(dollars in thousands)	FY 2004	FY 2005	FY 2006
Total, Congressionally Directed Activities	**41,234**	**35,334**	**0**

Explanation of Funding Changes

	FY 2006 vs. FY 2005 ($000)
Congressionally Directed Activities	
No funds are requested because activities are not closely aligned with the program's goal.	-35,334
Total Funding Change, Congressionally Directed Activities	**-35,334**

Intergovernmental Activities

Funding Profile by Subprogram

(dollars in thousands)

	FY 2004 Comparable Appropriation	FY 2005 Original Appropriation	FY 2005 Adjustments	FY 2005 Comparable Appropriation	FY 2006 Request
Intergovernmental Activities					
International Renewable Energy Program	5,841	6,500	-141[a]	6,359	2,910
Tribal Energy Activities	4,906	5,500	-43[b]	5,457	4,000
Renewable Energy Production Incentive	3,926	5,000	-40[c]	4,960	5,000
Total, Intergovernmental Activities	14,673	17,000	-224	16,776	11,910

Public Law Authorizations:

P.L. 95-91, "DOE Organization Act" (1977)
P.L. 102-486, "Energy Policy Act of 1992"

Mission

Intergovernmental Activities are managed as part of the Weatherization and Intergovernmental Program (WIP). WIP's intergovernmental mission is to provide partners, host countries, and Tribes with technical assistance, data, tools, capacity building, and financial strategies for improved energy utilization and reduced emissions from energy generation. Intergovernmental Activities promote the market transfer of clean energy innovations to promote sustainable development and increased trade.

Benefits

As part of WIP, Intergovernmental Activities support the DOE's Energy Strategic Goal 4 and the President's National Energy Policy (NEP) recommendations for market transfer of clean energy technologies and energy efficient products. The International Renewable Energy and the Tribal Energy Programs help foster diverse supply of reliable, affordable and environmentally sound energy through the market transfer of clean energy technologies. The NEP calls for the promotion of market-based solutions to environmental concerns and the export of U.S. clean energy technologies. The Clean Energy Technology Exports Initiatives, which focuses on exporting clean energy technologies to developing and transitional countries and is supported within the International Renewable Energy Program, is in direct response to this NEP recommendation.

---

[a] Reflects 0.80% rescission of -$51,000 and comparability adjustment for Cross-cutting Planning, Analysis and Evaluation of -$90,000.
[b] Reflects the 0.80% rescission of -$43,000.
[c] Reflects the 0.80% rescission of -$40,000.

The modeling long term benefits assumes that funding levels will be consistent with the President's commitment and assumptions in the 2006 Budget, and that funding will be applied to the core program. If the pattern of substantial congressionally directed projects persists over several years, the GPRA benefits estimates will need to be reduced.

Strategic and Program Goals

The Department's Strategic Plan identifies four strategic goals (one each for defense, energy, science, and environmental aspects of the mission) plus seven general goals that tie to the strategic goals. The Intergovernmental Program supports the following goal:

Energy Strategic Goal

General Goal 4, Energy Security: Improve energy security by developing technologies that foster a diverse supply of reliable, affordable, and environmentally sound energy by providing for reliable delivery of energy, guarding against energy emergencies, exploring advanced technologies that make a fundamental improvement in our mix of energy options, and improving energy efficiency.

The Intergovernmental Program has one program goal which contributes to General Goal 4 in the "goal cascade":

Program Goal 04.11.00.00: Intergovernmental Activities. Accelerate the adoption of clean, efficient and domestic energy technologies through efficient intergovernmental demonstration and delivery of cost-effective energy technologies which will benefit the public through improved energy productivity and reduced demand and particularly reduce the burden of energy cost on the disadvantaged.

Contribution to Program Goal 04.11.00.00 (Intergovernmental Activities)

The Intergovernmental Activities contribute to General Goal 4 by providing technical assistance in targeted intergovernmental communities that provide high leverage to accelerate the adoption of cost-effective EERE technologies leading to the building of 1000 MW of renewable generation globally by 2015 and 100 MW of generation in Indian country by 2010.

The suite of Weatherization and Intergovernmental activities key contribution to the Energy Security goal is through accelerating the adoption and broadening the markets of energy efficiency R&D technologies developed by EERE programs, and expanding and accelerating the direct reduction of demand for oil, natural gas, and electricity.

Annual Performance Results and Targets

FY 2001 Results	FY 2002 Results	FY 2003 Results	FY 2004 Results	FY 2005 Targets	FY 2006 Targets
Program Goal 04.11.00.00 (Intergovernmental Activities)					
International Renewable Energy/Tribal Energy					
			International Renewable Energy will strengthen and broaden activities supporting priority agreements, e.g. expanded the harmonization of standards to additional countries, ramped up implementation of the Energy Efficiency and Village Energy initiatives. Continue to work with APEC and NAEWG. [MET]	Provide technical analysis and reviews, data access, training and project support for 7 international clean energy projects which includes: developing 2 components for GIS tools to analyze U.S. EERE technology export markets; provide phase 1 technical assistance to secure access for EERE technologies to build 1,000 MW of generation globally over 10 years.	International Renewable Energy Program will provide technical analysis and support for 3 clean energy projects. Program will work with key Federal agencies and will train 100 foreign senior technical analysts to facilitate an estimated 50 MW of global generation.
	.		Tribal Energy will conduct 6 technical and policy development workshops. [MET]	Tribal Energy will provide direct technical assistance to tribal nations including: 4 development workshops, 2-3 economic development projects, 8-10 "first steps" efforts, and 6-10 feasibility studies, working toward the goal of 100 MW of generation in Indian country by 2010.	Tribal Energy will provide Tribe specific technical and financial assistance for 30-35 projects. Representative activities include National Tribal meetings and the competitive solicitation of "first-step" projects, feasibility and development projects to facilitate an estimated .5 MW of generation in Indian country.
			Contribute proportionately to EERE's corporate goal of reducing corporate and program uncosteds to a range of 20-25 percent by reducing program annual uncosteds by 10 percent in 2004 relative to the program uncosted baseline (in 2003) until the target range is met.	*Contribute proportionately to EERE's corporate goal of reducing corporate and program adjusted uncosted obligated balances to a range of 20-25 percent by reducing program annual adjusted uncosteds by 10 percent in 2005 relative to the program FY 2004 end of year adjusted uncosted baseline ($21,257K) until the target range is met.*	*Contribute proportionately to EERE's corporate goal of reducing corporate and program adjusted uncosteds to a range of 20-25 percent by reducing program annual uncosteds by 10 percent in 2006 relative to the program uncosted baseline (2005) until the target range is met.* *Maintain total Program Direction costs in relation to total Program costs in the range of 8% - 12% to demonstrate*

FY 2001 Results	FY 2002 Results	FY 2003 Results	FY 2004 Results	FY 2005 Targets	FY 2006 Targets
					efficient and effective EERE-wide business and technical support to mission direct programs.

Means and Strategies

The Intergovernmental Activities Program will use various means and strategies to achieve its program goals as described below. "Means" include operational processes, resources, information, and the development of technologies, and "strategies" include program, policy, management and legislative initiatives and approaches. Various external factors, as listed below, may impact the ability to achieve the program's goals. Collaborations are integral to the planned investments, means and strategies, and to addressing external factors.

Intergovernmental Activities uses several means (processes, technologies and resources) and program, policy, management and market based strategic approaches to achieve its program goals. Significant external factors outside the control of the program are important to achieving the program goals and intended impacts. Collaboration with other agencies and experts are integral to the investments, means and strategies planned and to addressing the external factors.

Intergovernmental Activities will implement the program through the following means:

- International Renewable Energy supports bilateral and multilateral agreements by developing projects, providing training and technical assistance, and building partnerships with international energy organizations and governments to foster information exchange on renewable energy and energy technology choices for consumers and businesses.

- The Tribal Energy Activity supports and manages technical and financial assistance projects to promote energy, environmental, and economic development policy objectives for Native Americans. This primarily involves the development of energy efficiency and renewable energy resources on Tribal lands. Projects include resource assessments and development plans for energy efficient and renewable energy technologies. Technical assistance helps Native American Tribes, and Tribal Colleges develop culturally compatible energy and economic development plans and strategies reflecting Tribal priorities. In addition, the program invests in technical program and market analysis and performance assessment in order to direct effective strategic planning.

- The Renewable Energy Production Incentive (REPI) encourages the acquisition of renewable generation systems that use solar, wind, geothermal or biomass technologies, by state and local governments and non-profit electric cooperatives by providing financial incentive payments for their electric production.

Intergovernmental Activities will implement the following strategies:

- Cost shared field validation projects to educate foreign energy decision makers about the merits of U.S. Energy Efficiency and Renewable Energy technologies;

- Assisting international educational institutions with the creation of renewable energy curricula, workshop development, and multi-year activity planning;

- Building partnerships with Tribal governments and assess Native American energy needs for residential, commercial, and industrial uses. Providing technical and financial assistance in energy efficiency and renewable energy development; and

- Through resource assessments, workshops, training and energy plan development assistance, developing the capacity to make knowledgeable decisions regarding their Tribes' energy future.

The following external factors could effect the Intergovernmental Activities ability to achieve its strategic goal:

- Extension of REPI tax credit;
- Geopolitical changes; and
- Cost-effectiveness of technologies and products that can substitute for current ones, but with significantly improved greenhouse gas (GHG) emission characteristics.

In carrying out the program mission, Intergovernmental Activities participates in the following collaborative activities:

- Tribal Energy Subprogram maintains a close collaboration with the Bureau of Indian Affairs, Department of Interior, Department of Justice, and the Environmental Protection Agency through the Federal Interagency Working Group on Environmental Justice (IWG). The IWG is comprised of 11 Federal agencies and several White House offices working to integrate environmental justice into individual programs.

Validation and Verification

To validate and verify program performance, the Intergovernmental Activities Program will conduct internal and external reviews and audits. These programmatic activities are subject to continuing review as described below. The table below summarizes validation and verification activities.

Data Sources: The Energy Information Administration's (EIA) Annual Energy Review, Renewable Energy Annual and Annual Energy Outlook. International Energy Agency, World Energy Outlook. Information collected directly from WIP performers and partners.

Baseline:

- Over 1.1 billion Kwh of qualified renewable energy produced in 2004.
- IREP 2002 baseline for primary renewable energy consumption in developing countries and transition economies is approximately 12 Quads (302.49 million tones of oil equivalent (Mtoe)).
- Tribal Energy 2003 baseline is 750 kWh of renewable generation capacity on Tribal lands.

Frequency: Annual.

Evaluation: In carrying out the program's mission, WIP uses several forms of evaluation to assess progress and to promote program improvement.

- Operational field measurement as appropriate
- Peer review by independent outside experts of both the program and subprogram portfolios

- Annual internal Program Review
- Specialized program evaluation studies to examine process, impacts, or market baseline and effects, as appropriate
- Quarterly and annual assessment of program and management results based performance through Joule (the DOE quarterly performance progress review of budget targets), R&DIC (annual internal review of performance planning and management of R&D programs against specific criteria), PMA (the Presidents Management Agenda -- annual departmental and PSO based goals whose milestones are planned, reported and reviewed quarterly).
- Annual review of methods, and recomputation of potential benefits for the Government Performance and Results Act (GPRA)

Data Storage: The EIA and other data sources store the data on their computers. WIP output information is contained in various reports and memoranda.

Verification: International Renewable Energy verifies program performance through National Laboratory reports. Tribal Energy maintains project information and received data from individual Tribal governments.

Funding by General and Program Goal

	(dollars in thousands)		
	FY 2004	FY 2005	FY 2006
General Goal 4, Energy Security			
Program Goal 04.11.00.00, Intergovernmental Activities			
International Renewable Energy Program	3,143	4,177	2,910
Tribal Energy Activities	1,669	3,473	4,000
Renewable Energy Production Incentive	3,926	4,960	5,000
Total, Program Goal 04.11.00.00, Intergovernmental Activities	8,738	12,610	11,910
All Other			
Congressionally Directed Activity, National Center for Energy Management and Building Technologies	0	198	0
Congressionally Directed Activity, International Renewable Energy Program/Renewable Energy Policy Project	736	0	0
Congressionally Directed Activity, International Renewable Energy Program/International Utility Efficiency Partnership	1,962	1,984	0
Congressionally Directed Activity, Tribal Energy Activities	3,237	1,984	0
Total, All Other	5,935	4,166	0
Total, General Goal 4 (Intergovernmental Activities)	14,673	16,776	11,910

Expected Program Outcomes

The Intergovernmental Program pursues its mission through integrated activities designed to improve the energy efficiency and productivity of our economy. We expect these improvements to reduce susceptibility to energy price fluctuations and potentially lower energy bills; reduce EPA criteria and other pollutants; enhance energy security by increasing the production and diversity of domestic fuel supplies; and provide greater energy security and reliability by improving our energy infrastructure. In addition to these “EERE business-as-usual” benefits, realizing the programs goals would provide the technical potential to reduce conventional energy use even further if warranted by future energy needs.

Also note that the modeling long term benefits assumes that funding levels will be consistent with the President’s commitment and assumptions in the 2006 Budget, and that funding will be applied to the core program. If the pattern of substantial congressionally directed projects persists over several years, the GPRA benefits estimates will need to be reduced.

The Renewable Energy Production Incentive could stimulate the generation of over 700 million kilowatt hours of electricity in 2015. This estimate assumes that funding for the program continues at the FY 2006 request level for the next decade. These results do not include benefits for the tribal and international intergovernmental activities, nor do they reflect the potential for this program to change consumer efficiency and renewable buying patterns over time.

International Renewable Energy Program

Funding Schedule by Activity

(dollars in thousands)

	FY 2004	FY 2005	FY 2006	$ Change	% Change
International Renewable Energy Program					
International Renewable Energy Program	3,143	4,177	2,910	-1,267	-30.3%
Congressionally Directed Activities, National Center for Energy Management and Building Technologies	0	198	0	-198	-100.0%
Congressionally Directed Activities, International Renewable Energy Program	2,698	1,984	0	-1,984	-100.0%
Total, International Renewable Energy Program	5,841	6,359	2,910	-3,449	-54.2%

Description

The International Renewable Energy Program (IREP) promotes market transformation in international energy markets to increase the installation of domestically-developed technologies. Specific activities include understanding local energy needs, raising awareness of renewable energy opportunities, and delivering training and technical assistance to foreign energy decision-makers apprising them of opportunities related to their domestic energy markets. Additionally, the Department co-sponsors targeted renewable energy projects that advance United States national energy technology and economic objectives. The results of these activities help to reduce both technical and non-technical barriers (e.g. financing, resources, tariffs, and local prohibitions) and increase the installation of renewable energy technologies.

Benefits

The IREP supports the program mission through technical assistance with National Laboratories and outside experts, helping meet specific commitments contained in bilateral and multilateral agreements. It provides technical support to the Clean Energy Technology Exports (CETE) initiative for joint public/private cooperation to increase the export of U.S. products and services and the Asian Pacific Economic Cooperation (APEC) forum to help U.S. energy firms competing in markets abroad by working to implement a system of clear, open and transparent rules and procedures governing foreign investment, thereby leveling playing fields for U.S. companies overseas, and reducing barriers to investment in EERE technologies. U.S. climate-change policy is currently based upon voluntary action and incentives. A key enabler for voluntary action is the availability and cost-effectiveness of technologies and products that can substitute for current ones, but with significantly reduced GHG emission characteristics. IREP activities directly support this goal and the President's stated commitment to support "growth that provides the resources for investment in clean technologies[a]."

Detailed Justification

(dollars in thousands)

	FY 2004	FY 2005	FY 2006
International Renewable Energy Program......................	**3,143**	**4,177**	**2,910**

International Renewable Energy activities are conducted in partnership with foreign governments and companies that design and install renewable energy technologies – both foreign and domestic. All efforts are focused on advancing U.S. energy technology, energy security, economic and national security interests.

In FY 2004 and 2005, the International Renewable Energy Program has supported market transformation efforts, such as National Laboratory technical support for the *Energy Efficiency and Sustainable Development Centers, Regional Centers, U.S.-China Renewable Cooperation,* and several multilateral agreements to develop energy efficiency and renewable energy projects and policies. Many of these efforts will be completed in FY 2005 and any further support will be limited to communication and reporting.

Much of the past work conducted by the International Renewable Energy Program has been performed by energy experts at the DOE National Laboratories. Although the laboratory experts remain an essential part of the IREP, the changing nature of energy markets requires the Department to rely on a broader base of experts, including those familiar with international finance, tariffs, city planning, codes and regulations. The program intends to include these additional experts within selected scheduled conferences, roadmapping sessions, and other for a addressing evolving international energy markets.

Specific projects in FY 2006 include energy awareness and planning workshops, renewable energy curricula development, support for foreign multi-year energy planning, technical training for designers, engineers and installers, resource assessments, energy infrastructure planning, energy codes harmonization and technical support to the CETE initiative. The program will train 100 foreign analysts, and will provide technical analysis and design support for 3 clean energy projects including test and evaluation support for 4 field validation projects.

[a] Remarks by the President on Climate Change and Clean Air National Oceanic and Atmospheric Administration Silver Spring, Maryland February 14th, 2002.

	(dollars in thousands)		
	FY 2004	FY 2005	FY 2006
Congressionally Directed Activity, National Center for Energy Management and Building Technologies	**0**	**198**	**0**

Activities funded under this Congressionally-directed project were to address HVAC research needs and improve the efficiency, productivity, and security of the U.S. building stock by developing and disseminating synergistic and complementary solutions to energy management, indoor environment quality, and security concerns in new and existing buildings.

Congressionally Directed Activity, Renewable Energy Policy Project	**736**	**0**	**0**

Activities funded under this congressionally directed activity were to fund the survey of all commercially viable domestic renewable enregy technologies to determine the skill requirements relating to manufacturing, installation, operation and maintenance for each technology.

Congressionally Directed Activity, International Utility Efficiency Partnership	**1,962**	**1,984**	**0**

Provides for the electric industry to partner with the developing world in voluntary greenhouse gas (GHG) reduction efforts.

Total, International Renewable Energy Program	**5,841**	**6,359**	**2,910**

Explanation of Funding Changes

	FY 2006 vs. FY 2005 ($000)
International Renewable Energy Program	
IREP will require fewer resources in FY 2006 as the program streamlines leveraged efforts in partnership with other U.S. agencies. Funding will be used for resource assessment, energy infrastructure planning and energy codes harmonization which require fewer resources	-1,267
Congressionally Directed Activity, National Center for Energy Management and Building Technologies	
Funding decrease represents successful completion of FY 2005 Congressionally Directed Activities........	-198
Congressionally Directed Activity, International Utility Efficiency Partnership	
Funding decrease represents successful completion of FY 2005 Congressionally Directed Activities........	-1,984
Total Funding Change, International Renewable Energy Program........	**-3,449**

Tribal Energy Activities

Funding Schedule by Activity

(dollars in thousands)

	FY 2004	FY 2005	FY 2006	$ Change	% Change
Tribal Energy Activities					
Tribal Energy Activities................	1,669	3,473	4,000	+527	+15.2%
Congressionally Directed Activities, Tribal Energy Activities......................................	3,237	1,984	0	-1,984	-100.0%
Total, Tribal Energy Activities.............	4,906	5,457	4,000	-1,457	-26.7%

Description

Tribal Energy Activities builds partnerships with Tribal governments to help assess Native American energy needs for residential, commercial, and industrial uses. Additionally, it provides technical and financial assistance in energy efficiency and renewable energy development. The activities provide the means for Tribal leaders to make knowledgeable choices regarding their Tribes' energy future, through resource assessments, workshops, training, and energy plan development assistance. Energy projects are competitively awarded on a cost-shared basis for Native American Tribes to implement comprehensive energy plans that incorporate energy efficiency and renewable energy technologies and resources. As a result, projects are underway for the development of renewable energy resources on Tribal lands.

Benefits

Tribal Energy Activities contribute to WIP's mission by building partnerships with Tribal governments to help assess Native American energy needs for residential, commercial, and industrial uses employing EERE technologies. Tribal Energy Activities develops, implements, and manages technical and financial assistance projects to promote energy, environmental, and economic development policy objectives for Native Americans.

Detailed Justification

	(dollars in thousands)		
	FY 2004	FY 2005	FY 2006
Tribal Energy Activities	**1,669**	**3,473**	**4,000**

The Tribal Energy activity supports the development of capacity within the 565 Federally recognized Native American Tribes to assess and meet their energy needs both for residential and economic development needs. Tribal Energy activities support cooperative agreements and build partnerships with Tribal governments, as other DOE programs do with the States, to foster information exchange, and technical and financial assistance projects. Tribal Energy activities provide financial and technical assistance to Tribes for:

- Strategic Planning
- Energy Options Analysis
- Organizational Development
- Capacity Building
- Feasibility Studies
- Cost-Shared Development Projects

Economic development is an ongoing challenge facing Tribal leaders and access to energy is a particular problem in this regard. Because of their remote locations and distance from, or access to, transmission and distribution systems, many Tribes have inadequate energy services, which inhibits economic development efforts and programs to promote rural education, public health, and safety. In many ways, the energy problems faced by the Tribes resemble the energy problems faced by developing nations and remote populations around the world.

In FY 2006, the Tribal Energy activities will continue to address the energy concerns of Tribal governments with the understanding that each may be at different locations on the "development spectrum" from needing assistance with resource analysis to seeking leveraged funding for a viable project. Thus, the Tribal Energy activities will include the issuance of competitive solicitations to meet program objectives. These activities will prepare the foundational work for private sector investment leading to an expected 100 MW of generation installed by 2010.

These solicitations will build on those undertaken in FY 2004 and FY 2005 to facilitate a "project pipeline" in Indian Country which will move projects from resource assessment to application Prior year efforts will be closed out where appropriate. Efforts will be undertaken with Tribal Colleges and Universities, to increase the awareness of the potential for renewable technologies among Tribal students and to prepare them for emerging jobs in renewable energy enterprises.

	(dollars in thousands)		
	FY 2004	FY 2005	FY 2006
Congressionally Directed Activity, Intertribal Council on Utility Policy	**1,275**	**0**	**0**
Provided support and funding for wind projects.			
Congressionally Directed Activity, Pyramid Lake Paiute Tribe Renewable Energy Park	**981**	**992**	**0**
Provided for an assessment of solar, wind and geothermal resources.			
Congressionally Directed Activity, Tribal Energy/Council of Renewable Energy Resource Tribes (CERT)	**981**	**992**	**0**
Provided technical expertise and training for Native Americans in renewable energy resources development.			
Total, Tribal Energy Activities	**4,906**	**5,457**	**4,000**

Explanation of Funding Changes

	FY 2006 vs. FY 2005 ($000)
Tribal Energy Activities	
Increase provides additional funds directed towards solicitations for more than 565 Federally recognized Tribes	+527
Congressionally Directed Activities, Tribal Energy Activities	
No funds requested to continue earmarks	-1,984
Total Funding Change, Tribal Energy Activities	**-1,457**

Renewable Energy Production Incentive (REPI)

Funding Schedule by Activity

(dollars in thousands)

	FY 2004	FY 2005	FY 2006	$ Change	% Change
Renewable Energy Production Incentive	3,926	4,960	5,000	+40	+0.8%
Total, Renewable Energy Production Incentive	3,926	4,960	5,000	+40	+0.8%

Description

REPI provides financial incentive payments to publicly owned utilities and electric cooperatives that own and operate qualifying facilities generating renewable electricity.

Benefits

REPI supports the WIP goal to promote increases in the generation and utilization of electricity from renewable energy sources and to further the advances of renewable energy technologies.

Detailed Justification

(dollars in thousands)

	FY 2004	FY 2005	FY 2006
Renewable Energy Production Incentive	**3,926**	**4,960**	**5,000**

REPI will review applications and distribute financial incentive payments for electricity produced and sold by qualifying renewable energy generation facilities owned by state and local government entities, such as municipal utilities and not-for-profit electric cooperatives, as allowed under Section 1212 of the Energy Policy Act of 1992.

	FY 2004	FY 2005	FY 2006
Total, Renewable Energy Production Incentive	**3,926**	**4,960**	**5,000**

Explanation of Funding Changes

	FY 2006 vs. FY 2005 ($000)
Renewable Energy Production Incentive	
No significant change	+40
Total Funding Change, Renewable Energy Production Incentive	**+40**

Departmental Energy Management Program

Funding Profile by Subprogram

(dollars in thousands)

	FY 2004 Comparable Appropriation	FY 2005 Original Appropriation	FY 2005 Adjustments	FY 2005 Comparable Appropriation	FY 2006 Request
Departmental Energy Management Program					
Energy Management Project Support	1,472	1,467	-12[a]	1,455	1,506
Energy Management Model Program Development	491	500	-4[b]	496	513
Total, Departmental Energy Management Program	1,963	1,967	-16	1,951	2,019

Public Law Authorizations:

P.L. 94-163, "Energy Policy and Conservation Act" (EPCA) (1975)
P.L. 94-385, "Energy Conservation and Production Act" (ECPA) (1976)
P.L. 95-91 "DOE Organization Act" (1977)
P.L. 95-619, "National Energy Conservation Policy Act" (NECPA) (1978)
P.L. 100-615, "Federal Energy Management Improvement Act" (1988)
P.L. 102-486, "Energy Policy Act" (1992)

Mission

The mission of the Departmental Energy Management Program (DEMP) is to promote energy security, environmental stewardship and cost reduction through energy efficiency and water conservation, the use of distributed and renewable energy, and sound utility management decisions at U.S. Department of Energy (DOE) Facilities.

Benefits

DEMP supports the mission of the Office of Energy Efficiency and Renewable Energy (EERE) by improving the energy efficiency and productivity of DOE buildings and by bringing clean, renewable technologies to the DOE facilities. DEMP supports DOE's goals by protecting our national and economic security by promoting a diverse supply and delivery of reliable, affordable, energy efficient and environmentally sound energy to DOE facilities.

Accomplishing DEMP's mission contributes to several national energy and environmental priorities. DOE deployment leadership in its facilities provides valuable insight to other Federal agencies reducing

[a] Reflects the 0.80% rescission of -$12,000.
[b] Reflects the 0.80% rescission of -$4,000.

change inertia. The President's National Energy Policy calls for America to modernize conservation efforts, increase energy supplies, "accelerate the protection and improvement of the environment and increase our Nation's energy security." It directs heads of executive departments and agencies to "take appropriate actions to conserve energy use at their facilities to the maximum extent consistent with the effective discharge of public responsibilities."

More detailed, integrated and comprehensive economic, energy and energy security benefits estimates are provided in the Expected Program Outcomes section at the end of the program level budget narrative.

Strategic and Program Goals

The Department's Strategic Plan identifies four strategic goals (one each for defense, energy, science, and environmental aspects of the mission) plus seven general goals that tie to the strategic goals. DEMP supports the following goal:

Energy Strategic Goal

General Goal 4, Energy Security: Improve energy security by developing technologies that foster a diverse supply of reliable, affordable and environmentally sound energy by providing for reliable delivery of energy, guarding against energy emergencies, exploring advanced technologies that make a fundamental improvement in our mix of energy options, and improving energy efficiency.

DEMP contributes to the FEMP goal which contributes to General Goal 4 in the "goal cascade":

Program Goal 04.13.00.00: FEMP. The Federal Energy Management Program's goal is to provide the efficiency and renewable energy-related technical assistance that Federal agencies need to lead the Nation by example through government's own actions, by reducing energy intensity in Federal buildings by 35 percent by 2010 (relative to the 1985 statutory baseline level of 138,610 Btus per gross square foot).

Contribution to Program Goal 04.13.00.00 (DEMP)

To lead other Federal agencies by its example, DEMP has a higher goal for DOE than the overall FEMP goal for all Federal agencies. The Departmental Energy Management Program's goal is to reduce the energy intensity in standard buildings by 45 percent by 2010 (using 1985 as a baseline) by funding energy efficiency projects and providing technical assistance to Departmental facilities. [DOE Order 430.2A].

DOE has already achieved its 2010 goal in 2003. The baseline (1985) energy intensity in standard buildings was 473,126 Btu per square foot, whereas the energy intensity in 2003 was 236,680 Btu per square foot, showing a 50 percent reduction in energy intensity in that time period. DEMP has established a new goal of reducing the energy intensity each year by 1 percent per year using FY 2003 as a baseline. Thus, by 2010, DOE will reduce its energy intensity by 7 percent as compared to the FY 2003 baseline. In addition, the retrofit projects at Federal facilities that DEMP funds will provide the required dollar savings to achieve a 20 percent return on the investment of the DEMP funding.

DEMP helps DOE site personnel reduce energy use and increase energy and water use efficiency at DOE facilities. This in-house program also works with designated site energy managers who are responsible for achieving energy management requirements and guides the ranking of retrofit projects. With improved energy management at DOE facilities, DOE can better manage its energy loads during both normal and emergency periods to the benefit of local authorities in the event of local energy supply constraints or emergencies.

Annual Performance Results and Targets

FY 2001 Results	FY 2002 Results	FY 2003 Results	FY 2004 Results	FY 2005 Targets	FY 2006 Targets
Program Goal 04.13.00.00 (DEMP)					
Departmental Energy Management Program					
		Complete the selection process for between 4 and 12 energy projects that will reduce the annual energy use in DOE facilities by 15 billion Btus. [MET]	Complete the selection for funding of 4 to13 energy efficiency projects through a competitive selection process that chooses those projects with the greatest return on investment. [MET]	Complete the selection for funding of 4 to13 energy efficiency projects through a competitive selection process that chooses those projects with the greatest return on investment.	Complete the selection for funding of energy retrofit projects that will provide the required dollar savings to achieve a 20 percent return on the investment of the DEMP funding. These projects will save over 12 billion Btus per year.
			Contributed proportionately to EERE's corporate goal of reducing corporate and program uncosteds to a range of 20-25 percent by reducing program annual uncosteds by 10 percent in 2004 relative to the program uncosted baseline (in 2003) until the target range is met.	*Contribute proportionately to EERE's corporate goal of reducing corporate and program adjusted uncosted obligated balances to a range of 20-25 percent by reducing program annual adjusted uncosteds by 10 percent in 2005 relative to the FEMP/DEMP Program FY 2004 end of year adjusted uncosted baseline ($11,266K) until the target range is met.*	*Contribute proportionately to EERE's corporate goal of reducing corporate and program adjusted uncosteds to a range of 20-25 percent by reducing program annual uncosteds by 10 percent in 2006 relative to the program uncosted baseline (2005) until the target range is met.* *Maintain total Program Direction costs in relation to total Program costs in the range of 8% - 12% to demonstrate efficient and effective EERE-wide business and technical support to mission direct programs.*

Means and Strategies

DEMP will use various means and strategies to achieve its program goals as described below. “Means” include operational processes, resources, information, and the development of technologies, and “strategies” include program, policy, management and legislative initiatives and approaches. Various external factors, as listed below, may impact the ability to achieve the program’s goals. Collaborations are integral to the success of the planned investments, means and strategies, and to addressing external factors.

DEMP will implement the following means:

- Conduct an annual call for projects among DOE sites and fund projects that support achievement of the goal;
- Provide funds or use private sector investments, if authorized, in energy efficiency technologies; and
- Analyze opportunities for energy management improvements and conservation measures at selected DOE facilities.

DEMP will implement the following strategies:

- Use of leveraged cost sharing (including private sector, if authorized, and/or other expense funded activities such as General Plant Project activities) at DOE sites.

These strategies will result in significant cost savings and a significant reduction in energy use while also achieving a 20 percent return on investment on the DEMP funding for retrofit projects. The following external factors could affect DEMP’s ability to achieve its strategic goal:

- Mission changes at DOE sites that would change building usage; and
- Availability of energy management personnel at DOE sites.

In carrying out the program’s mission, DEMP performs the following collaborative activities:

- Coordinates the review of alternative financing proposals from DOE sites with the appropriate DOE program offices;
- In cooperation with each DOE program office, DEMP establishes a performance agreement for the DOE organization, setting energy intensity reduction goals required under DOE 430.2A; and
- Collaborates with DOE sites regarding model programs to ensure that achievements in model programs can be replicated at other facilities.

Validation and Verification

To validate and verify program performance, DEMP will conduct internal and external reviews and audits. These programmatic activities are subject to continuing review by, for example, the Congress, the General Accounting Office, the Department's Inspector General, the U.S. Environmental Protection Agency, and state environmental agencies. The table below summarizes validation and verification activities.

Data Sources:	DOE facilities submit annual reports documenting energy use, cost, gross square footage, and exempt facilities. The reports are supplemented by FEMP's tracking and reporting and are submitted each year to Congress.
Baselines:	Baseline for Executive Order Goal: Federal energy management goals are measured from 1985 [473,126 Btu/ft^2] for standard buildings and 1990 [398,238 Btu/unit] levels for energy intensive buildings. Goals are expressed in BTU per gross square foot and are not normalized for other factors. Baseline for Additional Goal: The FY 2006 goal is measured from a baseline energy intensity at DOE buildings in FY 2003 [236,680 Btu per square foot].
Frequency:	Annual.
Evaluation:	In carrying out the program's mission, the Departmental Energy Management Program use several forms of evaluation to assess progress and to promote program improvement. ▪ Technology validation and operational field measurement, as appropriate ▪ Peer review by independent outside experts of both the program and subprogram portfolios ▪ Specialized program evaluation studies to examine process, impacts, or market baseline and effects, as appropriate ▪ Quarterly and annual assessment of program and management results based performance through Joule (the DOE quarterly performance progress review of budget targets), R&DIC (annual internal review of performance planning and management of R&D programs against specific criteria), PMA (the Presidents Management Agenda -- annual departmental and PSO based goals whose milestones are planned, reported and reviewed quarterly) and PART (common government wide program/OMB reviews of management and results). ▪ Annual review of methods, and recomputation of benefits for the Government Performance and Results Act (GPRA).
Data Storage:	DEMP maintains a database of reported information.
Verification:	External review is conducted annually. Reporting anomalies are identified and resolved during the annual reporting cycle.

Funding by General and Program Goal

	(dollars in thousands)		
	FY 2004	FY 2005	FY 2006
General Goal 4, Energy Security			
Program Goal 04.03.00.00, DEMP			
Energy Management Project Support	1,472	1,455	1,506
Energy Management Model Program Development	491	466	513
Total, Program Goal 04.03.00.00, DEMP	1,963	1,921	2,019
All Other			
National Center on Energy Management and Building Technologies	0	30	0
Total, General Goal 4 (DEMP)	1,963	1,951	2,019

Expected Program Outcomes

DEMP pursues its mission through integrated activities designed to improve the energy efficiency of the Department of Energy. We expect these improvements to reduce the energy intensity of DOE buildings, reduce the susceptibility of DOE sites to energy price fluctuations and to lower their energy bills; reduce EPA criteria and other pollutants in the cities where agency operations are located; and enhance energy security by increasing the flexibility of local energy demand.

Estimates of annual non-renewable energy savings, energy expenditure savings, and carbon emission reductions that result from the realization of FEMP's goals are shown in the table below through 2025. These estimates are for FEMP as a whole which includes the savings from all Federal agencies including the savings for the Department of Energy. DEMP's benefits are not broken out separately.

The assumptions and methods underlying the modeling efforts have significant impact on the estimated benefits, and results could vary significantly if external factors, such as future energy prices, differ from the "baseline case" assumed for this analysis. EERE's baseline case is essentially the same as the EIA "business-as-usual" case presented in its Annual Energy Outlook. In addition, possible changes in public policy and disruptions in the energy system which may affect estimated benefits are not modeled. The external factors such as unexpected changes in competing technology costs, identified in the Means and Strategies section above, could also affect the Program's ability to achieve its goals. Also note that the modeling long term benefits assumes that funding levels will be consistent with the President's commitment and assumptions in the 2006 Budget, and that funding will be applied to the core program. If the pattern of substantial congressionally directed projects persists over several years, the GPRA benefits estimates will need to be reduced.

The table below provides a useful picture of the potential change in national benefits over time if the technology, infrastructure and markets evolve as expected. Estimated benefits which follow assume that individual technology plans and market assumptions obtain. Final documentation is estimated to be completed and posted by March 31, 2005. Uncertainties are larger for longer term estimates. A summary of the methods, assumptions, and models used in developing these benefit estimates that are important for understanding these results are provided at www.eere.energy.gov/office_eere/budget_gpra.html.

FY 2006 GPRA Benefits Estimates for FEMP[a]

Mid-term benefits[b]	2010	2015	2020	2025
Primary Non-Renewable Energy Savings (Quads)	0.03	0.04	0.05	0.06
Energy Expenditure Savings (Billion 2001$)	0.2	0.3	0.4	0.5
Carbon Emission Reductions (MMTCE)	1	1	1	1

In addition to the benefits quantified here, improved Federal energy management increases the ability of the Federal Government to manage its energy loads during emergencies and facilitates coordination of Federal energy use with local authorities in the event of local energy supply constraints or emergencies. By helping large Federal facilities quickly reduce their peak demand, FEMP benefited California and other western States during past electricity shortages.

[a] Benefits reported are annual, not cumulative, for the year given. Estimates reflect the benefits that may be possible if all of the program's technical targets are met and funding continues at levels consistent with assumptions in the FY 2006 Budget.
[b] Mid-term program benefits were estimated utilizing the GPRA06-NEMS model, based on the Energy Information Administration's (EIA) National Energy Modeling System (NEMS) and utilizing the EIA's Annual Energy Outlook (AEO) 2004 Reference Case.

Energy Management Project Support

Funding Schedule by Activity

(dollars in thousands)

	FY 2004	FY 2005	FY 2006	$ Change	% Change
Energy Management Project Support	1,472	1,455	1,506	+51	+3.5%
Total, Energy Management Project Support	1,472	1,455	1,506	+51	+3.5%

Description

DEMP's Energy Management Project Support involves direct funding for energy retrofit projects and new energy technologies at DOE facilities. Project proposals are evaluated based on cost-effectiveness, energy savings, and return-on-investment. DEMP provides support through direct funding and leveraged cost sharing at various DOE facilities for energy projects to increase the energy efficiency of DOE facilities and reduce future utility and maintenance costs.

Benefits

DEMP supports the mission of the Office of Energy Efficiency and Renewable Energy by improving the energy efficiency and productivity of DOE buildings. DEMP supports DOE's goals by protecting our national and economic security by promoting a diverse supply of reliable, affordable, and environmentally sound energy to DOE facilities. It is expected that these activities will provide the required dollar savings to achieve a 20 percent return on the investment of DEMP's Project Support funding, based on the performance of DEMP projects previously funded. In FY 2004, the return on investment for all of DEMP's Project Support funding was approximately 24 percent.

DEMP Projects Using FY 2004 Funding

Site	Project	DEMP Funding ($K)	Cost Sharing ($K)	Simple Payback[a] (years)
Argonne National Laboratory (ANL)	Improve Auxiliaries Efficiency	$410.0	0	3.9
ANL	Upgrade Lighting	$100.0	40	4.0
Brookhaven National Laboratory (BNL)	Variable Frequency Drives for Main Magnet	$75.0	0	3.5
BNL	Free Cooling	$377.0	0	4.8
Fermi National Accelerator Laboratory (Fermi)	Natural Gas Retrofit	$11.1	10.3	4.0

[a] Projects with a simple payback of less than 5 years will have a return on investment of 20 percent or greater.

Site	Project	DEMP Funding ($K)	Cost Sharing ($K)	Simple Payback[a] (years)
Idaho National Engineering and Environmental Laboratory (INEEL)	Heating, Ventilating and Air Conditioning Retrofit Project	$94.4	0	4.0
INEEL	Lighting Retrofit Project	$158.4	445.9	4.0
INEEL	Air Compressor Replacement	$12.0	0	3.1
Stanford Linear Accelerator Center (SLAC)	Lighting Controls	$48.6	28.7	4.0
Lawrence Livermore National Laboratory (LLNL)	Retrofit of Variable Frequency Drives and Direct Digital Controls	$70.1	30	4.0
Lawrence Livermore National Laboratory (LLNL)	Heating, Venting and Air Conditioning Controls. (FY 2004 funding to project chosen in FY 2003)	129.0	73	4.0
Total		$1,485.60[a]	627.9	n/a

Detailed Justification

	(dollars in thousands)		
	FY 2004	FY 2005	FY 2006
Energy Management Project Support	**1,472**	**1,455**	**1,506**

DEMP will provide support through direct funding and leveraged cost-sharing at various DOE facilities for energy projects to increase the energy efficiency of DOE facilities and reduce future utility and maintenance costs. Leveraged cost sharing includes funding from the private sector and/or other DOE expenses funded activities at DOE sites. Funding will be provided to multiple projects which are identified through a DOE wide competition and selected to both maximize return on investment and demonstrate leadership in implementing emerging energy savings technologies. Performance will be measured by the following: achieving a 20 percent per dollar return on investment on DEMP funding and an annual savings of 12 billion Btu.

Program support will also be provided for technical analysis undertaken to address the inputs used for planning, reporting and evaluation of DEMP activities.

Total, Energy Management Project Support	**1,472**	**1,455**	**1,506**

[a] This total ($1,485.6K) represents the amount of FY 2004 funding that was provided to Energy Management Project Support projects in FY 2004. A total of $477K of FY 2004 funding was provided for activities in the Energy Management Model Program. Combining both the Project Support and Model Program funding yields a grand total of $1,963K of DEMP FY 2004 spending.

Explanation of Funding Changes

	FY 2006 vs. FY 2005 ($000)
Energy Management Project Support	
The increase will be used to fund at least one additional energy retrofit project to assist the Department of Energy in meeting its goal of reducing energy intensity in buildings	+51
Total Funding Change, Energy Management Project Support	**+51**

Energy Management Model Program Development

Funding Schedule by Activity

	(dollars in thousands)				
	FY 2004	FY 2005	FY 2006	$ Change	% Change
Energy Management Model Program Development					
Energy Management Model Program Development	491	466	513	+47	+10.1%
Congressionally Directed Activity, National Center for Energy Management and Building Technologies	0	30	0	-30	-100.0%
Total, Energy Management Model Program Development	491	496	513	+17	+3.4%

Description

The Energy Management Model Program Development involves a comprehensive approach to making energy improvements at DOE facilities by providing direct funding for the implementation of "best practices." Model programs have included such activities as sustainable building design, the acquisition of ENERGY STAR® Labels for buildings, building re-commissioning, and energy consumption reductions in excess buildings.

Benefits

The Energy Management Model Program Development supports the mission of the Office of Energy Efficiency and Renewable Energy by improving the energy efficiency and productivity of DOE buildings. This program supports DOE's goal of achieving a reliable, affordable, and environmentally sound energy supply at DOE's facilities.

Detailed Justification

	(dollars in thousands)		
	FY 2004	FY 2005	FY 2006
Energy Management Model Program Development	**491**	**466**	**513**

A solicitation for projects will be sent to DOE facilities with set criteria for ranking projects. DOE sites can request DEMP funding under Model Programs to accomplish the following in DOE owned buildings: to accelerate the implementation of the Executive Order 13123; to evaluate new

	(dollars in thousands)		
	FY 2004	FY 2005	FY 2006

approaches for reducing energy; to expand the use of private sector financing for saving energy; and to identify future cost effective energy efficiency retrofit projects. Between 10 to 15 activities will likely be selected, depending upon the cost of the activities. Most of the initiatives will be completed within one year of funding.

In past years, successful Model Program activities included sustainable building design and the achievement of the Energy Star designation for DOE buildings.

Performance will be measured by the following: acquiring ENERGY STAR® labels for two office buildings; and acquiring the minimum level Leadership in Energy and Environmental Design Building (LEED) Certification for one new sustainable building design.

Program support will also be provided for technical analysis undertaken to address the inputs used for planning, reporting and evaluation of DEMP activities.

Congressionally Directed Activity, National Center for Energy Management and Building Technologies	**0**	**30**	**0**

Activities funded under this Congressionally-directed project were to address HVAC research needs and improve the efficiency, productivity, and security of the U.S. building stock by developing and disseminating synergistic and complementary solutions to energy management, indoor environment quality, and security concerns in new and existing buildings.

Total, Energy Management Model Program Development	**491**	**496**	**513**

Explanation of Funding Changes

	FY 2005 vs. FY 2006 ($000)
Energy Management Model Program Development	
No significant change	+47
National Center for Energy Management and Building Technologies	
Funds redirected toward purposes supporting the program goal.....................................	-30
Total Funding Change, Energy Management Model Program Development	**+17**

Renewable Program Support

Funding Profile by Subprogram

(dollars in thousands)

	FY 2004 Comparable Appropriation	FY 2005 Original Appropriation	FY 2005 Adjustments	FY 2005 Comparable Appropriation	FY 2006 Request
Renewable Program Support					
Cross-cutting Planning Analysis and Evaluation	3,574	0	+2,977[a]	2,977	2,901
Congressionally Directed Activities	4,919	3,000	-23[b]	2,977	0
Total, Renewable Program Support	8,493	3,000	+2,954	5,954	2,901

Public Law Authorizations:

P.L. 95-91, "Department of Energy Organization Act" (1977)

Mission

Beginning in FY 2006, funding is requested to support activities previously conducted via support from individual technology programs, activities funded under Planning, Analysis, and Evaluation (PAE). PAE will collect, analyze, and integrate economic, market, and technology characterization data and develop cross-cutting technological and economic models and forecasts, providing the analytic basis for strategic planning, benefits estimation, and corporate portfolio analysis. (Previously, these activities were conducted via support from individual technology programs.) In addition, PAE funds development of enhanced planning, analytical, and evaluation methodologies and tools. In support of the Government Performance and Results Act (GPRA) and EERE's own strategic planning, PAE assesses the market and economic impact EERE's energy-efficiency and renewable energy technology portfolio might have, and the potential energy, economic, environmental, and social benefits that would result.

Provide for three Congressionally directed efforts: 1) support the National Renewable Energy Laboratory (NREL) to develop renewable energy resources uniquely suited to the Southwestern United States through its virtual site office in Nevada; 2) funding for the Energy Center of Wisconsin Renewable Fuels Project; and 3) support for the Lead Animal Shelter Animal Campus renewable energy demonstration project.

[a] Reflects an increase of $2,977 comparability adjustment from programs for Cross-cutting Planning, Analysis and Evaluation.
[b] Reflects the 0.80% rescission of -$23,000.

Cross-cutting Planning, Analysis and Evaluation

Funding Schedule by Activity

(dollars in thousands)

	FY 2004	FY 2005	FY 2006	$ Change	% Change
Cross-cutting Planning, Analysis and Evaluation..	3,574	2,977	2,901	-76	-2.6%
Total, Planning Analysis and Evaluation...............	3,574	2,977	2,901	-76	-2.6%

Description

Previously conducted via support from individual technology programs, activities funded under Planning, Analysis, and Evaluation (PAE) collect, analyze, and integrate economic, market, and technology characterization data and develop cross-cutting technological and economic models and forecasts, providing the analytic basis for strategic planning, benefits estimation, and corporate portfolio analysis. In addition, PAE funds development of enhanced planning, analytical, and evaluation methodologies and tools. In support of the Government Performance and Results Act (GPRA) and EERE's own strategic planning, PAE assesses the market and economic impact EERE's energy-efficiency and renewable energy technology portfolio might have, and the potential energy, economic, environmental, and social benefits that would result.

Both renewable and efficiency technologies have broad impacts across energy markets. Because of these market interactions, it is necessary to analyze the impacts of EERE (both EWD and Interior programs) investments in the context of EERE's overall portfolio and both energy supply and demand markets. For example, improvements in building efficiency will reduce the demand for electricity, and, as a result, affect the market for wind energy. Likewise, improvements in wind technologies will reduce the demand for natural gas in electricity markets, making additional natural gas available for use in industrial cogeneration or hydrogen production. The integrated approach used by EERE to analyze program market impacts provides the context necessary to ensure that these interactions are taken into account; improves consistency in assessing technology choices; provides a more realistic picture of impacts and helps to better understand synergies across EERE's portfolio. EERE is also working with other applied R&D programs to improve consistency in the methods and assumptions used to estimate benefits. The aim is to improve comparability to inform budget decisions across the Department’s energy technology portfolio.

These analyses are essential input for decision makers for their effective, results based program planning, prioritization, and management of robust program pathways that lead to the achievement of EERE goals in the most cost effective manner. A solid analytical foundation is basic to understanding the potential for increasing the penetration of energy efficient and renewable energy technologies, and for achieving the correct balance and direction of programmatic activities. These analyses and evaluation activities are required to ensure continued program alignment with the goals of the National Energy Policy (NEP) and the President's Management Agenda, and to properly explain the budgets and benefits of EERE's programs.

EERE consistently invests in maintaining strong capabilities in data analysis and model development to ensure that decisions regarding program direction and resource allocation are guided by the best possible information. Analytical capabilities and supporting databases are continually refined and strengthened to improve the information available for program guidance decisions and to better evaluate the energy, economic, and environmental impacts of programmatic alternatives. An FY06-11 Office of Planning, Budget, and Analysis (PBA) multiyear plan is under development to improve EERE's evaluation, planning, and analytical capabilities. PBA is building upon the benefits framework developed by the National Research Council (NRC), which relates different types of program benefits to various potential future energy needs, as one of the organizing principles for EERE's analytical agenda.

Detailed Justification

	(dollars in thousands)		
	FY 2004	FY 2005	FY 2006
Cross-cutting Planning, Analysis and Evaluation	**3,574**	**2,977**	**2,901**

EERE-wide Planning, Analysis and Evaluation (PA&E) activities provide a unified approach toward planning, budget formulation, and evaluation at both the individual program and corporate levels. These PA&E activities include the development and use of both programmatic and external economic, market, and technology characterization data to develop cross-cutting technological and economic models and forecasts, providing the analytic basis for strategic planning, benefits estimation, and portfolio analysis at the program and corporate level. This provides EERE with the capability of meeting the analysis and reporting requirements of the Government Performance and Results Act (GPRA); the President's Management Agenda (PMA); OMB's Program Assessment and Rating Tool (PART), and R&D Investment Criteria (RDIC); and EERE's own strategic planning in a consistent way across programs.

Activities include development of enhanced planning, analytical, and evaluation methodologies and tools; benefits analyses based upon the program and the integrated EERE portfolio; and the potential energy, economic, environmental, and social benefits that would result. These benefit estimates provide a consistent representation of the benefits likely to result from the budget request. EERE is also working with other applied R&D programs to improve consistency in the methods and assumptions used to estimate benefits. The aim is to improve comparability to inform budget decisions across the Department's energy technology portfolio.

In addition, the development and use of a portfolio approach helps align program and corporate investments with energy policies, needs, and uncertainties. The crosscutting PA&E activity also develops program performance and evaluation tools and methods that support the program in the corporate context and are routinely used to manage both program and corporate priorities. In the past, these activities have been supported by contributions from within program budget lines. In FY 2006 these investments in corporate analysis and portfolio decision-making are broken out under this heading to clearly identify the PAE costs.

Total, Cross-cutting Planning, Analysis and Evaluation.	**3,574**	**2,977**	**2,901**

Explanation of Funding Changes

	FY 2006 vs. FY 2005 ($000)
Cross-cutting Planning, Analysis and Evaluation	
Decrease is the result of a modest reduction in workload due to the elimination of the Hydropower Program..	-76
Total Funding Change, Cross-cutting Planning, Analysis and Evaluation	-76

Congressionally Directed Activities

Funding Schedule by Activity

(dollars in thousands)	FY 2004	FY 2005	FY 2006	$ Change	% Change
Congressionally Directed Activities					
Congressionally Directed Activity, Southwestern Multi-Programs Virtual Site Office in Nevada..	3,925	2,977	0	-2,977	-100.0%
Congressionally Directed Activity, Energy Center of Wisconsin Renewable Fuels Project......	746	0	0	0	0.0%
Congressionally Directed Activity, Lead Animal Shelter Animal Campus Renewable Energy Demonstration Project...............................	248	0	0	0	0.0%
Total, Congressionally Directed Activities.................	4,919	2,977	0	-2,977	-100.0%

Description

Continued Congressionally directed efforts of the National Renewable Energy Laboratory (NREL) to develop renewable energy resources uniquely suited to the Southwestern United States, through its virtual site office in Nevada. Additionally, this provided for Congressionally directed projects (from the Consolidated Appropriations Act 2004) for the Energy Center of Wisconsin Renewable Fuels Project and the Lead Animal Shelter Animal Campus renewable energy demonstration project.

Detailed Justification

(dollars in thousands)	FY 2004	FY 2005	FY 2006
Congressionally Directed Activities			
▪ **Congressionally Directed Activity, Southwestern Multi-Programs Virtual Site Office in Nevada**...........	**3,925**	**2,977**	**0**

Through support of the National Renewable Energy Laboratory (NREL) virtual site office in Nevada, assisted in the development of renewable energy resources uniquely suited to the Southwestern United States. Funding was reallocated in the FY 2006 Budget Request to support higher priorities within the EERE portfolio that will contribute to the achievement of technology program goals and portfolio results.

	(dollars in thousands)		
	FY 2004	FY 2005	FY 2006
▪ **Congressionally Directed Activity, Energy Center of Wisconsin Renewable Fuels Project**	**746**	**0**	**0**

Congressionally-directed funding for the Energy Center of Wisconsin Renewable Fuels Project, as provided for within the Consolidated Appropriations Act of 2004. Funding was reallocated in the FY 2005 Budget Request to support higher priorities within the EERE portfolio that will contribute to the achievement of technology program goals and portfolio results.

	FY 2004	FY 2005	FY 2006
▪ **Congressionally Directed Activity, Lead Animal Shelter Animal Campus Renewable Energy Demonstration Project**	**248**	**0**	**0**

Congressionally-directed funding for the Lead Animal Shelter Animal Campus Renewable Energy Demonstration Project, as provided for within the Consolidated Appropriations Act of 2004. Funding was reallocated in the FY 2005 Budget Request to support higher priorities within the EERE portfolio that will contribute to the achievement of technology program goals and portfolio results.

	FY 2004	FY 2005	FY 2006
Total, Congressionally Directed Activities	**4,919**	**2,977**	**0**

Explanation of Funding Changes

	FY 2006 vs. FY 2005 ($000)
Congressionally Directed Activity, Southwestern Multi-programs Virtual Site Office in Nevada	
Funding reallocated to support higher priorities within the EERE portfolio of technology programs	-2,977
Total Funding Change, Congressionally Directed Activities	**-2,977**

Facilities and Infrastructure

Funding Profile by Subprogram

(dollars in thousands)

	FY 2004 Comparable Appropriation	FY 2005 Original Appropriation	FY 2005 Adjustments	FY 2005 Comparable Appropriation	FY 2006 Request
Facilities and Infrastructure					
National Renewable Energy Laboratory	12,950	11,480	-91[a]	11,389	16,315
Total, Facilities and Infrastructure	12,950	11,480	-91	11,389	16,315

Public Law Authorizations:

P.L. 95-91, Department of Energy Organization Act (1977)

Mission

This Facilities and Infrastructure budget funds capital investments to support a vibrant world-class research and development program at major participant DOE laboratory sites. Included are funding requests for projects and equipment that are of general benefit to all research activities at the National Renewable Energy Laboratory (NREL).

Benefits

The National Renewable Energy Laboratory is a central part of Energy Efficiency and Renewable Energy's (EERE) programs. It provides in-house research, user facilities, and analysis for the Solar, Wind, Geothermal, Biomass, and Hydrogen Programs within the Energy Supply budget, and in some instances manages external R&D contracts and grants. It also performs the same function for the Vehicles, Fuel Cells, Buildings, and Distributed Energy Programs in the Energy Conservation budget, and supports high temperature superconductivity research in the Office of Electricity Transmission and Distribution. NREL is home to 1,100 researchers, engineers, analysts, and administrative staff, plus visiting professionals, graduate students, and interns on a 632-acre split campus in Golden, Colorado, occupying 289,000 square feet in 4 large research buildings (with another to set to begin construction), a dozen or so smaller facilities totaling about 80,000 square feet, and 296,000 square feet of research and administrative leased space in neighboring office buildings.

Maintaining state-of-the-art research facilities at NREL permits the EERE programs to advance the basic materials technologies, biosciences, aerodynamics, systems analysis, and structural engineering that underpin the advancements made by our R&D programs. This concentration of expertise also makes NREL a central player in EERE's deployment efforts.

[a] Reflects the 0.80% rescission of -$91,000.

National Renewable Energy Laboratory

Funding Schedule by Activity

(dollars in thousands)

	FY 2004	FY 2005	FY 2006	$ Change	% Change
National Renewable Energy Laboratory					
Operations and Maintenance	9,025	4,762	5,800	+1,038	+21.8%
Construction 02-NREL-001	3,925	6,627	10,515	+3,888	+58.7%
Total, National Renewable Energy Laboratory	12,950	11,389	16,315	+4,926	+43.3%

Description

Within Operations and Maintenance, Plant and Capital Equipment (P&CE) funds serve to address: (1) upgrades and capital replacements in NREL's facilities, such as roof and road upgrades and replacements; (2) small new facility needs; and (3) the ability to provide better operational efficiencies and maintain first-rate lab and user-facility capabilities by replacing general use laboratory and administrative equipment. The increase in P&CE funding will help reduce a current backlog of deferred equipment replacements and upgrades.

Funding to begin construction of the 71,000 square foot Science and Technology Facility was provided in FY 2004, and funds to complete the construction are included for FY 2006.

Detailed Justification

(dollars in thousands)

	FY 2004	FY 2005	FY 2006
Operations and Maintenance	**9,025**	**4,762**	**5,800**

These funds provide for general infrastructure upgrades and facility system replacements that address NREL's general facility and equipment capital needs. This does not include technology-specific capital equipment funded by individual program budgets. The funding provides for facility upgrades and small construction projects that improve or enhance general use facilities and general use research and support equipment replacement.

	FY 2004	FY 2005	FY 2006
▪ **Plant and Capital Equipment**	**4,120**	**3,770**	**5,800**
• **Plant Projects**	**2,060**	**2,482**	**3,828**

	(dollars in thousands)		
	FY 2004	FY 2005	FY 2006

The Plant Projects request supports annual investments to renovate and extend the capabilities of the buildings and infrastructure already in place at NREL sites. These projects apply to both the South Table Mountain (STM) and National Wind Technology Center (20 miles away) locations in Golden, CO. Projects may include safety and security improvements; replacements of roofs and other building components; upgrades to utilities and heating ventilation and air conditioning systems; energy efficiency improvements; reconfigurations of existing buildings to accommodate changes or growth in R&D programs or research support needs; upgrades of site-wide utility systems, telecommunications and computer networks; road and parking improvements; and walkways, landscaping, water management, water treatment, and other site improvements to enhance the sustainability, cohesiveness, and pedestrian nature of the site.

• **Capital Equipment**	**2,060**	**1,288**	**1,972**

NREL's current capital portfolio is currently more than 60 percent depreciated. The increase proposed for FY 2006 will begin to work off some of the backlog of replacements that are needed, and will allow EERE to move toward a more desirable replacement rate. EERE is developing a recapitalization strategy to determine the optimal rate of reinvestment for future years.

This equipment includes upgrades, replacements, and additions to NREL's information technology systems and NREL's multi-program scientific instrumentation, to replace equipment that is no longer reliable or serviceable, to meet changing research needs, and to keep these instruments near state-of-the-art in capability.

▪ **Congressionally Directed Activity, National Center for Energy Management and Building Technologies**	**4,905**	**992**	**0**

Activities funded under this Congressionally-directed project were to address HVAC research needs and improve the efficiency, productivity, and security of the U.S. building stock by developing and disseminating synergistic and complementary solutions to energy management, indoor environment quality, and security concerns in new and existing buildings.

Construction: NREL Science and Technology Facility	**3,925**	**6,627**	**10,515**

	(dollars in thousands)	
FY 2004	FY 2005	FY 2006

FY 2006 funding concludes construction of the Science and Technology Facility (S&TF) at NREL, which began in FY 2004. The S&TF will allow the NREL Photovoltaics Program and other activities to address complex processing and system manufacturing problems that are common to all thin-film and nanostructure energy technologies and that are beyond the capability of the industry to solve. The lab will institute a transformational research approach that will lower manufacturing costs and reduce time-to-market of next-generation thin-film and nanostructure technologies.

The S&TF will provide nine advanced material synthesis and general support laboratories, a unique process development and integration laboratory, and office space for 55 researchers. The S&TF has been designed to be a showcase facility for energy savings and sustainability in an R&D laboratory, with a goal of achieving a "Gold" LEED rating, and will be designed and built to incorporate all ES&H requirements for the intended research activities. The S&TF will be linked with the existing Solar Energy Research Facility.

The FY 2006 funding request represents a $1.5 million increase in the Total Estimated Cost (TEC) of the project. Significantly higher building construction escalation than was originally estimated has occurred in the past year due to market conditions accelerating construction material (metals, cement, wood, plastics, etc.) costs.

	FY 2004	FY 2005	FY 2006
Total, National Renewable Energy Laboratory	**12,950**	**11,389**	**16,315**

Explanation of Funding Changes

	FY 2006 vs. FY 2005 ($000)
Operations and Maintenance	
▪ **Plant and Capital Equipment**	
Provide for maintenance, renovations, and upgrades (ex. Security, HVAC, etc.) to the buildings and infrastructure at NREL (+$1.356M); increase the pace of addressing the backlog in general capital equipment (+$0.682M).	+2,030
▪ **National Center on Energy Management and Building Technologies**	
Funding for this congressionally-directed activity is not requested in FY 2006	-992
Total, Operations and Maintenance	**+1,038**
Construction, 02-NREL-001	
Complete construction according to current schedule and revised TEC	+3,888
Total Funding Change, National Renewable Energy Laboratory..............................	**+4,926**

02-NREL-001, Science and Technology Facility, National Renewable Energy Laboratory, Golden, Colorado

Significant Changes

The Current Estimate of Total Estimated Cost (TEC) shown here is $1.5 million higher than the Previous Estimate. This reflects the top-ranked offeror's construction proposal and actual FY 2004 construction market inflation of 8.7 percent, which is well above the 2.5 percent for FY 2004 and 2.9 percent for FY 2005 that were used in the Previous Estimate. These cost escalators increased the projected total execution costs (see section 4) by $2.3 million, and the design phase cost $100K more than the Previous Estimate. However with the design phase complete and the top-ranked, firm fixed-price construction proposal in hand, the contingencies were reduced by $900K. The result is a net increase in TEC of $1.5 million

The basis of the Previous Estimate was the final design estimate, which was reviewed and deemed reasonable at that time by an independent Architect-Engineering firm and by the External Independent Review (EIR) prior to Critical Decision (CD) 2 approval.

1. Construction Schedule History

	Fiscal Quarter				Total Estimated Cost ($000)	Total Project Cost ($000)
	A-E Work Initiated	A-E Work Completed	Physical Construction Start	Physical Construction Complete		
FY 02 Budget Request (*A+E and technical design only*) ...	1Q 2002	4Q 2002	--	--	800	1,195
FY 03 Budget Request *(A+E and technical design only)*....	1Q 2002	3Q 2003	--	--	1,600	2,020
FY 04 Budget Request	No Construction Data Sheet was included in the FY 2004 Budget.					
FY 05 Budget Request (*Performance Baseline*)	1Q 2002	4Q 2003	4Q 2004	4Q 2006	21,190	28,386
FY 06 Budget Request *(Revised Performance Baseline)*..................	1Q 2002	4Q 2003	1Q 2005	1Q 2007	22,690	29,886

2. Financial Schedule

(dollars in thousands)

	Appropriations	Obligations	Costs
Design and Construction			
FY 2002.......................	800	800	272
FY 2003.......................	770	770	1,226
FY 2004.......................	3,925	3,925	207
FY 2005.......................	6,627	6,627	9,611
FY 2006.......................	10,515	10,515	11,323
FY 2007.......................	53	53	51
Total....................................	22,690	22,690	22,690

3. Project Description, Justification and Scope

This project provides for the design, engineering and construction of a new facility for the National Renewable Energy Laboratory (NREL) in Golden, Colorado. This is the third inclusion of the capital construction budget request for this project, the Science and Technology Facility (S&TF).

The Science and Technology Facility, as designed, is a 71,000 sf. two story building with a third story mechanical penthouse. The laboratory block is 300 ft. long and varies between 60 ft. and 115 ft. wide on the two floors with a ceiling height of 18 ft. The office block is 165 ft. long and 75 ft. feet wide with a sloping roof structure that is 14 ft. tall at its highest point. The laboratories are constructed using structural concrete slabs with steel framing and are designed for H-5 (International Building Code - Semiconductor Fabrication Facilities Using Hazardous Production Materials) occupancy due to the use of hazardous production materials (HPM). The office section is constructed using slab-on-grade concrete floors with structural steel framing. The ventilation system for the laboratories is a variable air volume single pass system. The laboratories are similar in use to semiconductor fabrication facilities and have HPM and specialty gases distributed throughout with a toxic gas monitoring system. The facility has complete fire detection and suppression systems including standpipe configurations. The facility will be fully commissioned as a prerequisite for U.S. Green Building Council LEED™ certification. The LEED™ goal for the building is certification at the Gold level. (Gold certification is the second highest out of 4 possible certifications for new commercial construction, major renovations and high-rise residential buildings. Gold certification requires the attainment of 39 to 51 out of a possible 72 points for sustainable siting, energy and water efficiency, sustainable design in materials and resources, indoor environmental quality, and innovation.) Laboratory utility systems include compressed air, nitrogen, hydrogen, argon, and silane gas. Standard equipment for the facility includes office landscape furniture and laboratory casework and fume hoods.

Improvements to the land and utility connections for this project include roads, sidewalks, fire/potable water, sewer, electrical and natural gas utilities, and landscaping/water management. This project will also install equipment in the central plant of the existing Solar Energy Research Facility to support heating and cooling water requirements in the S&TF.

The purpose of the S&TF is to provide a facility to expand the research capabilities to help DOE to achieve its strategic goals, as outlined in the Department's Strategic Plan. The S&TF will do this by addressing complex processing and system manufacturing problems that are common to all hydrogen production and storage, fuel cells, advanced solid-state lighting, thin-film energy coatings/devices, electrochromics, photovoltaics, and related thin-film and nanostructure energy technologies. These processing and system manufacturing issues are beyond the capability of industry to economically resolve.

The expected results of constructing the S&TF include the following:

- The S&TF is designed to provide the capability to accelerate renewable energy technology advancement through performance-based R&D programs and public-private partnerships involving solar technologies, hydrogen technologies, fuel cell components, and distributed energy technologies.

- The research planned to be conducted in the S&TF will fill a critical knowledge gap that may help accelerate the introduction of new thin-film and nanostructure technologies and lower their cost.

- The S&TF will provide for a transformational research capability and approach that does not exist in the United States at this time. When fully outfitted and commissioned, the S&TF will combine process integration, diagnostics, and simulation with the fundamental and applied research and development that is currently conducted in the adjacent NREL Solar Energy Research Facility in ways that have not been done before.

- The S&TF has been designed to support the technology roadmaps and multiyear plans for photovoltaics, hydrogen, and buildings industries. In photovoltaics, for instance, the National Research Council has said, "The Solar Photovoltaics Program should give top priority to the development of sound manufacturing technologies for thin-film modules. Much more attention should be paid to moving the technology from the laboratory through integrated pilot-scale experiments to commercial-scale design." The Process Development and Integration Laboratory (PDIL) that the S&TF makes possible will directly address that concern.

- The research and development conducted in the S&TF will provide vital process information that is needed by U.S. industry in the highly competitive international marketplace. This will enable the United States to maintain a leadership position in the international marketplace for near-term and next-generation thin-film and nanostructure technologies.

- The S&TF is designed to promote energy efficiency by providing the facilities in support of the development of new advances in solid-state lighting, building-integrated photovoltaics, thin-film energy coatings/devices, electrochromic films for smart windows and related building technologies, and superconducting wires, tapes, and materials (NEP pp. 4-11, 4-12, 6-17, 7-17).

With the construction of the Science and Technology Facility at NREL and the process improvement knowledge that will be gained, EERE estimates that the time from laboratory to marketplace can be significantly shortened (from 25 percent to 65 percent) for these technologies. U.S. industry will have a totally new capability to aid them in competing in the international energy marketplace. The additional laboratory space and new capabilities of the Science and Technology Facility will greatly facilitate the successful accomplishment of DOE missions in photovoltaics, hydrogen, solar, buildings, solid-state lighting, thin-film energy coatings/devices, electrochromics, and nanotechnologies. The program impact is broad because the current Solar Energy Research Facility (SERF) at NREL, and the proposed S&TF, have been designed to be an integrated set of research facilities, enhancing the value from research currently conducted in the existing SERF. Achieving DOE goals for advancing renewable energy technologies based on thin-film and nanostructure technologies will require expanded laboratory facilities such as those in the STF, and the facility will help U.S. manufacturers to keep pace with foreign competitors in Japan and Europe.

Programmatic impacts include:

Solar. U.S. industry has clearly indicated that the capabilities of the unique Process Development and Integration Laboratory in the S&TF are critical for competing with foreign firms. European firms have now become aware of the value of this integrated process research approached and they have started prototype operations at their university partners to begin their own work. This facility also supports the fundamental work for next-generation PV products, which is also under threat from strong research investments in Germany and Japan. Timely construction of the Science and Technology Facility will provide U.S. research and industry with a competitive edge internationally.

Hydrogen. When the S&TF is constructed, hydrogen production research (photoelectrochemical and photovoltaic electrolysis) will gain valuable research space in the SERF, specially designed for toxic materials and explosive gases, to better conduct and expand hydrogen production research. Hydrogen storage research will also gain valuable space. The S&TF itself will also provide unique capabilities in engineering research for both hydrogen production and hydrogen storage technologies that cannot be done without the facility.

Buildings, Solid-State Lighting, Nanotechnologies. The S&TF will enable scale-up and process R&D on all thin-film technologies, including electrochromic films for smart windows, photovoltaic films integrated into architectural glass, and other thin-film technologies for the reduction of energy use in buildings; next generation solid-state lighting; nanostructure solar cells using quantum dots; and nanotubes for the storage of hydrogen.

A Life Cycle Cost Analysis (LCCA) has been completed to determine if needs can be met by modifying existing facilities. Six different options, including leasing and renovating commercial space and renovating abandoned government buildings, have been considered; however, life cycle cost analysis indicates these options to be less cost effective. There are currently no facilities in either the public or private sector that allow for the accelerated development and deployment of hydrogen and renewable energy technologies proposed for the S&TF. The recommended alternative with the greatest cost benefit is to construct the S&TF at NREL adjacent to the existing Solar Energy Research Facility.

The proposed funding for BY 2006 of $10,515,000 for this project will complete the interior building construction and finishes, allow for the purchase of the office landscape furniture, laboratory case work and fume hoods and provide for building commissioning.

Facility operating costs are included in Item 7, Related Annual Funding Requirements, shown below.

4. Details of Cost Estimate

(dollars in thousands)

	Current Estimate	Previous Estimate
Design Phase		
Preliminary and Final Design costs	1,438	1,332
Design Management costs (0.2 percent of TEC)	48	48
Project Management costs (0.1 percent of TEC)	12	12
Total, Design Costs (7.1 percent of TEC)	1,498	1,392
Execution (Construction) Phase		
Improvements to Land	1,137	1,152
Buildings	16,236	13,959
Utilities	666	674
Standard Equipment	761	692
Inspection, Design and Project Liaison, Testing, Checkout and Acceptance	582	589
Construction Management (2.2 percent of TEC)	472	478
Project Management (1.5 percent of TEC)	324	328
Total, Execution Costs	20,178	17,872
Contingencies		
Design Phase (0.0 percent of TEC)	0	139
Execution Phase (4.5 percent of TEC)	1,014	1,787
Total, Contingencies (4.5 percent of TEC)	1,014	1,926
Total Estimated Costs	22,690	21,190

5. Method of Performance

Design and inspection are being performed under a negotiated fixed price, design to budget, subcontract awarded on the basis of competitive bidding and best value selection. Construction execution and procurement will be accomplished by fixed-price subcontracts awarded on the basis of competitive bidding and best value selection. All subcontracts will be managed by the M&O Contractor with oversight by the Department of Energy.

6. Schedule of Project Funding (Cost Schedule)

(dollars in thousands)

	Prior	FY 2002	FY 2003	FY 2004	FY 2005	FY 2006	FY 2007	Total
Project Cost								
Design (PED)[a]	0	272	1,226	0	0	0	0	1,498
Execution (Construction)	0	0	0	207	9,611	11,323	51	21,192
Total, Line item TEC	0	272	1,226	207	9,611	11,323	51	22,690
Other Project Costs								
Conceptual design cost[b]	380	0	0	0	0	0	0	380
NEPA documentation costs[c]	0	10	10	0	0	0	0	20
ES&H costs[d]	0	5	5	0	5	5	0	20
Experimental equipment (Process Development and Integration Lab)[e]	0	0	0	0	3,100	2,590	790	6,480
Other Project-Related costs[f]	0	0	57	10	104	112	13	296
Total, Other Project Costs (OPC)	380	15	72	10	3,209	2,707	803	7,196
Total, Project Cost (TPC)	380	287	1,298	217	12,820	14,030	854	29,886

[a] Preliminary design was completed in December of 2002. Final design was completed in September of 2003.
[b] The final Conceptual Design Report was completed in February of 2002 to support the Critical Decision (CD) 1 approval.
[c] Preparation of the National Environmental Policy Act (NEPA) documentation for the proposed facility was completed as part of the update of the existing Environmental Assessment (EA) for the NREL South Table Mountain Site. This EA was completed and a Finding Of No Significant Impact (FONSI) determination was signed in July of 2003.
[d] ES&H costs represent the cost of preparing the Hazard Analysis Report and the Fire Hazard Analysis for the proposed facility.
[e] Eleven items of scientific equipment, purchased by the Solar Energy Program, will be installed following building construction and acceptance utilizing program capital funds to be allocated in FY 2005, 2006, and 2007.
[f] Other Project-Related costs include building commissioning, integrated project team support, and independent assessment of construction progress.

7. Related Annual Funding Requirements

Annual Operating Costs[a]	Current Estimate	Previous Estimate
	(dollars in thousands)	
Maintenance and Repair costs	341	341
Utility costs	250	250
Other costs	66	66
Total related annual funding (Operating from FY 2007 through FY 2057)	657	657

[a] Maintenance and Repair costs reflect historical site costs; Utility costs are based on the energy analysis completed during Final Design for the proposed facility; and other costs include custodial costs for the proposed facility.

Capital Operating Expenses and Construction Summary

Capital Operating Expenses

(dollars in thousands)

	FY 2004	FY 2005	FY 2006	$ Change	% Change
Capital Operating Expenses					
General Plant Projects					
Facility maintenance & upgrades and misc. small construction	2,060	2,482	3,828	+1,346	+54.2%
Subtotal, General Plant Projects	2,060	2,482	3,828	+1,346	+54.2%
Capital Equipment					
General-Purpose Equipment, NREL	2,060	1,288	1,972	+684	+53.1%
Hydrogen Technology	134	0	0	0	0.0%
Solar Energy	900	3,100	2,590	-510	-16.5%
Wind Energy Program	400	400	400	0	0.0%
Hydropower	0	50	0	-50	-100.0%
Geothermal Technology	0	0	0	0	0.0%
Biomass and Biorefinery Systems R&D	4,591	4,000	2,000	-2,000	-50.0%
Intergovernmental Activities	0	0	0	0	0.0%
Renewable Program Support	0	0	0	0	0.0%
Departmental Energy Management Program	0	0	0	0	0.0%
Program Direction	252	250	250	0	0.0%
Subtotal, Capital Equipment	8,337	9,088	7,212	-1,876	-20.6%
Total, Capital Operating Expenses	10,397	11,570	11,040	-530	-4.6%

Construction Projects

(dollars in thousands)

	Total Estimated Cost (TEC)	Prior-Year Appropriations	FY 2004	FY 2005	FY 2006	Unappropriated Balance
NREL Science & Tech Facility	21,190	800	3,925	6,627	10,515	53
Total, Construction	21,190	800	3,925	6,627	10,515	53

Major Items of Equipment

(dollars in thousands)

	Total Project Cost (TPC)	Total Estimated Cost (TEC)	Prior-Year Appropriations	FY 2004	FY 2005	FY 2006	Acceptance Date
Process Development & Integration Lab, NREL	6,480	6,480[a]	0	0	3,100	2,590	FY 2007
Total, Major Items of Equipment	6,480	6,480	0	0	3,100	2,590	

[a] Largest single item of equipment is $1.2 million.

Program Direction

Funding Profile by Category

(dollars in thousands/whole FTEs)

	FY 2004	FY 2005 [a]	FY 2006	$ Change	% Change
Headquarters					
Salaries and Benefits	8,971	8,944	9,525	+581	+6.5%
Travel	117	274	276	+2	+.0.7%
Support Services	2,125	3,453	1,527	-1,926	-55.8%
Other Related Expenses	1,673	1,722	1,802	+80	+4.6%
Total, Headquarters	12,886	14,393	13,130	-1,263	-8.8%
Full Time Equivalents	77	75	75	0	0.0%
Golden Field Office					
Salaries and Benefits	2,353	3,573	3,783	+210	+5.9%
Travel	108	123	155	+32	+26.0%
Support Services	475	398	189	-209	-52.5%
Other Related Expenses	668	577	900	+323	+56.0%
Total, Golden Field Office	3,604	4,671	5,027	+356	+7.6%
Full Time Equivalents	22	31	31	0	0.0%
Regional Offices					
Salaries and Benefits	0	0	641	+641	NA
Travel	0	0	44	+44	NA
Support Services	0	0	29	+29	NA
Other Related Expenses	0	0	172	+172	NA
Total, Regional Offices	0	0	886	+886	NA
Full Time Equivalents	0	0	6	+6	NA

[a] Reflects the 0.80% rescission of -$147,000.

	(dollars in thousands/whole FTEs)				
	FY 2004	FY 2005 [a]	FY 2006	$ Change	% Change
Total Program Direction					
Salaries and Benefits	11,324	12,517	13,949	+1,432	+11.4%
Travel	225	397	475	+78	+19.6%
Support Services	2,600	3,851	1,745	-2,106	-54.7%
Other Related Expenses	2,341	2,299	2,874	+575	+25.0%
Total, Program Direction	16,490	19,064	19,043	-21	-0.1%
Total, Full Time Equivalents	99	106	112	+6	+5.7%

Mission

Program Direction provides for the Federal staffing resources and associated costs for supporting management and oversight of the Office of Energy Efficiency and Renewable Energy (EERE) Programs funded by the Energy Supply appropriation. It funds staff, travel, policy review and coordination, infrastructure and construction management, contracts for security and administrative support at the Golden Field Office, support services for budget formulation and execution, development of management IT systems, IT hardware and other equipment and supplies, and general office and human resources management.

Adequate Program Direction funding is essential to the realization of the Department's renewable energy goals and objectives and implementation of the President's Management Agenda. Since the reorganization in 2002, supporting business management functions are now centralized to eliminate overlap of responsibilities and reinforce program customer focus. The new EERE business operation model is removing stovepiped and fragmented administrative practices and expenses; eliminating organizational layers; enhancing competitive sourcing, fiscal accountability and information technology services through one central organization for business systems and processes; empowering program managers with accountability; focusing their attention on results rather than bureaucratic processes; integrating performance planning and budgeting; and providing the Assistant Secretary for Energy Efficiency and Renewable Energy with more direct accessibility for improved program and business oversight. EERE's efforts in these respects have been recognized as exemplary by the Department and are being emulated by other components of DOE.

As stated in the Departmental Strategic Plan, DOE's Strategic and General Goals will be accomplished not only through the efforts of the major program offices in the Department but with additional effort from offices that support the programs in carrying out the mission. EERE performs critical functions which directly support the mission of the Department. These functions include managing information technology; ensuring sound legal and policy advice and fiscal stewardship; coordinating multi-year planning, performance measurement, budget formulation, execution and defense; developing and implementing uniform program policy and procedures; maintaining and supporting our workforce; providing security at our Golden Field Office; and providing Congressional and public liaison and information.

Detailed Justification

	(dollars in thousands)		
	FY 2004	FY 2005	FY 2006
Salaries and Benefits	**11,324**	**12,517**	**13,949**

Salaries and Benefits funds a total of 112 full time equivalent employees in FY 2006, including 6 FTE at EERE's Regional Offices (ROs) from the Energy Conservation account (Interior and Related Agencies appropriation) to the Energy Supply account. Staff funded in this decision unit provide the executive management, program oversight, analysis, and information required for the effective implementation of the EERE programs funded in the Energy Supply appropriation.

The DOE Headquarters component, consisting of 75 FTEs, is responsible for the development of policies, strategic plans and related guidance to renewable energy and hydrogen program offices; the evaluation of program performance; the formulation, defense and execution of renewable energy and hydrogen budgets; as well as communications with the public and stakeholders regarding policies, funding, program performance, and related issues.

EERE Energy Supply Program Direction also supports a Golden Field Office personnel level of 31 FTEs. This maintains a centralized EERE Project Management Office at Golden, with a particular emphasis on increasing the program execution support for the President's Hydrogen Fuel Initiative.

Funding is also requested in FY 2006 for 6 FTE at EERE's Regional Offices, as recommended in the National Academy of Public Administration's Final Report on EERE's recent restructuring, to move toward a fair distribution of costs between appropriations. This will allow the ROs to continue to provide local and regional outreach and deployment efforts on behalf of renewable energy and hydrogen technologies, such as assistance to Million Solar Roofs, Wind-Powering America, and the Hydrogen Technology Program's safety and education efforts.

Current and future staff performance is measured by responsiveness to National Energy Policy goals and objectives; implementation of the President's R&D criteria for priority decision making; continued improvement in the utilization of Federal personnel, travel, and support service activities; increases in competitive and cost-sharing procurement awards; extending the use of more efficient electronic government information systems; improving financial performance, particularly in reducing uncosted balances; and further integration of program metrics into resource allocation processes.

Travel	**225**	**397**	**475**

The increased staff and project management responsibilities at the Golden Field Office require greater travel funding for contractor oversight. The requested increase provides the per-capita travel budget at Golden that will allow proper management of the programs.

Support Services	**2,600**	**3,851**	**1,745**
▪ EERE Management and IT Support	2,600	2,351	1,745

Includes funding for support service contractors, including IT (LAN and PC) support and e-mail service; cross-cutting planning, analysis, and evaluation; and general Assistant Secretary initiatives that support all renewable energy resources programs. The requested increase for EERE management and IT support reflects more comprehensive budgeting under Program

	(dollars in thousands)		
	FY 2004	FY 2005	FY 2006

Direction for the full "costs of doing business" of the renewable energy and hydrogen programs and increased efforts to implement the President's Management Agenda. The request for Headquarters and Golden Field Office support provides roughly the same level of service as in the FY 2004 reprogramming, and also funds the 6 RO FTE's share of RO's support contracts. Adequate funding also will allow EWD-funded staff to receive reliable computer and e-mail support: at past funding levels they would have to rely on older, more unreliable servers.

By Congressional direction, general management support services are funded within this line-item. Technical program support for planning, road-mapping, market studies, etc., is funded within the individual R&D programs. The request provides support services needed for business management systems development and support for I-MANAGE, and CPS, safety and health support; facility safeguards and security; and computer hardware and software installation, configuration, and maintenance activities. The request for FY 2006 continues to provide full funding for the renewable energy and hydrogen programs' share of landlord services at the Golden Field Office and for their share of IT services and local-area network operations. It would also permit some additional program and project management activities to be directly funded and managed through the Golden Field Office, rather than having the work subcontracted through the National Laboratories, by providing assistance in activities that are not "inherently Federal," such as preparation of draft administrative paperwork, technical editing of contract and technical review documents and summary reports to GO and HQ management, funding of outside technical reviewers, and routine status tracking of contracts.

▪ Climate Change Technology Program Support	0	1,500	0

In the FY 2005 request, $1.5 million of this Support Service line were to provide analytical and technical support for the U.S. Climate Change Technology Program (CCTP). In FY 2006 CCTP support is requested within the budget for the Department's Office of Policy and International Affairs.

Other Related Expenses	**2,341**	**2,299**	**2,874**

This activity encompasses the Headquarters Working Capital Fund (WCF), IT equipment purchases and maintenance (such as a 3-year replacement cycle for desk-top PCs) at both Headquarters and the Golden Field Office, contractual services associated with landlord support of the Golden Field Office (GO), DCAA audits, and software purchases and licenses. Within the Working Capital Fund, rent is the largest component, but the WCF also includes telephones, copying, headquarters network operations, payroll and other employee services, printing, etc. The FY 2006 request continues to include the Energy Supply Programs' full share of rent and utilities at the Golden Field Office. The increase in FY 2006 includes the Energy Supply Programs' full share of IT investment and maintenance costs, along with anticipated increased costs for the WCF and Golden Field Office rent. It also includes Regional Office rent for the 6 RO FTEs now funded in this account.

Total, Program Direction	**16,490**	**19,064**	**19,043**

Explanation of Funding Changes

	FY 2006 vs. FY 2005 ($000)
Salaries and Benefits	
Provides for anticipated increases in pay and benefits costs: statutory increases, promotions and within-grade increases, performance awards, health benefits costs that are rising much faster than inflation, and for the first time includes 6 FTE at EERE's Regional Offices	+1,432
Travel	
Provides a modest increase in the travel budget to support increased project oversight in support of EERE's Project Management Initiative, and provides travel for the 6 FTE at the Regional Offices	+78
Support Services	
Provides a small increase for inflation and provides for minimal training activities and IT support, including intranet development and integration of EERE systems with new DOE-wide systems. Support for the CCTP is not requested in FY 2006 in this activity (moved to the Office of Policy and International Affairs). Six FTE's share of RO support services is also now included	-2,106
Other Related Expenses	
Provides for anticipated increased requirements for the headquarters Working Capital Fund and rent at the Golden Field Office, and will allow EERE's Energy and Water Development programs to pay their fair share of EERE IT hardware and infrastructure investment and maintenance. Also provides 6 FTEs share of Regional Office rent	+575
Total Funding Change, Program Direction	**-21**

Support Services by Category

	(dollars in thousands)				
	FY 2004	FY 2005	FY 2006	$ Change	% Change
Technical Support					
Technical, Economic, and Environmental Analyses (EERE)	1,615	300	300	0	0.0%
Technical, Economic, and Environmental Analyses (CCTP)	0	750	0	-750	-100.0%
Total, Technical Support	1,615	1,050	300	-750	-71.4%
Management Support					
IT Support (EERE)	510	625	700	+75	+12.0%
Administrative Support Services (EERE)	475	676	745	+69	+10.2%
Administrative Support Services (CCTP)	0	1,500	0	-1,500	-100.0%
Total, Management Support	985	2,801	1,445	-1,356	-48.4%
Total, Support Services	2,600	3,851	1,745	-2,106	-54.7%

Other Related Expenses by Category

	(dollars in thousands)				
	FY 2004	FY 2005	FY 2006	$ Change	% Change
Other Related Expenses					
Rent to GSA	280	381	519	+138	+36.2%
Communications, Utilities, Miscellaneous.	250	208	265	+57	+27.4%
Printing and Reproduction	25	25	45	+20	+80.0%
Other Services	265	56	159	+103	+183.9%
Operation and Maintenance of Equipment.	250	265	317	+52	+19.6%
Supplies and Materials	46	29	57	+28	+96.6%
Equipment	252	100	110	+10	+10.0%
Working Capital Fund	973	1,235	1,402	+167	+13.5%
Total, Other Related Expenses	2,341	2,299	2,874	+575	+25.0%

Electric Transmission and Distribution

Electric Transmission and Distribution

Table of Contents

Energy Supply
Office of Electric Transmission and Distribution

Overview

Appropriation Summary by Program

(dollars in thousands)

	FY 2004 Comparable Appropriation	FY 2005 Original Appropriation	FY 2005 Adjustments	FY 2005 Comparable Appropriation	FY 2006 Request
Energy Supply					
Electric Transmission and Distribution	101,213[ab]	121,155	-956[c]	120,199	95,604
Subtotal, Energy Supply	101,213	121,155	-956	120,199	95,604
Use of Prior Year Balances	-97[d]	-1,584[e]	0	-1,584	0
Total, Energy Supply	101,116	119,571	-956	118,615	95,604

Preface

The August 14, 2003, multi-region blackout - which left over 50 million Americans in the dark without electricity, and cost the Nation billions of dollars - underscored the need for modernizing the country's aging electric infrastructure. Just days prior to the blackout, Energy Secretary Spencer Abraham created the Office of Electric Transmission and Distribution (OETD) to address reliability concerns.

Within the Energy Supply appropriation, OETD is at the forefront of this effort to modernize and expand the Nation's electricity delivery system. These efforts will ensure a more reliable and robust national electricity supply.

Within the Energy Supply appropriation, OETD comprises one program, Electric Transmission and Distribution, with four subprograms: Research and Development, Electricity Restructuring, Energy Reliability and Efficiency Laboratory, and Program Direction.

This Overview will describe the Strategic Context, Mission, Benefits, Strategic Goals, and Funding by General Goal. These items together put the appropriation in perspective. The Annual Performance Results and Targets, Means and Strategies, and Validation and Verification sections address how the

[a] Reflects a total rescission of $479,000 from the consolidated (Omnibus) Appropriations Bill for FY 2004 and a general reduction of $1,080,000
[b] Reflects a total reduction of $1,945,068 for SBIR/STTR
[c] Reflects a total rescission of $956,000 from the Consolidated (Omnibus) Appropriations Bill for FY 2005.
[d] Reflects a total reduction of $97,000 in prior year balances.
[e] Reflects a total reduction of $1,584,000 in prior year balances.

goals will be achieved and how performance will be measured. Finally, this Overview will address R&D Investment Criteria, Program Assessment Rating Tool (PART), and Significant Program Shifts.

This Request is consistent with the Conference Report to the Consolidated Appropriations Act, 2005. The functions of the Office of Energy Assurance will be merged with OETD.

Strategic Context

Following publication of the Administration's National Energy Policy, the Department developed a Strategic Plan that defines its mission, four strategic goals for accomplishing that mission, and seven general goals to support the strategic goals. Each appropriation has developed quantifiable goals to support the general goals. Thus, the "goal cascade" is the following:

Department Mission → Strategic Goal (25 yrs) → General Goal (10-15 yrs) → Program Goal (GPRA Unit) (10-15 yrs)

To provide a concrete link between budget, performance, and reporting, the Department developed a "GPRA[f] Unit" concept. Within DOE, a GPRA Unit defines a major activity or group of activities that support the core mission and aligns resources with specific goals. Each GPRA Unit has completed or will complete a Program Assessment Rating Tool (PART). A unique program goal was developed for each GPRA Unit. A numbering scheme has been established for tracking performance and reporting.[g]

The goal cascade accomplishes two things. First, it ties major activities for each program to successive goals and, ultimately, to DOE's mission. This helps ensure the Department focuses its resources on fulfilling its mission. Second, the cascade allows DOE to track progress against quantifiable goals and to tie resources to each goal at any level in the cascade. Thus, the cascade facilitates the integration of budget and performance information in support of the GPRA and the President's Management Agenda (PMA).

Another important component of our strategic planning – and the President's Management Agenda – is use of the Administration's R&D investment criteria to plan and assess programs and projects. The criteria were developed in 2001 and further refined with input from agencies, Congressional staff, the National Academy of Sciences, and numerous private sector and nonprofit stakeholders.

The chief elements of the R&D investment criteria are quality, relevance, and performance. Programs must demonstrate fulfillment of these elements. For example, to demonstrate relevance, programs are expected to have complete plans with clear goals and priorities. To demonstrate quality, programs are expected to commission periodic independent expert reviews. There are several other requirements, many of which R&D programs have and continue to undertake.

An additional set of criteria were established for R&D programs developing technologies that address industry issues. Some key elements of the criteria include: the ability of the programs to articulate the appropriateness and need for Federal assistance; relevance to the industry and the marketplace; identification of a transition point to industry commercialization (or of an off-ramp if progress does not

---

[f] Government Performance and Results Act of 1993

[g] The numbering scheme uses the following numbering convention: First 2 digits identify the General Goal (01 through 07); second two digits identify the GPRA Unit; last four digits are reserved for future use.

meet expectations), and; the potential public benefits, compared to alternative investments, that may accrue if the technology is successfully deployed.

The OMB-OSTP guidance memo to agencies dated June 5, 2003, describes the R&D investment criteria fully and identifies steps agencies should take to fulfill them. (The memo is available on line at www.ostp.gov/html/fy05developingpriority.pdf.) Where appropriate throughout these justification materials, especially in Significant Program Shifts and Explanation of Funding Changes subheadings, specific R&D investment criteria and requirements are cited to explain the Department's allocation of resources.

Mission

The mission of the Office of Electric Transmission and Distribution is to lead a national effort to modernize and expand America's electric delivery system to ensure a more reliable and robust electricity supply, as well as economic and national security. This effort is accomplished through research, development, demonstration, technology transfer, and education and outreach activities in partnership with industries, businesses, utilities, States, and other Federal programs and agencies, universities, national laboratories, and other stakeholders.

As stated in the Departmental Strategic Plan, DOE's Strategic and General Goals will be accomplished not only through the efforts of the major program offices in the Department but with additional effort from offices which support the programs in carrying out the mission. The Office of Electric Transmission and Distribution performs critical functions which directly support the mission of the Department. These functions include (1) developing advanced technologies which improve the reliability, efficiency and affordability of the Nation's electric infrastructure and (2) taking actions which promote domestic energy security.

Benefits

The Office's research and development (R&D) in high temperature superconductivity, transmission reliability, distributive technologies, storage, GridWise and GridWorks improves the reliability, efficiency and affordability of the Nation's electric transmission and distribution system. These efforts foster a diverse supply of environmentally sound energy and more efficient use of existing energy resources, which in turn leads to primary energy savings, less dependency on foreign sources of energy, and environmental emissions reduction. OETD's efforts also improve the security of our electric infrastructure.

The Office's electricity restructuring unit includes analysis and outreach that supports States and regions in developing and improving policies, market mechanisms and activities that facilitate competitive, reliable, environmentally sensitive, and customer-friendly (i.e. demand response programs that are easy to understand and use) electric markets.

The Office's energy assurance activities help the Department of Homeland Security effort to assist States during energy emergencies as well as provide advice on the physical security of key components of the U.S. energy infrastructure. As a result of merging the functions of the Office of Energy Assurance with OETD, the combined activities will engender benefits that will increase the security, reliability, and resiliency of the U.S. energy infrastructures.

Strategic, General, and Program Goals
The Department's Strategic Plan identifies four strategic goals (one each for defense, energy, science, and environmental aspects of the mission) plus seven general goals that tie to the strategic goals. The Energy Supply appropriation supports the following goal:

Energy Strategic Goal: To protect our national and economic security by reducing imports and promoting a diverse supply of reliable, affordable, and environmentally sound energy.

General Goal 4, Energy Security: Improve energy security by developing technologies that foster a diverse supply of affordable and environmentally sound energy by providing for reliable delivery of energy, exploring advanced technologies that make a fundamental improvement in our mix of energy options, and improving energy efficiency.

The Programs funded within the Energy Supply Appropriation have one Program Goal that contributes to the General Goals in the "goal cascade." OETD's Program Goal is 04.12.00.00.

Program Goal 04.12.00.00 Electric Transmission and Distribution: OETD will lead a national effort to modernize and expand the Nation's electricity delivery system to ensure a more reliable and robust electricity supply, as well as economic and national security.

Contribution to General Goal
DOE created OETD in August 2003, in order to satisfy recommendations of the "President's National Energy Policy (NEP)" of May 2001 and DOE's "National Transmission Grid Study" of May 2002. Since its creation, OETD has further developed its objectives and goals to reflect the "Final Report on the August 14, 2003, Blackout in the United States and Canada: Causes and Recommendations" of April 2004, and the electric transmission and distribution stakeholders' "National Electric Delivery Technologies Roadmap" of January 2004.

Within OETD, the Research and Development Subprogram and the Electricity Restructuring Subprogram contribute to General Goal 4 as follows:

OETD pursues three strategic Critical Objectives to support the General Goal with regards to reliability, efficiency and affordability. These objectives address reducing the frequency of blackouts (reliability), reducing energy losses (efficiency), and reducing the cost of delivered electricity to consumers (affordability).

All Program Activities align with these Critical Objectives and support the General Goal. Each R&D activity has at least one annual target (see table on page 8).

The High Temperature Superconductivity (HTS) R&D Activity contributes to the General Goal primarily by improving the efficiency, as well as reliability, of the Nation's electric delivery system. To achieve these benefits, HTS pursues its long-term performance goal, which is as follows: By 2012, develop to the 100 percent operational capability level, wire and four types of high-temperature superconducting electric power prototypes with typically half the energy losses and half the size compared to conventional equipment of the same power rating. Annual targets - that track achievements toward this Activity goal - are detailed in the chart at the end of this "Overview" section, entitled "Targets for High Temperature Superconducting Electric Power Equipment Prototypes."

The Transmission Reliability R&D Activity contributes to this General Goal by improving the reliability, as well as the affordability of the electric delivery system, including an increase in transmission capability, with the development of real-time information and control technologies and systems. This Activity tracks its progress by measuring the amount of cumulative savings.

The Electric Distribution Transformation R&D Activity contributes to the General Goal by developing distributed sensing, intelligence and control technologies that improve the electric infrastructure's reliability, as well as affordability and efficiency. This Activity tracks its progress by measuring peak load reduction.

The Energy Storage R&D Activity contributes to the General Goal by developing storage technologies that reduce power quality disturbances and peak electricity demand, and improve system flexibility to reduce adverse effects to users. This, in turn, primarily improves the electric infrastructure's reliability. It also addresses efficiency and affordability. This Activity tracks its progress by measuring reductions in cost per kilowatt and cost per kilowatt-hour for three storage technologies.

The GridWise Activity contributes to the General Goal primarily by improving the electric infrastructure's reliability. It also addresses efficiency and affordability. This Activity develops communication and control systems to support adaptive intelligent grid operations, integrate distributed energy devices and enhance customer electric service. The use of real-time information improves reliability and system efficiency, and allows the electric system to be more resilient.

The GridWorks Activity contributes to the General Goal primarily by improving the electric infrastructure's reliability. It also addresses affordability and efficiency. This Activity provides seed support to accelerate development and demonstration of an integrated portfolio of advanced technologies. This will help provide reliable delivery of energy, improve energy efficiency, and guard against energy emergencies.

The long-term performance goal for both GridWise and GridWorks is to implement an advanced technologies and integrated-information management system for the Nation's electric system that will overcome today's limitations and reduce the annual frequency of intra-regional blackouts.

The Electricity Restructuring Subprogram contributes to this goal by providing technical assistance and analysis that supports States and regions for developing policies, market mechanisms, and programs that facilitate competitive, reliable, environmentally sensitive, and customer-friendly (with demand response programs that are easy to understand and use) wholesale and retail electric markets. This Subprogram tracks its progress by measuring the enactment of state and regional electric policies that enable grid infrastructure investments.

The Import/Export Authorization (IEA) activity – within Program Direction – contributes to this goal by managing the regulatory review of exports of electricity and the construction and operation of electric transmission lines which cross U.S. international borders. These regulatory activities help promote the national energy strategy goal of securing future energy supplies by helping ensure availability of competitively priced electricity supplies in a competitive and environmentally-sound manner. The activity also ensures that exports of electric energy and the construction of new international electric transmission lines do not adversely impact the reliability of the U.S. electric power supply system and that electricity trade occurs in the freest possible marketplace.

Funding by General and Program Goal

(dollars in thousands)

	FY 2004	FY 2005	FY 2006
General Goal 4, Energy Security			
Program Goal 04.12.00.00, Electric Transmission	90,850	111,295	84,157
Total, General Goal 4 (Energy Supply)	90,850	111,295	84,157

Major FY 2005 Achievements

High Temperature Superconductivity R&D: In FY 2005, Southwire will pass the milestone of 31,000 hours (almost 4 years) of operation in the long-term reliability test of a 30-meter long, three-phase, HTS power cable that supplies electricity to the Southwire industrial complex in Carrollton, Georgia. The length of operation has far exceeded the FY 2001 annual target of 6,000 hours.

Transmission Reliability: In FY 2005, Transmission Reliability R&D will support deployment of the first phase of a real-time, synchronized, wide area measurement system in the Eastern United States with 50 measuring units at 6 interconnected data gathering locations. This system should help improve the reliability of one of the three major regions of the Nation's electric infrastructure.

Annual Performance Results and Targets

FY 2001 Results	FY 2002 Results	FY 2003 Results	FY 2004 Results	FY 2005 Targets	FY 2006 Targets
Electric Transmission and Distribution/Research and Development/High Temperature Superconductivity R&D					
Document 6,000 hours (100 percent load) operation of the first successful HTS power delivery system to power an industrial use. (MET GOAL)	Complete initial testing of Detroit superconducting transmission cable and document operational costs and reliability. (NOT MET)	Increase the capability to reproducibly fabricate a 10-meter length of Second Generation HTS wire to carry 50 amps of electricity and 1-meter lengths that carry 100 amps from a 40-amp base. (MET GOAL)	Complete testing of 10 MVA superconducting transformer in operation on the Wisconsin Electric Power Company grid.	Complete the manufacture of a 200m superconducting power cable for American Electric Power (AEP)	Operate a first-of-a-kind superconducting power cable on the electric grid for 240 hours.
Install first-of-a-kind superconducting electrical transmission cables to replace existing delivery to an urban substation serving 14,000 customers in Detroit, Michigan and begin testing operation and reliability. (MET GOAL)					
Electric Transmission and Distribution/Research and Development/Transmission Reliability R&D					
			Install and operate a prototype wide area measurement system in the Nation's Eastern Interconnection with real time synchronized measuring instruments that feed data into two data archiving and analysis locations.	Install four additional data concentrators at four different data archiving and analysis locations, achieving a prototype wide area measurement system in the Nation's Eastern Interconnection consisting of six fully functioning data archiving and analysis locations installed at six different utilities.	Facilitate the installation and operation of 250 measurement units in a real-time measurement network that covers 80% of the Eastern Interconnection and feeds data into eight archiving and analysis locations.

FY 2001 Results	FY 2002 Results	FY 2003 Results	FY 2004 Results	FY 2005 Targets	FY 2006 Targets
Electric Transmission and Distribution/Research and Development/Electric Distribution Transformation R&D					
					Gain acceptance of, and implement, the small generation interconnection standard in the Pennsylvania / Jersey / Maryland (PJM) Regional Transmission Operator (RTO) / Independent System Operator (ISO) Region.
Electric Transmission and Distribution/Research and Development/Energy Storage R&D					
		Support the field test of a 100kW lithium battery system for 700 hrs at a utility site. (MET GOAL)	Test and evaluate the performance of a 500kW/750kWh sodium sulfur battery (first in U.S) installed at an American Electric Power site for six months to determine technical and economic performance.	Complete the manufacture of and factory testing on a 2MW/2MWh zinc-bromine battery system (consisting of four 500kW / 500kWh units) for supplying extra power during peak load conditions at a utility substation.	Commission three pioneering energy storage systems in collaboration with the California Energy Commission and collect preliminary technical and economic data.
Electric Transmission and Distribution/Research and Development/GridWise					
				Complete field hardware installation at a cumulative total of at least 100 commercial, industrial and/or municipal customers participating in the demand response and load conservation network in Connecticut, and reduce peak demand (kilowatt hours) in real time by 5-8% on average (as compared to non-curtailed kilowatt hour consumption) for all participating customers, thereby improving the efficiency of electricity usage.	Draft reference architecture identifying areas for standardization to enable integration with electric markets operation.

FY 2001 Results	FY 2002 Results	FY 2003 Results	FY 2004 Results	FY 2005 Targets	FY 2006 Targets
Electric Transmission and Distribution/Research and Development/GridWorks					
					For the first time with a transmission and distribution focus, commence research on silicon carbide basic materials to discover high voltage, high power applications in power electronics.
Electric Transmission and Distribution					
				Reduce by 10% the total time required by OETD to complete its FY 2006 CFO, OMB and Congressional budget submissions as compared to its comparable FY 2005 budget submissions	Maintain a funding level ratio of program direction to total program funding at or below 10%

Means and Strategies
The OETD Program will use various means and strategies to achieve its Program goals. However, various external factors may impact the ability to achieve these goals. The Program also performs collaborative activities to help meet its goals.

With regards to means, as OETD reaches full operating capacity in human and information technology resources, greater focus will be placed on expanding staff skills with training in information technology and cross-training in electric transmission and related technologies outside of the specialty of a given staff member. The training will further the integration of OETD's knowledge base and efforts to oversee fuller integration of electric transmission R&D technologies.

Information Technology will provide more efficient tracking of, and access to, essential program management-related information and office support functions, and allow for more productive and efficient use of staff time in pursuit of OETD's technology goals.

Among OETD's strategies, increasing market penetration of electric transmission and distribution systems is achieved through 1) advances in technology cost and performance, and 2) the implementation of national standards for interconnecting power with the grid. Technology advances include development of first generation superconducting wire, development of real-time monitoring and control software tools, and development of system operating models to improve grid reliability and efficiency. Modernization and expansion of the electricity infrastructure is achieved by improving the reliability, efficiency and cost-effectiveness of the system with the following achievements: 1) improving the efficiency and production of high temperature superconducting wires and power equipment; 2) developing real-time information and control technologies and systems; 3) developing distributed intelligence sensing and control technologies; 4) reducing the cost and increasing the energy density of energy storage systems; 5) providing technical assistance and analysis that supports State and regional wholesale and electric market improvements; and 6) developing an integrated portfolio of these advanced technologies that achieves commercial viability and addresses the crucial needs of the entire electric system.

These strategies will result in significant improvements in the reliability, efficiency, and costs of the Nation's electric transmission and distribution infrastructure.

In carrying out OETD's program mission, the subprograms perform the following collaborative activities:

- Planning, reviewing, partnering and cost sharing with leading U.S. companies pursuing R&D and related work on electric transmission technologies;
- Consulting with utilities, Regional Transmission Organizations and Independent System Operators on regional policies, market assessments, planning, and regulations;
- Collaborating with other DOE offices and related entities - including the Offices of Fossil Energy and Energy Efficiency and Renewable Energy - on how to best ensure energy security (per DOE's General Goal 4) with a diverse supply of reliable, affordable, and environmentally sound energy; the Energy Information Agency on market analysis; the Power Marketing Administrations and the Tennessee Valley Authority on evaluating transmission-related

technologies that enhance reliability and lower costs to consumers; and DOE laboratories on planning, managing, reviewing and completing R&D technical work with industry;

- Working with other Federal agencies, such as the Federal Energy Regulatory Commission to develop policies, market mechanisms, regulations, laws and programs that facilitate modernizing and expanding the Nation's grid, and the Department of Defense to develop and test technologies;
- Collaborating with non-governmental organizations, such as the North American Electric Reliability Council and the Electric Power Research Institute to analyze market mechanisms and develop improved approaches to grid modernization and expansion;
- Working with States and regional entities, such as regional governors' associations and the National Association of Regulatory Utility Commissioners to develop policies, market mechanisms, regulations, state laws, and programs to improve the electric grid at the local, State and regional levels;
- Partnering with universities to develop plans and reviews, and to further R&D.

Validation and Verification

To validate and verify OETD's performance, the office conducts various internal and external reviews and audits. OETD's programmatic activities are subject to continuing review by OMB and the Congress, the General Accounting Office, and the Department's Inspector General. Senior management invites external reviews of office-wide planning, design, management and programmatic results in order to improve office effectiveness. Each Program Activity manager conducts annual peer reviews - comprised of independent, subject-area experts - to review the management and technical achievements of both programs and projects. Program Activity managers maintain long-term goals, annual targets and milestones, which are tracked by OMB and DOE's program management reporting system. In FY 2006 OETD plans to develop a computerized and integrated project tracking system that will allow closer monitoring of all the important aspects of every project. In addition, senior management and budget personnel ensure that expenditures are within financial plans and in accord with budget requests. Senior management tracks the progress of each Program Activity on at least a quarterly basis, and makes adjustments necessary to achieve annual targets and long-term goals. OETD will use these methodologies in regards to the over-target required by the acceleration in development of real time monitoring for the grid modernization by two years.

Program Assessment Rating Tool (PART)

The Department implemented a tool to evaluate selected programs. PART was developed by the Office of Management and Budget (OMB) to provide a standardized way to assess the effectiveness of the Federal Government's portfolio of programs. The structured framework of the PART provides a means through which programs can assess their activities differently than through traditional reviews.

The current focus is to establish outcome- and output-oriented goals, the successful completion of which will lead to benefits to the public, such as increased national security and energy security, and improved environmental conditions. DOE has incorporated feedback from OMB into the FY 2006 Budget Request, and the Department will take the necessary steps to continue to improve performance.

The High Temperature Superconductivity R&D Program Activity underwent a PART review prior to submission of the FY 2005 budget.

The PART recommended that the program participate in the development of a consistent framework for the Department to analyze the costs and benefits of its R&D investments, and to apply this guidance as part of FY 2006 budget development. The Department prepared preliminary benefits estimates for its applied R&D programs, but still needs to improve consistency across programs in methodology and assumptions used in estimating program costs and benefits.

In arriving at a summary score of 70, evaluation under the PART found a score of 88 on Program Management. This score is attributed to OETD's use of near-term and long-term tracking systems to measure progress toward annual targets and long-term performance goals, use of independent peer reviews, spend plans, and site visit reviews. In keeping with the effective management practices tracked in PART, OETD has supported an acceleration of second generation wire development as a higher performance/lower cost technology for equipment over the longer term, and has refocused on applications (i.e. cables) where first generation wire performance is sufficient in the short term.

Scores on Program Purpose and Design (80), Strategic Planning (70) and Program Results (59), primarily reflected PART findings that: the Program Activity did not demonstrate how factors of risk, years to commercialization, public benefits, and total Federal costs have impact upon — and are used to prioritize — its investments on R&D; the Program Activity lacked complete and transparent linkage between annual and long-term performance goals and resource needs; the Program Activity lacked a cost-effectiveness measure; and the Program Activity demonstrated only to a "small extent" progress in achieving its long-term performance goal.

To address these findings, this budget contains a more complete and transparent presentation of resource needs in terms of annual targets and long-term performance goals.

Targets for High Temperature Superconducting Electric Power Equipment Prototypes

	HTS Wire	HTS Motors		HTS Generators		HTS Transformers		HTS Power Cables		
Metric	Cost $/kA-m	Voltage kV	Power MW	Voltage kV	Power MW	Voltage kV	Power MW	Voltage kV	Power MW	Length mile
Current Status (2004)	200	4.18	0.75	4.16	1.8	13.8	1.7	12.5	25	0.02
2005										
2006	150							13.2	69	0.12
2007										
2008								34.5	48	0.2
2009										
2010	100	10	5	13.8	100	138	50	138	600	0.5
2011										
2012	75			20	340					
2013										
2014	50							138	600	2
2015										
2016	20	10	5	20	850	345	340	345	750	2

This FY 2006 budget submission reflects OETD management's more formalized application of budget and performance integration. Portfolio balancing and funding decisions are made in part based on the past performance of a given activity.

For example, management determined - based on not meeting the HTS FY 2004 annual performance target due to problems associated with first generation wire in completing the test of the 10 MVA superconducting transformer in operation on the Wisconsin Electric Power Company grid - that more resources needed to be devoted to developing second generation wire. The technology associated with second generation wire is more advanced and robust than first generation wire, and it likely will improve the performance of superconducting transformers and thereby improve the reliability and efficiency of electric transmission."

As another example, OETD increased funding for Real Time Grid Reliability Management based on their assessment of the degree of positive impact on electricity reliability that this activity has had in FY 2004 and the beginning of FY 2005. With the successful installation and operation of the initial components of a prototype wide area measurement system in the Nation's Eastern Interconnection, the FY 2004 target and all quarterly milestones for FY 2004 and first quarter FY 2005 were met.

Energy Supply
Office of Electric Transmission and Distribution

Funding by Site by Program

(dollars in thousands)

	FY 2004	FY 2005	FY 2006	$ Change	% Change
NNSA Service Center					
Lawrence Berkeley National Laboratory	5,696	4,367	5,505	+1,138	+ 26.1%
Chicago Operations Office					
Argonne National Laboratory	1,170	1,200	1,400	+200	+ 16.7%
Brookhaven National Laboratory	500	300	400	+100	+ 33.3%
Chicago Operations Office	16,423	30,611	9,128	-21,483	- 70.2%
National Renewable Energy Laboratory	5,652	3,157	1,900	-1,257	+ 39.8%
Total, Chicago Operations Office	23,745	35,268	12,828	-22,440	- 63.6%
Golden Field Office					
Golden Field Office	12,905	16,000	19,000	+3,000	+ 18.8%
Idaho Operations Office					
Idaho Operations Office	697	1,280	1,280	0	0.0%
Idaho National Engineering Laboratory	0	5,000	0	-5,000	- 100.0%
Total, Idaho Operations Office	697	6,280	1,280	-5,000	-79.6%
Los Alamos Site Office					
Los Alamos National Laboratory	6,200	6,000	8,000	+2,000	+33.3%
Oak Ridge Operations Office					
Oak Ridge Operations Office	1,000	20	1,020	+1,000	+500.0%
Oak Ridge National Laboratory	13,114	14,498	17,570	+3,072	+ 21.2%
Total, Oak Ridge Operations Office	14,114	14,518	18,590	+4,072	+ 28.0%
Richland Operations Office					
Pacific Northwest National Laboratory	2,219	3,353	4,900	+1,547	+ 46.1%

	(dollars in thousands)				
	FY 2004	FY 2005	FY 2006	$ Change	% Change
Sandia Site Office					
Sandia National Laboratories	7,355	10,450	3,630	-6,820	- 65.3%
National Energy Technology Laboratory	16,978	14,500	7,400	-7,100	- 49.0%
Washington Headquarters	11,304	9,463	14,471	+5,008	+ 52.9%
Total, Energy Supply	101,213	120,199	95,604	-24,595	- 20.5%

Site Description

NNSA Service Center

Lawrence Berkeley National Laboratory (LBNL)

LBNL has the lead for a national laboratory/industry/university consortium that was formed to support research in Transmission Reliability R&D. This consortium is assisting in implementing the DOE Transmission Reliability R&D Activity. In support of the Electricity Restructuring Subprogram, LBNL provides DOE with nationally recognized expert technical assistance to individual State public utility commissions and energy offices, regional transmission organizations/independent system operators and regional State groups. Also, LBNL provides transmission policy analysis support to DOE such as in the identification of National Interest Transmission Bottlenecks and in the implementation of increased grid reliability standards and other recommendations from the August 2003 blackout investigation.

Chicago Operations Office

Argonne National Laboratory (ANL)

Argonne National Laboratory performs research and development for the High Temperature Superconductivity R&D (HTS) Activity. Argonne uses unique expertise in superconducting materials science and in developing characterization tools to help improve the understanding of current flow in HTS materials. Unique facilities such as the Intense Pulsed Neutron Source (IPNS) and the Advanced Photon Source are used for measurement and characterization in ANL's research. Argonne also provides support to energy assurance visualization activities.

Brookhaven National Laboratory (BNL)

BNL supports the High Temperature Superconductivity R&D Activity by working with national laboratory/industry teams and universities to undertake research on fundamental wire properties and processing issues.

Chicago Operations Office (COO)

The Chicago Operations Office commissioned the solicitation for "Cooperative Research and Development for Advanced Communication and Control" and has been providing project management support to the five financial assistance subcontracts awarded through the solicitation. The COO also administers all contracts for the composite conductor network. COO is used to issue grants to national and regional State-based non-profit organizations that have developed expertise in providing technical assistance in electric markets to States and regions. These groups include the National Association of Regulatory Utility Commissioners (NARUC), the National Governors Association, and the National Conference of State Legislatures. For GridWorks R&D, COO will manage partnerships with industry for cable and conductors as well as substations and auxiliary equipment.

National Renewable Energy Laboratory (NREL)

NREL works with industry to develop a uniform national standard for interconnection of distributed power resources with the electric grid and performs research to develop related test and certification procedures. NREL performs analysis addressing regulatory and institutional barriers to distributed power and provides technical assistance to State agencies and others on these issues. NREL commissioned two rounds of solicitations and has been providing project management support to 14 R&D subcontracts. NREL administers Congressionally-directed funds for the Dine' Power Authority Navajo Transmission Project and the Northwest Indiana Electric Infrastructure Project. NREL also supports the High Temperature Superconductivity R&D Activity by working with national laboratory/industry teams and universities to undertake research on fundamental wire processing and application issues. For GridWorks, NREL conducts research on substation equipment and protective devices.

Golden Field Office (GFO)
GFO administers the Superconductivity Partnership with Industry (SPI) for the High Temperature Superconductivity R&D Activity. The SPI is 50 percent cost-shared with industry and consists of 8 projects to develop first-of-a-kind designs for more efficient power cables, transformers, fault current limiters, industrial motors and flywheel energy systems.

Idaho Operations Office
Idaho Operations Office (IDO)
The Idaho Operations Office administers all financial assistance agreements consisting of Congressionally directed funds for Alaska transmission construction projects. IDO also administers the University Cooperative Projects for the High Temperature Superconductivity R&D Activity. The University projects are in cooperation with the National Laboratories and consist of seven projects to transfer new technologies developed at the universities to individual National Laboratories that would benefit from these new technologies.

Idaho National Engineering and Environmental Laboratory (INEEL)
The Idaho National Engineering and Environmental Laboratory provides a Supervisory Control And Data Acquisition (SCADA) test bed to the Transmission Reliability R&D Activity.

Los Alamos Site Office
Los Alamos National Laboratory (LANL)
LANL works with industry to develop second generation HTS wires based on the ion beam assisted deposition (IBAD) process pioneered by LANL. LANL's expertise in film deposition processes and materials science is used to improve the performance of IBAD wires. Commercial versions are expected to carry 1,000 amperes of current through a centimeter wide metal strip coated with a film the thickness of only a few human hairs - a revolutionary change. LANL is also developing superconducting transmission cables and superconducting fault current limiters (a device that protects the electrical system against lightning strikes and other accidents). Finally, LANL provides support to energy assurance visualization activities.

Oak Ridge Operations Office
Oak Ridge Operations Office
The Oak Ridge Operations Office administers the Interagency Agreement with the Department of Defense for the Title III procurement of industry pilot plants to produce Second Generation Superconducting Wire. Through extensive interaction with the Department of Defense, the industry projects will accelerate the commercial availability of Second Generation Wire by three to five years. The Office also administers the Interagency Agreements with the Department of Commerce for two projects at the National Institute of Standards and Technology. These projects involve research on superconducting materials chemistry and mechanical properties research.

Oak Ridge National Laboratory (ORNL)
ORNL is part of a national laboratory/industry/university consortium that was formed to support research in Transmission Reliability R&D. ORNL operates the National Transmission Technology Research Center for testing transmission technologies. The Energy Reliability and Efficiency Laboratory (EREL) is planned to accommodate larger and more advanced testing capabilities. ORNL also develops second generation HTS wires based on the rolling-assisted biaxially textured substrate process (RABiTS) patented by ORNL. ORNL is applying its expertise in cryogenic systems and power system technology in projects to develop superconducting fault current limiters, generators, transformers and transmission cables. For the Electricity Restructuring Subprogram, ORNL is providing support on the monitoring and implementation of increased reliability standards and other recommendations from the August 2003 blackout investigation. ORNL also participates in strategic planning for the next generation control architecture for the distribution system. In support of GridWorks, ORNL will work on cables and conductors, substations and auxiliary equipment, power electronics, and silicon carbon and diamond research.

Richland Operations Office
Pacific Northwest National Laboratory (PNNL)
PNNL is supporting development of communication and control architectures and technologies, as well as the integration of multi-vendor distributed energy resources into the distribution system. PNNL supports development of technologies for improved load/demand management while responding to market prices and electricity supply/demand conditions. PNNL is involved in the GridWise Alliance and Industrial Consortium. PNNL is part of a national laboratory/industry/university consortium that was formed to support research on Transmission Reliability R&D. PNNL conducts evaluations of the technological and institutional aspects of recent reliability events on the Nation's electric power system, and is the lead for research activities in real-time monitoring and control for the power grid. PNNL will conduct research for GridWorks on sensors.

Sandia Site Office
Sandia National Laboratories (SNL)
In conjunction with Lawrence Berkeley National Laboratory, the National Science Foundation, and the California Energy Commission, SNL is involved in the design, demonstration, and analysis of the Microgrid concept. SNL is part of a national laboratory/industry/university consortium that was formed to support research on Transmission Reliability R&D. SNL also works to develop advanced superconductors based on the sol-gel chemical deposition process. For energy storage, SNL develops improved energy storage system components including power conversion electronics and modular multi-functional energy storage systems and manages joint DOE Storage Initiatives with the California Energy Commission and the New York State Energy Research and Development Authority. For GridWorks, SNL will conduct power electronics and storage research. Finally, SNL provides support to energy assurance visualization activities.

National Energy Technology Laboratory (NETL)
NETL will provide strategic planning and technical support to the Electric Distribution Transformation R&D Activity as well as intra- and inter-departmental coordination support with other Federal Programs. NETL manages Congressionally-directed funds for energy assurance activities and electric grid modeling activities. Additional Congressionally-directed funds were given to NETL to continue the planning, design, and construction of an energy assurance training facility in West Virginia.

Washington Headquarters

In conjunction with LBNL, SNL and the California Energy Commission, the National Science Foundation, through a Headquarters grant, is involved in the design, demonstration, and analysis of the Microgrid concept. DOE Headquarters also issues grants to national and regional State-based non-profit organizations that have developed expertise in providing technical assistance in electric markets to States and regions, such as the Western Governors Association. Other activities include SBIR/STTR, I-Manage and communications.

Electric Transmission and Distribution

Funding Profile by Subprogram

(dollars in thousands)

	FY 2004 Comparable Appropriation	FY 2005 Original Appropriation	FY 2005 Adjustments	FY 2005 Comparable Appropriation	FY 2006 Request
Electric Transmission and Distribution					
Research and Development	71,499	92,179	-726	91,453	71,757
Electricity Restructuring	19,351	20,000	-158	19,842	12,400
Construction	736	775	-6	769	0
Program Direction	9,627	8,201	-66	8,135	11,447
Total, Electric Transmission and Distribution	101,213[ab]	121,155	-956[c]	120,199	95,604

Public Law Authorizations:

P.L. 95-91, "Department of Energy Organization Act" (1977)
P.L. 95-618, "Energy Tax Act of 1978"
P.L. 96-294, "Energy Security Act" (1980)
P.L. 100-697 "Superconductivity and Competitiveness Act of 1988"
P.L. 102-486 Energy Policy Act of 1992 (EPACT)

Mission

The mission of the Office of Electric Transmission and Distribution (OETD) is to lead a national effort to modernize and expand America's electric delivery system to ensure a more reliable and robust electricity supply, as well as economic and national security. This effort is accomplished through research, development, demonstration, technology transfer, and education and outreach activities in partnership with industries, businesses, utilities, States, other Federal programs and agencies, universities, national laboratories, and other stakeholders.

Benefits

The Office of Electric Transmission and Distribution (OETD) supports the Energy Supply Appropriation in its role at the forefront of the effort to modernize and expand the Nation's electricity delivery system. These endeavors will ensure a more reliable, efficient and affordable national electricity supply.

---

[a] Reflects a total rescission of $479,000 from the consolidated (Omnibus) Appropriations Bill for FY 2004 and a general reduction of $1,080,000
[b] Reflects a total reduction of $1,945,068 for SBIR/STTR
[c] Reflects a total rescission of $956,000 from the Consolidated (Omnibus) Appropriations Bill for FY 2005.

The Office's research and development (R&D) in high temperature superconductivity, transmission reliability, distributive technologies, energy storage, GridWise and GridWorks improves the reliability, efficiency and affordability of the Nation's electric transmission and distribution system. These efforts foster a diverse supply of environmentally sound energy and more efficient use of existing energy resources, which in turn leads to primary energy savings and environmental emissions reduction. OETD's efforts also improve the security of our electric infrastructure.

The Office's electric markets technical assistance, under the electricity restructuring subprogram, includes analysis and outreach that supports States and regions in developing and improving policies, market mechanisms and activities that facilitate competitive, reliable, environmentally sensitive, and customer-friendly (i.e. demand response programs that are easy to understand and use) electric markets.

The Office's Energy Security and Assurance activities collaborates with State and local governments, Federal partners, and the private sector to coordinate security and protection activities, to share best practices and information and to develop improved methodologies and approaches to reducing the vulnerability of the critical energy infrastructure to both natural and terrorist events.

Research and Development

Funding Schedule by Activity

	(dollars in thousands)				
	FY 2004	FY 2005	FY 2006	$ Change	% Change
Research and Development					
High Temperature Superconductivity R&D	37,150	54,562	45,000	-9,562	-17.5%
Transmission Reliability R&D.................	11,431	15,600	9,220	-6,380	-40.9%
Electric Distribution Transformation R&D	13,464	5,418	4,037	-1,381	- 25.5%
Energy Storage R&D	8,763	3,969	3,000	-969	- 24.4%
GridWise..	691	6,448	5,500	-948	-14.7%
GridWorks..	0	5,456	5,000	-456	-8.4%
Total, Research and Development	71,499	91,453	71,757	-19,696	-21.5%

Description

The mission of the Research and Development subprogram is to advance the technologies which will allow OETD to lead a national effort to modernize and expand America's electricity delivery system to ensure a more reliable and robust electricity supply, as well as economic and national security, that in turn supports the Department of Energy's mission for protecting national and economic security by promoting a diverse supply and delivery of reliable, affordable, and environmentally sound energy.

Benefits

This subprogram provides for the research and development that will advance high temperature superconductivity, transmission reliability, electric distribution and energy storage technologies and the integration of these and other new technologies within GridWise and GridWorks. Together, these efforts provide a backbone for modernizing and expanding the Nation's grid, making it more reliable, efficient and affordable.

Activity Focus
The Subprogram focuses on six main Activities. The High Temperature Superconductivity R&D Activity works to bring the unique efficiency and capacity advantages of superconductivity to electric power applications, as well as greater reliability. The Transmission Reliability R&D Activity supports modernization of the Nation's transmission infrastructure through information technologies that provide enhanced grid reliability and efficient electricity markets under competition. The Electric Distribution Transformation R&D Activity transforms today's electric distribution infrastructure for increased reliability, affordability and efficiency. The Energy Storage R&D Activity includes research in advanced energy storage systems for applications ranging from power quality for digital facilities to voltage support for transmission lines primarily for improved reliability. The GridWise Activity focuses

on developing distributed intelligent agents to diagnose local faults and coordinate with power electronics and other existing, conventional protection schemes that will provide autonomous control and protection at the local level. The GridWorks Activity accelerates the development of a robust portfolio of technologies for modernizing and expanding the electric grid, thereby reducing the likelihood and impact of reliability events, including blackouts. Both the GridWise and GridWorks Activities focus primarily on reliability.

Detailed Justification

(dollars in thousands)

	FY 2004	FY 2005	FY 2006
High Temperature Superconductivity R&D	**37,150**	**54,562**	**45,000**

The benefits of the High Temperature Superconductivity (HTS) R&D Activity include providing the unique efficiency and capacity advantages of superconductivity to the national effort to modernize and expand America's electricity delivery system. Fully operational, pre-commercial prototypes of electric power equipment, which incorporate HTS wires, are under development that will generate only half the energy losses with half the size of conventional power units.

This Activity focuses on developing more reliable and robust HTS distribution and transmission cables that have three to five times the capacity of conventional copper cables and higher efficiency, which is especially useful in congested urban areas.

The High Temperature Superconductivity (HTS) R&D Activity utilizes the property of certain crystalline materials that become free of electrical resistance at, and below, the temperature of liquid nitrogen. The absence of electrical resistance makes possible super-efficient electrical power components that have only half the energy losses and are half the size of conventional technology of the same power rating. In the long-term, HTS electrical wires will someday be able to carry 100 times the amount of electricity compared to the same size conventional copper wires. In the near-term, superconductive transmission cables that carry three to five times more power than present technology will enable direct replacement of existing underground power cables by urban utilities to meet demand growth without costly and disruptive construction.

In the "Final Report on the August 14, 2003, Blackout in the United States and Canada: Causes and Recommendations," the Blackout Task Force identified the direct causes for the blackout and made recommendations. The Superconductivity Program for Electric Power is conducting R&D that directly mitigates:

- Direct Cause #1: Failure to maintain adequate reactive power support.
- Recommendation #23: Strengthen reactive power and voltage control practices in all North American Electric Reliability Council (NERC) regions.

The High Temperature Superconductivity (HTS) R&D Activity, in a cost-shared project with industry, is developing the 100 MVA HTS generator. Superconducting generators have the ability to produce much greater reactive power than conventional generators and this reactive power can be used to stabilize the electric grid.

Statutory mandates for this Activity include the Superconductivity and Competitiveness Act of 1988, Public Law 100-697 and the Energy Policy Act of 1992, Public Law 102-486. The public benefits result primarily from the increase in the efficiency and capacity of a wide range of electric power

	(dollars in thousands)		
	FY 2004	FY 2005	FY 2006

equipment using HTS wires.

▪ **Superconductivity Partnerships**	**12,895**	**18,000**	**19,000**

Complete construction and begin initial performance testing of three prototype, high-efficiency, HTS cables with American Superconductor, Southwire, and Super Power. Complete construction and begin initial performance testing of the HTS flywheel with Boeing. Evaluate the impact of secure power networks enabled by HTS technology development.

▪ **Second Generation Wire Development**	**12,225**	**13,385**	**16,000**

The coordinated industry-national laboratory-university effort to establish manufacturing capability at two private companies will conduct research that will result in the availability of 1 kilometer lengths of high performance "second generation" (2G) wire. Research will focus on the most promising deposition processes (from the six or more actively examined in FY 2003) to reliably protect against over currents, build in mechanical properties of flexibility and ruggedness, reduce alternating current losses, and accelerate processing times to reduce costs. The Cooperative Research and Development Agreement (CRADA) mechanism will be used to help accelerate development of 2G wires that carry high currents in the presence of strong magnetic fields.

▪ **Strategic Research**	**7,100**	**8,296**	**10,000**

The cause of alternating current energy losses in HTS wires will be understood, resulting in more efficient HTS wires (while resistance losses are eliminated by high temperature superconductivity, there remain alternating current losses which can be reduced). Prototypes of more efficient, compact, and powerful cryogenic systems will be developed that are suitable for use in a wide variety of applications. Wire research will focus on gaining understanding of ways to reduce processing times as well as to improve the electrical and mechanical properties (flexibility and strength) of second generation wires.

▪ **Congressionally Directed Activities**	**4,930**	**14,881**	**0**
Joint research program to attempt to enhance the performance of second-generation, high-temperature coated conductors, in collaboration with Wright Patterson Air Force Base	953	0	0
Florida university electric power infrastructure and security research. OETD is in the process of developing a workscope	0	4,961	0
Planning, design and construction of the Camp Dawson energy assurance training center	3,977	4,960	0
Advanced thermal storage with renewable energy. OETD is in the process of developing workscope	0	1,984	0

(dollars in thousands)

	FY 2004	FY 2005	FY 2006
Ionic fluids research for power. OETD is in the process of developing a workscope.	0	1,488	0
Smart Energy Management (Alabama). OETD is in the process of developing a workscope.	0	992	0
Alternative fuel source study (Alabama). OETD is in the process of developing a workscope.	0	496	0
Transmission Reliability R&D	**11,431**	**15,600**	**9,220**

The Transmission Reliability R&D Activity supports modernization of the Nation's transmission infrastructure through information technologies that provide enhanced grid reliability and efficient electricity markets under competition. A real-time information platform will allow grid operators to monitor, track, predict and react to grid, market, and security operational trends to extract full capability from the transmission infrastructure while maintaining high-quality, low-cost, secure electricity delivery services. This includes developing real-time monitoring and control software tools and system operating models for grid operators, and market design research, including demand response integration, to support restructured markets development.

The Transmission Reliability R&D Activity focuses primarily on software for the transmission system, improving information flow to grid operators, and on the development of software at the transmission level.

The benefits of the Transmission Reliability R&D Activity include supporting the mission of the OETD program to modernize and expand the Nation's electricity delivery system to ensure a more reliable and robust electricity supply by developing information management, real time measurement, and reliability compliance systems that enable reliable power system operation and efficient electricity delivery through fair, competitive markets. This Activity also supports the integration of monitoring and control systems into the national grid, and the design and testing of competitive electricity markets through electricity industry partnerships, and OETD's goal of developing enhanced economic security through efficient electricity markets.

The Transmission Reliability R&D Activity also focuses on developing information management, wide area measurement, disturbance recognition, and reliability compliance monitoring systems to enable reliable system operation, efficient electricity markets, and compliance with electric reliability and security standards. This Activity collaborates with transmission system operators and other electricity industry stakeholders through peer reviews to identify electric transmission technology research needs. It also provides technical and analytical support to allow customers to control their own loads and participate in competitive electricity markets, performs experimental market monitoring and design analyses to identify market participant behavior and impacts, and conducts unbiased, third-party analysis on technically-based policy options for efficient, fair competitive markets.

	FY 2004	FY 2005	FY 2006
▪ **Real Time Grid Reliability Management**	**3,219**	**3,304**	**5,250**

Supports recommendations in the "National Energy Policy" (NEP), the "National Transmission Grid Study" (NTGS), and the "Final Report on the August 14, 2003, Blackout in the United

	(dollars in thousands)		
	FY 2004	FY 2005	FY 2006

States and Canada." The NEP calls for the Department to extend transmission reliability R&D and to conduct the NTGS. The NTGS contains 17 specific recommendations that call for technical support related to this activity, and the blackout report recommends that DOE expand research on reliability-related real time tools and technologies. This subactivity includes development of real time grid monitoring sensors, software and system deployment.

	FY 2004	FY 2005	FY 2006
▪ **Reliability and Markets**	**1,556**	**1,628**	**3,970**

Supports recommendations in the "National Energy Policy" (NEP), the "National Transmission Grid Study" (NTGS), and the "Final Report on the August 14, 2003, Blackout in the United States and Canada." The NTGS recommends that DOE research and identify reliability data and performance metrics, and evaluate performance-based regulations, in addition to accelerating development and demonstration of voluntary load reduction technologies and activities. The blackout report recommends a study of the relationship between markets and reliability.

	FY 2004	FY 2005	FY 2006
▪ **Congressionally Directed Activities**	**6,656**	**10,668**	**0**
Field testing of aluminum ceramic fiber composite conductors.	3,414	0	0
Power Grid Project, New Jersey and Pennsylvania, Drexel University.	1,907	0	0
Dine' Power Authority in New Mexico to continue development of the Navajo Transmission Project.	381	0	0
Indian Point Energy Center Study in New York.	954	0	0
SCADA Test Bed. OETD is in the process of developing a workscope.	0	4,962	0
Lead Carbon Acid Asymmetric Supercapacitor. OETD is in the process of developing a workscope.	0	2,977	0
University of Missouri-Rolla Electric Transmission Program. OETD is in the process of developing a workscope.	0	1,985	0
Electric Utility Transmission and Distribution Line Training. OETD is in the process of developing a workscope.	0	744	0

	FY 2004	FY 2005	FY 2006
Electric Distribution Transformation R&D	**13,464**	**5,418**	**4,037**

The mission of the Electric Distribution Transformation R&D is to transform today's electric distribution infrastructure into an adaptive power network that is reliable in power delivery, responsive to customer needs, and secure and resilient against power disturbance events. This mission will be accomplished through integration of transmission technologies as they pertain to distributed energy resources (DER), which includes distributed generation, energy storage and demand response, with electric power systems and enabled by development and implementation of interconnection

	(dollars in thousands)	
FY 2004	FY 2005	FY 2006

standards for distributed generation and through the distribution system modernization activities described in the GridWise Subprogram.

The benefit of the Electric Distribution Transformation Activity will enable the full integration of distributed resources into distribution operations, by developing and testing advanced interconnection standards and technologies to ensure interoperability of DER and between DER and the electric power system. This integration will lead to reduction in peak load through increased use of existing and new DER assets, and enhancement in system reliability and resilience through implementation of advanced distribution system concepts on adaptive islanding, microgrids, etc. The R&D conducted within the Electric Distribution Transformation R&D Activity supports the mission of the Electric Transmission & Distribution Program by ensuring greater system reliability and by increasing technology choices for expanding America's electricity delivery system.

	FY 2004	FY 2005	FY 2006
▪ **Peak Load Reduction**..	**3,117**	**2,794**	**4,037**

R&D will continue to focus on the planned progression in achieving interoperability of DER equipment and in aggregating DER at a scale to significantly support grid operations in demand response programs and ancillary services. To support achieving interoperability, development of the Institute of Electrical and Electronics Engineers (IEEE) P1547 series of standards, as companion standards to the published ANSI/IEEE 1547-2003 *Standard for Interconnecting Distributed Resources with Electric Power Systems*, will continue, and advanced modular plug-and-play interconnection technologies will be developed, tested, and validated to meet the prescribed standards requirements. To support achieving significant DER participation in grid operations and build on the completion of field demonstration of three DER aggregation designs in FY 2005 (each with an aggregation capacity of >10 MW), DER aggregation designs to a greater capacity (aggregation capacity of >multi-10s MW) will be initiated in FY 2006 for proof-of-concept testing, followed by field demonstration in FY 2007 and FY 2008, as a phased progression from commercial facility to industrial facility, utility, and smart utility levels.

The two focus areas of Peak Load Reduction, interconnection standards/technologies for DER and DER aggregation, will enable economic dispatch of DER to participate in demand response initiatives. This responds to two important areas of reliability research called out in Recommendation 13 of the *Final Report on the August 14, 2003 Blackout in the United States and Canada*: investigation of protection and control alternatives, including demand response, to slow or stop cascading power outages, and examination of the economic obstacles to the economic deployment of demand response and DER.

(dollars in thousands)

	FY 2004	FY 2005	FY 2006
▪ **Congressionally Directed Activities**	**10,347**	**2,625**	**0**
Testing of a microgrid in Vermont	238	0	0
Analysis of distributed energy and microgrid systems to improve electric reliability in Hawaii at the Natural Energy Laboratory in Hawaii	477	0	0
Electric Infrastructure Technology, Training and Assessment Program in Pennsylvania. Distribution infrastructure technology assessment and transfer	2,861	0	0
Research and development of packaged thermal energy and distributed energy systems at the Center for Distributed Generation and Thermal Distribution at Washington State University	477	0	0
Automated energy distribution and reliability systems in Indiana. Development of distributed energy solutions in industrial complexes.	954	0	0
Navajo electrification project	2,861	0	0
Research on advanced ceramic engines and materials for energy applications	286	746	0
Research at the Georgia Institute of Technology on the use of recycled carpet as fuel for kilns	286	0	0
The Connecticut Power Technologies Project. Demand response technology demonstration.	1,907	0	0
Center for Grid Modernization (Pennsylvania). OETD is in the process of developing a workscope.	0	1,482	0
Dine' Power Authority in New Mexico to continue development of the Navajo Transmission Project. OETD is in the process of developing a workscope.	0	397	0
Energy Storage R&D	**8,763**	**3,969**	**3,000**

Energy Storage R&D Activity includes research in advanced electrical energy storage systems aimed at increasing the reliability of the electric grid. Energy storage mediates between variable sources and variable loads. Some of the variations are the normal, cyclical variations produced by loads coming on and off, such as the day-night cycle. Some of these variations are abnormal, but expected as a result of equipment failures, rapid load changes or storms. In the case of security issues, these variations could be the result of malevolent actions. Whatever the cause, energy storage provides network operators with the opportunity to improve response to an event in a coordinated, planned manner.

	(dollars in thousands)	
FY 2004	FY 2005	FY 2006

The benefits of the Energy Storage R&D Activity include developing advanced electricity storage technologies supporting OETD's goal of modernizing America's electric delivery system to provide a reliable and robust electricity supply. This is done with strong industry partnership insuring the technologies developed will play a significant role in improving the operations of the electric delivery system. Energy storage technologies will improve the quality, reliability, flexibility and cost effectiveness of the existing system during normal operation. During abnormal operation, energy storage will provide a cushion or buffer that mitigates the effects of outages and limits their spread. The Energy Storage Activity supports Recommendation 13 of the "Final Report on the August 14, 2003, Blackout in the United States and Canada" by developing storage systems capable of providing both reactive and active power for transmission stability and voltage control. The "National Transmission Grid Study" recognizes that "distributed generation and storage allows customers to reduce reliance on the transmission system by `distributing` or placing generation and storage sources close to locations at which electricity is used." Improved energy storage technologies will allow for increased equipment utilization, and reduce the number and severity of transmission congestion events.

	FY 2004	FY 2005	FY 2006
▪ **Energy Storage R&D**	**2,087**	**1,985**	**3,000**

Energy Storage R&D Activity includes research on advanced energy storage systems for applications ranging from power quality enhancement, to substation reliability, to voltage support for transmission lines. Large scale, megawatt-level energy storage systems can significantly reduce transmission system congestion, help manage peak loads, and increase the reliability of the overall electric grid. Energy storage can also benefit transmission system stability by injecting power to quickly damp out system disturbances. Such disturbances have led to grid collapse and widespread costly blackouts. Storage will help relieve transmission bottlenecks through better operations, a goal identified in the *National Transmission Grid Study*. Energy storage will help make renewable energy sources more dispatchable, and control frequency and voltage deviations. These activities also support Chapter 7 of the *National Energy Policy* recommendations to develop a comprehensive energy delivery system.

The Activity emphasizes the design of storage systems with integrated power electronics and controls that are dedicated to improving the reliability of the grid. The Activity performs research on advanced storage systems and components, and conducts strategic research analysis developing economic and performance models to effectively guide future research. Technologies involved in the Energy Storage R&D Activity include advanced battery systems, flywheels, supercapacitors, power electronic and control systems.

In FY 2006, collaborative demonstration projects with the California Energy Commission will be operational with one year of service completed. Data collection - both economic and technical - will finish with final reports on the systems performance. A second joint State energy project with New York Energy Research and Development Authority will involve testing. Power electronics activities will include full power testing of an Emitter Turn-Off (ETO) based inverter in collaboration with the Navy and the refining of a cascade inverter concept and electro-optic

	FY 2004	FY 2005	FY 2006

(dollars in thousands)

sensing that was developed under a Small Business Innovation Research contract.

	FY 2004	FY 2005	FY 2006
▪ **Congressionally Directed Activities**	**6,676**	**1,984**	**0**
Continue development of bipolar nickel metal hydride battery storage system	954	1,984	0
Research, development and demonstration of advanced thermal energy storage technology integrated with renewable energy technology.	1,907	0	0
Electricity transmission research at the University of Missouri-Rolla.	954	0	0
Research into lead carbon acid asymmetric supercapacitors.	2,861	0	0
GridWise	**691**	**6,448**	**5,500**
▪ **GridWise**	**691**	**3,472**	**5,500**

The mission of the GridWise Activity is to modernize the Nation's electric infrastructure by employing real time controls at the local level, along with advanced communication and information technologies. The activity will help achieve a more resilient electric system by incorporating automated system reconfiguration ("self-healing") to more quickly overcome power disruptions. Unlike GridWorks - which focuses on hardware technologies - GridWise focuses on distribution level software technologies, and unlike Transmission Reliability - which focuses on the transmission system and improving information available to grid operators - GridWise focuses primarily on the distribution system and improving the information flow to, and increasing control among, end users and utilities.

The benefits of GridWise include enabling a higher level of reliability and efficiency primarily at the local level. Using advancements in high-tech industries, GridWise will deliver real-time information via an integrated network that functions much as a nervous system in a living organism. Access to this continuous information stream enables timely detection and reaction to pressures on the energy system, allows for a more informed decision-making process, and provides customers with choices and empowerment to participate in electric/market operations - all of which leads to increased electric distribution reliability, efficiency and affordability for individuals, organizations, and the country, in accordance with the mission of OETD.

GridWise includes development of sensors, monitoring systems, and distributed control to create a smart electric power network for electric distribution. Strategic placement of distributed control systems with built-in intelligence will significantly improve management and optimization of distribution system performance and its response to any potential disturbance. The distributed intelligence will also allow broad customer participation in load/demand management to further enhance grid reliability by decreasing unnecessary power drains on the system. These activities improve the capabilities and tools for system

	(dollars in thousands)		
	FY 2004	FY 2005	FY 2006

monitoring and management, which supports Transmission Reliability R&D in addressing recommendation 13 of the "Final Report on the August 14, 2003 Blackout in the United States and Canada" investigation of protection and control alternatives, including demand response, to slow or stop cascading power outages, and examination of the economic obstacles to the economic deployment of demand response and DER.

A key objective of GridWise is architecture/standards development to enable the operational principle of Grid 2030 — i.e. that all components and systems in the Nation's power grid will be interoperable, including with the existing legacy systems. GridWise pursues an open architecture collaborative design and analysis environment to allow integration of all vendor products that meet the open-source standards. In FY 2006, GridWise system architecture and standards development will continue, using the resources of the Architecture Council and representative constituencies of utility/communications/information technology sectors. GridWise will work in collaboration with the Transmission Reliability R&D Activity to provide continued support for development of an advanced simulation tool to model the effects of market rules and price signals on demand/load management responses. This activity should improve the balance between electricity supply and demand, which in turn contributes to improved grid reliability.

Also, GridWise will support a utility consortium's efforts to improve timely location of faults and notification of utilities of feeder problems, and improve recovery measures with development of real-time monitors for fault detection/anticipation on distribution lines. This fault location/recovery system project supports recommendation 11 of the "Report of the DOE Power Outage Study Team on Electric Reliability Events of the Summer 1999" to develop technologies and expertise to reduce electric power system outage vulnerabilities.

	FY 2004	FY 2005	FY 2006
▪ **Congressionally Directed Activities.......................**	**0**	**2,976**	**0**
Northwest Indiana Electric Infrastructure Project. OETD is in the process of developing a workscope. .	0	1,488	0
Iowa Stored Energy Plant underground aquifer. OETD is in the process of developing a workscope. .	0	1,488	0
GridWorks	**0**	**5,456**	**5,000**
▪ **GridWorks...**	**0**	**3,472**	**5,000**

Developing the infrastructure of the modern, 21st century electric grid necessitates integration of a portfolio of advanced, deployable hardware technologies to meet reliability, efficiency, and affordability objectives. Under GridWorks, these advanced hardware technologies -- including transformers, cables, conductors, power electronic devices, and sensors -- are integrated into systems that will modernize the key attributes of the grid, and provide the platform necessary for the control, communication, and information technologies of GridWise. GridWorks focuses primarily on integrating advanced hardware technologies into systems that will modernize the key attributes of the grid, and provide the platform necessary for the control, communication, and information technologies.

Without GridWorks, industry most likely will resort to stop-gap measures to address reliability problems, as power outages become more frequent with the Nation's infrastructure aging beyond its design life. Solutions will not be integrated in a way that supports the grid as a whole, but rather will reflect each utility's individual short-term concerns. Progress toward modernizing and expanding the electric grid will be slower, less systematic, and more piecemeal than the integrated approach under GridWorks.

GridWorks funds effort in three major areas: 1) cables and conductors; 2) substation and auxiliary equipment; and 3) power electronics.

1. Work in cables and conductors involves accelerating the development and testing of advanced underground cables and advanced conductors that will enable expansion of transmission and distribution capacity by using existing rights-of-way and avoiding the need for new siting. This activity supports the recommendation in the National Transmission Grid Study to accelerate development and demonstration of grid-related technologies, and to evaluate them at a national test center.

The transmission of electricity over long distances and at higher voltages has become an important component of a modernized electric system. Transmission and distribution capacity need to be increased in order to relieve congestion costs, and ensure the reliable and efficient operation of the grid. Furthermore, siting new transmission lines is time-consuming and expensive, and often meets with public resistance.

2. GridWorks will accelerate the development of advanced substation equipment. Substations are located at both ends of the transmission line, and play an essential role in the successful transmission of electricity throughout the grid. A transmission substation, located near the power plant, uses large transformers to increase the generated voltage to extremely high voltages (tens or hundreds of thousands of volts) for long-distance transmission on the grid. And at the other end of the transmission line, a distribution substation uses transformers to step transmission voltages down to distribution voltages (typically less than 35,000 volts).

Failure of a transformer can be catastrophic. Maintaining a supply of spares is complicated by the variety of sizes in use, and thus can become considerably costly to utilities, and ultimately to consumers. Real-time procurement is not an option since domestic manufacturers are limited, and the lead-time for replacement is months. Thus, GridWorks will conduct research in the area of advanced transformers.

In addition, a distribution substation has circuit breakers, switches, and other protective devices so that distribution lines can be disconnected when necessary. GridWorks will develop faster fault protection equipment to limit the propagation of faults throughout the electric system.

3. With regards to power electronics, GridWorks will conduct research to further development of advanced high voltage, high current, high frequency power switches, including technical analysis of Diamond and SiC (silicon carbon)-based power electronics that offer the potential to improve the mechanical robustness and increase the service lifetime of power electronic

	(dollars in thousands)		
	FY 2004	FY 2005	FY 2006
devices for electric system applications.			
Presently, faults and instability in an electrical grid are detected by protective relaying, and cleared by operation of circuit breakers or fuses. Advanced power electronics holds the promise of much faster stability protection and clearing of faults, which in turn prevent cascading outages that lead to larger blackouts.			
▪ **Congressionally Directed Activities.......................**	**0**	**1,984**	**0**
Development of high-power silicon-carbide based power electronics systems. OETD is in the process of developing a workscope.	0	992	0
Large Scale Energy Center (Michigan). OETD is in the process of developing a workscope.....................	0	992	0
Total, Research and Development	**71,499**	**91,453**	**71,757**

Explanation of Funding Changes

	FY 2006 vs. FY 2005 ($000)
High Temperature Superconductivity R&D	
▪ **Superconductivity Partnerships**	
Funding is increased to restore U.S. industry cooperative development of prototype transmission cables, motors, generators, energy storage flywheels, and fault current limiters...	**+1,000**
▪ **Second Generation Wire Development**	
Funding is increased to accelerate the development of second-generation HTS wires, which are essential for development of electric power technologies such as motors, generators and transformers that operate with significant magnetic fields. Based on not meeting the HTS FY 2004 annual performance target due to problems associated with first generation wire in completing testing of a superconducting transformer using first generation wire, more resources are needed to be devoted to developing second generation wire. The technology associated with second generation wire is more advanced and robust than first generation wire, and it likely will improve the performance of superconducting transformers and thereby improve the reliability and efficiency of electric transmission.	**+2,615**

	FY 2006 vs. FY 2005 ($000)
▪ **Strategic Research**	
Funding is increased to restore cooperative strategic research between the national laboratories and U.S. industry for development and testing of more efficient and higher-capacity refrigeration systems needed for superconducting power equipment.	**+1,704**
▪ **Congressionally Directed Activities**	
Florida university electric power infrastructure and security research. No funds requested	-4,961
Camp Dawson energy assurance training center. No funds requested.	-4,960
Advanced thermal storage with renewable energy. No funds requested.	-1,984
Ionic fluids research for power. No funds requested.	-1,488
Smart Energy Management. No funds requested.	-992
Alternative fuel source study. No funds requested.	-496
Total, Congressionally Directed Activities	**-14,881**
Total Funding Change, High Temperature Superconductivity R&D	**-9,562**
Transmission Reliability R&D	
▪ **Real Time Grid Reliability Management**	
Increase accelerates development and deployment of real time grid monitoring systems in the Eastern United States and research to upgrade power systems analysis software to incorporate real time data. Based on the performance successes in FY 2004 and early FY 2005 with regards to installing and operating a prototype wide area measurement system in the Nation's Eastern Interconnection - to further build on the successes that will help make the Nation's transmission infrastructure more reliable.	**+1,946**
▪ **Reliability and Markets**	
Increase accelerates research and development in market design and evaluation, and in demonstration of demand responsive load as spinning reserve capacity.	**+2,342**
▪ **Congressionally Directed Activities**	
SCADA Test Bed Idaho National Engineering Laboratory. No funds requested	-4,962

	FY 2006 vs. FY 2005 ($000)
Lead carbon acid asymmetric supercapacitor. No funds requested.	-2,977
University of Missouri-Rolla electric transmssion program. No funds requested.	-1,985
Electric utility transmission and distribution line training. No funds requested.	-744
Total, Congressionally Directed Activities	**-10,668**
Total Funding Change, Transmission Reliability R&D	**-6,380**
Electric Distribution Transformation R&D	
▪ **Peak Load Reduction**	
Support research which builds on the completion of field demonstrations of DER aggregation designs in FY 2005 with a capacity of >10 MW.	**+1,243**
▪ **Congressionally Directed Activities**	
Research on advanced ceramic engines and materials for energy applications. No funds requested.	-746
Center for Grid Mondernization (PA). No funds requested.	-1,482
Dine' Power Authority (New Mexico). No funds requested.	-397
Total, Congressionally Directed Activities	**-2,625**
Total Funding Change, Electric Distribution Transformation R&D	**-1,382**
Energy Storage R&D	
▪ **Energy Storage R&D**	
Increase covers technical management and monitoring of highly leveraged joint energy projects with New York State and California as these projects become fully operational.	**+1,015**
▪ **Congressionally Directed Activities**	
Bi-polar Ni-Mh wafer cell battery storage. No funds requested.	-1,984
Total, Congressionally Directed Activities	**-1,984**
Total Funding Change, Energy Storage R&D	**-969**

	FY 2006 vs. FY 2005 ($000)
GridWise	
▪ **GridWise**	
Initiate R&D of real-time monitors for the detection and anticipation of distribution line faults to reduce electric power system outage vulnerabilities.	**+2,028**
▪ **Congressionally Directed Activities**	
Northwest Indiana Electric Infrastructure Project. No funds requested.	-1,488
Iowa Stored Energy Plant underground aquifer. No funds requested.	-1,488
Total, Congressionally Directed Activities	**-2,976**
Total Funding Change, GridWise ………..	**-948**
GridWorks	
▪ **GridWorks**	
Increase supports research in the areas of cable and conductors, substation and auxiliary equipment, and power electronics	**+1,528**
▪ **Congressionally Directed Activities**	
Development of high power silicon-carbide based power electronics systems. No funds requested.	-992
Large Scale Energy Center (Michigan). No funds requested.	-992
Total, Congressionally Directed Activities	**-1,984**
Total Funding Change, GridWorks………	**-456**
Total Funding Change, Research and Development	**-19,696**

Electricity Restructuring

Funding Schedule by Activity

(dollars in thousands)

	FY 2004	FY 2005	FY 2006	$ Change	% Change
Electricity Restructuring					
Electric Markets Technical Assistance	2,020	3,646	5,000	+1,354	+37.1%
Blackout Investigation	4,905	0	0	0	0.0%
Energy Security and Assurance	0	0	7,400	+7,400	+100.0%
Congressionally Directed Funding	12,426	16,196	0	-16,196	-100.0%
Total, Electricity Restructuring	19,351	19,842	12,400	-7,442	-37.5%

Description

The mission of the Electricity Restructuring subprogram is to provide technical assistance and analytical support to States and regions for policies, market mechanisms, and activities that facilitate competitive, reliable, environmentally sensitive, and customer-friendly wholesale and retail electric markets. The mission includes modeling and analysis to identify the causes of reliability events and to develop recommendations for avoiding such future events.

In FY 2005, the Office of Energy Security and Assurance merged into OETD per Congressional direction. The President has designated the Department of Energy as the Lead Sector Specific Agency responsible for protecting the Nation's critical energy infrastructure. The Energy Security and Assurance activity is responsible to the Secretary of Energy for coordinating and carrying out these responsibilities of the Department of Energy.

Benefits

Using education and outreach, the Electricity Restructuring subprogram helps States, regional electric grid operators, and Federal agencies develop policies, market mechanisms, regulations, State laws, and programs that facilitate the Office of Electric Transmission and Distribution's mission to modernize and expand America's electric grid to ensure a more reliable and robust electric supply.

The Energy Security and Assurance activity will engender an immediate benefit that will increase the security, reliability and resiliency of the U.S. energy infrastructures. Benefits include:

- Improved execution of energy security and emergency response programs by training State and local governments, administering programs to facilitate information sharing, and coordinating planning among the energy sector, States, and Federal agencies.

- Reduced vulnerability of critical energy assets by facilitating vulnerability assessments and working with Federal and industry partners on protection programs.
- Decreased attractiveness to use energy assets as weapons.
- Improved public safety and reduced recovery time following an energy disruption by assisting state and local governments in improving their energy assurance and response strategies, and supporting emergency operations.
- Mitigating the likelihood and impact of disruptions to the energy infrastructure and other critical infrastructures.
- Motivating increased private investment in energy security by raising awareness of energy security and reliability issues, and developing strategies that encourage private investment.

Detailed Justification

	(dollars in thousands)		
	FY 2004	FY 2005	FY 2006
Electric Markets Technical Assistance..........................	**2,020**	**3,646**	**5,000**

Expert technical assistance is provided on an as-requested basis to State public utility commissions, State legislatures, regional State associations, regional transmission organizations/independent system operators, Federal officials and Governors' offices. This includes technical assistance to States, with substantial State public purpose ("system benefit") funds, that are members of the Clean Energy Funds Network. Technical assistance to these States focuses on best management practices. Topics of technical assistance, or supporting technical analysis, are the reliable and efficient supply and delivery of retail electric service and portfolio management, which includes demand response (peak load response) and other policy and market mechanisms for energy efficiency and renewable energy technologies in electricity markets. Electric Markets Technical Assistance provides technical assistance in these same subjects increasingly to existing and emerging regional electricity organizations that are responsible for wholesale power system operations or coordination among State regulators.

Emphasis will be given to technical assistance to existing or emerging regional electric market grid operators and related groups to support better regional transmission and resource planning methods as an essential step in the process of gaining public acceptance and regulatory approvals for the development of new grid infrastructure.

A parallel effort will focus on analysis and monitoring implementation of the reliability and other recommendations contained in the April 2004 "Final Report on the August 14, 2003, Blackout in the United States and Canada: Causes and Recommendations" and related actions directed by the U.S. Congress in energy legislation.

Emphasis will also be given to rapid dissemination of findings of sponsored technical analyses, accomplished in partnership with State, regional, and national organizations that have roles in electric markets and regulation. Electric Markets Technical Assistance serves as a clearinghouse to assist and inform State- and regionally-based policymakers on electricity market policies and programs. This subprogram respects State and regional differences and avoids directing their actions.

	(dollars in thousands)		
	FY 2004	FY 2005	FY 2006

Electric Markets Technical Assistance will also begin the second cycle under the biannual National Interest Transmission Bottleneck identification process started in FY 2004. This process implements the "National Energy Policy's National Transmission Grid Study" recommendation to identify transmission bottlenecks (chokepoints) that are especially significant as threats to grid reliability or barriers to economic efficiency. These bottlenecks, called "National Interest Electric Transmission Bottlenecks," are identified through a two-year open and public process using input from industry, States, independent experts, and other stakeholders to focus industry, State, regional and government attention on resolving these major bottlenecks. After identifying bottlenecks, DOE will work pragmatically with affected parties to identify appropriate investments and remove obstacles to their realization.

Funds will also be used to accelerate identification of pre-approved transmission corridors across Federal lands in the Western U.S., including work with other Federal agencies and States on needed environmental impact statements.

Additional areas of possible transmission and reliability policy analyses include these items from the "National Transmission Grid Study" review of the adequacy of Federal reliability and transmission data collection; development of objective standards for performance evaluation of Regional Transmission Organizations (RTOs); exploring how to encourage electric infrastructure investments, including newer more efficient yet riskier technologies; and investigation of benefits from bulk power "superhighways" and other alternative electric grid architectures.

Blackout Investigation	**4,905**	**0**	**0**

For FY 2005 and FY 2006, work related to the August 2003 blackout investigation and implementation of its recommendations is combined with Electricity Restructuring subprogram.

These funds were used in FY 2004 to conduct an extensive investigation, including modeling and analysis, into the August 14, 2003, blackout that affected 50 million people in Midwestern and Northeastern States as well as Canada. The investigation was conducted to meet the needs of the U.S. – Canada Power Outage Task Force, who are seven U.S. and Canadian government officials. Based on the investigation, the Task Force issued its final report in April 2004. The Task Force's "Final Report on the August 14, 2003, Blackout in the United States and Canada" identified the causes of the blackout and made 46 key recommendations for immediate action by industry and government in both the U.S. and Canada to prevent and minimize future electric grid disturbances. The charter of the Task Force was extended into FY 2005 to ensure that its recommendations for action are implemented.

Energy Security and Assurance	**0**	**0**	**7,400**
▪ **State/Local Government Partnerships**	**0**	**0**	**2,000**

Assist States with energy security activities and energy disruption plans. Provide guidelines and tools to help States perform vulnerability assessments. Operate and expand the Energy Emergency Assurance Coordinators system, a communications protocol for State- and local-level

	(dollars in thousands)		
	FY 2004	FY 2005	FY 2006
energy personnel and DOE.			
▪ **Training and Exercises**	**0**	**0**	**1,100**
Conduct training, education, simulations, and outreach that will permit State and local governments to improve energy security practices and emergency planning and response capabilities.			
▪ **Visualization**	**0**	**0**	**1,350**
Develop visualization and modeling capabilities to create simulations for training State and local governments and tracking in real time emerging energy sector problems. This activity facilitates increased understanding of energy sector security and reliability issues and critical interdependency issues with other sectors like banking and finance, water and transportation and supports informed decision making during energy disruptions.			
▪ **Criticality/Vulnerability Assessment**	**0**	**0**	**950**
Partner with industry and the Department of Homeland Security (DHS) to conduct or facilitate in-depth vulnerability assessments and prioritize critical energy assets and nodes in oil, gas, and electricity sensors. This activity also supports tactical vulnerability and security exercises conducted in cooperation with DHS.			
▪ **Private Sector Collaboration**	**0**	**0**	**2,000**
Engage the electric sector in programs and practices to enhance security, support security clearances for key energy sector personnel, and develop working relationships with private sector entities on energy security and assurance issues.			
Congressionally Directed Activities	**12,426**	**16,196**	**0**
Northwest Regional Development Project. OETD is in the process of developing a workscope.	0	1,488	0
Pacific Northwest Bi-National Regional Planning Initiative (AK). OETD is in the process of developing a workscope.	0	322	0
Camp Dawson physical improvements. OETD is in the process of developing a workscope.	0	3,968	0
State/Local Government Partnerships. Assist States with energy security activities and energy disruption plans. Provide guidelines and tools to help States perform vulnerability assessments. Operate and expand the Energy Emergency Assurance Coordinators system, a	1,269	2,917	0

	(dollars in thousands)		
	FY 2004	FY 2005	FY 2006
communications protocol for State- and local-level energy personnel and DOE.			
Training and Exercises. Conduct training, education, simulations, and outreach that will permit State and local governments to improve energy security practices and emergency planning and response capabilities.	3,275	1,528	0
Visualization. Develop visualization and modeling capabilities to create simulations for training State and local governments and tracking in real time emerging energy sector problems. This activity facilitates increased understanding of energy sector security and reliability issues and critical interdependency issues with other sectors like banking and finance, water and transportation and supports informed decision making during energy disruptions.	2,094	1,875	0
Criticality/Vulnerability Assessment. Partner with industry and the Department of Homeland Security (DHS) to conduct or facilitate in-depth vulnerability assessments and prioritize critical energy assets and nodes in oil, gas, and electricity sensors. This activity also supports tactical vulnerability and security exercises conducted in cooperation with DHS.	3,838	1,319	0
Private Sector Collaboration. Engage the electric sector in programs and practices to enhance security, support security clearances for key energy sector personnel, and develop working relationships with private sector entities on energy security and assurance issues.	1,950	2,779	0
Total, Electricity Restructuring	**19,351**	**19,842**	**12,400**

Explanation of Funding Changes

	FY 2006 vs. FY 2005 ($000)
Electric Markets Technical Assistance	
Increase analysis needed for monitoring and implementation of improved electric grid reliability standards and other recommendations from U.S. – Canada Power System Outage Task Force Final Report on the August 2003 Blackout. Increase technical assistance to States and regions on policies and regulations to encourage investments in electric grid reliability and grid modernization	+1,354
Total, Electric Markets Technical Assistance	**+1,354**
Energy Security and Assurance	
▪ **State/Local Government Partnerships**	
Increase to assist States with energy security activities and energy disruption plans. Provide guidelines and tools to help states perform vulnerability assessments. Operate/expand the Energy Emergency Assurance Coordinators system, a communications protocol for State- and local-level energy personnel and DOE.	+2,000
▪ **Training and Exercises**	
Increase to conduct training, education, simulations, and outreach that will permit energy sector stakeholders to improve emergency planning and response capabilities	+1,100
▪ **Visualization**	
Increase to develop visualization and modeling capabilities to create simulations for training stakeholders and tracking in real time emerging energy sector problems. This activity facilitates increased understanding of energy sector security and reliability issues and critical interdependency issues with other sectors like banking and finance, water and transportation and supports informed decision making during energy disruptions	+1,350
▪ **Criticality/Vulnerability Assessment**	
Increase to partner with industry and DHS to conduct or facilitate in-depth vulnerability assessments and prioritize critical energy assets and nodes in oil, gas, and electricity sectors. This activity also supports tactical vulnerability and security exercises conducted in cooperation with DHS	+950

	FY 2006 vs. FY 2005 ($000)
▪ **Private Sector Collaboration**	
Increase to engage the electric sector in programs and practices to enhance security, to support security clearances for key energy sector personnel, and to develop working relationships with private sector entities on energy security and assurance issues…………………………..	+2,000
Total, Energy Security and Assurance…..	**+7,400**
Congressionally Directed Activities	
Northwest Regional Development Project. No funding requested...	-1,488
Pacific Northwest Bi-National Regional Planning Initiative (AK). No funding requested…………………………………	-322
Camp Dawson physical improvements. No funding requested.……..	-3,968
State/Local Government Partnerships. No funding requested.	-2,917
Training and Exercises. No funding requested.………………………	-1,528
Visualization. No funding requested.……………………………………......................	-1,875
Criticality/Vulnerability Assessment. No funding requested.…………	-1,319
Private Sector Collaboration. No funding requested.…………………	-2,779
Total, Congressionally Directed Activities	**-16,196**
Total Funding Change, Electricity Restructuring	**-7,442**

Construction

Funding Schedule by Subactivity

(dollars in thousands)

	FY 2004	FY 2005	FY 2006	$ Change	% Change
Construction					
Project Engineering & Design	736	769	0	-769	-100.0%
Total, Construction	736	769	0	-769	-100.0%

Description

The mission of the Energy Reliability and Efficiency Laboratory (EREL) is to research and develop electric transmission and distribution technologies, distributed energy resources and demand-responsive building systems in order to create an electric grid that is reliable, efficient and affordable, as well as secure and environmentally sound.

Benefits

EREL will help the Office of Electric Transmission and Distribution develop an electric grid that is reliable, efficient and affordable. In addition, EREL will contribute to security from physical and cyber terrorism, the flexibility of incorporating both central and distributed generation, the use of embedded intelligence to manage power flows under normal and emergency circumstances, and meets the Nation's growing needs for increased transmission capacity and power quality.

The EREL facility will provide R&D resources needed to successfully develop and introduce high temperature superconducting (HTS) cables, advanced overhead conductors, power electronics, and sensors and controls that can help expand and modernize the grid, relieve transmission constraints and improve system reliability. It will develop integrated energy systems that optimize and integrate end-use generation and combined heat and power to achieve greater energy efficiency, high power quality, and reliability. Finally, the EREL facility will develop and verify the performance of advanced building systems that integrate heating and cooling equipment, appliances and building materials, with the communications, sensors and controls required for price-responsive demand.

Detailed Justification

	(dollars in thousands)		
	FY 2004	FY 2005	FY 2006
Project Engineering & Design (PED)............................	**736**	**769**	**0**

In FY 2004, Oak Ridge National Laboratory (ORNL) provided project management and will award an Architect-Engineer (AE) contract for the project design. The preliminary design will be completed and the Critical Decision 2 (CD2) ? DOE's approval of the performance baseline ? also will be completed in early calendar 2005.

A life cycle cost analysis was conducted to examine two alternatives to new construction: (1) renovation of existing laboratories and offices at ORNL, and (2) lease space from the private sector. For the renovation alternative, adequate space at various locations throughout the complex would be upgraded to meet the needs, goals and objectives of the DOE/OETD R&D program initiatives. Leasing space from the private sector includes modifying the space from the private sector to meet the needs of the EREL and returning the facility to its original condition upon completion of the research program. The results indicate that construction of the new facility as proposed has the lowest present value life cycle cost.

All DOE facilities, including EREL, are designed and constructed in accordance with applicable Public Laws, Executive Orders, OMB Circulars, Federal Property Management Regulations, and DOE Orders. The total estimated cost of the project includes the cost of measures necessary to assure compliance with Executive Order 12088, "Federal Compliance with Pollution Control Standards"; section 19 of the Occupational Safety and Health Act of 1970, the provisions of Executive Order 12196, and the related Safety and Health provisions for Federal Employees (CFR Title 29, Chapter XVII, Part 1960); and the Architectural Barriers Act, Public Law 90-480, and implementing instructions in 41 CFR 101-19.6. This project will be located in an area not subject to flooding determined in accordance with the Executive Order 11988. DOE has reviewed the U.S. General Services Administration (GSA) inventory of Federal Scientific laboratories and found insufficient space available, as reported by the GSA inventory.

Preliminary design work for this facility will continue in FY 2005. Start of construction has been postponed until FY 2007 due to funding of higher priority activities.

Total, Construction..	**736**	**769**	**0**

Explanation of Funding Changes

	FY 2006 vs. FY 2005 ($000)
Construction	
Project Engineering and Design	
Construction has been postponed until FY 2007 due to funding of higher priority activities……………………………………………………………………………………	-769
Total Funding Change, Construction……	**-769**

Program Direction

Funding Profile by Category

(dollars in thousands/whole FTEs)

	FY 2004	FY 2005	FY 2006	$ Change	% Change
Chicago Operations Office					
Argonne National Laboratory					
Support Services	0	100	200	+100	+ 100.0%
Total, Argonne National Lab................................	0	100	200	+100	+ 100.0%
Full Time Equivalents..............	0	0	0	0	+ 0.0%
Chicago Field Office					
Salaries and Benefits	301	372	411	+39	+10.5%
Travel	38	60	60	0	+ 0.0%
Support Services	26	40	40	0	+ 0.0%
Other Related Expenses	0	80	80	0	+ 0.0%
Total, Chicago Field Office	365	552	591	+39	+7.1%
Total, Chicago Operations Office	365	652	791	+139	+ 21.3%
Full Time Equivalents	2	3	3	0	+ 0.0%
Idaho Operations Office					
Salaries and Benefits	148	0	0	0	+ 0.0%
Travel	19	0	0	0	+ 0.0%
Support Services	30	0	0	0	+ 0.0%
Other Related Expenses	0	0	0	0	+ 0.0%
Total, Idaho Operations Office	197	0	0	0	+ 0.0%
Full Time Equivalents	1	0	0	0	+ 0.0%
NETL					
Salaries and Benefits	3,397	0	0	0	+ 0.0%
Travel	59	0	0	0	+ 0.0%
Support Services	0	0	0	0	+ 0.0%
Other Related Expenses	24	0	0	0	+ 0.0%
Total, NETL...	3,480	0	0	0	+ 0.0%
Full Time Equivalents	19	0	0	0	+ 0.0%

(dollars in thousands/whole FTEs)

	FY 2004	FY 2005	FY 2006	$ Change	% Change
Headquarters					
Salaries and Benefits	4,345	5,842	7,489	+1,647	+ 28.2%
Travel	285	480	690	+210	+ 43.8%
Support Services	128	357	850	+493	+ 138.1%
Other Related Expenses	827	804	1,627	+823	+ 102.4%
Total, Headquarters	5,585	7,483	10,656	+3,173	+ 42.4%
Full Time Equivalents	20	43	46	+3	+ 7.0%
Total Program Direction					
Salaries and Benefits	8,191	6,214	7,900	+1,686	+ 27.1%
Travel	401	540	750	+210	+ 38.9%
Support Services	184	497	1,090	+593	+ 119.3%
Other Related Expenses	851	884	1,707	+823	+ 93.1%
Total, Program Direction	9,627	8,135	11,447	+3,312	+ 40.7%
Total, Full Time Equivalents	23	46	49	+3	+ 6.5%

Mission

Program Direction provides the Federal staffing resources and associated costs required to provide overall direction and execution of the Office of Electric Transmission and Distribution. It also includes associated properties, equipment, supplies and materials required for supporting the responsive management and oversight of programs. Activities also include necessary funds for support service contractors, equipment, and travel.

DOE's Strategic and General Goals will be accomplished not only through the efforts of the major program offices in the Department but with additional effort from staff offices that support the programs in carrying out the mission. DOE's staff offices perform critical functions necessary for success in achieving the Department's goals which include, but are not limited to, managing information technology, ensuring sound legal advice and fiscal stewardship, developing and implementing uniform program policy and procedures, maintaining and supporting our workforce, safeguarding our work spaces, and providing Congressional and public liaison.

As stated in the Departmental Strategic Plan, DOE's Strategic and General Goals will be accomplished not only through the efforts of the major program offices in the Department, but with additional effort from offices which support the programs in carrying out the mission. The Office of Electric Transmission and Distribution performs critical functions which directly support the mission of the Department. These functions include providing for reliable delivery of energy, improving energy efficiency, exploring advanced technologies that make a fundamental change in our mix of energy options, and guarding against energy emergencies.

In FY 2005, the Import/Export Authorization (IEA) electricity activity was transferred from Fossil Energy under the Interior and Related Agencies Appropriation to OETD under the Energy Supply Appropriation because its activities directly support the mission of OETD to ensure a robust and reliable electric supply by increasing the supply of imported electricity.

Consistent with the Conference Report to the Consolidated Appropriations Act 2005, the Energy Security and Assurance Program activities were merged with the OETD. Program Direction funds will provide the programmatic management of energy assurance activities and enable the Department to execute its emergency support responsibilities as mandated by Homeland Security Presidential Directive 8 – "National Preparedness".

Detailed Justification

	(dollars in thousands)		
	FY 2004	FY 2005	FY 2006
Salaries and Benefits	**8,191**	**6,214**	**7,900**

Funds a total of 49 FTEs that will provide the executive management, program oversight, analysis, and information required for the effective implementation of the OETD programs.

The DOE Headquarters component has 46 FTEs who are responsible for the development of policies, strategic plans and related guidance to program offices; evaluation of program performance; formulation, defense and execution of budgets; as well as communications with the public and stakeholders regarding polices, funding, program performance and related issues.

OETD Program Direction also supports three Chicago Field Office personnel who are accountable for contract acquisition and management, as well as direct R&D project direction and monitoring.

In addition, headquarters salaries and benefits includes $762K for 6 FTEs that are responsible for performing the congressionally mandated electricity functions of the Import/Export Authorization (IEA) activity, which grants and/or modifies Presidential permits for the construction, operation, maintenance and connection of electric transmission facilities at the U.S. international borders. IEA manages the regulatory review of exports of electricity and the construction and operation of electric transmission lines which cross U.S. international borders. These regulatory activities help promote the national energy strategy goal of securing future energy supplies by helping to ensure availability of competitively priced electricity supplies in a competitive and environmentally sound manner. The activity also ensures that exports of electric energy and the construction of new international electric transmission lines do no adversely impact on the reliability of the U.S. electric power supply system and that electricity trade occurs in the freest possible marketplace.

OETD Program Direction also includes $4.6M for salaries and benefits at Headquarters for 20 FTEs that are responsible for performing the functions of the Energy Security and Assurance functions by

	(dollars in thousands)		
	FY 2004	FY 2005	FY 2006

coordinating energy infrastructure protection, planning, and energy reliability functions with 50 States, four territories, and 87,000 local jurisdictions. These FTEs support State and local governments in developing State energy assurance plans and preparing for energy disruptions. Staff oversees training of industry and State/local government stakeholders, conducts energy emergency exercises, and develops tools to understand and visualize energy system operations and emergencies. Coordinates critical infrastructure identification and prioritization activities with the oil, gas, coal, and electricity sectors. Staff leads efforts to conduct and facilitate vulnerability assessments. Provides technical and analytical support to monitor the supply/demand of energy; respond to energy disruptions; and restore energy systems during disasters.

Travel...	**401**	**540**	**750**

Travel will allow OETD to effectively manage R&D programs and provide technical outreach to regional, State and local organizations. Of the amount requested, $17K would be used by staff performing IEA activities. Also includes $799 for E-Travel expenses.

Additionally, the OETD travel estimate includes $200K for regional meetings to coordinate energy assurance activities, participation in vulnerability and criticality assessments, required regional training and emergency exercises, participation in National Response Plan regional coordination meetings, and ongoing partnership development activities with states, local governments, and the private sector.

Support Services..	**184**	**497**	**1,090**

Includes funding for support service contractors, equipment, and general OETD initiatives that support all energy resources programs. Provides support services needed for energy technology specific advisement on critical science, engineering, environmental, economic, and legal issues; safety and health support; facility safeguards and security; computer systems development along with subsequent hardware and software installation, configuration and maintenance activities. A critical level of contracted skills and abilities is necessary to help assess and exploit the potential of energy technologies, as well as implement the President's Management Agenda to the fullest extent possible.

Of the amount requested in FY 2006, $535K will be used to provide for contractor support to execute IEA activities. This constitutes an increase of $305K in environmental contractor services for IEA activities which is needed to provide the environmental analyses required to process an increased number of Presidential permit applications.

In addition, funding will provide critical technical services to Energy Assurance including support of protection programs and exercises; development and maintenance of online applications to communicate with state/local energy personnel; technical review of methodologies to identify critical energy assets; development of criteria for prioritizing energy assets; identification of needs and approaches for training. This funding will also provide critical management services to EA including development of strategic and program plans; support for EA's National Laboratory Coordinating Council (LCC); website development and design; preparation of outreach and communication materials; support for EA emergency functions; stakeholder and contact database development;

	(dollars in thousands)		
	FY 2004	FY 2005	FY 2006

support for program reviews; logistical support for meetings and conferences; development of program metrics; assistance with budget, President's Management Agenda, and security reporting requirements.

Other Related Expenses..	**851**	**884**	**1,707**

This includes working capital expenses such as rent, supplies, copying, graphics, mail services, printing, and telephones. This also includes equipment replacements, credit card procurements, training, and other needs to sustain federal staff not identified in above categories. Also, this provides training, supplies and working capital fund costs for the six IEA program staff, $4.4K for E-Government expenses and $13K for STARS operations and maintenance assessment.

Total, Program Direction..	**9,627**	**8,135**	**11,447**

Explanation of Funding Changes

	FY 2006 vs. FY 2005 ($000)

Salaries and Benefits

- Increase supports all costs associated with 49 FTE's. It also includes promotions and cost of living adjustment .... +1,686

Travel

- Increase is due to greater travel needs to manage growing mission-related responsibilities, including addressing the recommendations of the "Final Report on the August 14, 2003 Blackout in the United States and Canada: Causes and Recommendations" issued in April 2004.. +210

Support Services

- Reflects an increase of $288K in funding for program-specific information technology data base development, hardware and software installation, and configuration and an increase of $305K in environmental contractor services for IEA activities needed to provide the environmental analyses required to process an increased number of Presidential permit applications.. +593

	FY 2006 vs. FY 2005 ($000)
Other Related Expenses	
▪ Reflects an increase for information technology infrastructure and systems (including websites and intranet).	+823
Total Funding Change, Program Direction	**+3,312**

Support Services by Category

(dollars in thousands)

	FY 2004	FY 2005	FY 2006	$ Change	% Change
Technical Support					
Energy Technology Advisement on Critical Issues	133	125	125	0	+ 0.0%
Contractor Services (IEA)	0	230	535	+305	+ 132.6%
Total, Technical Support	133	355	660	+305	+ 85.9%
Management Support					
Capital Planning, IT Program Management, and Mission Specific System Development, Configuration, Installation and Maintenance	0	57	280	+223	+ 391.1%
Preparation of Program Plans	28	25	50	+25	+ 100.0%
Training and Education	23	60	100	+40	+ 66.7%
Total, Management Support	51	142	430	+288	+ 202.8%
Total, Support Services	184	497	1,090	+593	+ 119.3%

Other Related Expenses by Category

	(dollars in thousands)				
	FY 2004	FY 2005	FY 2006	$ Change	% Change
Other Related Expenses					
Equipment	20	20	150	+130	+ 650.0%
Communications, Utilities and Miscellaneous Charges (Information Technology Infrastructure and Systems)[a]	148	242	400	+158	+ 65.3%
Training, Supplies and Working Capital[b]	0	0	399	+399	+ 100.0%
Working Capital Fund[c]	683	622	758	+136	+ 21.9%
Total, Other Related Expenses	851	884	1,707	+823	+ 93.1%

[a] Including eXCITE, website, intranet, telecommunications, and, in 2006, e-Government
[b] Import/Export Authorization (IEA)
[c] Including STARS in 2006 and office space

Nuclear Energy

Nuclear Energy

Table of Contents

Energy Supply
Office of Nuclear Energy, Science and Technology

Overview

Appropriation Summary by Program

(dollars in thousands)

	FY 2004 Comparable Appropriation	FY 2005 Original Appropriation	FY 2005 Adjustments	FY 2005 Comparable Appropriation	FY 2006 Request
Energy Supply					
University Reactor Infrastructure and Education Assistance	23,055	24,000	-190[a]	23,810	24,000
Research and Development					
Nuclear Energy Plant Optimization	2,863	2,500	-20[a]	2,480	0
Nuclear Energy Research Initiative	6,410	2,500	-19[a]	2,481	0
Nuclear Power 2010	19,360	50,000	-395[a]	49,605	56,000
Generation IV Nuclear Energy Systems Initiative	26,981	40,000	-317[a]	39,683	45,000
Nuclear Hydrogen Initiative	6,201	9,000	-71[a]	8,929	20,000
Advanced Fuel Cycle Initiative	65,750	68,000	-538[a]	67,462	70,000
Total, Research and Development	127,565	172,000	-1,360	170,640	191,000
Infrastructure					
Radiological Facilities Mgmt	63,431	69,110	-547[a]	68,563	64,800
Idaho Facilities Management	75,534	123,050	-730[a]	122,320	80,100
Idaho Sitewide Safeguards and Security	56,654	58,103	0	58,103	0
Total, Infrastructure	195,619	250,263	-1,277	248,986	144,900
Spent Nuclear Fuel Management	0	6,723[b]	-6,723[b]	0	0
Program Direction	60,256	60,285	+89[c]	60,374	30,006
Subtotal, Energy Supply	406,495	513,271	-9,461	503,810	389,906

[a] Distribution of the rescission from the Consolidated Appropriations Act, 2005.
[b] Amount includes $5.223M Energy Supply and $1.5M for Other Defense Activities that are being transferred to the Office of Environmental Management.
[c] Amount includes comparability adjustments of $209K for the rescission in the Consolidated Appropriations Act, 2005, $97K for one FTE transfer to the Office of the Chief Information Officer, and $395K for 2 FTEs from the National Nuclear Security Administration.

	(dollars in thousands)				
	FY 2004 Comparable Appropriation	FY 2005 Original Appropriation	FY 2005 Adjustments	FY 2005 Comparable Appropriation	FY 2006 Request
Use of Prior-Year Balances	0	-4,217[a]	0	-4,217	0
Less Security Charge for Reimbursable Work	-3,003	0	0	0	0
Funding from Other Defense	-112,306	-114,347	0	-114,347	0
Funding from Naval Reactors	0	-10,000	0	-10,000	0
Total, Energy Supply	291,186	384,707	-9,461	375,246	389,906
Other Defense Activities					
Infrastructure					
Idaho Facilities Management	21,296	20,886	-167[b]	20,719	17,762
Idaho Sitewide Safeguards and Security	56,343	58,103	-441[b]	57,662	75,008
Total, Infrastructure	77,639	78,989	-608	78,381	92,770
Spent Nuclear Fuel Management	0	1,500[c]	-12[b]	1,488[c]	0
Program Direction	33,979	33,858	-339[d]	33,519	31,103
Subtotal, Other Defense Activities	111,618	114,347	-959	113,388	123,873
Less Security Charge for Reimbursable Work	0	-3,003	0	-3,003	-3,003
Total, Other Defense Activities	111,618	111,344	-959	110,385	120,870
Total, Energy Supply and Other Defense Activities (NE)	402,804	496,051	-10,420	485,631	510,776

[a] The Office of Nuclear Energy, Science and Technology's portion of the use of prior year balances reduction from the Consolidated Appropriations Act, 2005.
[b] Distribution of the rescission from the Consolidated Appropriations Act, 2005.
[c] This amount, as well as $5.223M in Energy Supply is being transferred to the Office of Environmental Management.
[d] Amount includes comparability adjustments of $271K for the rescission in the Consolidated Appropriation Act, 2005, and $68K for A-76 financial services.

Appropriation Summary by Program

(Excludes Transfers to Other Defense Activities)

(dollars in thousands)

	FY 2004 Comparable Appropriation	FY 2005 Original Appropriation	FY 2005 Adjustments	FY 2005 Comparable Appropriation	FY 2006 Request
Energy Supply					
University Reactor Infrastructure and Education Assistance	23,055	24,000	-190[a]	23,810	24,000
Research and Development					
Nuclear Energy Plant Optimization	2,863	2,500	-20[a]	2,480	0
Nuclear Energy Research Initiative	6,410	2,500	-19[a]	2,481	0
Nuclear Power 2010	19,360	50,000	-395[a]	49,605	56,000
Generation IV Nuclear Energy Systems Initiative	26,981	40,000	-317[a]	39,683	45,000
Nuclear Hydrogen Initiative	6,201	9,000	-71[a]	8,929	20,000
Advanced Fuel Cycle Initiative	65,750	68,000	-538[a]	67,462	70,000
Total, Research and Development	127,565	172,000	-1,360	170,640	191,000
Infrastructure					
Radiological Facilities Mgmt	63,431	69,110	-547[a]	68,563	64,800
Idaho Facilities Management	54,119	92,164	-730[a]	91,434	80,100
Total, Infrastructure	117,550	161,274	-1,277	159,997	144,900
Spent Nuclear Fuel Management	0	5,223	-6,723[b]	-1,500	0
Program Direction	26,019	26,427	+89[c]	26,516	30,006
Subtotal, Energy Supply	294,189	388,924	-9,461	379,463	389,906
Less Security Charge for Reimbursable Work	-3,003	0	0	0	0
Use of Prior-Year Balances	0	-4,217[d]	0	-4,217	0

[a] Distribution of the rescission from the Consolidated Appropriations Act, 2005.
[b] Amount includes $5.223M Energy Supply and $1.5M for Other Defense Activities that are being transferred to the Office of Environmental Management.
[c] Amount includes comparability adjustments of $209K for the rescission in the Consolidated Appropriations Act, 2005, $97K for one FTE transfer to the Office of the Chief Information Officer, and $395K for 2 FTEs from the National Nuclear Security Administration.
[d] The Office of Nuclear Energy, Science and Technology's portion of the use of prior year balances reduction from the Consolidated Appropriations Act, 2005.

	(dollars in thousands)				
	FY 2004 Comparable Appropriation	FY 2005 Original Appropriation	FY 2005 Adjustments	FY 2005 Comparable Appropriation	FY 2006 Request
Total, Energy Supply	291,186	384,707	-9,461	375,246	389,906
Other Defense Activities					
Infrastructure					
Idaho Facilities Management	21,296	20,886	-167	20,719	17,762
Idaho Sitewide Safeguards and Security	56,343	58,103	-441	57,662	75,008
Total, Infrastructure	77,639	78,989	-608	78,381	92,770
Spent Nuclear Fuel Management	0	1,500[a]	-12	1,488[a]	0
Program Direction	33,979	33,858	-339[b]	33,519	31,103
Subtotal, Other Defense Activities	111,618	114,347	-959	113,388	123,873
Less Security Charge for Reimbursable Work	0	-3,003	0	-3,003	-3,003
Total, Other Defense Activities	111,618	111,344	-959	110,385	120,870
Total, Energy Supply and Other Defense Activities (NE)	402,804	496,051	-10,420	485,631	510,776

Preface

The Office of Nuclear Energy, Science and Technology (NE) leads the Government's efforts to develop new nuclear energy generation technologies to meet energy and climate goals, to develop advanced, proliferation-resistant nuclear fuel technologies that maximize energy from nuclear fuel, and to maintain and enhance the national nuclear technology infrastructure. NE serves the present and future energy needs of the Nation by managing the safe operation and maintenance of the DOE critical nuclear infrastructure that provides nuclear technology goods and services.

Within the Energy Supply appropriation, NE has ten programs: University Reactor Infrastructure and Education Assistance, Nuclear Energy Plant Optimization, Nuclear Energy Research Initiative, Nuclear Power 2010, Generation IV Nuclear Energy Systems Initiative, Nuclear Hydrogen Initiative, Advanced Fuel Cycle Initiative, Radiological Facilities Management, Idaho Facilities Management, and Program Direction. NE also has two programs that are partially funded within the Other Defense Activities appropriation—Idaho Facilities Management and Program Direction—and one program completely funded within the Other Defense Activities appropriation—Idaho Sitewide Safeguards and Security.

[a] This amount, as well as $5.223M in Energy Supply is being transferred to Environmental Management.
[b] Amount includes comparability adjustments of $271K for the rescission in the Consolidated Appropriations Act, 2005, and $68K for A-76 financial services.

This Overview will describe Strategic Context, Mission, Benefits, Strategic Goals and Funding by General Goal. These items together put the appropriation in perspective. The Annual Performance Results and Targets, Means and Strategies, and Validation and Verification sections address how the goals will be achieved and how performance will be measured. Finally, this Overview will also address R&D Investment Criteria, Program Assessment Rating Tool (PART), and Significant Program Shifts.

Strategic Context

Following publication of the "National Energy Policy", the Department developed a Strategic Plan that defines its mission, four strategic goals for accomplishing that mission, and seven general goals to support the strategic goals. Each appropriation has developed quantifiable goals to support the general goals. Thus, the "goal cascade" is the following:

Department Mission → Strategic Goal (25 yrs) → General Goal (10-15 yrs) → Program Goal (GPRA Unit) (10-15 yrs)

To provide a concrete link between budget, performance, and reporting, the Department developed a "GPRA[a] unit" concept. Within DOE, a GPRA unit defines a major activity or group of activities that support the core mission and aligns resources with specific goals. Each GPRA unit has completed or will complete a Program Assessment Rating Tool (PART). A unique program goal was developed for each GPRA unit. A numbering scheme has been established for tracking performance and reporting.[b]

The goal cascade accomplishes two things. First, it ties major activities for each program to successive goals and, ultimately, to DOE's mission. This helps ensure the Department focuses its resources on fulfilling its mission. Second, the cascade allows DOE to track progress against quantifiable goals and to tie resources to each goal at any level in the cascade. Thus, the cascade facilitates the integration of budget and performance information in support of the GPRA and the President's Management Agenda (PMA).

Another important component of our strategic planning – and the President's Management Agenda – is use of the Administration's R&D investment criteria to plan and assess programs and projects. The criteria were developed in 2001 and further refined with input from agencies, Congressional staff, the National Academy of Sciences, and numerous private sector and nonprofit stakeholders.

The chief elements of the R&D investment criteria are quality, relevance, and performance. Programs must demonstrate fulfillment of these elements. For example, to demonstrate relevance, programs are expected to have complete plans with clear goals and priorities. To demonstrate quality, programs are expected to commission periodic independent expert reviews. There are several other requirements, many of which R&D programs have and continue to undertake.

An additional set of criteria were established for R&D programs developing technologies that address industry issues. Some key elements of the criteria include: the ability of the programs to articulate the appropriateness and need for Federal assistance; relevance to the industry and the marketplace; identification of a transition point to industry commercialization (or of an off-ramp if progress does not

[a] Government Performance and Results Act of 1993
[b] The numbering scheme uses the following numbering convention: First two digits identify the General Goal (01 through 07); second two digits identify the GPRA Unit; last four digits are reserved for future use.

meet expectations), and; the potential public benefits, compared to alternative investments, that may accrue if the technology is successfully deployed.

The OMB-OSTP guidance memo to agencies dated June 5, 2003, describes the R&D investment criteria fully and identifies steps agencies should take to fulfill them. (The memo is available online at www.ostp.gov/html/fy05developingpriority.pdf.) Where appropriate throughout these justification materials, especially in Significant Program Shifts and Explanation of Funding Changes subheadings, specific R&D investment criteria and requirements are cited to explain the Department's allocation of resources.

Mission

The mission of the Office of Nuclear Energy, Science and Technology is to lead the DOE investment in the development and exploration of advanced nuclear science and technology. NE leads the Government's efforts to develop new nuclear energy generation technologies; to develop advanced, proliferation-resistant nuclear fuel technologies that maximize energy from nuclear fuel; and to maintain and enhance the national nuclear technology infrastructure. NE aims to serve the present and future energy needs of the Nation by managing the safe operation and maintenance of the DOE nuclear infrastructure that provides nuclear technology goods and services. NE manages research laboratories and radiological facilities and is the Lead Program Secretarial Officer for the Idaho National Laboratory.

Benefits

The benefits of nuclear power as an emissions free, reliable, and affordable source of energy are an essential element in the Nation's energy and environment future. Nuclear power has become the second most abundant source of electric energy in the U.S., and existing plants are among the most economic sources of electricity on the grid today. NE focuses on the development of advanced nuclear technologies to assure diversity in the U.S. energy supply. This budget request responds to the Energy Security goal to develop new generation capacity to fortify U.S. energy independence and security while making improvements in environmental quality. It builds on important work started over the last three years to deploy new nuclear plants in the U.S. by early in the next decade, to develop advanced, next generation nuclear technology, and to strengthen our Nation's nuclear education infrastructure.

The NE budget request supports development of new nuclear generation technologies that provide significant improvements in sustainability, economics, safety and reliability, and non-proliferation and resistance to attack. Specifically, the Nuclear Hydrogen Initiative will develop advanced technologies that can be used in tandem with next generation nuclear energy plants to generate economic, commercial quantities of hydrogen to support a sustainable, clean energy future for the U.S. The Generation IV Nuclear Energy Systems Initiative establishes a basis for expansive cooperation with our international partners to develop next generation reactor and fuel cycle systems that represent a significant leap in economic performance, safety, and proliferation resistance.

Through NE programs and initiatives, NE seeks to develop advanced, proliferation-resistant nuclear fuel technologies that maximize energy output, minimize wastes, and operate in a safe and environmentally sound manner. The Advanced Fuel Cycle Initiative develops technologies that would enable the reduction of spent nuclear fuel waste requiring geologic disposal and the recovery of spent nuclear fuel's valuable energy. Over the last five years, the U.S. has joined several countries in an international effort to pursue advanced technologies that could treat and transmute spent nuclear fuel from nuclear power plants, while reducing overall proliferation risk.

NE plans to maintain and enhance the national nuclear infrastructure currently in place to help meet the Nation's energy, environmental, health care, and national security needs. This existing infrastructure including personnel, equipment, and facilities requires enhancements to meet the systems, fuels, and material testing requirements for advanced nuclear research such as the Generation IV Nuclear Energy Systems Initiative. Key activities include assuring that all NE facilities meet essential safety and environmental requirements and are maintained at user-ready levels. One of the essential facilities for ongoing and planned national security and energy research programs at the Idaho National Laboratory is the Advanced Test Reactor (ATR).

Strategic, General, and Program Goals

The Department's Strategic Plan identifies four strategic goals (one each for defense, energy, science, and environmental aspects of the mission) plus seven general goals that tie to the strategic goals. The Office of Nuclear Energy, Science and Technology supports the following goals:

Energy Strategic Goal: To protect our national and economic security by promoting a diverse supply of reliable, affordable, and environmentally sound energy.

General Goal 4, Energy Security: Improve energy security by developing technologies that foster a diverse supply of reliable, affordable and environmentally sound energy by providing for reliable delivery of energy, guarding against energy emergencies, exploring advanced technologies that make a fundamental improvement in our mix of energy options, and improving energy efficiency.

The programs funded by the Office of Nuclear Energy, Science and Technology have the following three Programs Goals which contribute to General Goal 4 in the "goal cascade":

Program Goal 04.14.00.00: Develop new nuclear generation technologies that foster the diversity of the domestic energy supply through public-private partnerships that are aimed in the near-term (2014) at the deployment of advanced, proliferation-resistant light water reactor and fuel cycle technologies and in the longer-term (2025) at the development and deployment of next-generation advanced reactors and fuel cycles.

Program Goal 04.17.00.00: Maintain and enhance the national nuclear infrastructure to meet the Nation's energy, environmental, medical research, space exploration and national security needs.

Program Goal 04.63.00.00: Enable, by 2015, the Nation's nuclear engineering universities to support a stable national undergraduate enrollment of approximately 1,500 to meet the Nation's need for trained nuclear scientists and engineers.

Contribution to General Goal 4

The Nuclear Power 2010 program is focused on resolving the technical, institutional, and regulatory barriers to the deployment of new nuclear power plants by 2010, consistent with the recommendations of the Nuclear Energy Research Advisory Committee (NERAC) report, "A Roadmap to Deploy New

Nuclear Power Plants in the United States by 2010." In order to support the "Nation Energy Policy" and the President's goal of reducing greenhouse gas intensity by 18 percent by 2012, the Nuclear Power 2010 program will help enable an industry decision to deploy at least one new advanced nuclear power plant in the U.S. early in the next decade.

For the longer-term future, the Department believes that new, next-generation technologies should be considered to enhance the prospects for a significant expansion in the use of nuclear energy in the United States. Engaging this area requires the kind of long-term, high-risk, high-pay-off research that only Government-sponsored research can address. As a prime example, the Department believes that the future energy picture of the United States can and should include a large role for hydrogen as a fuel for automobiles and other elements of the vast U.S. transportation infrastructure. The use of hydrogen would make it possible for this Nation to realize a primary objective of the "National Energy Policy"—to enhance the energy independence and security of the United States while making significant improvements in environmental quality. Hydrogen could someday be used to power our entire transportation system, reducing our reliance on imported oil, and dramatically reducing the harmful emissions associated with the combustion of fossil fuels.

The Department is working with industry and overseas governments to establish what may prove to be an important answer: nuclear energy-produced hydrogen. Applying advanced thermochemical processes, it may be possible to develop a new generation of nuclear energy plants to produce very large amounts of hydrogen without emitting carbon dioxide or other gases—and do so at a cost that is very competitive with imported fossil fuels. The Nuclear Hydrogen Initiative will develop new technologies to generate hydrogen on a commercial scale in an economic and environmentally benign manner. The Department's Offices of Nuclear Energy, Science and Technology; Fossil Energy; and Energy Efficiency and Renewable Energy are working in coordination to provide the technological underpinnings of the President's National Hydrogen Fuel Initiative. In the case of nuclear energy, the Department will conduct research and development into advanced thermochemical technologies which may, when used in tandem with next-generation nuclear energy systems, enable the United States to generate hydrogen at a scale and cost that would support a future, hydrogen-based economy.

Developing the next-generation nuclear systems to make hydrogen possible is one aspect of the Generation IV Nuclear Energy Systems. Through this effort, the United States will lead multi-national research and development projects to usher forth next-generation nuclear reactors and fuel cycles. This international approach allows for the development of technologies that are widely acceptable; enables the Department to access the best expertise in the world to develop complex new technologies; and allows us to leverage our scarce nuclear R&D resources. After two years of detailed analysis by over 100 of the world's top scientists and engineers, the Nuclear Energy Research Advisory Committee (NERAC), working with the Generation IV International Forum (GIF), has identified six systems in pursuit of which the international community will collaborate and conduct joint research.

The FY 2006 Budget expands research and development that could help achieve the desired goals of sustainability, economics, and proliferation resistance. Further investigation of technical and economic challenges and risks, including waste products, will help inform a decision on whether to proceed with a demonstration of the Next Generation Nuclear Plant, which would use very high temperature reactor technologies to economically produce both electricity and hydrogen gas.

As the United States considers the expansion of nuclear energy, it is clear that the Nation must optimize its approach to managing spent nuclear fuel. While the planned geologic repository at Yucca Mountain would be sufficient for all commercial spent fuel generated in the United States through 2015, the current "once-through" approach to spent fuel will require the United States to build additional repository space to assure the continued, safe management of nuclear waste from currently operating plants and a new generation of nuclear plants. Further, long-term issues associated with the toxicity of nuclear waste and the eventual proliferation risks posed by plutonium in spent fuel remain.

The Advanced Fuel Cycle Initiative (AFCI) is focused on developing technologies which can reduce the volume and long-term toxicity of high level waste from spent nuclear fuel, reduce the long-term proliferation threat posed by civilian inventories of plutonium in spent fuel, and provide for proliferation-resistant technologies to recover the energy content in spent nuclear fuel. Currently, the spent nuclear fuel at nuclear plant sites contains the energy equivalent of 6 billion barrels of oil or about two full years of U.S. oil imports. The AFCI will make it possible to establish an improved, optimized nuclear fuel cycle that will turn this waste into a huge source of energy and do so in a manner that improves the long-term proliferation-resistance of the civilian nuclear fuel cycle.

In addition to nuclear research and development programs, the Department has the responsibility to maintain and enhance the Nation's nuclear infrastructure currently in place. This includes one of the world's most comprehensive research infrastructures—most of which was constructed in the 1950s and 1960s. The Department is also responsible for providing critical support to our Nation's university nuclear engineering programs and associated research reactor infrastructure. It is imperative that we maintain and enhance our national nuclear capabilities by managing these resources and capabilities to ensure that they continue to be operational and available for the fulfillment of important national research and security missions. Guided by invaluable input from NERAC, we seek efficient ways to preserve our national nuclear assets and make appropriate investments to enhance them before passing them on to future generations.

The Radiological Facilities Management program maintains irreplaceable DOE nuclear technology facilities in a safe, secure, environmentally compliant and cost-effective manner to support national priorities. It maintains the Department's vital resources and capabilities of NE-managed facilities at Oak Ridge National Laboratory (ORNL), Los Alamos National Laboratory (LANL), Sandia National Laboratory (SNL), and Brookhaven National Laboratory (BNL). Central to this infrastructure is the Nation's nuclear technology laboratory, the multi-program Idaho National Laboratory (INL). The Department is proceeding with plans to establish the INL as the world's finest nuclear technology laboratory within 10 years. The Radiological Facilities Management program also supports the oversight and planning required to assure that the Department's nuclear fuel cycle assets—principally the Paducah Gaseous Diffusion Plant—can respond, as required, to future national requirements.

The Idaho Facilities Management program maintains the Department's facilities at Idaho in a safe, secure and environmentally compliant condition for a range of vital Federal missions. The Idaho Sitewide Safeguards and Security program supports activities that are required to protect the Department's Idaho complex assets from theft, diversion, sabotage, espionage, unauthorized access, compromise, and other hostile acts which may cause unacceptable adverse impacts on national security, program continuity, the health and safety of employees, the public, or the environment.

The University Reactor Infrastructure and Education Assistance program supports the operation and upgrade of university research and training reactors, provides graduate fellowships and undergraduate scholarships to outstanding students, uses innovative programs to bring nuclear technology education to small, minority-serving institutions, and provides nuclear engineering research grants to university faculty. The program helps to maintain domestic capabilities to conduct research and the critical infrastructure necessary to attract, educate, and train the next generation of scientists and engineers with expertise in nuclear energy technologies. The Department also partners with industry in a 50/50 cost share program to assist the universities in maintaining their research capabilities. DOE also provides the supply of fresh fuel to university research reactors and supports reactor equipment upgrades at universities.

The Program Direction account funds expenses associated with the technical direction and administrative support of NE programs. NE is responsible for leading the Federal government's investment in nuclear science and technology by investing in innovative science and preserving the national research and development infrastructure. This program supports NE's Headquarters, Idaho, and Oak Ridge offices, and the U.S. mission to the Organization for Economic Cooperation and Development. NE plans to perform its mission, goals, and activities with excellence in accordance with the President's Management Agenda by: creating an organization that will more effectively implement the Secretary's priorities; updating and expanding the independently created Office of Nuclear Energy, Science and Technology Workforce Plan; and continuing to recruit a well-qualified, diverse workforce.

Funding by General and Program Goal

(dollars in thousands)

	FY 2004	FY 2005	FY 2006
General Goal 4, Energy Security			
Program Goal 04.14.00.00, Develop new nuclear generation technologies	118,292	165,679	191,000
Program Goal 04.17.00.00, Maintain and enhance the national nuclear infrastructure	195,189	238,378	237,670
Program Goal 04.63.00.00, Enhance the Nation's nuclear education infrastructure capability	23,055	23,810	24,000
All Other	69,271	64,984	61,109
Total, General Goal 4, Energy Security	405,807	492,851	513,779

Major FY 2004 Achievements

In FY 2004, the Department issued an innovative Request for Proposals that was designed to make the Idaho National Laboratory the premier nuclear energy research laboratory in the world in ten years. The INL will play a lead role in developing Generation IV nuclear energy systems, advanced nuclear fuel cycle technologies, and space nuclear power applications. The new contract was awarded in November

2004 to Batelle Energy Alliance, LLC. Beginning in the second quarter of FY 2005, the Idaho National Engineering and Environmental Laboratory (INEEL) will be merged with Argonne National Laboratory-West (ANL-W) to establish the basis of the Idaho National Laboratory (INL). The Secretary of Energy has designated INL as the center for the Department's strategic nuclear energy research and development efforts. The INL will play a lead role in Generation IV nuclear energy systems development, advanced fuel cycle development, testing of naval reactor fuels and reactor core components, and space nuclear power applications. While the laboratory has transitioned its research and development focus to nuclear energy programs, it is also maintaining its multi-program national laboratory status to serve a variety of current and planned Department and national research and development missions.

In FY 2004, the Department issued a solicitation inviting proposals from teams led by power generation companies to initiate New Nuclear Plant Licensing Demonstration Projects to obtain an NRC license to construct and operate a new nuclear power plant. Industry response to the November 20, 2003 solicitation has been encouraging with Department receiving proposals from three consortia representing nine U.S. power generation companies and four advanced reactor technology suppliers. The nine power generation companies responding to the solicitation operate 63 of the 103 U.S. commercial nuclear power plants. Although no company has yet announced a decision to build a plant, these companies are evaluating the construction of new nuclear plants.

Program Assessment Rating Tool (PART)

The Department implemented a tool to evaluate selected programs. PART was developed by the Office of Management and Budget (OMB) to provide a standardized way to assess the effectiveness of the Federal Government's portfolio of programs. The structured framework of the PART provides a means through which programs can assess their activities differently than through traditional reviews.

The current focus is to establish outcome- and output-oriented goals, the successful completion of which will lead to benefits to the public, such as increased national security and energy security, and reduced atmospheric emissions. DOE has incorporated feedback from OMB into the FY 2006 Budget Request, and the Department will take the necessary steps to continue to improve performance.

The Infrastructure program prepared a PART focused on the Idaho Facilities Management program where a majority of the funding requirements will occur. NE has incorporated feedback from OMB during the FY 2006 assessment as well as the FY 2004-FY 2005 assessments for Nuclear Energy R&D into the FY 2006 Budget Request and has taken or will take the necessary steps to continue to improve performance.

The results of the FY 2005 review for the Research and Development programs and the FY 2006 review for the Infrastructure program are reflected in the FY 2006 Budget Request as follows:

Nuclear Power 2010 (NP 2010) received an overall score of 69 (adequate), Generation IV Nuclear Energy Systems Initiative received an overall score of 79 (moderately effective), Advanced Fuel Cycle Initiative (AFCI) received an overall score of 76 (moderately effective), and Infrastructure received an overall score of 49 (results not demonstrated). All four were assessed perfect scores for clarity of program purpose and soundness of program design. In the planning area, OMB found a need for stronger links between budget and performance data for all four. To address these findings, stronger links between program goals and funding requests are shown in this budget submission. In the program management area, NP 2010 needs to measure and achieve cost effectiveness in program execution. In the program results area, NP 2010 needs to establish on an annual basis an independent assessment of the overall program. Generation IV lacks periodic external review. AFCI needs to better demonstrate the cost effectiveness of the program. These findings are also addressed in this budget submission. Idaho Facilities Management received a 0 score in the program results area. This is a new program and accomplishments have yet to be demonstrated. The assessment did find that the program is effectively targeted through the formal Idaho National Laboratory Ten Year Site Plan that identifies the mission-essential infrastructure and facilities, planned annual work scope, and performance measures for the laboratory.

NERAC's Subcommittee on Evaluations, formed in FY 2004, conducted independent program evaluations of NE's Generation IV Nuclear Energy Systems Initiative, Nuclear Power 2010 program, and the Advanced Fuel Cycle Initiative. The Subcommittee submitted its findings to the full NERAC in FY 2005. These findings will be incorporated into future NE budget requests.

Significant Program Shifts

- Nuclear Hydrogen Initiative. The Administration strongly supports nuclear energy as an important part of its energy portfolio. The Nuclear Hydrogen Initiative (NHI) activities are required to support the milestones identified in the "DOE Hydrogen Posture Plan" and the "Nuclear Hydrogen R&D Plan". These plans are revised periodically and provide clear performance measures upon which to base annual budget requests. Technology development work to date which has been conducted in accordance with the "Nuclear Hydrogen R&D Plan" has proved successful and justifies continued work. For example, in FY 2004, experiments were successfully completed on individual high-temperature electrolysis cells for hydrogen production. Since the results show that the hydrogen output of the cells closely matched the theoretical calculations, in FY 2005 the program is evaluating the performance of stacks of cells to achieve higher hydrogen production rates. Based on progress to date, in FY 2006 the program will proceed with the plan to test cell stacks for long-duration and transient operation, and an integrated 50kW system will be constructed for operation in FY 2007. As a result of these successes and other technical progress, the FY 2006 budget request includes an increase of $11,071,000 (+124%) to support continued development of nuclear hydrogen technologies that can be used in tandem with next generation nuclear energy systems that span a range of operating temperatures.

- Idaho Facilities Management. The overall funding for the Idaho Facilities Management program decreases from FY 2005 to FY 2006 because of a $43,453,000 one time cost associated with restructuring the Idaho National Laboratory complex and supporting site infrastructure services. This decrease is offset by an increase of $19,718,000 for maintenance and recapitalization projects to support the goal of achieving and maintaining an expenditure rate of 2-4 percent of Replacement Plant Value, a level recommended by the National Academy of Sciences, for the facilities at INL. One of the essential facilities for ongoing and planned national security and energy research programs at the Idaho National Laboratory is the Advanced Test Reactor (ATR). Replacing the ATR with a new test reactor with similar capabilities would exceed two billion dollars and likely take at least ten years to build. An independent review group of reactor experts studied the ATR and provided their perspectives on the life extension of the reactor. This review prompted several projects, most notably an exhaustive safety basis reconstitution to assure that all safety related systems meet modern standards. This project is in progress and results to date are favorable. The recommendations of this review and other analyses will be incorporated into the INL Ten Year Site Plan (TYSP), which is the foundation for INL facilities and infrastructure strategic planning and the cornerstone of the Program's initiative to restore the INL and the other essential facilities on the site. Specifically, the TYSP includes a prioritized list of recapitalization projects that is based upon a formal prioritization methodology that preferentially targets deferred maintenance reduction, particularly for mission-essential facilities and infrastructure and provides the basis for the budget request.

- Idaho Sitewide Safeguards and Security. As a result of merging the Idaho National Engineering and Environmental Laboratory (INEEL) and the Argonne National Laboratory-West site into the Idaho National Laboratory (INL), the two existing safeguards and security programs at the Idaho site will be merged into a single program. This integration will continue in FY 2005 with additional changes anticipated to increase efficiency and contain costs for safeguards and security for the site. The Department issued a revised Design Basis Threat (DBT) in October 2004. These requirements will be implemented using a risk-informed approach to physical upgrades and by seeking efficiencies associated with combining the two contracts. The Department believes that early investment in improved positions for defending forces, more capable detection systems, and technological deterrent devices at target locations will result in cost avoidance over the lifetime of enduring facilities by reducing the number of additional protective force members needed to counter the revised threat. The FY 2006 request reflects increased funding of $17,346,000 to permit these investments.

Office of Nuclear Energy, Science and Technology
Funding by Site by Program

(dollars in thousands)

	FY 2004	FY 2005	FY 2006	$ Change	% Change
Chicago Operations Office					
Chicago Operations Office					
Idaho Facilities Management	500	500	500	+0	+0.0%
Argonne National Laboratory					
University Reactor Infrastructure and Education Assistance	110	110	110	+0	+0.0%
Generation IV Nuclear Energy Systems Initiative	2,335	2,423	2,500	+77	+3.2%
Nuclear Power 2010	90	16	0	-16	-100.0%
Nuclear Hydrogen Initiative	710	640	1,000	+360	+56.3%
Advanced Fuel Cycle Initiative	8,200	6,913	7,000	+87	+1.3%
Total, Argonne National Laboratory	11,445	10,102	10,610	+508	+5.0%
Brookhaven National Laboratory					
Generation IV Nuclear Energy Systems Initiative	250	320	320	+0	+0.0%
Nuclear Power 2010	0	60	0	-60	-100.0%
Advanced Fuel Cycle Initiative	700	556	550	-6	-1.1%
Radiological Facilities Management.	2,373	2,673	2,650	-23	-0.9%
Total, Brookhaven National Laboratory	3,323	3,609	3,520	-89	-2.5%
Total, Chicago Operations Office	15,268	14,211	14,630	+419	+2.9%
Idaho Operations Office					
Idaho Operations Office					
University Reactor Infrastructure and Education Assistance	17,571	20,203	20,393	+190	+0.9%
Generation IV Nuclear Energy Systems Initiative	4,542	9,531	14,643	+5,112	+53.6%
Nuclear Energy Research Initiative	2,726	2,274	0	-2,274	-100.0%
Nuclear Energy Plant Optimization	880	200	0	-200	-100.0%
Nuclear Hydrogen Initiative	1,007	650	4,750	+4,100	+630.8%
Nuclear Power 2010	18,936	47,727	54,000	+6,273	+13.1%

	(dollars in thousands)				
	FY 2004	FY 2005	FY 2006	$ Change	% Change
Advanced Fuel Cycle Initiative	5,677	6,376	8,488	+2,112	+33.1%
Program Direction	33,375	32,235	31,103	-1,132	-3.5%
Total, Idaho Operations Office	84,714	119,196	133,377	+14,181	+11.9%
Idaho National Laboratory					
University Reactor Infrastructure and Education Assistance	4,950	3,132	3,132	+0	+0.0%
Generation IV Nuclear Energy Systems Initiative	11,137	14,084	15,250	+1,166	+8.3%
Nuclear Hydrogen Initiative	1,303	2,320	7,500	+5,180	+223.3%
Nuclear Energy Plant Optimization	650	1,710	0	-1,710	-100.0%
Nuclear Energy Research Initiative	503	0	0	+0	+0.0%
Nuclear Power 2010	20	138	0	-138	-100.0%
Advanced Fuel Cycle Initiative	27,712	25,961	32,000	+6,039	+23.3%
Radiological Facilities Management	19,244	14,732	12,200	-2,532	-17.2%
Idaho Facilities Management	74,915	111,653	97,362	-14,291	-12.8%
Idaho Sitewide Safeguards and Security	56,343	57,662	75,008	+17,346	+30.1%
Total, Idaho National Laboratory	196,777	231,392	242,452	+11,060	+4.8%
University of Nevada, Las Vegas					
Nuclear Hydrogen Initiative	1,900	3,800	2,000	-1,800	-47.4%
Advanced Fuel Cycle Initiative	3,500	6,944	4,000	-2,944	-42.4%
Total, University of Nevada, Las Vegas	5,400	10,744	6,000	-4,744	-44.2%
Total, Idaho Operations Office	286,891	361,332	381,829	+20,497	+5.7%
NNSA Service Center					
NNSA Service Center					
Nuclear Power 2010	70	0	0	+0	+0.0%
Lawrence Livermore National Laboratory					
Generation IV Nuclear Energy Systems Initiative	316	410	500	+90	+22.0%
Advanced Fuel Cycle Initiative	150	175	150	-25	-14.3%
Total, Lawrence Livermore National Laboratory	466	585	650	+65	+11.1%

	(dollars in thousands)				
	FY 2004	FY 2005	FY 2006	$ Change	% Change
Los Alamos National Laboratory					
Generation IV Nuclear Energy Systems Initiative	367	229	250	+21	+9.2%
Nuclear Energy Research Initiative	261	0	0	+0	+0.0%
Advanced Fuel Cycle Initiative	12,105	13,300	10,000	-3,300	-24.8%
Radiological Facilities Management	15,212	16,960	16,922	-38	-0.2%
Total, Los Alamos National Laboratory	27,945	30,489	27,172	-3,317	-10.9%
Sandia National Laboratories					
Generation IV Nuclear Energy Systems Initiative	1,270	445	600	+155	+34.8%
Nuclear Hydrogen Initiative	570	210	2,500	+2,290	+1,090.5%
Nuclear Plant Optimization	200	170	0	-170	-100.0%
Nuclear Energy Research Initiative	799	0	0	+0	+0.0%
Nuclear Power 2010	125	0	0	+0	+0.0%
Advanced Fuel Cycle Initiative	1,800	1,700	1,800	+100	+5.9%
Radiological Facilities Management	1,750	1,900	2,000	+100	+5.3%
Total, Sandia National Laboratories	6,514	4,425	6,900	+2,475	+55.9%
Total, NNSA Service Center	34,995	35,499	34,722	-777	-2.2%
Savannah River Site Office					
University Reactor Infrastructure and Education Assistance	300	300	300	+0	+0.0%
Nuclear Energy Research Initiative	331	0	0	+0	+0.0%
Nuclear Power 2010	0	50	0	-50	-100%
Nuclear Hydrogen Initiative	180	300	750	+450	+150.0%
Advanced Fuel Cycle Initiative	800	583	700	+117	+20.1%
Total, Savannah River Site Office	1,611	1,233	1,750	+517	+41.9%
Oak Ridge Operations Office					
Oak Ridge Operations Office					
Radiological Facilities Management	0	496	500	+4	+0.8%
Program Direction	1,896	1,957	2,032	+75	+3.8%
Total, Oak Ridge Operations Office	1,896	2,453	2,532	+79	+3.2%

	(dollars in thousands)				
	FY 2004	FY 2005	FY 2006	$ Change	% Change
Oak Ridge National Laboratory					
University Reactor Infrastructure and Education Assistance	38	25	25	+0	+0.0%
Nuclear Energy Plant Optimization	150	150	0	-150	-100.0%
Generation IV Nuclear Energy Systems Initiative	6,252	10,110	9,050	-1,060	-10.5%
Nuclear Hydrogen Initiative	245	130	500	+370	+284.6%
Nuclear Energy Research Initiative	615	0	0	+0	+0.0%
Advanced Fuel Cycle Initiative	3,380	2,391	3,500	+1,109	+46.4%
Radiological Facilities Management	24,400	31,350	30,028	-1,322	-4.2%
Total, Oak Ridge National Laboratory	35,080	44,156	43,103	-1,053	-2.4%
Pacific Northwest National Laboratory					
Nuclear Energy Plant Optimization	930	200	0	-200	-100.0%
Nuclear Energy Research Initiative	1,052	0	0	+0	+0.0%
Advanced Fuel Cycle Initiative	450	150	150	+0	+0.0%
Total, Pacific Northwest National Laboratory	2,432	350	150	-200	-57.1%
Total, Oak Ridge Operations Office	39,408	46,959	45,785	-1,174	-2.5%
Washington Headquarters					
University Reactor Infrastructure and Education Assistance	86	40	40	+0	+0.0%
Nuclear Energy Plant Optimization	53	50	0	-50	-100.0%
Nuclear Energy Research Initiative	123	207	0	-207	-100.0%
Nuclear Power 2010	119	1,614	2,000	+386	+23.9%
Generation IV Nuclear Energy Systems Initiative	512	2,131	1,887	-244	-11.5%
Nuclear Hydrogen Initiative	286	879	1,000	+121	+13.8%
Advanced Fuel Cycle Initiative	1,276	2,413	1,662	-751	-31.1%
Radiological Facilities Mgmt	452	452	500	+48	+10.6%
Program Direction	24,727	25,843	27,974	+2,131	+8.2%
Total, Washington Headquarters	27,634[a]	33,629	35,063	+1,434	+4.3%
Total, Nuclear Energy[a]	405,807	492,863	513,779	+20,916	+4.2%

[a] Includes funding identified to fund the Environmental Management liability for OVEC in FY 2004.

Site Description

Chicago Operations Office

Idaho Facilities Management

Chicago Operations Office administers a contract with BWXT Service, Inc. for continuing spent nuclear fuel and other related material storage at the BWXT Lynchburg Technology Center.

Argonne National Laboratory

Introduction

Argonne National Laboratory (ANL) is one of the Department of Energy's scientific research laboratories and was the Nation's first national laboratory, chartered in 1946. ANL, located in Illinois, is the main laboratory and occupies 1,500 acres, surrounded by a forest preserve about 25 miles southwest of the Chicago Loop.

University Reactor Infrastructure and Education Assistance

ANL administers the International Student Exchange Program (ISEP). This program provides for student exchanges between the United States and several other nations enabling nuclear engineering and science students the opportunity to work in another nation's national laboratories and increase their training opportunities. ANL also administers part of the university summer internship program.

Generation IV Nuclear Energy Systems Initiative

ANL continues to play an important role in conducting key R&D in support of the Generation IV Nuclear Energy Systems Initiative. ANL participates in system design and evaluation activities for several Generation IV systems, makes important contributions to Generation IV fuels and materials efforts, and leads or participates in joint projects with France, Korea, Canada, Euratom, and Japan. ANL is responsible for staffing the position of Generation IV National Technical Director for Design and Evaluation Methods, who coordinates the U.S. efforts on method development and validation. ANL provides one of two U.S. experts for the Generation IV International Forum (GIF) Experts Group.

Nuclear Hydrogen Initiative

ANL supports the program by conducting laboratory analyses of thermochemical hydrogen production methods, specifically the calcium-bromine (Ca-Br) cycle.

Advanced Fuel Cycle Initiative

ANL staffs the AFCI National Technical Director position for separations technology development, providing leadership over multi-laboratory research activities in aqueous and pyroprocessing spent fuel treatment. ANL also supports the AFCI program by performing reactor physics calculations, including spent fuel throughput calculations, for existing commercial light water reactors and Generation IV thermal and fast reactor concepts. ANL also has the lead for key systems analysis activities, including certain program reports to Congress and their subsequent updates.

---

[a] Funding totals exclude reduction for security charge for reimbursable work of $3.003M. In addition, FY 2005 excludes the use of prior year reduction of $4.229M.

Brookhaven National Laboratory

Introduction
The Brookhaven National Laboratory (BNL) is a multiprogram laboratory located in Upton, New York. The Department of Energy's BNL conducts research in the physical, biomedical, and environmental sciences, as well as in energy technologies. Brookhaven also builds and operates major facilities available to university, industrial, and government scientists. BNL provides expertise in the design of spallation targets and also related work in the design of the subcritical multiplier.

Generation IV Nuclear Energy Systems Initiative
BNL is conducting probabilistic risk assessment tasks in support of the Generation IV proliferation resistance studies and conducting an I-NERI project on advanced gas-cooled reactors.

Advanced Fuel Cycle Initiative
BNL supports the AFCI program in the conduct of transmutation and fuel systems analyses.

Radiological Facilities Management
The Brookhaven Linear Isotope Producer (BLIP) at BNL uses a linear accelerator that injects 200 million-electron-volt protons into the 33 giga-electron-volt Alternating Gradient Synchrotron. The BLIP facility operations have decreased from 20 weeks to 10 weeks per year. Isotopes such as strontium-82, germanium-68, copper-67, and others that are used in medical diagnostic applications are produced at BLIP.

Idaho Operations Office
The Idaho Operations Office provides procurement, contract, cooperative agreement, and grant support for the Generation IV Nuclear Energy Systems Initiative, Nuclear Energy Research Initiative, Nuclear Energy Plant Optimization, Nuclear Hydrogen Initiative, Nuclear Power 2010, and the Advanced Fuel Cycle Initiative programs.

University Reactor Infrastructure and Education Assistance
The Idaho Operations Office administers the grants for the NE & HP fellowships and scholarships and the DOE/Industry Matching Grants program, and the NE Education Opportunities program.

Idaho National Laboratory

Introduction
The Idaho National Laboratory (INL) is an extensive research and engineering complex that has been the center of nuclear energy research since 1949. It occupies 890 square miles in southeastern Idaho along the western edge of the Snake River Plain, 42 miles northwest of Idaho Falls, Idaho. There are nine primary facilities at the INL as well as administrative, engineering, and research laboratories in Idaho Falls, Idaho. The Office of Nuclear Energy, Science and Technology (NE) has assumed Lead Program Secretarial Office (LPSO) responsibility for the Idaho Operations Office (ID). With the transfer of INL from EM to NE, INL will become the center for NE’s strategic nuclear energy research and development enterprise, INL’s revised mission will play a major role in Generation IV nuclear energy systems development, advanced fuel cycle development, and space nuclear power and propulsion applications. The INL will transition its research and development focus from environmental programs to nuclear energy programs while maintaining its multi-program national laboratory status to best serve

ongoing and future DOE and national needs. While INL will focus on its new role as the center for nuclear research and development as a multi-program national laboratory, the INL will continue to pursue appropriate roles in national security, environmental and other activities. Beginning in the second quarter of FY 2005, ANL-West will become part of INL.

University Reactor Infrastructure and Education Assistance
INL administers the University Reactor Infrastructure and Education Assistance Program to provide fuel for university research reactors including fuel for conversions from highly enriched uranium (HEU) to low enriched uranium (LEU), and to ship spent fuel from university reactors to DOE's Savannah River Site. INL also administers the peer-review of the Nuclear Engineering Education Research (NEER) program that provides competitive investigator-initiated, research grants to nuclear engineering schools; the university reactor upgrade program that provides funding for improvements and maintenance of 20-25 university research reactors; and part of the university programs summer internship program.

Generation IV Nuclear Energy Systems Initiative
INL is the lead laboratory for the Generation IV Nuclear Energy Systems Initiative and conducts the program's technical integration activities. INL provides the R&D leadership for the Very High Temperature Reactor (VHTR) and is responsible for the system integration aspects of the Gas Fast Reactor, the Supercritical-Water Reactor, and the Lead Fast Reactor (with LLNL). INL leads or participates in system design and evaluation activities for these systems, and makes important contributions to fuel, materials and energy conversion system efforts. INL, together with ORNL, is the principal laboratory responsible for the development of advanced gas reactor fuel for the VHTR. INL leads or participates in a number of joint projects with France, Korea, Canada, Euratom, and Japan. INL is responsible for staffing the position of Technical Director of the Generation IV International Forum (GIF) Secretariat and supporting staff, and plays a key role in organizing international GIF Policy Group meetings. INL is also responsible for staffing the position of Chair of the GIF Experts Group and for the organization of the GIF Experts Group meetings. INL provides chairs or co-chairs for several GIF System Steering Committees and GIF Project Management Boards.

Nuclear Hydrogen Initiative
INL will provide leadership in executing the Nuclear Hydrogen Initiative. INL will cooperate with SNL, in its role as Generation IV National Technical Director for Energy Conversion Systems, to ensure efficient integration of Generation IV and Nuclear Hydrogen Initiative activities.

Nuclear Energy Plant Optimization
INL is conducting activities which include hot cell modifications to support post irradiation examination of commercial light water reactor fuel and related materials.

Nuclear Power 2010
INL will complete work to assess the transportation and fuel cycle impacts of advanced reactor designs in support of the Early Site Permit applications to be submitted to NRC under the Nuclear Power 2010 program.

Advanced Fuel Cycle Initiative
INL staffs the AFCI National Technical Director positions for Fuels and Systems Analysis, leading the efforts of several national laboratories in the Generation IV and transmutation fuels, systems analysis and computer modeling arenas. INL has the lead role for the design of the AFCI Uranium Extraction

Plus (UREX+) engineering scale experiment (ESE) to establish the feasibility of the advanced aqueous treatment process for conditioning spent nuclear fuel. INL is also responsible for pyroprocessing research and qualification of resulting waste forms. INL capabilities also include nuclear fuel development, irradiation of AFCI transmutation and Generation IV test fuels, post-irradiation examinations, waste and nuclear material characterization, and development of dry, interim storage for spent fuel and other highly radioactive materials.

Radiological Facilities Management

INL operates the radioisotope power systems heat source and test and assembly operations that were transferred from the Mound Site. Activities also include the transfer of neptunium-237 (Np-237) inventory from the Savannah River Site to the INL during FY 2005.

Idaho Facilities Management

NE manages the Advanced Test Reactor (ATR) and other non-reactor nuclear facilities at INL including day-to-day oversight with responsibility for safe operations; startup authority; safety basis documentation approval; accomplishment of program missions on schedule and within budget; and protection of the workers, the public, and the environment. The Idaho Test Reactor Area (TRA) is located within the INL. Since the early 1950s, test reactors, laboratories, hot cells and supporting facilities have been built at TRA. The principal facility operating at TRA is the ATR. The ATR is one of the world's largest and most advanced test reactors. It currently provides vital irradiation testing for reactor fuels and core components, primarily for the U.S. Navy Nuclear Propulsion Program. The ATR can also produce isotopes critically needed by medicine and industry.

Other facilities currently operating on the site are: the ATR Critical Facility reactor, which supports ATR operations; the TRA Hot Cells; the Office of Science's Safety and Tritium Applied Research (STAR) Facility, which does fusion fuel research and has been designated by the Secretary of Energy as a National User Facility; and the INL Applied Engineering and Development Laboratory. ATR operations and a wide variety of scientific research projects are planned to continue at TRA until well into the twenty-first century. The following facilities at TRA are shutdown in a surveillance and maintenance status awaiting decontamination and decommissioning: the Materials Test Reactor (MTR), the MTR Canal, the Engineering Test Reactor, the Coupled Fast Reactivity Measurement Facility, and the Advanced Reactivity Measurement Facility.

The INL Infrastructure account provides for maintaining and upgrading TRA common use facilities and the utility infrastructure to ensure that programmatic, reliability and ES&H requirements are met.

Activities under the Idaho Facilities Management Program involve a number of significant facilities, including the Hot Fuel Examination Facility (HFEF), Fuel Conditioning Facility (FCF), Fuel Manufacturing Facility (FMF), Analytical Laboratory (AL), Electron Microscopy Laboratory (EML), and Radioactive Scrap and Waste Facility (RSWF). These facilities are supported by several other nuclear, radiological and industrial support and office facilities.

Idaho Sitewide Safeguards and Security

The Idaho Sitewide Safeguards and Security program provides protection of nuclear materials, classified matter, government property, and other vital assets from unauthorized access, theft, diversion, sabotage, espionage, and other hostile acts that may cause risks to national security, the health and safety of DOE and contractor employees, the public or the environment. Program activities include security systems, material control and accountability, information and cyber security, and personnel security. In addition, a protective force is maintained. These activities ensure that the site, personnel, and assets remain safe from potential threats.

University of Las Vegas, Nevada

Nuclear Hydrogen Initiative

UNLV is working with the Department to perform research and development on candidate heat exchanger designs. UNLV's scope has increased to include much of the complimentary materials development activities. UNLV actively involves other universities, industry, and national laboratories, making it an effective tool for developing the future work force and an important part of the NHI program.

Advanced Fuel Cycle Initiative

UNLV is actively engaged in experiments on lead alloy coolants and targets in accelerator-based systems with potential application to fast reactor systems. UNLV also conducts research using student participation.

Lawrence Livermore National Laboratory

Introduction

Lawrence Livermore National Laboratory (LLNL) is a multi-disciplinary research and development laboratory focused on national defense, which has two noncontiguous geographic locations in northern California. LLNL is approximately one square mile and is located 40 miles east of San Francisco. LLNL conducts research in advanced defense technologies, energy, environment, biosciences, and basic science.

Generation IV Nuclear Energy Systems Initiative

LLNL is working on the development of the Generation IV lead-cooled fast reactor and associated fuel cycle. LLNL and INL serve as the Systems Integration Manager for the lead-cooled fast reactor.

Advanced Fuel Cycle Initiative

LLNL provides expertise on the impact of separation technologies on the geological repository.

Los Alamos National Laboratory

Introduction

Los Alamos National Laboratory (LANL) is a multi-disciplinary research facility located on approximately 28,000 acres near the town of Los Alamos in northern New Mexico. LANL is engaged in a variety of programs for DOE and other government agencies. The primary mission for LANL is research and technical activities supporting the Nation's defense. LANL also supports DOE missions related to arms control, non-proliferation, nuclear material disposition, energy research, science and technology, and environmental management. Research and development in the basic sciences, mathematics, and computing have a broad range of applications, including: national security, non-nuclear defense, nuclear and non-nuclear energy, atmospheric and space research, geoscience, bioscience, biotechnology, and the environment.

Generation IV Nuclear Energy Systems Initiative
LANL is working on the development of the Generation IV lead-cooled fast reactor and associated fuel cycle. A senior LANL scientist serves as the National Technical Director for fuels research.

Advanced Fuel Cycle Initiative
LANL supports the AFCI and Generation IV programs through advanced fuels, materials and transmutation engineering research, including accelerator-driven systems. LANL staffs the AFCI National Technical Director position for Transmutation Engineering. LANL also supports activities under the transmutation science education program related to nuclear science and engineering research at U.S. universities.

Radiological Facilities Management
At LANL, a portion of the Plutonium Facility-4 at the Technical Area-55 is dedicated to Pu-238 activities. This capability is the only existing Pu-238 purification and encapsulation capability within the DOE complex and is used to process and encapsulate Pu-238 used in radioisotope power sources for the National Aeronautics and Space Administration (NASA) space exploration missions and national security applications. The LANL capabilities were expanded to include establishing a Pu-238 scrap recovery capability to recycle Pu-238 scrap for use in future missions.

At LANL, the 100 MeV Isotope Production Facility (IPF) will be operable in FY 2005 and will produce major isotopes, such as germanium-68, a calibration source for Positron Emission Tomography (PET) scanners; strontium-82, the parent of rubidium-82, used in cardiac PET imaging; and arsenic-73 used as a biomedical tracer.

Sandia National Laboratories

Introduction
Sandia National Laboratories (SNL) is a research development facility located on approximately 18,000 acres on the Kirtland Air Force Base reservation near Albuquerque, New Mexico and has smaller facilities in Livermore, California and Tonopah, Nevada. The mission of SNL is to meet national needs in the nuclear weapons and related defense systems, energy security, and environmental integrity.

Generation IV Nuclear Energy Systems Initiative
SNL is responsible for staffing the position of National Technical Director for Energy Conversion, who coordinates the U.S. R&D on advanced systems for converting nuclear-generated heat into marketable energy products. This R&D is focused on advanced gas turbo-machinery with helium or supercritical carbon dioxide as the working fluids.

Nuclear Hydrogen Initiative
SNL serves as the technical integrator for the Nuclear Hydrogen Initiative, responsible for coordinating the participation of all laboratories in the development and conduct of the Nuclear Hydrogen Initiative R&D program. SNL is conducting research and development on the sulfur-iodine thermochemical process to complete an integrated demonstration in FY 2007.

Nuclear Energy Plant Optimization
SNL has supported and conducted analysis on a security pilot demonstration project to be conducted at an existing nuclear power plant.

Advanced Fuel Cycle Initiative
SNL serves as NE's technical integrator for AFCI, responsible for coordinating the participation of all laboratories in the development and conduct of the AFCI R&D program. SNL is also an integral part of the AFCI systems analysis effort.

Radiological Facilities Management
NE manages the Annular Core Research Reactor (ACRR) and other non-reactor nuclear facilities at SNL including day-to-day oversight with responsibility for safe operations; startup authority; safety basis documentation approval; accomplishment of program missions on schedule and within budget; and protection of the workers, the public, and the environment. The ACRR is a highly flexible facility applied to the mission requirements of the Department in both isotope and national security applications. National security programs use the ACRR's short duration high-power pulse capabilities for component testing.

Savannah River Operations Office

University Reactor Infrastructure and Education Assistance
Savannah River administers the radiochemistry program.

Nuclear Hydrogen Initiative
Savannah River assists with thermochemical cycle activities.

Advanced Fuel Cycle Initiative
Savannah River assists with separations technology activities, advanced fuels development activities, and systems analysis activities.

Oak Ridge Operations Office

Radiological Facilities Management
To assess USEC Inc.'s (USEC) performance, the Oak Ridge Operations Office will establish a baseline by evaluating and assessing the status of key systems required for plant viability and conduct quarterly status review meetings with USEC. The Oak Ridge Operations Office will also monitor (via an earned value management system) the DOE contractor supporting the Paducah Gaseous Diffusion Plant Operational Assurance Program.

Oak Ridge National Laboratory

Introduction
The Oak Ridge National Laboratory (ORNL) is a U.S. Department of Energy scientific research laboratory located in Oak Ridge, Tennessee. ORNL also maintains the DOE computer code system, software, and documentation at the Radiation Safety Information Computational Center (RSICC) and serves as a repository for DOE computational research activities, including computer software that is developed by NEER research projects. The RSICC computer software is made available to nuclear engineering departments, NERI and NEER awardees.

University Reactor Infrastructure and Education Assistance
ORNL administers part of the university summer internship program.

Generation IV Nuclear Energy Systems Initiative
ORNL and INL are the principal laboratories responsible for the development of advanced gas reactor fuel for the Very High Temperature Reactor. ORNL will fabricate gas reactor fuel in a laboratory-scale facility to supply demonstration fuel for irradiation testing and fuel performance modeling. ORNL also staffs the Generation IV National Technical Director for Materials and conducts much of the materials testing in support of the Generation IV Nuclear Energy Systems Initiative.

Nuclear Hydrogen Initiative
ORNL conducts research on the potential for thermochemical process improvements using membranes, specifically those previously developed for the gaseous diffusion process.

Advanced Fuel Cycle Initiative
ORNL conducts research in basic and applied science in support of the AFCI program. ORNL provides materials expertise to develop spallation targets and specific reactor components, conducts research and development on advanced separations technologies, transmutation fuels for light water and gas-cooled reactors and participates in the development and deployment planning of advanced aqueous spent fuel treatment technologies.

Radiological Facilities Management
ORNL provides the unique capabilities for fabricating carbon insulator and iridium heat sources components for radioisotope power sources used for NASA space exploration missions. These sophisticated heat source components are necessary for the safe operation of these power systems during normal operation and during launch, reentry or other deployment accidents.

Enriched stable isotopes are processed at two new laboratories. The material laboratory performs a wide variety of metallurgical, ceramic, and high vacuum processing techniques; the chemical laboratory performs scraping, leaching, dissolving, oxidizing processes to remove unwanted materials and place the isotope into a "chemically stable" form. Radioactive isotopes are chemically processed and packaged in hot cells in Building 3047.

ORNL provides baseline operation and maintenance of Building 3019, which has 1.5 metric tons of uranium, containing 450 kilograms of U-233. ORNL will begin the construction phase of the uranium-233 project, which includes procuring and installing uranium processing equipment in Building 3019, facility modifications and removal of legacy equipment. This effort will support the uranium-233 down blending and extraction of the medical isotope thorium-229 that is scheduled to begin in FY 2009.

Pacific Northwest National Laboratory

Introduction
Pacific Northwest National Laboratory (PNNL) is a multi-program laboratory located on approximately 640 acres of the Department's Hanford site. PNNL also monitors a marine science lab in Sequim, Washington.

Nuclear Energy Plant Optimization
PNNL is contracting with AEA technologies to transfer the Mechanical Stress Improvement Process to other countries in the former Soviet Union.

Advanced Fuel Cycle Initiative
PNNL provides technical support to the AFCI in the areas of advanced separations, fuels, and systems analysis.

Washington Headquarters

Washington Headquarters includes funding for the FY 2004 reduction to fund OVEC and other small business initiatives. In FY 2005, funding for the use of prior year balances reduction, Small Business and Innovative Research (SBIR), and other small business initiatives is included in Washington Headquarters. FY 2006 includes funding for SBIR and other small business initiatives.

University Reactor Infrastructure and Education Assistance
Includes funding to Morgan State University for the continuation of the DOE/NE Nuclear Energy Bridge Program.

Nuclear Power 2010
Includes funding for activities to be conducted in support of the combined Construction and Operating License (COL) demonstration projects.

Radiological Facilities Management
Includes funding for annual NRC certification for isotope shipping casks, independent financial audits of the revolving fund, and other related expenses.

University Reactor Infrastructure and Education Assistance

Funding Profile by Subprogram

(dollars in thousands)

	FY 2004 Comparable Appropriation	FY 2005 Original Appropriation	FY 2005 Adjustments	FY 2005 Comparable Appropriation	FY 2006 Request
University Reactor Infrastructure and Education Assistance	23,055	24,000	-190	23,810	24,000

Mission

The mission of the University Reactor Infrastructure and Education Assistance program is to enhance the national nuclear education infrastructure to meet the manpower requirements of the Nation's energy, environmental, health care, and national security sectors.

Benefits

The United States has led the world in the development and application of nuclear technology for many decades. This leadership, which spans energy, national security, environmental, medical and other applications, has been possible because the United States Government has helped foster advanced nuclear technology education at many universities and colleges across the Nation. The government's role is now to help these programs to maintain the education and training infrastructure necessary to develop the next generation of nuclear scientists and engineers. During the 1980s and 1990s, the number of students entering nuclear engineering programs in the United States declined causing a corresponding decline in nuclear engineering programs and research reactors. As the decline continued, the existing expertise in the nuclear field was reaching retirement age. Thus, the demand for nuclear scientists and engineers exceeded supply. The University Reactor Infrastructure and Education Assistance program addresses these issues by providing support to university nuclear engineering programs and the university research reactor community.

Strategic and Program Goals

The Department's Strategic Plan identifies four strategic goals (one each for defense, energy, science, and environmental aspects of the mission) plus seven general goals that tie to the strategic goals. The University Reactor Infrastructure and Education Assistance program supports the following goal:

Energy Strategic Goal

General Goal 4, Energy Security: Improve energy security by developing technologies that foster a diverse supply of reliable, affordable and environmentally sound energy by providing for reliable delivery of energy, guarding against energy emergencies, exploring advanced technologies that make a fundamental improvement in our mix of energy options, and improving energy efficiency.

The University Reactor Infrastructure and Education Assistance program has one program goal which contributes to General Goal 4 in the "goal cascade":

Program Goal 04.63.00.00: Enable, by 2015, the Nation's nuclear engineering universities to support a stable national undergraduate enrollment of approximately 1,500 to meet the Nation's need for trained nuclear scientists and engineers.

Contribution to Program Goal 04.63.00.00 (Enhance the Nation's nuclear education infrastructure)

The University Reactor Infrastructure and Education Assistance program contributes to the program goal by supporting outstanding students and faculty and providing support for education and research activities in the nuclear-related fields that will benefit the Nation's universities, laboratories, private sector and government. It also provides funding to improve existing infrastructure to ensure that the vital facilities used in training and educating our nuclear workforce are effective. Annual increases in undergraduate and graduate enrollments in nuclear engineering and science curricula are monitored to ensure the effectiveness of the program goal in producing nuclear scientists and engineers to fulfill national requirements.

Annual Performance Results and Targets

FY 2001 Results	FY 2002 Results	FY 2003 Results	FY 2004 Results	FY 2005 Targets	FY 2006 Targets
Program Goal 04.63.00.00 (Energy Security)					
University Reactor Infrastructure and Education Assistance					
					Establish the performance baseline for the management of the Innovations in Nuclear Infrastructure and Education grant initiative based on initial program evaluations of the six consortia members.
Support U.S. universities' nuclear energy research and education capabilities by: - Providing fresh fuel to all university reactors requiring this service; - Funding at least 23 universities with research reactors for reactor upgrades and improvements; - Partnering with private companies to fund 18 or more DOE/Industry Matching Grants Program for universities; and - Continue to support Reactor Sharing enabling each of the 29 schools eligible for the program to improve the use of their reactors for teaching, training, and educating within the surrounding community. (MET GOAL)	Support U.S. universities' nuclear energy research and education capabilities by: - Providing fresh fuel to university reactors requiring this service; - Funding all of the 23 universities with research reactors that apply for reactor upgrades and improvements; - Partnering with private companies to fund 20 to 25 DOE/Industry Matching Grants for universities; - Providing funding for Reactor Sharing with the goal of enabling all of the 28 eligible schools that apply for the program to improve the use of their reactors for teaching, training, and educating; and - Award two or more Innovations in Nuclear Infrastructure and Education awards. (MET GOAL)	Protect national nuclear research assets by funding 4 regional reactor centers; providing fuel to University Research Reactors; funding 20 to 25 DOE/Industry Matching Grants, 18 equipment and instrumentation upgrades, and 37 Nuclear Engineering Education Research grants; and providing 18 fellowships and 40 scholarships. (MET GOAL)	Fund the six existing regional reactor centers; provide fuel to University Research Reactors; fund 20 to 25 DOE/Industry Matching Grants, 20 equipment and instrumentation upgrades, and 50 Nuclear Engineering Education Research grants; and provide 18 fellowships and 47 scholarships. (MET GOAL)	Issue funding to the six existing Innovations in Nuclear Infrastructure and Education consortia; provide fuel to University Research Reactors; issue funding to 20 to 25 DOE/Industry Matching Grants, 20 equipment and instrumentation upgrades, and 50 Nuclear Engineering Education Research grants; and provide 25 fellowships and 75 scholarships.	Issue funding to the six existing Innovations in Nuclear Infrastructure and Education consortia; provide fuel to University Research Reactors; award 20 grants for reactor sharing; issue funding to 20 to 26 DOE/Industry Matching Grants, 20 equipment and instrumentation upgrades, and 48 Nuclear Engineering Education Research grants; provide 30 fellowships, 67 scholarships and 6 health physics fellowships; and establish and award 3 to 5 Junior Faculty grants.

FY 2001 Results	FY 2002 Results	FY 2003 Results	FY 2004 Results	FY 2005 Targets	FY 2006 Targets
Attract outstanding U.S. students to pursue nuclear engineering degrees by: - Providing 24 fellowships; - Increasing the number of Nuclear Engineering Education Research Grants to approximately 50 existing and new grants; and - Providing scholarships to approximately 50 sophomore, junior, and senior nuclear engineering and science scholarship recipients, including the partnering of minority institutions with nuclear engineering schools to allow these students to achieve a degree in their chosen course of study and nuclear engineering. (MET GOAL)	Attract outstanding U.S. students to pursue nuclear engineering degrees by: - Providing 18 graduate student fellowships with higher stipends beginning in FY 2002; - Supporting 50 university Nuclear Engineering Education Research Grants to encourage creative and innovative research at U.S. universities; and - Providing scholarships and summer on-the-job training to approximately 40 sophomore, junior and senior nuclear engineering and science scholarship recipients. (MET GOAL)				

Means and Strategies

NE will use various means and strategies to achieve its program goals. However, various external factors may impact the ability to achieve these goals. NE also performs collaborative activities to help meet its goals.

The Department will implement the following means:

- Continue to use educational incentives, including fellowships, scholarships, research funding, faculty support and private sector funding support from our Matching Grant program to increase enrollments and graduates in nuclear engineering reversing two decades of nuclear engineering infrastructure erosion.
- Pursue, as has been done the past several years, programs that increase minority participation and support by pairing nuclear engineering schools with minority institutions enabling students from minority universities to achieve degrees in both nuclear engineering and their chosen technical field.

The Department will implement the following strategies:

- Develop a pipeline of qualified and interested students in the area of nuclear science by training and educating middle and high school science teachers through the funding of the American Nuclear Society (ANS) Workshops. In addition, the Department is developing a nuclear science and technology pilot program with the Pittsburgh Public School System which will introduce a new curriculum in nuclear science allowing educators to teach nuclear science to high school students. The Department plans to partner with the private sector and other institutions to make this educational material available across the country.
- Improve the tools available to present and future students by upgrading university reactors and enabling others to share reactor time creating a stronger infrastructure by improving reactor operations and broadening the reach of the reactor facilities to those who would not otherwise have access to such sophisticated facilities.
- Meet periodically throughout the year with stakeholder organizations such as the Nuclear Engineering Department Heads Organization (NEDHO), the University Working Group, the Test, Research and Training Reactor Management Group (TRTR), and other committees of professional organizations such as the American Nuclear Society to review program activities, discuss program issues and solicit input, advice and guidance.

Validation and Verification

- All peer-reviewed university activities grantees are required to submit annual reports to DOE outlining the progress achieved. Once annual reports are submitted, they are logged in the NE database and reviewed by the NE Program Manager for compliance with the Program's stated goal and objectives. Nuclear Engineering Education Research (NEER) annual and final reports are posted to the NEER web page at http://neer.inel.gov/. These annual reports provide an opportunity to verify and validate performance. Also, quarterly, semi-annual and annual reviews of financial reports consistent with program plans are held to ensure technical progress, cost and schedule adherence, and responsiveness to program requirements.

- Program evaluations of INIE grant activities are conducted typically twice a year in conjunction with ANS meetings. In addition, comprehensive reviews are held with each INIE consortia to go over performance and cost. Each consortia member has an opportunity to provide progress information and input into upcoming performance. In addition, INIE awardees are required to submit annual progress reports to NE. They are logged in the NE database and reviewed by the NE Program Manager for compliance with program goals.

- NE conducts annual reviews of existing fellowship and scholarship recipients prior to renewing any awards.

- All three-year radiochemistry grants are reviewed annually through site visits by the program manager.

Funding by General and Program Goal

(dollars in thousands)

	FY 2004	FY 2005	FY 2006
General Goal 4, Energy Security			
Program Goal 04.63.00.00, Enhance the Nation's nuclear education infrastructure	23,055	23,810	24,000
Total, General Goal 4 (University Reactor Infrastructure and Education Assistance)	23,055	23,810	24,000

Other Information

The University Reactor Infrastructure and Education Assistance program supports the "National Energy Policy" objective to expand nuclear energy in the United States by preserving the education and training infrastructure at universities that is needed as the United States continues its reliance on advanced nuclear technologies. This program supports the continued operation of the Nation's university research and training reactors, which play a valuable role in supporting nuclear education and training.

University nuclear engineering programs supply highly skilled nuclear scientists and engineers to industry in fields such as electricity generation, national security, environmental restoration, and medicine, and to government agencies and national laboratories. To help ensure the continued viability of these programs, the Department provides assistance to university nuclear science and engineering and related programs. Assistance includes the DOE/Industry Matching Grants program which leverages public sector funds with private sector contributions in a 50/50 cost share arrangement. The Matching Grants program permits universities to strengthen their nuclear engineering course of study in a way that best fits each institution. Approximately 35 utilities and private companies match DOE's funds. Typically 20-25 universities receive funding each year. In the past several years, industry has provided more than 50 percent of the funds. The Matching Grants program has enabled university nuclear engineering programs to provide funding to areas most in need. In addition, this program has provided the means of fostering close working partnerships with the private sector.

The Nuclear Engineering Education Research (NEER) program provides vital research funding to university nuclear technology programs, encouraging innovative research at university reactors for both faculty and students. It is a competitive, peer-reviewed grant program that provides funding to conduct innovative research in nuclear science, engineering and related areas. The grants run from one to three years and are focused in one of the nine technical areas related to nuclear engineering: reactor physics, reactor engineering, reactor materials, radiological engineering, radioactive waste management, applied radiation science, nuclear safety and risk analysis, innovative technologies for next generation reactors, space power and propulsion, radiation sources or health physics. University Administrations are less apt to support nuclear engineering departments that lack viable external research support.

Academic assistance is provided to outstanding students and faculty through the Fellowships and Scholarships, Health Physics and Radiochemistry programs. A key component to the human resource capability continues to be the quality of nuclear engineering students produced by the universities. The fellowships and scholarships program helps assure outstanding students are attracted to university nuclear engineering undergraduate and graduate degree programs. The Department provides tuition, stipends, and a practicum to outstanding graduate students studying nuclear engineering and health physics and scholarships and a practicum to undergraduate students pursuing a nuclear engineering course of study. These scholarships and fellowships contribute to providing the necessary supply of trained nuclear scientists and engineers. This highly competitive program has produced outstanding graduates who have become leaders in nuclear research and university education. Also, within the fellowships and scholarships program is the University Partnership program, which encourages students, enrolled at minority-serving institutions to pursue a nuclear engineering degree at universities with nuclear engineering programs. There are currently six university partnerships consisting of 13 institutions working cooperatively in this innovative program. South Carolina State University (SCSU) and the University of Wisconsin were involved in the pilot program and now SCSU administers the program for all university partnership members. SCSU has also added two nuclear engineering faculty members and has become the only historically black college or university (HBCU) in the United States with an accredited nuclear engineering program.

One educational area that has been overlooked in the past has been Health Physics. While several of the fellowships awarded each year have been provided to students pursuing a degree in Health Physics, funds for Health Physics fellowships and scholarships have not been specifically designated in the budget. The Department formally established a Health Physics fellowships and scholarships program in FY 2005 to help increase enrollments in Health Physics to begin to address the shortage of these specialty trained personnel. This program will help heighten the visibility of Health Physics as a viable career opportunity and strengthen the Health Physics pipeline to replace retiring professionals.

The Department also provides grants every three years to support faculty and graduate/post doctorate students in radiochemistry. This program is linked to several national priorities including medicine, energy, and national defense and has been well leveraged since its inception with recipient universities supplementing the federal assistance. The once dormant radiochemistry educational apparatus has been re-energized by this program producing additional faculty and attracting new students to the discipline. Within the Radiochemistry program, the Department will establish the "Nuclear Engineering Junior Faculty Research Grants Initiative" in FY 2006. This grant initiative will assist universities in recruiting and retaining new faculty in nuclear science and engineering. The Junior Faculty Research Grants

Initiative will be a peer-reviewed grants program aimed at increasing the number of junior faculty members conducting nuclear research, which in turn will increase the level of nuclear research performed. This initiative will benefit the nuclear engineering programs by demonstrating to university administrators that viable research opportunities are available to entry-level faculty.

The Innovations in Nuclear Infrastructure and Education (INIE) program, established in FY 2002 in response to a Nuclear Energy Research Advisory Committee (NERAC) Task Force recommendation, encourages universities to make new investments in their research reactor and nuclear engineering programs while establishing strategic partnerships with other universities, national laboratories and industry. Today, the Department funds six INIE consortia, providing support to 33 universities in 23 states across the Nation. The Department's investment in this program has spurred the universities to increase their financial support for nuclear education and reactor infrastructure. The consortia ignited strategic partnerships between universities, national laboratories, and industry. These partnerships have resulted in increased use of the university nuclear reactor research and training facilities, upgrading of facilities, increased support for students, and additional research opportunities for students, faculty and other interested researchers.

To complement INIE and the other university assistance programs, the University Reactor Infrastructure and Education Assistance program provides for the fabrication and shipment of fresh fuel to university research reactors. There are currently 27 operating university research reactors at 26 institutions in the United States. These research reactors are unique and irreplaceable assets for technical education, and are used for a variety of research, educational and training purposes.

The Reactor Upgrade program provides assistance to universities to improve the operational and experimental capabilities of their research reactors. Grants are provided to universities to purchase equipment and services necessary to upgrade the reactor facilities, such as reactor instrumentation and control equipment, data recording devices, radiation, security and air monitoring equipment, and gamma spectroscopy hardware and software. Each year, approximately 20-25 universities request and receive this assistance. This program has improved the operations, safety and security of the Nation's university research reactors. The Reactor Sharing program enables universities with reactors to "share" access to their facilities with students and faculty at their own institutions, with universities that lack such a facility, and with visiting students from other local institutions including high schools and middle schools. The reactors are made available for use in research, experiments, material irradiations, neutron activation analysis and training, and for facility tours and other educational activities. Reactor Sharing is an important component of nuclear outreach providing tens of thousands of students and others the opportunity to learn about the operation of a nuclear reactor.

The Nuclear Engineering Education Support program prepares students for nuclear engineering and science careers and assists universities with special needs to improve their educational infrastructure. This program is helping to address the knowledge gap of incoming college freshmen in the area of nuclear science and engineering. In FY 2005 a nuclear science and technology education pilot was established between the Department and the Pittsburgh Public School System to provide advanced placement high school students an intensive educational experience in the field of nuclear science and technology. This effort provides course materials, tours to nuclear facilities, and lectures from internationally-recognized experts. In FY 2006, the program will apply the model used in the Pittsburgh pilot to other programs across the country, thereby strengthening the understanding of nuclear science in our public schools.

To ensure the Department's programs are aligned with the needs of the university community and the Nation, several studies have been completed to ascertain the current status and future outlook for nuclear engineering education in the U.S. and recommend initiatives to strengthen this vital sector of the university education curriculum. The Organization for Economic Cooperation and Development Nuclear Energy Agency conducted a review of nuclear engineering education in its member countries, "Nuclear Education and Training: Cause for Concern." Similarly, the Nuclear Energy Department Heads Organization (NEDHO) surveyed U.S. industry and universities concerning manpower requirements (see www.engin.umich.edu/~nuclear/NEDHO/). The conclusion of both studies was that the enrollment trends of the 1990s were not encouraging and that more students will need to be educated in nuclear engineering to provide the trained nuclear scientists and engineers required in the future. A third study by an expert panel appointed by NERAC in 1999 recommended programmatic and funding improvements to support the nuclear engineering infrastructure in the United States. (This and related studies can be found at www.nuclear.gov.) Since then, NE funding for these efforts has doubled.

Recent surveys conducted by NEDHO and the Department have found that the increased federal support of university nuclear engineering activities has resulted in significant increases in undergraduate nuclear engineering enrollments and increased support by universities to their nuclear engineering programs and research reactors. Federal funding remains a catalyst for ensuring a viable education and training infrastructure for tomorrow's nuclear scientists and engineers.

Funding Schedule by Activity

(dollars in thousands)

	FY 2004	FY 2005	FY 2006	$ Change	% Change
University Reactor Infrastructure and Education Assistance					
University Nuclear Infrastructure	15,355	15,010	14,100	-910	-6.1%
DOE/Industry Matching Grants Program	800	1,000	1,000	0	+0.0%
Fellowships/Scholarships to Nuclear Science and Engineering Programs at Universities	1,200	2,000	2,350	+350	+17.5%
Health Physics Fellowships & Scholarships	0	200	300	+100	+50.0%
Nuclear Engineering Education Research (NEER) Grants	5,000	4,900	5,000	+100	+2.0%
Nuclear Engineering Education Opportunities	400	400	600	+200	+50.0%
Radiochemistry Awards	300	300	650	+350	+116.6%
Total, University Reactor Infrastructure and Education Assistance	23,055	23,810	24,000	+190	+0.7%

Detailed Program Justification

	(dollars in thousands)		
	FY 2004	FY 2005	FY 2006
University Nuclear Infrastructure (UNI)	**15,355**	**15,010**	**14,100**

The UNI program provides fuel for the universities; instrumentation, electronics, hardware, and software upgrades for the research reactors; and reactor sharing and research support for educational institutions to facilitate the development of the Nation's next generation of nuclear scientists and engineers. A continued emphasis on research infrastructure support is needed to continue the successes made to date in the Nation's university nuclear engineering programs. In FY 2004, the program provided fuel elements for the reactors at the Massachusetts Institute of Technology, Kansas State University, and the University of Missouri, California (Davis-McClellan), Penn State and Utah. In FY 2005, the program will provide fuel elements for the reactors at the Massachusetts Institute of Technology, the Universities of Missouri, Texas A&M, and California (Davis-McClellan). In FY 2006, the program will continue to provide fuel elements for these universities.

In FY 2004, the program awarded 21 grants permitting universities without research reactors to have access to reactors for training, education, and research purposes. In FY 2005 and FY 2006, the number of reactor sharing grants is expected to remain relatively constant.

In FY 2004, the program supported 20 universities to address maintenance and upgrades to equipment required at university research reactors; provided new equipment to replace antiquated equipment; maintained reactor systems; and upgraded experimental capabilities. In FY 2005 and FY 2006, the number of reactor upgrades is expected to remain constant.

In FY 2004, the Innovations in Nuclear Infrastructure and Education (INIE) grant initiative encompassed 33 universities aligned in six INIE consortia; this structure will remain intact for FY 2005. The INIE grants assist universities in continuing the integration of academics and reactor research, which enhances the quality of student education, and encourages universities to better work with the Department's national laboratories, private industry and other universities. Promoting this collaborative effort expands the use of university facilities for research, education, and training of nuclear engineers and scientists by establishing regional research and training centers and strategic partnerships. In FY 2006, the INIE program will continue these activities.

DOE/Industry Matching Grants Program.................................	**800**	**1,000**	**1,000**

In FY 2004, the DOE/Industry Matching Grants program awarded grants to 26 universities for education, training, and innovative research. This program provides grants up to $60,000 that are matched by industry. In FY 2005 and FY 2006, an expected 20-26 universities will receive awards.

	(dollars in thousands)		
	FY 2004	FY 2005	FY 2006
Fellowships/Scholarships to Nuclear Science and Engineering Programs at Universities	**1,200**	**2,000**	**2,350**

In FY 2004, a total of 21 fellowships and 54 scholarships were awarded to students enrolled in nuclear science and engineering at U.S. universities. Fellowships are provided to M.S. and PhD. students and scholarships to undergraduate students. The fellowship and scholarship program has had many more qualified applicants than could be funded, challenging some students to continue in the field of nuclear engineering. In FY 2005, approximately 25 fellowships and 75 scholarships are expected to be awarded. In FY 2006, approximately 30 fellowships and 67 scholarships are expected to be awarded.

The University Partnership program encourages students enrolled in minority-serving institutions to pursue a nuclear engineering degree in cooperation with universities that grant those degrees. In FY 2004, the Department funded five university partnerships and expects to establish two additional partnerships in FY 2005 and one additional in FY 2006 for a total of eight.

Health Physics Fellowships & Scholarships	**0**	**200**	**300**

In FY 2005 and FY 2006, a combination of research grants**,** fellowships and scholarships will be provided to graduate and undergraduate students enrolled in Health Physics programs at U.S. universities**.** Fellowships will be provided to M.S. and PhD. students and scholarships to undergraduate students. Health physicists are responsible for ensuring the safety of workers, the general public, and the environment against the potentially harmful effects of radiation, while allowing for its beneficial uses in power production, industry, and medicine. The current demand for Health Physics professionals outstrips the supply by a factor of approximately 1:6.

Nuclear Engineering Education Research (NEER) Grants	**5,000**	**4,900**	**5,000**

In FY 2004, existing and new NEER grants totaled 51. New and existing NEER grants planned are 50 for FY 2005 and 48 for FY 2006. The NEER program provides grants allowing nuclear engineering faculty and students to conduct innovative research in nuclear engineering and related areas.

Nuclear Engineering Education Opportunities	**400**	**400**	**600**

The teacher workshops program is conducted in conjunction with the American Nuclear Society (ANS) which uses qualified volunteers from its membership to train teachers and students, keeping costs down. In FY 2004, the teacher workshops reached over five hundred teachers enabling them to teach nuclear science and engineering principles to their students. The workshops planned for FY 2005 and FY 2006 will reach thousands of teachers enabling them to teach nuclear science and engineering principles to their students. In addition, in FY 2005, the Department will introduce a new curriculum in nuclear science and technology in a national pilot program. The new program will be tested as part of the Pittsburgh Public Schools' Advanced Placement physics course.

In FY 2006, the Department will provide additional support to relevant pre-college education efforts; providing interested students and teachers with educational information about nuclear technology through development of workshops, visuals aids and other materials.

	(dollars in thousands)		
	FY 2004	FY 2005	FY 2006
Radiochemistry Awards	**300**	**300**	**650**

The three-year radiochemistry awards provide faculty support and student fellowships to help educate a new generation of radiochemists to address the technical challenges associated with radioactive wastes and contaminated sites. In FY 2004, the program continued to fund the existing three grants at three universities offering faculty and graduate student support. In FY 2005, the program will award three new grants. In FY 2006, the Department will establish the NE Junior Faculty Research Grants Initiative. This grants initiative will be a peer-reviewed grants program aimed at increasing the number of junior faculty members conducting nuclear research. The program will also continue to fund the existing three grants and begin to award three to five additional research grants for young faculty researchers at U.S. universities.

	FY 2004	FY 2005	FY 2006
Total, University Reactor Infrastructure and Education Assistance	**23,055**	**23,810**	**24,000**

Explanation of Funding Changes

	FY 2006 vs. FY 2005 ($000)
University Nuclear Infrastructure (UNI)	
The decrease of $910,000 reflects a reduction of the reactor fuel program fresh fuel requirements and spent fuel shipments	-910
Fellowships/Scholarships to Nuclear Science and Engineering Programs at Universities	
The increase of $350,000 will allow for additional fellowships/scholarships to students enrolled in nuclear science and engineering at U.S. universities. Also, funds will support an additional university partnership with minority institutions to attract more minority students into the nuclear field	+350
Health Physics Fellowships & Scholarships	
The increase of $100,000 will allow for two additional fellowships to health physics students	+100
Nuclear Engineering Education Research (NEER) Grants	
The increase of $100,000 in NEER is to maintain the research efforts in the program	+100
Nuclear Engineering Education Opportunities	
The increase of $200,000 to the Nuclear Engineering Support and Education program will continue the outreach activities to more middle schools and begin activities assisting pre-college teachers and students	+200

Radiochemistry Awards

The increase of $350,000 in the Radiochemistry program will establish an NE Junior Faculty Research Grants Initiative and award three to five research grants for faculty.	+350
Total Funding Change, University Reactor Infrastructure and Education Assistance	**+190**

Research and Development
Funding Profile by Subprogram

(dollars in thousands)

	FY 2004 Comparable Appropriation	FY 2005 Original Appropriation	FY 2005 Adjustments	FY 2005 Comparable Appropriation	FY 2006 Request
Research and Development					
Nuclear Energy Plant Optimization	2,863	2,500	-20	2,480	0
Nuclear Energy Research Initiative	6,410	2,500	-19	2,481	0
Nuclear Power 2010	19,360	50,000	-395	49,605	56,000
Generation IV Nuclear Energy Systems Initiative	26,981	40,000	-317	39,683	45,000
Nuclear Hydrogen Initiative	6,201	9,000	-71	8,929	20,000
Advanced Fuel Cycle Initiative	65,750	68,000	-538	67,462	70,000
Total, Research and Development	127,565[a]	172,000	-1,360	170,640	191,000

Mission

The mission of the Research and Development program is to secure nuclear energy as a viable, long-term commercial energy option to provide diversity in the energy supply. In the short-term, governmental and institutional barriers will be addressed to enable new plant deployment decisions by nuclear power plant owners and operators who wish to be among the first to license and build new nuclear facilities in the United States. In the longer-term, new nuclear technologies will be developed that can compete with advanced fossil and renewable technologies, enabling power providers to select from a diverse group of generation options that are economical, reliable, safe, secure, and environmentally acceptable.

Benefits

The benefits of nuclear science and technology to our society are numerous and increasingly important to the Nation's future. Nuclear energy presents some of our most promising solutions to the world's long-term energy challenges. Nuclear energy has the potential to generate electricity to drive our 21st century economy, to produce vast quantities of economical hydrogen for transportation use without emitting greenhouse gases, and to produce heat and clean water to support growing industry and populations all over the world. At the same time, nuclear energy presents challenges that must be met—

[a] Includes $1.83M identified as use of prior year balances to fund the Environmental Management liability for OVEC in FY 2004.

some through excellence in its use, but many others such as nuclear waste and economics—through advances in technology. Fully realizing nuclear energy's potential requires investment in long-term research to address the issues hindering its worldwide expansion. Much of the research at issue is far beyond the province of private industry given its long-term, high-risk nature; thus, the role of government in establishing a long-term future for nuclear power is clear.

Strategic and Program Goals

The Department's Strategic Plan identifies four strategic goals (one each for defense, energy, science, and environmental aspects of the mission) plus seven general goals that tie to the strategic goals. The Nuclear Energy Research and Development program supports the following goal:

Energy Strategic Goal
General Goal 4, Energy Security: Improve energy security by developing technologies that foster a diverse supply of reliable, affordable and environmentally sound energy by providing for reliable delivery of energy, guarding against energy emergencies, exploring advanced technologies that make a fundamental improvement in our mix of energy options, and improving energy efficiency.

The Nuclear Energy Research and Development program has a program goal that contributes to General Goal 4 in the "goal cascade":

Program Goal 04.14.00.00: Develop new nuclear generation technologies that foster the diversity of the domestic energy supply through public-private partnerships that are aimed in the near-term (2014) at the deployment of advanced, proliferation-resistant light water reactor and fuel cycle technologies and in the longer-term (2025) at the development and deployment of next-generation advanced reactors and fuel cycles.

Contribution to Program Goal 04.14.00.00 (Develop new nuclear generation technologies)

The Nuclear Power 2010 program supports intermediate-term research, technology development and demonstration activities that advance the "National Energy Policy" (NEP) goals of enhancing long-term U.S. energy independence and reliability and expanding the contribution of nuclear power to the Nation's energy portfolio. The Nuclear Power 2010 program supports this goal by identifying sites for new nuclear power plants, developing and bringing to market advanced standardized nuclear plant designs, evaluating the business case for building new nuclear power plants, and demonstrating untested regulatory processes leading to an industry decision in the next few years to seek Nuclear Regulatory Commission approval for building and operating at least one new advanced light water reactor plant in the United States.

The Generation IV Nuclear Energy Systems Initiative supports this goal through the development of innovative, next-generation reactor and fuel cycle technologies. The FY 2006 Budget expands research and development that could help achieve the desired goals of sustainability, economics, and proliferation resistance. Further investigation of technical and economic challenges and risks, including waste products, will help inform a decision on whether to proceed with a demonstration of the Next Generation Nuclear Plant, which would use very high temperature reactor technologies to economically produce both electricity and hydrogen gas. The Generation IV program will also invest in the development of next-generation fast neutron spectrum reactor technologies that hold significant promise for advancing sustainability goals and reducing nuclear waste generation.

The Nuclear Hydrogen Initiative contributes to this program goal by researching, developing and demonstrating economical hydrogen production technologies using high temperature heat from advanced nuclear energy systems. The initiative will develop hydrogen production technologies that are compatible with nuclear energy systems through scaled demonstrations.

The Advanced Fuel Cycle Initiative supports this goal by developing enabling technologies to reduce spent fuel volume, separate long-lived, highly radiotoxic elements, and reclaim spent fuel's valuable energy.

Annual Performance Results and Targets

FY 2001 Results	FY 2002 Results	FY 2003 Results	FY 2004 Results	FY 2005 Targets	FY 2006 Targets
Program Goal 04.14.00.00 (Energy Security)					
Nuclear Energy Research and Development					
				Achieve cumulative variance of less than 10 percent from each of the cost and schedule baselines for the Advanced Fuel Cycle, Generation IV Nuclear Energy Systems and Nuclear Hydrogen Initiatives.	*Achieve cumulative variance of less than 10 percent from each of the cost and schedule baselines for the Advanced Fuel Cycle, Generation IV Nuclear Energy Systems and Nuclear Hydrogen Initiatives.*
Nuclear Power 2010					
	Complete and issue the government/industry roadmap to build new nuclear plants in the United States by 2010. (MET GOAL)	Under the cooperative agreements with U.S. power generation companies, support the preparation and submittal of at least two Early Site Permit applications for commercial sites to NRC. (MET GOAL)	Select for award at least one cost-shared project with a power generating company-led team for activities required to demonstrate for the first time the combined Construction and Operating License (COL) process. (MET GOAL)	Issue project implementation plans for two Construction and Operating Licensing (COL) Demonstration Projects.	Obtain the Early Site Permit (ESP) for at least one commercial site.
					Issue a Nuclear Regulatory Commission-reviewed guidance document for preparation of Construction and Operating License applications.
	Complete at least two cooperative agreements with U.S. power generating companies to jointly proceed with at least two Nuclear Regulatory Commission (NRC) Early Site Permit applications for specific DOE and/or commercial sites. (MET GOAL)	Following a competitive process, award at least one industry cost-shared cooperative agreement for technology development and regulatory demonstration activities. (NOT MET) [Procurement activities were delayed into FY 2004 pending outcome of the Energy legislation under consideration in Congress. Target was achieved in FY 2004.]			
Generation IV Nuclear Energy Systems Initiative					

FY 2001 Results	FY 2002 Results	FY 2003 Results	FY 2004 Results	FY 2005 Targets	FY 2006 Targets
Program Goal 04.14.00.00 (Energy Security)					
Formally establish the Generation IV International Forum to assist in identifying and conducting cooperative R&D. Initiate development of a Generation IV Technology Roadmap for development of next generation nuclear energy systems. (MET GOAL)	Complete the draft Generation IV Technology Roadmap for development of the next generation nuclear energy systems. (MET GOAL)	Issue the Generation IV Technology Roadmap to develop the most promising next generation nuclear energy system concepts. (MET GOAL)			
		Develop preliminary functional requirements for the Generation IV Very-High-Temperature Reactor. (MET GOAL)	Award one or more contracts for the Next Generation Nuclear Plant (NGNP) pre-conceptual design. (NOT MET) [However, DOE engaged the industry and the public in an open process to inform its development of an acquisition strategy for the NGNP. By the end of the fiscal year, the Office of Nuclear Energy, Science and Technology finalized both the Mission Need Statement and the Draft Program Announcement for the NGNP.]	Issue the final design documents for the fuel capsule, test train, fission product monitoring system, and control system for the fuel irradiation shakedown test (AGR-1).	Complete assembly of the Advanced Gas Reactor 1 (AGR-1) fuel irradiation experiment and initiate irradiation in the Advanced Test Reactor (ATR) for Very High Temperature Reactor (VHTR) fuels.
					Issue an integrated Research and Development Plan for selected Generation IV technologies.
Nuclear Hydrogen Initiative					
			Complete final designs for the baseline thermochemical and high-temperature electrolysis laboratory-scale experiments. (MET GOAL)	Issue conceptual design documents for the thermochemical and high-temperature electrolysis pilot scale experiments.	Complete construction of process hardware for the baseline thermochemical process required for integrated laboratory-scale operation in FY 2007.
Advanced Fuel Cycle Initiative					
Establish new international agreement on advanced			*Achieve variance of less than 10 percent from cost and schedule*		

FY 2001 Results	FY 2002 Results	FY 2003 Results	FY 2004 Results	FY 2005 Targets	FY 2006 Targets
Program Goal 04.14.00.00 (Energy Security)					
accelerator applications programs with at least one country that significantly leverages financial and technical resources, to the mutual benefit of both countries particularly in areas such as safety, fuels and materials development, and facility operations. (MET GOAL)			*baselines for Advanced Fuel Cycle Initiative (AFCI) activities. (MET GOAL)*		
	Successfully manufacture advanced transmutation non-fertile fuels and testing containers for irradiation testing in the Advanced Test Reactor. (MET GOAL)	Complete fabrication of test articles containing proliferation resistant transmutation fuels for irradiation in the ATR beginning in FY 2004. (MET GOAL)	Complete fabrication and irradiation of advanced light water reactor (LWR) proliferation-resistant transmutation fuel samples, and initiate post-irradiation examination of the samples. (MET GOAL)	Issue preliminary report on the post-irradiation examination (PIE) of actinide-bearing metal and nitride transmutation fuels irradiated in the Advanced Test Reactor.	Issue the reports on the post-irradiation examination and analysis of light-water reactor transmutation irradiation test articles intended to demonstrate the integrity of at least one oxide fuel form containing 5 percent plutonium and neptunium, and actinide-bearing metal and nitride transmutation fuels.
	Demonstrate separation of uranium from spent nuclear fuel at a level of 99.9 percent using the Uranium Extraction (UREX) process to support the development of advanced fuel cycles for enhanced repository performance. (MET GOAL)	Demonstrate a laboratory scale extraction of plutonium/neptunium as well as cesium/strontium from other actinides and fission products to support the development of advanced fuel cycles for enhanced repository performance. (MET GOAL)	Issue the report on the demonstration of a laboratory-scale separation of americium/curium from spent nuclear fuel to support the development of advanced fuel cycles for enhanced repository performance. (MET GOAL)	Conduct laboratory-scale test of group actinide separation process (plutonium, neptunium, americium and curium extracted together) with actual light water reactor (LWR) spent fuel and report preliminary results.	
Establish a new Advanced Accelerator Applications university fellowship program and fund 10 new graduate students in engineering and science. (MET GOAL)					

Means and Strategies

NE is using various means and strategies to achieve its program goals. However, various external factors may impact the ability to achieve these goals. Collaborative activities with other organizations and countries contribute to achieving NE's goals.

The Department is using the following means to achieve its program goals:

- A joint government/industry cost-shared effort to identify sites for new nuclear power plants, develop advanced standardized nuclear plant designs, evaluate the business case for building new nuclear power plants, and demonstrate untested regulatory processes leading to an industry decision in the next few years to seek the Nuclear Regulatory Commission's approval to build and operate at least one new advanced nuclear power plant in the United States.

- Hydrogen production technologies compatible with nuclear energy systems are being developed by the Nuclear Hydrogen Initiative. This program includes participation of the Nation's laboratories, industry, and university research communities as well as international research partners. While these technologies are not sufficiently mature to require industry cost sharing at this time, cost sharing will be required for the final engineering-scale demonstration. The initiative will employ competitive selection processes for design, construction, and operation activities.

- Advanced, next-generation reactor systems that offer the most sustainable, cost-competitive, reliable, and secure means of generating electricity and hydrogen are being developed by the Generation IV Nuclear Energy Systems Initiative. The program includes participation by the Nation's laboratories, industry, and university research communities as well as the international research community represented by the Generation IV International Forum. Industrial and international cost sharing will be pursued where practical during the research and development on these intermediate- and long-term reactor technologies.

- Research and development on advanced, proliferation-resistant fuels and fuel cycle technologies that will be used by the Generation IV reactor concepts are being developed by the Advanced Fuel Cycle Initiative. In addition, these fuels and fuel cycle technologies aim to maximize the extraction of useful energy from spent nuclear fuel and reduce civilian plutonium inventories in existing light water reactors and future light water reactors and gas-cooled reactors. The program includes participation by the Nation's laboratories, industry, and university research communities as well as the international research community. Industrial and international cost sharing will be pursued where practical during the research and development on these intermediate- and long-term fuel cycle technologies.

The Department is deploying the following strategies:

- Partnering with the private sector, national laboratories, universities, and international partners to develop advanced nuclear technologies to increase the use of nuclear energy in the United States.

- Leading the international community in pursuit of advanced nuclear technology that will benefit the United States with enhanced safety, improved economics, and reduced production of wastes.

- Integrating the NERI and I-NERI research project methodologies into its mainline nuclear R&D programs—Generation IV Nuclear Energy Systems Initiative, Advanced Fuel Cycle Initiative, and Nuclear Hydrogen Initiative.

- Conducting international cost-shared R&D in the Generation IV Nuclear Energy Systems Initiative, Advanced Fuel Cycle Initiative, and Nuclear Hydrogen Initiative.

The following external factors could affect NE's ability to achieve its strategic goal:

- Whether new nuclear plant technology is deployed depends to a large extent on power demand and economic and environmental factors beyond the scope of DOE research and development programs. In the near-term, it depends on complex economic decisions made by industrial partners.

- Approval of VHTR high temperature materials by government regulators and by national codes and standards committees introduces risk to the overall project schedule.

- Deployment of advanced fuel cycle technologies will depend upon policy towards implementation of advanced spent fuel reprocessing technologies.

- All nuclear energy research programs rely heavily on data produced through collaborations with foreign nations. Should vital data from foreign partners prove unavailable, an increased U.S. effort in technology development would be required.

In carrying out the program's mission, NE performs the following collaborative activities:

- The Department and the Nuclear Regulatory Commission (NRC) coordinate program planning to assure that their research and development activities are complimentary, cost-effective, and without duplication.

- The Department is working with industry on a cost-shared basis to conduct demonstrations of untested Federal regulatory and licensing processes governing the siting, construction, and operation of nuclear power plants.

- The Generation IV Nuclear Energy Systems Initiative is receiving broad international cooperation and support, consistent with the objectives of the program. The Generation IV International Forum (GIF), composed of representatives from ten governments and the European Union, provides guidance for executing the research and development of these next-generation nuclear energy systems.

- Participation in international experiments related to the development of advanced fuel cycle technologies is being performed in support of the objectives of the Advanced Fuel Cycle Initiative.

- NE collaborates with other programs within the Department, such as the Office of Science and the Office of Energy Efficiency and Renewable Energy, on the hydrogen fuel initiative.

Validation and Verification

To validate and verify program performance, the Office of Nuclear Energy, Science and Technology (NE) conducts various internal and external reviews and audits. NE's programmatic activities are subject to continuing review by the Congress, the General Accountability Office, the Department's Inspector General, the Nuclear Regulatory Commission, the U.S. Environmental Protection Agency, state environmental and health agencies, the Defense Nuclear Facilities Safety Board, and the Department's Office of Engineering and Construction Management. In addition, NE provides continual management and oversight of its research and development programs—the Nuclear Power 2010 program, the Generation IV Nuclear Energy Systems Initiative, the Nuclear Hydrogen Initiative, and the Advanced Fuel Cycle Initiative (AFCI). Periodic internal and external program reviews evaluate progress against established plans. These reviews provide an opportunity to verify and validate performance. Monthly, quarterly, semi-annual and annual reviews, consistent with program management plans and project baselines, are held to ensure technical progress, cost and schedule adherence, and responsiveness to program requirements.

Special reviews, including peer reviews, are also conducted by NE as appropriate. In FY 2003 and FY 2004, comprehensive NERI project reviews were held with all active NERI principal investigators together in a single forum to provide an evaluation of the significance and technical validity of research and development projects in progress. Each principal investigator served as both the presenter of their project and as a reviewer of the other projects in their technical field. These peer reviews provided an evaluation of each NERI project's continued technical merit, its progress in accomplishing stated objectives, and its programmatic contribution.

The Department obtains advice on the direction of nuclear energy R&D programs from the independent Nuclear Energy Research Advisory Committee (NERAC). NERAC, a formal Federal advisory committee, provides expert advice on long-range plans, priorities, and strategies for the nuclear technology R&D and research infrastructure activities of the Office of Nuclear Energy, Science and Technology (NE). NERAC has several active subcommittees examining various aspects of nuclear technology R&D. Reports issued by these subcommittees that address the future of nuclear energy include: the "Long-Term Nuclear Technology Research and Development Plan", the "Nuclear Science and Technology Infrastructure Roadmap", "A Roadmap to Deploy New Nuclear Power Plants in the United States by 2010", and "A Technology Roadmap for Generation IV Nuclear Energy Systems". In FY 2005, NERAC issued the "Report of the Subcommittee on Nuclear Laboratory Requirements" and "An Evaluation of the Proliferation Resistant Characteristics of Light Water Reactor Fuel with the Potential for Recycle in the United States". The former report identified what will be needed to develop the Idaho National Laboratory into a world-class nuclear laboratory within a decade, and the latter report provided expert advice to help guide the development of new technology approaches to proliferation-resistant civilian nuclear fuel cycles.

NERAC's Subcommittee on Evaluations, formed in FY 2004, conducted independent program evaluations of NE's Generation IV Nuclear Energy Systems Initiative, Nuclear Power 2010 program, and the Advanced Fuel Cycle Initiative. The Subcommittee submitted its findings to the full NERAC in FY 2005, and they contributed to the formulation of this budget request. The Subcommittee will continue independently to evaluate and report on key NE programs at least annually. The Subcommittee on Generation IV Nuclear Energy Systems, also formed in FY 2004, submitted its first report on the development of the Generation IV program to the full NERAC in FY 2005.

Program Assessment Rating Tool (PART)

The Department implemented a tool to evaluate selected programs. PART was developed by the OMB to provide a standardized way to assess the effectiveness of the Federal Government's portfolio of programs. The structured framework of the PART provides a means through which programs can assess their activities differently than through traditional reviews. The Nuclear Energy R&D program has incorporated feedback from OMB during the FY 2004-FY 2005 PART assessments into the FY 2006 Budget Request and has taken or will take the necessary steps to continue to improve performance.

The results of the FY 2005 review are reflected in the FY 2006 Budget Request as follows:
For the Nuclear Power 2010 program, an overall PART score of 69 was achieved with a perfect 100 score for Section I, Program Purpose & Design. A score of 89 was achieved for Section II, Strategic Planning reflecting the need to improve the linkage between budget and performance data at the Departmental level. A score of 88 was achieved for Section III, Program Management reflecting the need to measure and achieve cost effectiveness in program execution. A score of 45 was achieved for Section IV, Program Results/Accountability, indicating that the program needs to establish on an annual basis an independent assessment of the overall program, evaluating the program's progress against established annual and long-term goals. In addition, OMB did recognize that the NP 2010 is a relatively new program with limited progress in achieving its long-term goals. To address these findings, the Department has established an annual assessment process for the program, which will address the appropriateness, adequacy and completeness of current and planned activities for achieving the program goals and objectives.

For the Generation IV Nuclear Energy Systems Initiative, an overall PART score of 79 was achieved with perfect scores of 100 for Section I, Program Purpose & Design, and Section III, Program Management. These scores reflect the continued effective management of the program. A score of 90 was achieved for Section II, Strategic Planning reflecting the need to improve the linkage between budget and performance data at the Departmental level. A score of 60 was achieved for Section IV, Program Results/Accountability, which reflects the strengthening of long-term performance goals for the program compared with the previous year's performance goals. The need for improvements in the conduct of independent evaluations was identified. This area was strengthened in early FY 2004 by the establishment of the new NERAC Subcommittee on Evaluations.

For the Advanced Fuel Cycle Initiative (AFCI), an overall PART score of 76 was achieved with top scores of 100 in Section I, Program Purpose & Design, and Section III, Program Management. These scores are attributable to the continued use of effective program management practices. A score of 90 was achieved for Section II, Strategic Planning reflecting the need to improve the linkage between budget and performance data at the Departmental level. A score of 53 was achieved for Section IV, Program Results/Accountability, indicating the need to better demonstrate the cost effectiveness of the program. To address these findings, the program revised its near and long-term goals, and is working to increase cost effectiveness by continuing to increase international cost-shared research and development costs through expanded collaborations.

Funding by General and Program Goal

	(dollars in thousands)		
	FY 2004	FY 2005	FY 2006
General Goal 4, Energy Security Program Goal 04.14.00.00: Develop new nuclear generation technologies	118,292	165,679	191,000
All Other	9,273	4,961	0
Total General Goal 4 (Research and Development)	127,565	170,640	191,000

Other Information

Our Nation's investments in nuclear energy R&D are made to improve the quality of life, energy security, and economic prospects for the American people. Currently, 20 percent of our Nation's electricity is produced with emission-free nuclear power plants. The "National Energy Policy" calls for the expansion of nuclear energy in the United States. In support of this goal, the Department's nuclear energy R&D programs address two critical objectives:

Develop New Nuclear Generation Technologies:

U.S. electricity demand continues to grow at approximately two percent per year. Forecasts indicate that the United States will need about 335,000 megawatts of new generating capacity by 2025—even if ambitious assumptions are correct regarding the implementation of energy efficiency practices and technologies. If electricity demand grows at our current higher rates, even more generating capacity will be needed. This growth would require the United States to build between 1,000 and 1,200 new power plants over the next two decades. This averages to building and commissioning 50 to 60 new power plants per year. To help meet this need, the "National Energy Policy" recommends the expansion of nuclear energy in the United States, including the construction of new nuclear power plants.

The Nuclear Power 2010 program supports intermediate-term research, technology development and demonstration activities that advance the "National Energy Policy" goals of enhancing long-term U.S. energy independence and reliability and expanding the contribution of nuclear power to the Nation's energy portfolio. Because nuclear energy is the only large-scale, non-emitting energy source that can expand to meet growing demand and replace retiring fossil-fueled capacity over the next twenty years, efforts taken with industry to increase the production of nuclear-generated electricity are vital to meeting the country's energy and environmental goals.

The Nuclear Power 2010 program is focused on resolving the technical, institutional, and regulatory barriers to the deployment of new nuclear power plants by 2010, consistent with the recommendations of the NERAC report, "A Roadmap to Deploy New Nuclear Power Plants in the United States by 2010." In order to support the "National Energy Policy" and the President's goal of reducing greenhouse gas intensity by 18 percent by 2012, the Nuclear Power 2010 program will help enable an industry decision to deploy at least one new advanced nuclear power plant in the U.S. early in the next decade.

Recognizing growing concerns worldwide about sustainable development, the Department started the Generation IV Nuclear Energy Systems Initiative. As documented in "A Technology Roadmap for Generation IV Nuclear Energy Systems", Generation IV advanced reactor and fuel cycle technologies are poised to play an important role in meeting the needs for electricity, hydrogen, clean water, and process heat. Generation IV Nuclear Energy Systems Initiative will meet these needs by:

- conducting research and development on thermal-spectrum Generation IV technology that can provides significant improvements in proliferation and terrorism resistance, safety and reliability, and economics, and demonstrate efficient electricity and hydrogen production; and

- conducting research and development, in collaboration with international partners, on fast-spectrum Generation IV nuclear energy systems for deployment in the longer-term future that, with successful Advanced Fuel Cycle Initiative research, provide significant improvements in proliferation and terrorism resistance, safety and reliability, economics, and long-term sustainability.

While contributing 17 percent of electricity generation worldwide, nuclear energy currently contributes only seven percent to the overall global energy requirements. Considering emerging issues such as sustainable development of world economies, the capacity of nuclear energy to deliver energy that is free from greenhouse gas emissions or other air pollutants offers a renewed incentive to consider a broadened, energy-intensive product mix. Nuclear technology, combined with advanced thermochemical or high-temperature electrolysis technologies, presents a very promising approach to produce hydrogen in a sustainable and environmentally friendly manner. A large market for hydrogen already exists in the fertilizer and petrochemical industries. Hydrogen and other synthetic chemical fuels are expected to find broadening application on world energy markets; the transportation sector has already begun a transition to hydrogen enrichment of fuels. The Nuclear Hydrogen Initiative is focused on the research, development and demonstration of a commercially viable, reactor-driven process for the large-scale production of hydrogen.

Beginning in FY 2004, the Department integrated the Nuclear Energy Research Initiative (NERI) activity directly into its mainline nuclear R&D programs to achieve greater participation of the Nation's university research community in these programs. The competitive solicitations for this research seek universities to conduct research that is focused specifically on programmatic issues for the Generation IV Nuclear Energy Systems Initiative, the Advanced Fuel Cycle Initiative, and the Nuclear Hydrogen Initiative. Funding for these research projects is provided directly from the budgets of these programs and will be devoted entirely to the research conducted at universities and colleges throughout the United States. The new approach to executing this research retains the independent peer review critical to ensuring the pursuit of leading-edge technologies, and integrates the Nation's universities into the Department's mainline nuclear R&D programs. Also, beginning in FY 2004, the Department used the bilateral I-NERI agreements implemented with other nations to continue international cost-shared R&D on the Generation IV Nuclear Energy Systems Initiative, the Advanced Fuel Cycle Initiative, and the Nuclear Hydrogen Initiative. This new approach to executing international, cost-shared research allows the Department to use all nuclear energy R&D programs as a basis for international, cost-shared R&D

thereby significantly increasing the amount of research achievable otherwise. Beginning in FY 2005, research on International Near Term Deployment technologies identified in the "Generation IV Technology Roadmap" by NERAC and the Generational IV International Forum that are relevant to U.S. technology needs will be conducted under the I-NERI sub-element of the Generation IV line item.

Develop Advanced, Proliferation-Resistant Nuclear Fuel Technologies:

As the United States considers the expansion of nuclear energy (as recommended in the "National Energy Policy"), it is clear that the Nation must optimize its approach to managing spent nuclear fuel. While the Yucca Mountain site may be sufficient to store all commercial spent fuel waste generated by existing nuclear power plants, the current "once-through" approach to the fuel cycle could require the United States to build additional repository space to assure the continued, safe management of nuclear waste from a new generation of nuclear plants. Further, long-term issues associated with the heat load and radiotoxicity of nuclear waste and the proliferation risks posed by plutonium in spent fuel remain.

To address these issues, the Department has embarked, with its international partners, on a research effort with both an intermediate-term and a long-term component. This program, the Advanced Fuel Cycle Initiative, seeks to develop advanced, proliferation-resistant nuclear fuel cycle technologies that can:

- enhance the design and reduce the long-term cost of the Nation's first geologic repository;
- reduce or eliminate the technical need for an additional repository;
- reduce the inventory of plutonium from commercial spent nuclear fuel; and
- recover the energy value of commercial spent nuclear fuel.

The development of the advanced fuels and fuel cycle technologies needed for the next-generation reactors under development in the Department's Generation IV Nuclear Energy Systems Initiative is also being conducted under the Advanced Fuel Cycle Initiative.

Nuclear Energy Plant Optimization

Funding Schedule by Activity

	(dollars in thousands)				
	FY 2004	FY 2005	FY 2006	$ Change	% Change
Nuclear Energy Plant Optimization					
Nuclear Energy Plant Optimization	2,863	2,412	0	-2,412	-100.0%
Small Business Innovative Research/Small Business Technology Transfer Program	0	68	0	-68	-100.0%
Total, Nuclear Energy Plant Optimization	2,863	2,480	0	-2,480	-100.0%

Description

The Nuclear Energy Plant Optimization (NEPO) program was started by the Department of Energy in FY 2000 to address the technical issues that may prevent the continued operation of existing nuclear power plants. Such technical issues include plant aging and improving plant reliability, availability, and productivity. The FY 2006 Budget proposes to terminate this program.

Benefits

NEPO research and development has made progress toward addressing material aging and generation optimization issues which have been identified by the industry as the long-term issues facing current operating plants. Currently, 30 of the 104 operating U.S. nuclear plants have received approval from the Nuclear Regulatory Commission to extend the operation of the nuclear plant for an additional 20 years for a total plant life expectancy of 60 years. Nearly all the U.S. nuclear plants are expected to seek and gain license renewal for this additional 20-year period of operation. As these nuclear plants mature, material aging and equipment degradation issues are being identified that affect continued operation of these plants. Examples of recent results from the NEPO program include new electrical cable monitoring techniques for improved prediction of cable lifetimes; development of techniques to qualify digital instrumentation transmitters to replace existing analog transmitters which are less accurate, difficult to maintain, or no longer available from the vendors; and the development of guidelines for the implementation of hybrid and digital control room technology. Further information about current projects and recent results of the NEPO program can be obtained at the NEPO web site (http://www.nuclear.gov).

The Nuclear Energy Research Advisory Committee (NERAC) provides the Department independent expert advice on the planning and execution of the NEPO program. NEPO research is coordinated with industry and R&D projects have been awarded on a competitive basis. Non-competitive awards are made when the R&D requires a unique facility or unique knowledge of and experience with the R&D being conducted.

No funding is requested for this activity in FY 2006.

Detailed Justification

	(dollars in thousands)		
	FY 2004	FY 2005	FY 2006
Nuclear Energy Plant Optimization	**2,863**	**2,412**	**0**

In FY 2004, R&D activities continued using prior year funds on 14 one-year projects that started in FY 2003. In FY 2004, two new one-year projects were initiated. One NEPO project is focused on techniques and methods for validation of enhanced nuclear plant security. The second FY 2004 NEPO project addresses issues related to commercial light water reactor fuel clad material degradation. In addition, the transfer of the Mechanical Stress Improvement Process Technology to the Ignalina plant in Lithuania was completed.

In FY 2005, activities will focus on addressing the affects of aging on material in nuclear plants. The program will use and further develop the capabilities on the newly formed Idaho National Laboratory to help resolve nuclear industry issues in this area. In particular, R&D activities related to commercial Light Water Reactor fuel degradation will continue.

No funding is being requested for FY 2006.

	FY 2004	FY 2005	FY 2006
Small Business Innovative Research and Small Business Technology Transfer Programs	**0**	**68**	**0**
Total, Nuclear Energy Plant Optimization	**2,863**	**2,480**	**0**

Explanation of Funding Changes

	FY2006 vs. FY 2005 ($000)
Nuclear Energy Plant Optimization	
The funding decrease of $2,412,000 reflects no funds being requested in FY 2006	-2,412
Small Business Innovative Research and Small Technology Programs	
The funding decrease of $68,000 reflects no funds being requested in FY 2006	-68
Total Funding Change, Nuclear Energy Plant Optimization	**-2,480**

Nuclear Energy Research Initiative

Funding Schedule by Activity

(dollars in thousands)

	FY 2004	FY 2005	FY 2006	$ Change	% Change
Nuclear Energy Research Initiative					
Nuclear Energy Research Initiative	6,410	2,415	0	-2,415	-100.0%
Small Business Innovative Research/Small Business Technology Transfer Program	0	66	0	-66	-100.0%
Total, Nuclear Energy Research Initiative	6,410[a]	2,481	0	-2,481	-100.0%

Description

The Nuclear Energy Research Initiative (NERI), started in 1999, has conducted research to advance the state of nuclear science and technology in the United States by addressing technical issues impacting the expanded use of nuclear energy. Specifically, the NERI program has focused on research and development on next-generation nuclear energy systems, proliferation resistant nuclear fuel cycle technologies, generation of hydrogen using nuclear power, improvements in light water reactor technology, and fundamental areas of nuclear science that directly impact the long-term success of nuclear energy. In FY 2004, the Department integrated the Nuclear Energy Research Initiative (NERI) activity directly into its mainline nuclear R&D programs - the Generation IV Nuclear Energy Systems Initiative (Generation IV), the Advanced Fuel Cycle Initiative (AFCI), and the Nuclear Hydrogen Initiative (NHI)- to achieve greater participation of the Nation's universities in these National R&D programs.

Benefits

NERI featured a competitive, investigator-initiated, peer-reviewed selection process to fund innovative nuclear energy-related research. Modeled after successful research programs such as those conducted by the National Science Foundation and DOE's Office of Science, the NERI program solicited proposals from the U.S. scientific and engineering community for research at universities, national laboratories, and industry. NERI encouraged collaborative research and development activities among these different research organizations, as well as participation of research organizations funded by other nations. The Nuclear Energy Research Advisory Committee (NERAC) provided oversight and advice on the planning and implementation of the NERI program.

The NERI research effort, conducted by the Nation's university, laboratory and industry partners, has helped to maintain the nuclear research infrastructure in this country and has focused attention on the United States as a nuclear research and development leader. Research accomplishments include: reactor system and plant infrastructure concepts that utilize nuclear energy to produce hydrogen; new advanced controls, diagnostic techniques and information systems for potential use in automating future

[a] For comparability purposes, the I-NERI funding has been included in the Generation IV Nuclear Energy Systems Initiative program. In FY 2004, the I-NERI funding is $4.2M of which $0.116M is SBIR/STTR.

nuclear plants; high temperature ceramic materials that could allow higher burn-ups resulting in maximized energy production and improved plant economics; evaluation of direct energy conversion technologies for advanced nuclear power plants; and reactor physics data for advanced nuclear power systems. By funding innovative nuclear research at the Nation's universities, the NERI program has stimulated student enrollment in nuclear fields of study. Further highlights of the NERI program are contained in the "Nuclear Energy Research Initiative 2003 Annual Report" (see http://neri.ne.doe.gov/).

Beginning in FY 2004, the Department integrated the Nuclear Energy Research Initiative (NERI) activity directly into its mainline nuclear R&D programs to achieve greater participation of the Nation's university research community in these programs. The competitive solicitations for NERI research seek universities to conduct research that is focused specifically on programmatic issues for Generation IV Nuclear Energy Systems Initiative, Advanced Fuel Cycle Initiative and Nuclear Hydrogen Initiative. Funding for these research projects comes directly from the budgets of these programs and is devoted to research conducted at universities and colleges throughout the United States. The new approach to executing NERI research retains the independent peer review critical to ensuring the pursuit of leading-edge technologies, and integrates the Nation's universities into the Department's mainline nuclear R&D programs. Funds appropriated in FY 2005 for the NERI program will be used in conjunction with FY 2004 and FY 2005 funds provided by the mainline R&D programs to award 35 cooperative agreements to U.S. universities to conduct research on the Generation IV, AFCI, and the NHI programs. As the NERI activities are integrated into the Department's mainline nuclear R&D programs, no funding is requested in FY 2006 for a stand-alone NERI program.

Detailed Justification

	(dollars in thousands)		
	FY 2004	FY 2005	FY 2006
Nuclear Energy Research Initiative	**6,410**	**2,415**	**0**

The NERI program conducts research and development on next-generation nuclear energy systems, proliferation resistant nuclear fuel cycle technologies, generation of hydrogen using nuclear power, improvements in light water reactor technology, and fundamental areas of nuclear science that directly impact the long-term success of nuclear energy. Beginning in FY 2004, new NERI research projects support the Generation IV, AFCI and NHI programs and are conducted by U.S. universities.

In FY 2004, the Department began to integrate the NERI activity directly into its mainline nuclear R&D programs. Solicitations were issued in late FY 2004 and the selection of 35 cooperative agreements will be awarded in early 2005 to U.S. universities to conduct research on the Generation IV, AFCI and the NHI programs.

In FY 2006, no funding is requested in the NERI program as the mainline R&D programs will provide funding for the NERI university awards.

	(dollars in thousands)		
	FY 2004	FY 2005	FY 2006
Small Business Innovative Research and Small Business Technology Transfer Programs (SBIR/STTR)	**0**	**66**	**0**
Total, Nuclear Energy Research Initiative	**6,410**	**2,481**	**0**

Explanation of Funding Changes

	FY 2006 vs. FY 2005 ($000)
Nuclear Energy Research Initiative	
The decrease of $2,415,000 is due to no funding being requested in FY 2006 for the NERI program; all NERI projects are being funded by the Generation IV, AFCI and NHI programs in FY 2006	-2,415
Small Business Innovative Research and Small Technology Programs	
The decrease of $66,000 is due to no NERI funding being requested in FY 2006	-66
Total Funding Change, Nuclear Energy Research Initiative	**-2,481**

Nuclear Power 2010

Funding Schedule by Activity

	(dollars in thousands)				
	FY 2004	FY 2005	FY 2006	$ Change	% Change
Nuclear Power 2010	19,360	49,605	56,000	+6,395	+12.9%
Total, Nuclear Power 2010	19,360	49,605	56,000	+6,395	+12.9%

Description

The Nuclear Power 2010 program supports intermediate-term research, technology development and demonstration activities that advance the "National Energy Policy" (NEP) goals of enhancing long-term U.S. energy independence and reliability and expanding the contribution of nuclear power to the Nation's energy portfolio. Because nuclear energy is the only large-scale, non-emitting energy source that can expand to meet growing demand and replace retiring fossil-fueled capacity over the next twenty years, efforts taken with industry to increase the production of nuclear-generated electricity are vital to meeting the country's energy and environmental goals.

Nuclear Power 2010 is a joint government/industry cost-shared effort to: identify sites for new nuclear power plants, develop and bring to market advanced standardized nuclear plant designs, evaluate the business case for building new nuclear power plants, and demonstrate untested regulatory processes. These efforts are designed to pave the way for an industry decision in the next few years to seek Nuclear Regulatory Commission approval to build and operate a new advanced nuclear power plant in the United States.

The Department is actively engaged with the industry to address the issues affecting future expansion of nuclear energy in this country. The Department and the private sector have identified specific issues to be addressed through cooperative research, technology development, analysis, and regulatory demonstration activities. The objectives of these activities are focused on the expansion of nuclear generation capacity through deployment of new nuclear plants.

Benefits

Electricity demand in the United States is expected to grow sharply in the 21st century, requiring new generation capacity. Forecasts indicate that the United States will need about 335,000 megawatts of new generating capacity by 2025 - even if ambitious assumptions are correct regarding the implementation of energy efficiency practices and technologies. If electricity demand grows at our current higher rates, even more generating capacity will be needed. This growth would require the United States to build between 1,000 and 1,200 new power plants over the next two decades. This averages to building and commissioning 50 to 60 new power plants per year.

With about 20 percent of our Nation's current electricity production generated by nuclear power plants, the Department believes it is important to deploy new baseload nuclear generating capacity within a decade. This goal supports the "National Energy Policy" objectives of energy supply diversity and energy security. In order to maintain nuclear power's electricity share to meet future electricity demand, the technical, regulatory, and institutional barriers, which currently exist, must be successfully addressed by government and industry. More specifically, major obstacles to building new nuclear plants include the uncertainties associated with Federal regulatory processes, the initial high capital costs of the first nuclear plants and the business risks resulting from these uncertainties. The Nuclear Power 2010 program was designed to address these obstacles by partnering with industry to achieve near-term expansion of nuclear energy. This program also implements "National Energy Policy" recommendations to expand the role of nuclear energy in the United States.

A Near-Term Deployment Working Group, operating under the auspices of the Nuclear Energy Research Advisory Committee (NERAC), and composed of representatives from the nuclear industry, national laboratories, and United States universities, initiated a concerted effort in FY 2001 to identify the technical, institutional, and regulatory barriers to the deployment of new nuclear power plants by the end of the decade. On October 31, 2001, the working group issued, "A Roadmap to Deploy New Nuclear Power Plants in the United States by 2010," which recommends action to be taken by industry and the Department to support deployment of new advanced nuclear power plants in the United States by 2010 (see http://nuclear.gov/nerac/ntdroadmapvolume1.pdf). The analysis from NERAC notes that research and development on near-term advanced reactor concepts that offer enhancements to safety and economics is needed to enable these new technologies to be competitive in the deregulated electricity market. The recommendations of the near-term deployment roadmap, which have broad industry support, provide the basis for the activities of the Nuclear Power 2010 program.

The technology focus of the Nuclear Power 2010 program is on Generation III+ advanced light water reactor designs which offer advancements in safety and economics over the Generation III+ designs certified in the 1990s by the Nuclear Regulatory Commission. To reduce the regulatory risks and enable the deployment of new Generation III+ nuclear power plants in the United States, it is essential to demonstrate the untested Federal regulatory and licensing processes for the siting, construction, and operation of new nuclear plants. In addition, design development and Nuclear Regulatory Commission certification of these near-term Generation III+ advanced reactor concepts is needed to reduce the high initial capital costs of the first new plants such that these new technologies can be competitive in the deregulated electricity market and deployable within the next decade.

The economics and business case for building new nuclear power plants is also being evaluated as part of the Nuclear Power 2010 program to identify the necessary conditions under which power generation companies would add new nuclear capacity. In July 2002, the Department released the "Business Case for New Nuclear Power Plants in the United States," which presents the results of this evaluation and provides recommendations for Federal government assistance (see http://nuclear.gov/home/bc/businesscase.html). The Department continues to evaluate and develop strategies to mitigate specific financial risks identified in this report associated with deployment of new nuclear power plants. The Department also sponsored an independent study by the University of Chicago's Department of Economics that examined the economic viability of new nuclear power plants in the United States and considered the possible effectiveness of temporary federal government policies to assist in the competitiveness of the first few new plants. The results of the study are documented in the September 2004 report, "The Economic Future of Nuclear Power" (see http://nuclear.gov/NucPwr2010/NucPwr2010_PI.html). The information obtained from these studies is used to focus the program's activities on issues of the greatest impact.

The Nuclear Power 2010 program incorporates competitive procurement processes for the regulatory demonstration and design development activities and requires a minimum of 50 percent industry cost-share for these program activities. Through the competitive procurement process, the Department has successfully encouraged industry to form consortia—innovative business arrangements among power generation companies, reactor vendors and architect-engineers—that have strong incentives to build and operate new nuclear plants in the United States. This consortium approach is designed to advance real plans for building new nuclear power plants and to ensure that investments for standardized design development are directed toward those advanced reactor technologies which power companies are willing to build.

To demonstrate the new untested regulatory process for obtaining U.S. Nuclear Regulatory Commission (NRC) approval for siting a new nuclear power plant, the Department established competitively selected, cost-shared cooperative agreements in FY 2002 with three nuclear power generating companies to obtain Early Site Permits (ESP) for three commercial sites. The ESP process includes resolution of site safety, environmental and emergency planning issues in advance of a power company's decision to build a new nuclear power plant. In fall of 2003, the three power generation companies, working under the auspices of the Nuclear Power 2010 program, prepared and submitted ESP applications for NRC approval. Currently, the three ESP applications are undergoing NRC staff review. To identify additional qualified sites, the Department initiated additional cost-shared studies in FY 2003 and FY 2004 to prepare technical (*e.g.* geotechnical, geological and seismological) and financial evaluations and to assess the electricity transmission impacts associated with siting a new commercial nuclear plant. ESP demonstration project tasks in FY 2005 will focus on industry activities to assure timely completion of the NRC staff and Advisory Committee on Reactor Safeguards (ACRS) reviews of the ESP applications and Atomic Safety and Licensing Board (ASLB) hearings. NRC issuances of ESPs are expected in FY 2006.

To demonstrate the new untested regulatory process for obtaining NRC approval for constructing and operating a new nuclear power plant, the Department will implement combined Construction and Operating License (COL) regulatory demonstration projects. The COL process is a "one-step licensing" process established by the Energy Policy Act of 1992 and intended to resolve all public health and safety issues associated with the construction and operation of a new nuclear power plant before construction begins. In FY 2003, the Department initiated a cost-shared project with the industry to develop generic guidance for preparing a COL application and to resolve anticipated generic COL regulatory issues. This project, to be concluded in FY 2006, will result in an NRC-reviewed guidance document available for industry to use in preparing COL applications.

In November 2004, the Department selected two utility-led consortia to initiate New Nuclear Plant Licensing Demonstration Projects and to obtain an NRC license to construct and operate new nuclear power plants in the United States. In responding to the Department's solicitation issued in FY 2004, these consortia provided specific plans that the utilities believe could lead to groundbreaking activities for new U.S. nuclear power plants by 2010. This engineering, regulatory demonstration, and analysis work will complete the steps necessary to allow one or more nuclear plants to be ordered by the end of 2008. The work includes design certification and completion efforts related to state-of-the-art Generation III+ nuclear plant designs; site-specific analysis and engineering required to obtain Combined Construction/Operating Licenses from the NRC; and other activities required to allow for a utility order for a new plant to proceed.

A third consortium was awarded cost-shared funding in FY 2004 to conduct a detailed cost and schedule analysis of the potential construction of a Generation III+ nuclear power plant in Alabama. This work is scheduled to be completed in late FY 2005. The three consortia now active under the Nuclear Power 2010 program represent four advanced reactor technology suppliers and 12 power generation companies that operate more than two-thirds of all the U.S. nuclear power plants in operation today.

Detailed Justification

	(dollars in thousands)		
	FY 2004	FY 2005	FY 2006
Nuclear Power 2010	**19,360**	**49,605**	**56,000**

During FY 2004, the Department made significant progress toward evaluating sites and candidate technologies for building new nuclear power plants and working with industry to resolve associated regulatory issues. Specifically, the Department:

- Continued the Early Site Permit (ESP) demonstration projects with resolution of site-specific issues arising from the NRC review of the ESP applications. Two of the three ESP applications were submitted to NRC in FY 2003 and the third ESP application was submitted in early FY 2004. Successful resolution of these site issues will lead to issuance of ESPs in FY 2006 thus providing three NRC approved sites that will be available for the construction of new nuclear power plants.
- Continued the nuclear plant site suitability study initiated in FY 2003. Activities in FY 2004 focused on conducting technical evaluations (*e.g.* geotechnical, geological and seismological) and assessing the electricity transmission impacts associated with siting a new commercial nuclear plant. Completion of this study will provide key information to support the power company decision to proceed with a combined Construction and Operating License (COL) to construct a nuclear power plant.
- Initiated a Texas Gulf Coast Nuclear Power Plant Feasibility Study to explore the feasibility of siting, licensing, financing, and construction of a privately funded new nuclear power plant in Texas to meet the growing and diverse energy requirements in the Texas Gulf Coast area.
- Completed a nuclear construction technology assessment initiated in FY 2003 that independently evaluated the schedule and construction methods of advanced nuclear plant designs. This assessment provides important input to the power generation companies for their technology selection for the next nuclear power plant to be built in the United States.
- Continued the industry cost-shared project initiated in FY 2003 to develop generic guidance for the combined Construction and Operating License (COL) application preparation and to resolve generic COL regulatory issues. This project, to be concluded in FY 2006, will make an NRC-reviewed guidance document available to power generation companies for use in preparing COL applications.
- Completed a macroeconomic study initiated in FY 2003 on the economic viability of new nuclear power plants in the United States and the effectiveness of temporary federal government policies to assist in the competitiveness of the first few new plants.

- Issued a solicitation in FY 2004 to invite proposals from power generation company-led teams for New Nuclear Plant Licensing Demonstration Projects to demonstrate the untested COL regulatory process. Demonstration of this process is essential to building new nuclear power plants. Under these cost-shared projects, power companies will conduct studies, analyses, and other activities necessary to make technology selections and prepare site-specific, technology-specific COL applications. In FY 2004, review and evaluation of the three industry consortia proposals was completed and one project was initiated to conduct cost and schedule studies to enable a decision by the power company on proceeding with preparing a COL application.

In FY 2005, the Department will make significant progress toward obtaining NRC approval of potential sites for building new nuclear power plants. Progress will also be made toward completing activities to enable a power generation company decision to proceed with preparing a COL application. Specifically, the Department will:

- Continue the ESP demonstration projects by supporting resolution of site-specific issues arising from the NRC review of the ESP applications. Final NRC Safety Evaluation Reports are projected to be completed in FY 2005.
- Complete the commercial nuclear plant site suitability study initiated in FY 2003 potentially making another site available in Alabama for building new nuclear plants. Results of this study will be used by the power company to make decisions on proceeding with a COL application to construct a new nuclear power plant.
- Complete the Texas Gulf Coast Nuclear Power Plant Feasibility Study initiated in FY 2004. This study will prepare the business and technical case for constructing a privately financed nuclear power plant to serve the needs of general public and industry end-users in the Texas Gulf Coast region.
- Continue the industry cost-shared project initiated in FY 2003 to develop generic guidance for the COL application preparation and to resolve generic COL regulatory issues. A draft guidance document will be completed and provided to the NRC for review.
- Begin the New Nuclear Plant Licensing Demonstration Projects. Cost and schedule evaluation by one power generation company-led team selected in FY 2004 will be completed. Two additional projects to demonstrate the COL process will be initiated. One of these project teams seeks to obtain a COL for a site in Virginia while the second will proceed with evaluations to select one or two sites over the next year. Both projects will begin with the development of detailed project cost and schedule information, establishment of a DOE interface/project oversight agreement, and other milestones specific to each project.

In FY 2006, the Department will:

- Complete the ESP demonstration projects with issuance of three Early Site Permits by the NRC. This will make three NRC approved sites available for building new nuclear power plants. Activities in FY 2006 will focus on completing final project reports documenting lessons learned and recommendations for future ESP applicants.
- Complete the industry cost-shared project initiated in FY 2003 to develop generic guidance for

	(dollars in thousands)	
FY 2004	FY 2005	FY 2006

the COL application preparation and to resolve generic COL regulatory issues. This will make NRC approved guidance available to power generation companies for use in preparing COL.

- Continue the implementation phase of the two New Nuclear Plant Licensing Demonstration Projects awarded in FY 2005. The implementation phase for both projects will include preparation of combined Construction and Operating License (COL) applications and approval by the NRC, and confirmatory financial evaluations and other technical activities necessary to enable the power companies to make decisions on ordering and building at least one new nuclear power plant. These activities will be conducted in an integrated manner to efficiently achieve the Nuclear Power 2010 program's overall objectives.

	FY 2004	FY 2005	FY 2006
Total, Nuclear Power 2010	**19,360**	**49,605**	**56,000**

Explanation of Funding Changes

	FY 2006 vs. FY 2005 ($000)
Nuclear Power 2010	
Nuclear Power 2010 solicitations and proposals for regulatory demonstration projects were received and evaluated in FY 2004, demonstrating the encouraging interest of the industry in this joint government/industry cost-shared effort. Following an evaluation of the proposals, two New Nuclear Plant Licensing Demonstration Projects were awarded in FY 2005. Based on the progress to date, in FY 2006 the program will continue the implementation phase of the two projects awarded in FY 2005. The increase of $6,395,000 allows these projects to proceed on a schedule more in line with what was proposed by industry.	+6,395
Total Funding Change, Nuclear Power 2010	**+6,395**

Generation IV Nuclear Energy Systems Initiative

Funding Schedule by Activity

	(dollars in thousands)				
	FY 2004	FY 2005	FY 2006	$ Change	% Change
Generation IV Nuclear Energy Systems Initiative					
Generation IV R&D	22,897	34,753	39,753	+5,000	+14.4%
International Nuclear Energy Research Initiative	4,084	4,060	4,060	0	+0.0%
Small Business Innovative Research and Small Business Technology Transfer Programs	0	870	1,187	+317	+36.4%
Total, Generation IV Nuclear Energy Systems Initiative	26,981[a]	39,683	45,000	+5,317	+13.4%

Description

The goal of the Generation IV Nuclear Energy Systems Initiative is to address the fundamental research and development issues necessary to establish the viability of next-generation nuclear energy system concepts. Successfully addressing the fundamental research and development issues of Generation IV system concepts that excel in safety, sustainability, cost-effectiveness and proliferation-resistance will allow these advanced systems to be considered for commercial development and deployment by the private sector, thus realizing their considerable promise for the future.

Benefits

The Department's strategic plan lays the ground work of the ambitious, long-term vision of a zero-emission future, free of the reliance on imported energy. The Generation IV Nuclear Energy Systems Initiative is a vital component of this vision and takes up the mission of securing nuclear energy as a viable, long-term commercial energy option to provide diversity in the energy supply. The Generation IV Nuclear Energy Systems Initiative will work to develop new nuclear energy systems that can compete with advanced fossil and renewable technologies, enabling power providers to select from a diverse group of generation options that are economical, reliable, safe, secure, and environmentally acceptable.

Demand for electricity in the United States is expected to increase sharply in the 21st century. Forecasts indicate that the United States will need about 335,000 megawatts of new generating capacity by 2025 - even accounting for ambitious implementation of energy efficiency practices and technologies. Should demand for energy continue to grow at current rates, the United States would need to construct between 1,000 and 1,200 new power plants over the next two decades - about 50 to 60 new power plants per year.

---

[a] For comparability purposes, the I-NERI funding has been included in the Generation IV Nuclear Energy Systems Initiative program. In FY 2004, the I-NERI funding is $4.2M of which $0.116M is SBIR/STTR.

To help meet this need for new electricity generation, the "National Energy Policy" (NEP) has recommended expansion of nuclear energy in the United States as a major component of our Nation's energy picture. As new power plants are built and older ones are retired, there will be a shift to technologies that have fewer air emissions than those presently deployed. In the President's Clear Skies and Climate Change Initiatives, nuclear energy is highlighted as a greenhouse gas free source of power for our Nation. Finally, in FY 2003, the President launched the Hydrogen Fuel Initiative. The hydrogen economy will require vast quantities of green-house gas free energy for the production of hydrogen. Advanced nuclear energy systems have the potential to meet a significant portion of that need.

While current nuclear power plant technology has proven to be an efficient means to produce baseload quantities of emissions-free energy, new technologies will be needed to enable an expansion in the use of nuclear energy over the long-term future. Over the coming decades, the Department believes that Generation IV nuclear energy systems can play a vital role in fulfilling the Nation's needs for low cost and efficient electricity and commercial quantities of hydrogen. Generation IV systems represent a new generation of nuclear energy technologies that can be made available in the 2020-2030 timeframe, and offer significant advances in the areas of sustainability, proliferation resistance and physical protection, safety, and economics.

Next-generation nuclear energy systems are being developed with new features to provide power systems that can serve a vital role in the Nation's long-term, diversified energy supply. High operating temperatures and improved efficiencies make some Generation IV systems ideal for providing clean burning hydrogen needed to power fuel cell driven vehicles in the future. Growing concerns for the environment favor energy sources that can satisfy the need for electricity and other energy-intensive products on a sustainable basis with minimal environmental impact. Advances in sustainability entail improvements in fuel utilization and waste management. Advances in proliferation resistance and physical protection will further decrease the possibility that nuclear plants could prove to be viable targets for terrorist groups or that nuclear materials present in civilian fuel cycles could be diverted to make weapons. Advances in safety—with a goal of eliminating the need for offsite emergency response—will improve public confidence in the safety of nuclear energy while providing improved investment protection for plant owners. Advances in economics will ensure competitive life cycle cost and acceptable financial risk. Generation IV nuclear energy systems will not only be safe, economic, and secure but also include energy conversion systems that produce non-electricity products such as hydrogen, desalinated water, and process heat. These features make Generation IV reactors ideal for meeting the President's energy and environmental objectives.

To guide the development of Generation IV reactor designs, a "Technology Roadmap for Generation IV Nuclear Energy Systems (Roadmap)" was prepared under the auspices of the Department's independent Nuclear Energy Research Advisory Committee (NERAC) and the Generation IV International Forum (GIF). GIF is a formal, chartered organization of governments with representatives from Argentina, Brazil, Canada, France, Japan, the Republic of Korea, the Republic of South Africa, Switzerland, the United Kingdom, EURATOM, and the United States. "The Roadmap", prepared by nearly one hundred experts from GIF countries and international organizations, was issued in March 2003 and outlines the benefits, the technical and institutional barriers, and the research needs for the most promising nuclear energy system concepts. "The Roadmap" identified the six most promising nuclear energy systems, complete with fuel cycle, power conversion, waste management, and other nuclear infrastructure elements. These systems are the Very-High-Temperature Reactor (VHTR), the Supercritical Water-Cooled Reactor (SCWR), the Gas-Cooled Fast Reactor (GFR), the Lead-Cooled Fast Reactor (LFR), the

Sodium-Cooled Fast Reactor (SFR), and the Molten Salt Reactor (MSR). "The Roadmap" also serves as the organizing basis for national, bilateral, and multilateral research and development activities for the development of Generation IV systems.

Work continues across the breadth of Generation IV technologies. That said, the great advantage of the high degree of international cooperation inherent to the Generation IV process (which is coordinated by the 11-member Generation IV International Forum) is the fact that not all countries need conduct primary efforts in all technologies. The Generation IV International Forum, or GIF, has developed an international approach to research that places one country in the lead of a given system. Other countries can participate in research in any system that interests them to whatever degree they find appropriate. Japan, for example, is lead country on the Sodium-Cooled Fast Reactor; France on the Gas-Cooled Fast Reactor; and Canada on the Supercritical Water-Cooled Reactor.

Because it features high power densities, large economies of scale, and improved electrical conversion efficiencies to economically generate electricity in large central stations, the Department plans cooperative research with its international partners to explore the Supercritical-Water-Cooled Reactor. The Lead-Cooled Fast Reactor, the Gas-Cooled Fast Reactor, and the Sodium-Cooled Fast Reactor have potential for acting in concert with Advanced Fuel Cycle Initiative (AFCI) technologies to transmute the actinide components of spent nuclear fuel into far shorter-lived, less toxic species. The Department plans to work closely with the lead countries for each of these technologies, performing cooperative research and development as appropriate to allow the United States to select a lead fast reactor technology for future, focused research and development. Roughly a third of the DOE Generation IV Nuclear Energy Systems Initiative is focused on cooperative research on technologies in which other countries have the primary technical lead, but in which the Untied States has interest.

The FY 2006 Budget expands research and development that could help achieve the desired goals of sustainability, economics, and proliferation resistance. Further investigation of technical and economic challenges and risks, including waste products, will help inform a decision on whether to proceed with a demonstration of the Next Generation Nuclear Plant, which would use very high temperature reactor technologies to economically produce both electricity and hydrogen gas. Key to the strategy for conducting all Generation IV research and development is the multiplication effect derived from international collaboration. By coordinating U.S. efforts with those of the GIF partner nations; our funding is leveraged by a factor of two to ten, depending on the reactor concept involved.

Funding for International Near Term Deployment (INTD) work identified by NERAC and GIF in the Generation IV Technology Roadmap that is relevant to U.S. technology needs is included in the Generation IV Nuclear Energy Systems Initiative program. International, cost-shared R&D enhances the Department's ability to leverage its limited research funding with nuclear technology research funding from other countries while also providing the United States greater credibility and influence in international activities associated with the application of nuclear technologies. The Department currently has in place bilateral International Nuclear Energy Initiative agreements with France, the Republic of Korea, the Organization of Economic Cooperation and Development Nuclear Energy Agency, the European Union, Canada, Brazil, and Japan. Negotiations to establish new agreements are underway with the Republic of South Africa, and the United Kingdom.

Finally, the Department's Office of Nuclear Energy, Science and Technology (NE) is working in close cooperation with the Office of Science (SC) through the "Materials for Advanced Energy Systems

Initiative" to coordinate research to develop advanced materials for use in Generation IV nuclear energy systems, fusion energy systems, and advanced energy technologies such as hydrogen production systems. Through a joint working group, the offices are coordinating on energy materials related issues with the purpose of investigating materials behavior in high temperature, radiation, and hostile corrosive environments, as well as the fabrication and non-destructive evaluation or monitoring of such materials. As common projects are identified, the offices will work to establish research objectives and cooperative work plans to leverage research funding.

Detailed Justification

(dollars in thousands)

	FY 2004	FY 2005	FY 2006
Generation IV R&D	**22,897**	**34,753**	**39,753**

Very-High-Temperature Reactor: The Department plans to work closely with both the international community and the U.S. private sector to continue research on the Very High Temperature Reactor. DOE intends to continue its effort to investigate the challenges and risks of VHTR technology, including costs and waste products. The ongoing research and development activities begun in FY 2003 and carried through FY 2005 will continue to analyze very high temperature reactor enabling technologies such as high temperature materials and graphite particle fuels. This R&D will be conducted in close cooperation and association with the member nations of the Generation IV International Forum. In FY 2004, the Department focused on developing a high-burnup VHTR particle fuel that can withstand postulated accident conditions while maintaining the integrity of the fuel and retaining the fission products within the kernel. Work also in developing design data needs for such key components as the reactor vessel and Brayton cycle turbine-generator. The Department remains optimistic about the potential for a future collaboration with countries such as France, Japan, and the Republic of Korea to demonstrate this technology.

In FY 2004, the following activities were supported:

- The point design for VHTR was completed to support the specification of critical fuel parameters necessary to advance the fuel qualification program. The point design establishes overall system parameters including nuclear thermal heat generation, fuel kernel temperatures during normal operation, reactor coolant flow rates and vessel material operating temperatures.
- Parametric evaluations of TRISO fuel particle coating (three layers of coatings) were conducted using small coaters to better understand and optimize the TRISO coating process.
- An inspection capability for quality control of TRISO coated particles and fuel compacts was established.

A compacting process to agglomerate fuel particles into a suitable shape for loading into a reactor core was developed. These efforts allowed for development of improved compact processing at a lower cost, and demonstrate the improved TRISO fuel/compact performance at higher temperatures for the VHTR.

(dollars in thousands)

FY 2004	FY 2005	FY 2006

In FY 2005, the Department is focused on VHTR fuel fabrication and qualification testing, systems integration studies, materials development and testing, and program planning. The following activities are being conducted:

- Publish a research and development plan to guide the materials, fuel, and codes and methods research and development that is broadly applicable across VHTR candidate technologies.
- Analyze candidate materials meeting the requirements for ultra-long-life power conversion components in high-temperature helium and salt environments. Because of the exposure to extreme heat, pressure and irradiation, these candidate materials are breaking new scientific ground in performance and consist of new age high-temperature metals, ceramics, and composites for critical structural, heat and radiation attenuation, and intermediate heat exchange components.
- Complete fabrication of irradiation test fuel specimens and the multi-cell capsule and test train for the initial irradiation tests.
- Begin planning and design activities for the second fuel qualification tests for the baseline TRISO fuel design. This second test campaign will irradiate the reference TRISO fuel and provide required information for the VHTR fuel design activities.
- Initiate development of advanced TRISO fuel characterization techniques.
- Conduct a comprehensive evaluation of candidate VHTR reactor technologies.

In FY 2006, the Department will:

- Develop and issue a detailed VHTR research and development plan that identifies all outstanding technology data needs and associated schedules for meeting them.
- Initiate the irradiation of TRISO fuel in the new ATR multi-cell capsule and test train to provide shakedown test information.
- Complete the consolidation of existing phenomenological models into an integrated fuel performance model.
- Begin scale-up of the TRISO fuel coater and fabrication process from laboratory-scale to an intermediate scale to evaluate coater diffuser and flow distribution effects. Reference VHTR TRISO fuel and design fuel variants will be produced for future testing.
- Complete the design and fabrication of a low flux irradiation fixture and initiate irradiations of candidate reactor pressure vessels steels.
- Complete preliminary high-flux irradiations and initiate post-irradiation examination of potential metallic alloys for reactor internals and initiate mechanical testing of candidate materials in the VHTR coolant environment.
- Purchase pre-production lots of candidate graphite and support American Society for the Testing of Materials standard materials specification development for VHTR graphite.
- Develop models to predict the behavior of candidate VHTR pressure boundary materials and very high-temperature component materials under expected operating conditions.

Lead-Cooled Fast Reactor: The Lead-Cooled Fast Reactor (LFR) concept is a lead or lead-bismuth-cooled small modular reactor with a closed fuel cycle. The design features a long-lived core (15-30 years), replaceable as an integral unit with vessel and coolant for high proliferation resistance. The LFR will utilize the advantages of lead or lead-bismuth eutectic (LBE) coolant to achieve high core outlet temperatures, which will allow realization of high system efficiency and/or production of hydrogen using high-temperature processes. Efficiency improvements with either lead or LBE might be obtained through the use of an innovative energy conversion system with supercritical carbon-dioxide as the working fluid. The reactor will accommodate a closed fuel cycle while ensuring substantial proliferation resistance by limiting access to fuel and associated fuel handling infrastructure. Generation IV International Forum (GIF) partner countries including Japan, Switzerland, and Korea have expressed interest in exploring this concept in cooperation with the United States.

In FY 2004, research and development was conducted as follows:

- Completed reference point designs; evaluated and selected a preferred concept. This activity supported core physics and thermal-hydraulic designs of proposed design concepts. Emphasis was placed on meeting design objectives, such as long-lifetime cores for enhanced proliferation resistance, passive safety, and autonomous load following. Conducted limited materials screening tests for compatibility with lead alloy coolant.

- Developed analysis tools and a refueling approach. Incorporated computer models and LFR-related properties for coolant, structural materials, and fuels into analysis codes to be used for core physics design, thermal-hydraulic design, and lead alloy coolant flow characteristics. Conducted core configuration and fuel-loading studies to determine design features necessary to accommodate 10, 20, and 30-year core lives.

In FY 2005, research and development in LFR is focusing on the following activities:

- Completing a point design of the reference LFR reactor and associated system components to sufficient level of detail to permit the start of preliminary concept design in FY 2006.

- Completing the analysis of materials test specimens which have completed 1000 hours of corrosion testing in the lead-bismuth DELTA loop, and continuing the testing of additional test specimens.
- Completing the design of a new liquid-lead high-temperature, natural-circulation test loop. Lead Fast Reactor materials research and development will be closely coordinated with the Office of Science research on materials to accelerate advancement of this technology.

In FY 2006, LFR research and development will focus on the following activities:

- LFR materials testing and analysis will continue with the objective of selecting key structural materials and cladding for lead-bismuth compatibility. Lead and lead-bismuth research will be expanded and will include the fabrication of a high-temperature liquid-lead experiment at the

Idaho National Laboratory. LFR materials research and development will be closely coordinated with the Office of Science to leverage and accelerate the understanding of materials corrosion, particularly in the area of irradiation testing.

- Complete the preliminary concept design of the LFR reactor and associated systems. This includes analyses to ensure that the systems meet design objectives of 15-30 year core refueling intervals for enhanced proliferation resistance, natural circulation and other passive safety features, and autonomous load-following.

Gas-Cooled Fast Reactor: The Gas-Cooled Fast Reactor (GFR) system features a fast-spectrum, helium-cooled reactor and closed fuel cycle as the reference concept. Like thermal-spectrum helium-cooled reactors such as the Very High Temperature Reactor, the high outlet temperature of the helium coolant makes it possible to deliver electricity, hydrogen, or process heat with high conversion efficiency. The GFR uses a direct-cycle helium turbine for highly-efficient electricity production. An alternate GFR concept which uses supercritical carbon-dioxide as the coolant may offer similar high efficiency while maintaining lower coolant temperatures. The GFR's fast neutron spectrum makes it possible to utilize available fissile and fertile materials (including depleted uranium from enrichment plants) several orders of magnitude more efficiently than thermal-spectrum gas reactors with once-through fuel cycles. Furthermore, through the combination of a fast neutron spectrum and full recycle of actinides, GFRs minimize the production of long-lived radioactive waste isotopes, and can be designed for management of minor-actinides in spent fuel. Interest for the GFR is high in GIF member countries France and Japan.

In FY 2004, research and development for the GFR was conducted as follows:

- Accident scenarios for both the reference and alternate concepts were analyzed to verify the reactor’s ability to shutdown passively through negative reactivity coefficients. This activity included the optimization of safety systems for decay-heat removal (short, intermediate, and long-term), including physics and thermal-hydraulic analyses for the reference and optional systems. In addition, reactor control issues were identified and analyzed for operational modes and accident scenarios.

- Screening and testing of candidate high-temperature materials, including both refractory ceramics and refractory or special metals were initiated.
- Supercritical-carbon-dioxide corrosion studies of candidate materials, including coolant chemistry were completed. Screening of candidate materials for in-core and ex-core service was also conducted based on performance at high pressure and medium temperatures.

In FY 2005, research and development activities for the GFR are focusing on the following activities:

- Continuing material characterization and fabrication, including the preparation of candidate materials for irradiation testing in FY 2006.

- Performing preliminary pre-conceptual design of the GFR core and safety systems.

- Continuing the analysis of off-normal accident analysis to optimize safety systems and support the overall reactor design.

In FY 2006, research and development activities for the GFR will focus on the following:

- Fabricate structural material test samples and initiate irradiation testing. Initiate thermal-hydraulic experiments using the Matched-Index-Refraction flow test system developed by the INL.

- Continue to perform preliminary concept design of the core and safety systems based on the optimized safety systems studies completed in FY 2005.

Supercritical-Water-Cooled Reactor: The Supercritical-Water-Cooled Reactor (SCWR) concept is a high-temperature, high-pressure water-cooled reactor that operates above the thermodynamic critical point of water. The system may have a thermal or fast neutron spectrum depending upon the core design. The focus in the United States will be on the thermal-spectrum version. The SCWR holds the potential for significant advantages compared to existing water-cooled reactors. The advantages are due to greater thermal efficiency; lower coolant mass flow rate per unit core thermal power; elimination of discontinuous heat transfer regimes within the core, and the elimination of steam dryers, steam separators, re-circulation pumps, as well as steam generators. Therefore, the SCWR will be a simpler plant with fewer major components and better economics. There is strong international interest in the SCWR within the Generation IV International Forum from Japan, Korea, and Canada.

In FY 2004, research and development was conducted as follows:

- A SCWR materials testing research and development plan was devised.

- A coolant chemistry-control strategy was developed. Analysis was conducted of existing light-water reactor and supercritical fossil plant coolant chemistry control strategies and their applicability to the SCWR system was evaluated.

In FY 2005, SCWR research and development focuses on the following activities:

- Complete the design of a test section to perform supercritical-water heat transfer studies in an existing supercritical-water facility (the Benson loop in Erlangen, Germany).

- Complete the concept design of the containment and safety systems.

In FY 2006, SCWR research and development will:

- Establish experimental capability for measuring corrosion in supercritical-water loops and improve the characterization of test variables like oxygen, conductivity and pH. The supported experiments will develop corrosion rates of candidate materials under various prototypical temperature, oxygen, and conductivity conditions.

	(dollars in thousands)		
	FY 2004	FY 2005	FY 2006

- Design laboratory-scale, multi-sample, stress-corrosion cracking, supercritical-water loop experiments for investigating candidate materials. These experiments are required to understand the susceptibility of candidate materials to stress-corrosion cracking.

- Design a high-pressure facility for critical-flow experiments at critical conditions. Data on basic critical flow and heat transfer are lacking for prototypical supercritical-water conditions and are needed to evaluate the safety and performance characteristics of candidate materials.

Crosscutting Research and Development: Crosscutting research activities are being conducted where results will have applicability to two or more of the Generation IV concepts.

In FY 2004, the following crosscutting research activities were conducted:

- Design and Evaluations - established the methodology for measuring proliferation resistance and physical protection of Generation IV reactor and fuel cycle systems, and developed the methodology to be used in evaluating the economics of Generation IV systems.

- Materials - prepared an integrated program plan for the qualification and development of advanced materials for use in Generation IV reactors.

- Energy Conversion - prepared a conceptual design of a supercritical-carbon-dioxide cycle that would provide cycle efficiencies of 40% or more with a coolant inlet temperature above 500 ºC.

- Regulatory - supported the Nuclear Regulatory Commission's development of a framework for risk informed licensing. Such a licensing framework may be applied to all of the Generation IV concepts in the future.

In FY 2005, the following crosscutting research activities are being conducted:

- Design and Evaluation – validating computer models for the use of design and safety analysis applications; developing methodology for evaluating the economics of Generation IV systems including associated hydrogen production; developing methods for evaluating proliferation resistance and physical protection metrics and developing a framework for computerization of the methodology; and participating in Generation IV International Forum activities.

- Materials – initiating mechanical tests and irradiation tests on commercially available and advanced materials; coordinating the specific materials needs of each reactor type; coordinating the specific materials needs of power conversion systems; initiating the development of a comprehensive irradiation-effects materials database for materials needed for radiation service; and initiating the development of a comprehensive high-temperature materials properties database to support the design, use, and codification of materials needed.

- Energy Conversion – developing a preliminary system and turbo machinery design for a 300 megawatts electric supercritical-carbon-dioxide commercial cycle; and developing a preliminary design for a scaled supercritical-carbon-dioxide demonstration experiment.

(dollars in thousands)

	FY 2004	FY 2005	FY 2006

In FY 2006, the following crosscutting research activities will be conducted:

- Design and Evaluation - modify and validate computer models for the use in design and safety analyses; validate the methodology for evaluating the economics of hydrogen production with Generation IV systems; validate methods for evaluating proliferation resistance and physical protection metrics, and complete the development of a computer program to apply the methodology to Generation IV systems; and ongoing U.S. participation in GIF activities.

- Materials - continue mechanical scoping tests of high-temperature materials; initiate the development of the rules for the use of low-temperature design criteria for reactor pressure vessels in limited high-temperature service, initiate creep-fatigue tests and the development of a creep-fatigue damage models for modified 9Cr-1Mo steel and Alloy 617, and complete the design of facilities for low and high flux, high-temperature irradiations.

- Energy Conversion – develop the system and turbo-machinery design for a 300 megawatts electric supercritical-carbon-dioxide commercial cycle; and initiate the fabrication of components for a scaled supercritical-carbon-dioxide demonstration experiment.

	FY 2004	FY 2005	FY 2006
International Nuclear Energy Research Initiative (I-NERI)	**4,084**	**4,060**	**4,060**

In FY 2004, the program funded bilateral research projects with France, the Republic of Korea, and the Organization for Economic Cooperation and Development (OECD) Nuclear Energy Agency initiated in FY 2001 through FY 2003. Three projects initiated with France in FY 2001, in the areas of advanced reactor technology, advanced nuclear fuels and materials, were completed. The Department neared completion of bilateral agreements with the Republic of South Africa, Japan, and the United Kingdom. New projects initiated in FY 2004 with France, the Republic of Korea, Canada and the European Union were funded under specific research areas of the Generation IV Nuclear Energy Systems Initiative, Advanced Fuel Cycle Initiative, and Nuclear Hydrogen Initiative programs. The new approach to executing international, cost-shared research allows the Department to use all nuclear energy R&D programs as a basis for international, cost-shared R&D thereby significantly increasing the amount of research achievable otherwise.

In FY 2005, the Department initiated new collaborations with Japan and Brazil and continues to use its existing bilateral International Nuclear Energy Research Initiative agreements to conduct international cost-shared R&D. The budget request included base funding for existing projects awarded in FY 2003 and support for International Near Term Deployment Systems (INTD) work identified by the GIF that is relevant to U.S. technology needs.

In FY 2006, the Department plans to use the requested funding to initiate new INTD research and development projects under the bilateral agreements with GIF member countries.

	(dollars in thousands)		
	FY 2004	FY 2005	FY 2006
Small Business Innovative Research and Small Business Technology Transfer Programs	**0**	**870**	**1,187**
Total, Generation IV Nuclear Energy Systems Initiative	**26,981**	**39,683**	**45,000**

Explanation of Funding Changes

	FY 2006 vs. FY 2005 ($000)
Generation IV R&D	
As a result of R&D successes in FY 2004 and FY 2005, the FY 2006 budget request includes an increase of $5,000,000 to expand R&D efforts required to establish the technical viability of Generation IV technology	+5,000
Small Business Innovative Research and Small Business Technology Transfer Programs	
The increase of $317,000 is due to increased funding for research and development activities.	+317
Total Funding Change, Generation IV Nuclear Energy Systems Initiative	**+5,317**

Nuclear Hydrogen Initiative

Funding Schedule by Activity

(dollars in thousands)

	FY 2004	FY 2005	FY 2006	$ Change	% Change
Nuclear Hydrogen Initiative					
Nuclear Hydrogen Initiative	6,201	8,679	19,440	+10,761	+124.0%
Small Business Innovative Research/Small Business Technology Transfer Program	0	250	560	+310	+124.0%
Total, Nuclear Hydrogen Initiative	6,201	8,929	20,000	+11,071	+124.0%

Description

The Nuclear Hydrogen Initiative (NHI) will conduct research and development on enabling technologies, demonstrate nuclear-based hydrogen production technologies, and study potential hydrogen production schemes to support the President's vision for a future Hydrogen economy. The objective of the Nuclear Hydrogen Initiative is 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.

Benefits

With increased international concern about global climate change and greenhouse gases, there is an ongoing global effort to reduce carbon dioxide emissions and to develop carbon-free fuels. Currently, the most promising non-carbon fuel is hydrogen. Hydrogen is the most abundant element and makes up about 90 percent of the universe by weight. On earth, most hydrogen is bound up in molecules like water and methane. Hydrogen can be produced by splitting water into hydrogen and oxygen. However, the economic feasibility of large-scale production of hydrogen from water is as yet unproven.

Hydrogen offers significant promise as a future domestic energy source, particularly for the transportation sector. Hydrogen can be combusted in a traditional internal combustion engine, or can produce electricity in a fuel cell. Significant progress in hydrogen combustion engines and fuel cells is bringing the day closer when transportation using hydrogen fuel will be a reality. Before hydrogen can become a significant part of the Nation's energy infrastructure, the cost associated with the production, storage, and delivery of hydrogen must be reduced considerably.

Currently, the only economical, large-scale method of hydrogen production involves the conversion of methane into hydrogen through a steam reforming process. This process produces ten kilograms of greenhouse gases for every kilogram of hydrogen, defeating a primary advantage of using hydrogen—its environmental benefits. Another existing method, electrolysis, converts water into hydrogen using electricity. Electrolysis is typically used for small production quantities but is inherently less efficient because electricity must first be produced to run the equipment used to convert the water into hydrogen. Additionally, the environmental benefits of electrolysis are negated unless a non-emitting technology, such as nuclear or renewable energy, is used to produce the electricity.

The NHI is part of the Department's Hydrogen Program, which is made up of programs within the Offices of Nuclear Energy, Science and Technology (NE), Energy Efficiency and Renewable Energy (EE), Fossil Energy (FE), and Science (SC). The Department created the "Hydrogen Posture Plan" (http://www.eere.energy.gov/hydrogenandfuelcells/posture_plan04.html) to describe its plan for successfully integrating and implementing technology research, development, and demonstration activities needed to cost-effectively produce, store, and distribute hydrogen for use in fuel cell vehicles and electricity generation. The Posture Plan describes the interface of the Department's hydrogen activities with those of other federal agencies. The Department pursues an integrated approach to hydrogen R&D, with EE, NE, and SC conducting coordinated research activities related to thermochemical hydrogen production cycles. NE has primary responsibility for processes that operate across a range of temperatures for the various advanced reactors being researched by the Generation IV Nuclear Energy Systems Initiative.

NE has built upon the "Hydrogen Posture Plan" and the "National Hydrogen Energy Roadmap" (http://www.eere.energy.gov/hydrogenandfuelcells/pdfs/national_h2_roadmap.pdf) released by the Secretary of Energy in November 2002, to develop the "Nuclear Hydrogen R&D Plan" (http://www.nuclear.gov). The "Nuclear Hydrogen R&D Plan" was developed by experts in hydrogen generation and nuclear technology to define the R&D required to develop an integrated nuclear hydrogen production plant. The plan presents the approach that the NHI program will use to achieve its overall objective, including priorities and technology selection, development and potentially demonstration.

The "Nuclear Hydrogen R&D" Plan describes major research areas required to support the development of these technologies, such as high-temperature materials, separation membranes, advanced heat exchangers and supporting systems. Based on their level of maturity, the sulfur family of cycles (sulfur-iodine, hybrid sulfur, sulfur-bromine), and high-temperature electrolysis are considered "baseline" processes, and have the highest R&D priority. The "Nuclear Hydrogen R&D Plan" also outlines a robust strategy that provides for the assessment of several alternative cycles have been identified as deserving of further study, such as the calcium-bromine cycle (which might be applicable to liquid metal fast reactor systems in the longer-term future). As some alternative hydrogen production technologies may also be pursued by other DOE offices, all such work is coordinated carefully to avoid duplication of effort. The program is conducting R&D on these processes to determine their feasibility as applied to nuclear systems. The alternative cycles involve significantly more technical risk, but their lower temperature requirements and, in some cases, reduced complexity, make them worthy of continued research—particularly since they could provide a pathway for future fast reactor systems to produce hydrogen on an economic bases.

While the Department believes that fast reactors may have a long-term future in the United States, there is a consensus in the international community and in the U.S. private sector that advanced gas-cooled reactors have the greatest potential among all Generation IV technologies to be commercialized in the foreseeable future. These systems, because of the high temperatures they produce, are projected to have considerable capability to produce electricity at very high levels of efficiency. Another capability related to the high-temperature heat that can be derived from these systems is their ability to drive high-temperature hydrogen production processes.

The NHI is sponsoring research within the university research community. For example, the Department is working with the University of Nevada, Las Vegas (UNLV), to perform research and development on candidate heat exchanger designs. As a result of significant research needs in this area, UNLV's scope has increased to include much of the complimentary materials development activities. UNLV actively involves other universities, industry, and national laboratories.

Detailed Justification

	(dollars in thousands)		
	FY 2004	FY 2005	FY 2006
Nuclear Hydrogen Initiative	**6,201**	**8,679**	**19,440**

The program will conduct research and development on processes that operate across a range of temperatures for various advanced reactors being researched by the Generation IV Nuclear Energy Systems Initiative. Much of the program's focus is vested in the most promising technologies—the sulfur-iodine (S-I) thermochemical cycle and high-temperature electrolysis. However, alternative processes with significant potential, such as the calcium-bromine and copper-chlorine cycles, continue to be evaluated.

The S-I thermochemical cycle is a series of chemical reactions that converts water to hydrogen and oxygen. This process offers the potential for high-efficiency hydrogen production at large-scale production rates, but has several technical issues that must be resolved to make the process technically and economically feasible. High-temperature electrolysis produces hydrogen from steam using electricity. This method has the potential for higher efficiencies than standard electrolysis and can operate across a range of temperatures. To better leverage this research and increase the probability of achieving the program objective, the hybrid sulfur (HS) cycle will be investigated, which is similar to the S-I cycle, but replaces a challenging chemical step with an electrolytic step. In addition, research on alternative processes, which operate over a range of temperatures, will include system analyses based on a consistent flowsheet methodology. The supporting technologies required at these temperatures and the overall objective to improve process performance will involve overcoming many technical challenges, including the development of high-temperature materials, advanced heat exchanger technologies and separation membranes.

In FY 2004, the Department:

- Initiated laboratory-scale research, experimental design, and fabrication on the baseline hydrogen production technologies - the S-I thermochemical cycle and high-temperature electrolysis (HTE).
- Completed initial conceptual design and the preliminary laboratory-scale demonstration plan for HS cycle.
- Completed the flowsheet analysis of process options and the preliminary laboratory-scale demonstration plan for Ca-Br cycle.
- Initiated screening and testing of component materials to determine compatibility with process working fluids.
- Initiated analysis of balance-of-plant issues for the design of the hydrogen production plants, such as establishing system interface conditions including temperatures, pressures, and flow

rates; and identifying and addressing reagent inventory issues.

- Continued research to determine candidate high-temperature process heat exchanger concepts and materials.
- Initiated conceptual design of two pilot-scale experiments (200 kilowatt HTE experiment and a 500 kilowatt S-I thermochemical process experiment).
- Completed an initial assessment of membranes and catalysts for thermochemical cycles to determine where process improvements can be made.
- Established a consistent analysis methodology to perform thermodynamic and flowsheet analysis for baseline and alternative thermochemical cycles. Completed flowsheet analysis of the S-I cycle and one alternative cycle.

In FY 2005, the Department will:

- Continue laboratory-scale research, experimental design, and fabrication on S-I and HTE hydrogen production technologies.
- Begin targeted laboratory-scale research, engineering assessments, and experimental design for alternative thermochemical cycles.
- Continue screening and testing of component materials to determine compatibility with process working fluids.
- Continue research on candidate high-temperature process heat exchanger concepts and materials for baseline technologies; initiate engineering design of selected heat exchanger designs to be tested before pilot and engineering-scale technology experiment operations; conduct thermal hydraulic and structural analysis of heat exchanger concepts for use with alternative hydrogen production technologies.
- Complete conceptual design of the pilot-scale experiments (200 kilowatt HTE experiment and the 500 kilowatt S-I thermochemical process experiment).
- Continue flowsheet analysis of alternative cycles.

In FY 2006, the Department will:

- Complete fabrication of heat exchangers for the S-I cycle and the HTE laboratory-scale experiments.
- Operate the S-I cycle chemical component reaction sections individually and initiate assembly in preparation for integrated laboratory-scale system operation in FY 2007.
- Complete long-duration and transient testing of HTE cell stacks that incorporate various cell materials and configuration options.
- Construct modular arrays of HTE cell stacks for integrated laboratory-scale operation in FY 2007.
- Complete thermal optimization and characterization of the S-I and HTE laboratory-scale experiments.
- Investigate the viability of the Ca-Br thermochemical process including a technical solution to the decomposition of hydrogen bromide.
- Complete flowsheets, economic analyses, and system designs for laboratory-scale experiments of high-potential alternative thermochemical cycles.
- Initiate preliminary design of pilot-scale experiments (200 kilowatt HTE experiments and the 500 kilowatt S-I thermochemical process experiment) to be completed in FY 2007.

	(dollars in thousands)		
	FY 2004	FY 2005	FY 2006

- Begin National Environmental Policy Act (NEPA) documentation to support hydrogen production.
- Complete assessment of codes and standards applicable to a hydrogen production facility coupled to a nuclear reactor.

	FY 2004	FY 2005	FY 2006
Small Business Innovative Research and Small Business Technology Transfer Programs	**0**	**250**	**560**
Total, Nuclear Hydrogen Initiative	**6,201**	**8,929**	**20,000**

Explanation of Funding Changes

	FY 2006 vs. FY 2005 ($000)
Nuclear Hydrogen Initiative	
The Nuclear Hydrogen Initiative (NHI) activities support the milestones identified in the "DOE Hydrogen Posture Plan" and the "Nuclear Hydrogen R&D Plan" (RDIC 1a – President's Hydrogen Initiative). In FY 2005, the program will evaluate the performance of stacks of cells to achieve higher hydrogen production rates. In FY 2006, the program will proceed with the plan to test cell stacks for long-duration and transient operation. The FY 2006 budget request includes an increase of $10,761,000 to support enhanced development of both the S-I thermochemical and high-temperature electrolysis hydrogen production methods as well as alternative hydrogen production methods to determine process viability	+10,761
Small Business Innovative Research and Small Business Technology Transfer Programs	
The increase of $310,000 is due to the increased funding for research and development activities	+ 310
Total Funding Change, Nuclear Hydrogen Initiative	**+11,071**

Advanced Fuel Cycle Initiative

Funding Schedule by Activity

(dollars in thousands)

	FY 2004	FY 2005	FY 2006	$ Change	% Change
Advanced Fuel Cycle Initiative					
Separations Technology Development	32,703	26,456	29,088	+2,632	+9.9%
Advanced Fuels Development	15,517	12,151	19,250	+7,099	+58.4%
Transmutation Engineering.........................	8,675	18,834	10,000	-8,834	-46.9%
Systems Analysis	4,330	4,736	5,000	+264	+5.6%
Transmutation Education	4,525	4,285	5,000	+715	+16.7%
Small Business Innovative Research and Small Business Technology Transfer Programs	0	1,000	1,662	+662	+66.2%
Total, Advanced Fuel Cycle Initiative	65,750	67,462	70,000	+2,538	+3.8%

Description

The mission of the Advanced Fuel Cycle Initiative (AFCI) is to develop and demonstrate technologies that will enable the United States and other advanced countries to implement an improved, long-term nuclear fuel cycle that provides substantial environmental, nonproliferation, and economic advantages over the current once-through fuel cycle. AFCI is designed to develop these new technologies so that they may be deployed to support the operation of current nuclear power plants, Generation III+ light water reactors, and Generation IV advanced reactors in order to achieve a significant reduction in the amount of high-level radioactive waste requiring geologic disposal; to reduce significantly accumulated plutonium in civilian spent fuel; and to extract more useful energy from nuclear fuel.

Under all scenarios, the Nation will need to establish a permanent geological repository to deal with the radioactive wastes resulting from the operation of nuclear power plants. However, as highlighted in a recent report by the independent experts of the Nuclear Energy Research Advisory Committee (NERAC), any substantial growth projected in the use of nuclear energy in the United States (such as is called for in the "National Energy Policy") will require the construction of additional geologic repositories to address the nuclear waste generated over time. Conservative scenarios that assume the replacement of existing nuclear plants by new nuclear capacity are projected to require one-to-three additional repositories by 2100.

AFCI provides an alternative to building multiple "Yucca Mountains" while still supporting an expanding role for nuclear power in the United States. AFCI's primary near-term goal is to develop advanced, proliferation-resistant fuel cycle technologies in order to inform a recommendation by the Secretary of Energy regarding the need for additional geologic repositories. Current legislation requires the Secretary to make a recommendation to Congress regarding the need for a second repository as early as January 1, 2007, but before January 1, 2010.

In the longer term, AFCI's development of a system involving spent-fuel partitioning, recycling of actinides and other long-lived radioactive components in thermal-spectrum reactors, and transmutation of nuclear materials using fast-spectrum technologies could result in a de facto fifty-fold increase in the capacity of the planned Yucca Mountain repository. This de facto increase would come from the destruction of actinides that generate the heat that limits repository capacity. The capacity increase would be more than enough to accommodate all the spent fuel generated in the U.S. this century from any conceivable nuclear energy deployment scenario.

Benefits

Of the challenges that must be addressed to enable a future expansion in the use of nuclear energy in the United States and worldwide, none is more important or more difficult than that of dealing effectively with spent nuclear fuel. Compared to other industrial waste, the spent nuclear fuel generated during the production of electricity is relatively small in quantity. However, it is highly toxic for many thousands of years, and its disposal requires that many political, societal, technical, and regulatory issues be addressed. For many years, several countries around the world have pursued advanced technologies that could treat and transmute spent nuclear fuel from nuclear power plants. These technologies have the potential to dramatically reduce the quantity and toxicity of waste requiring geologic disposal. Over the last four years, the United States has joined this international effort and found considerable merit in this area of advanced research.

While these technologies are clearly not an alternative to a geologic repository, they could provide a means to optimize the first U.S. repository and reduce the technical need for additional repositories. These technologies could also provide other important benefits such as enhancing national security by reducing proliferation risk through the reduction of inventories of commercially-generated plutonium (which is contained in all commercial spent fuel) and enhancing national energy security by recovering the significant energy value contained in spent nuclear fuel. (The 44,000 metric tonnes of spent nuclear fuel currently stored at nuclear power plant sites across the country contain the energy equivalent of over 6 billion barrels of oil, or about two full years of U.S. oil imports.) Through the research conducted by the Department and its international partners, sufficient evidence exists to warrant cautious optimism that the benefits of these technologies can be realized in a proliferation-resistant manner.

Over the long term, the AFCI program will demonstrate technologies that could reduce the volume and initial heat generation of high-level repository wastes. The AFCI program, in cooperation with the Department's Office of Civilian Radioactive Waste Management (RW) and international partners, will develop proliferation-resistant separations processes and advanced fuels for application to current light water reactor systems and advanced light water and gas-cooled reactor systems to enable the energy value of these materials to be recovered, while destroying significant quantities of plutonium. This work provides the opportunity to optimize use of the Nation's first repository and reduces the technical need for additional repositories.

For the longer term, the advanced technologies emerging from the AFCI program will build upon the benefits described above by enabling the destruction of minor actinides, greatly reducing the long-term radiotoxicity and long-term heat load of high-level waste sent to a geologic repository. This will be accomplished through the development of Generation IV fast reactor fuel cycle technologies and, possibly, accelerator-driven systems (ADS). Implementation of these technologies in conjunction with those being developed for application to thermal reactor systems will significantly delay or eliminate the need for an additional repository. Working closely in an integrated manner with the Department's Generation IV Nuclear Energy Systems Initiative, the AFCI program will develop advanced, proliferation-resistant fuels and fuel cycle technologies needed for Generation IV systems.

Based on research conducted to date, the following benefits are attainable through the AFCI program:

- Reduce Spent Fuel Volume: Develop proliferation-resistant technologies to significantly reduce the absolute volume of high-level nuclear waste requiring geologic disposal and lower the cost of its disposal;
- Separate Long-Lived, Highly Radiotoxic Elements (i.e., actinides such as plutonium and americium): Develop by approximately 2030, advanced, proliferation-resistant spent nuclear fuel treatment and transmutation technologies for Generation IV fast reactor systems that will significantly reduce its volume and heat generation, and create waste forms sufficiently clean of long-lived, highly toxic species to reduce the time it takes for the radiotoxicity of the waste to decay to that of the original uranium ore from 300,000 years to less than 1,000 years; and
- Reclaim Spent Fuel's Valuable Energy While Reducing Proliferation Risk from the Plutonium in Spent Fuel: Develop advanced, proliferation-resistant nuclear fuels that will enable the consumption of plutonium in existing light water reactors (LWR) or Generation IV reactors that may be available in the future. In addition, develop ultra-high burn-up fuels in order to extract more energy from fuel during its initial cycle and improve spent fuel management and storage. For example, very high burn-ups are possible in high-temperature gas reactors, such that recycling of spent nuclear fuel is unnecessary to optimize consumption of the fuel and minimize the radiotoxicity of spent fuel.

This work can realize the vision anticipated by the "National Energy Policy" to explore advanced technologies to deal with spent nuclear fuel in cooperation with our international partners. The AFCI program implements the recommendations of the "National Energy Policy" with respect to reconsideration of next generation fuel cycle technologies, specifically:

> "....United States should reexamine its policies to allow for research, development and deployment of fuel conditioning methods (such as pyroprocessing) that reduce waste streams and enhance proliferation resistance. In doing so, the United States will continue to discourage the accumulation of separated plutonium, worldwide."
>
> "The United States should also consider technologies, in collaboration with international partners with highly developed fuel cycles and a record of close cooperation, to develop reprocessing and fuel treatment technologies that are cleaner, more efficient, less waste intensive, and more proliferation resistant."

The Department will continue to emphasize joint collaborative activities in spent fuel treatment research, design and development. Considerable expertise in these technologies has been developed internationally, and the potential for significant cooperation and collaboration is very high. The Department is currently collaborating with France, Switzerland, the European Union, Canada, Japan and the Republic of Korea in separations, fuels, transmutation engineering and test facilities.

The AFCI program is comprised of five main research elements: Separations Technology Development; Advanced Fuels Development; Transmutation Engineering; Systems Analysis, and Transmutation Education. Each element is integrated into an overall effort guided by detailed research plans that have been independently reviewed by NERAC.

Separations Technology Development

The AFCI program is investigating technologies in two primary separations areas – advanced aqueous-based processing and pyroprocessing. Many aqueous-based approaches to treat spent nuclear fuel exist. The Uranium Extraction Plus (UREX+) method is an advanced aqueous process with significant potential for meeting proliferation-resistant separations objectives while minimizing the waste generation historically associated with aqueous separations technologies. While UREX+ has great potential to address the spent fuel challenge associated with today's light water reactors, pyroprocessing is potentially better suited to address the needs of Generation IV fast reactor fuels.

Experiments completed by the AFCI program have proven the advanced, aqueous-based Uranium Extraction (UREX) technology to be capable of removing uranium from spent fuel at such a high level of purity that we expect it to be sufficiently free of high-level radioactive contaminants to allow it to be disposed of as low-level waste or reused as reactor fuel. These laboratory-scale tests have proven uranium separation at purity levels of 99.999 percent. If spent fuel were processed in this manner, the volume of high-level waste requiring disposal in a geologic repository could be significantly reduced, potentially lowering the cost of storing the remaining high-level waste.

UREX+ is an extension of the UREX technology and is a key element of the AFCI program. Additional research is underway to evaluate aqueous chemical treatment methods to separate selected actinide and fission product isotopes from the UREX stream after the uranium has been removed. For example, UREX+ would provide mixtures of plutonium and selected minor actinides for preparing proliferation-resistant transmutation fuels. Long-lived fission products, iodine-129 and technicium-99, which are major contributors to the long-term radiotoxicity of spent fuel, could be separated for long-term storage or incorporated into advanced fuels for next generation reactors.

Pyroprocessing is a highly efficient, proliferation-resistant non-aqueous approach to separate the actinides in spent fuel from fission products. The AFCI pyroprocessing activities support the reduction of the radiotoxicity of nuclear waste through the transmutation of minor actinides in future Generation IV fast spectrum reactors or in dedicated transmuter devices. In addition, these activities provide the means for closure of the fuel cycle for Generation IV fast reactors.

The Department is also conducting research in other advanced separation technologies, *e.g.* Actinide Crystallization Process (ACP), to remove the uranium from the spent fuel. In addition, other advanced techniques have been identified that may improve the overall economic viability as well as enhance the proliferation resistance of closed fuel cycles. Examples of these technologies include:

- Voloxidation: After uranium dioxide spent fuel is exposed by decladding or puncturing, the fuel is treated with high temperature oxygen or oxygen/steam mixtures which convert uranium dioxide to uranium trioxide or intermediate oxide mixtures. Perforated cladding may be split but in any case, the resulting fuel is much more soluble in subsequent reagents compared with the dense, inert dioxide;

- Fission Product Volatility: Besides improved solubility, another potential benefit of oxygen pretreatment of uranium dioxide fuels is the removal of several volatile fission products such as chemically-inert xenon and krypton plus iodine and cesium. Research on removal of volatile radionuclides and their selective collection could greatly simplify later separation steps;

- Dissolution in Basic Media: Aqueous separations processes throughout the world use acidic dissolution as the first step. Preliminary experiments have indicated that carbonate solutions may replace acids under some conditions with a potential for subsequent improved separations including crystallization.

Advanced Fuels Development

The AFCI fuels development activity is focused on developing proliferation-resistant light water reactor and gas-cooled (thermal) reactor fuels that will enable the consumption of significant quantities of plutonium from accumulated spent fuel, simultaneously extracting more useful energy from the spent fuel materials. A series of advanced oxide fuel tests containing plutonium, neptunium and americium are in progress that will demonstrate the ability to fabricate the fuels and transmute the higher actinides in thermal reactors. Ultra-high burnup fuels are also under investigation that have the potential to extract more energy from the fuel and reduce the amount of high-level waste requiring repository disposal.

The fuels program is also developing advanced fuels containing higher actinides (plutonium, neptunium, americium, and curium) for transmutation in Generation IV fast reactor systems. Transmutation of the actinides in these advanced reactor fuels would significantly reduce the actinide inventory in the spent fuel, thereby reducing the radiotoxicity and long-term heat load in a geologic repository. A series of tests are in progress using the Advanced Test Reactor (ATR) in Idaho to irradiate metal, nitride and dispersion transmutation fuels. Data from the initial metal and nitride fuel tests conducted in FY 2004 are being evaluated now to prepare documentation needed to insert similar test articles into a fast reactor (the Phenix reactor in France) in FY 2007 to determine behavior of these fuels in a fast neutron spectrum. Because the Phenix reactor is scheduled to be permanently deactivated in 2008, the Department is pursuing establishment of a Gas Test Loop to be fitted into the ATR.

Transmutation Engineering

Transmutation is a process by which certain long-lived radioactive species are converted to short-lived and lower radiotoxicity species. Transmutation can convert the most significant long-lived species in spent nuclear fuel such that the most radiotoxic materials requiring geologic disposal will decay in a few centuries instead of hundreds of millennia.

AFCI transmutation engineering activities are developing the engineering for the transmutation of minor actinides and long-lived fission products from spent fuel. This includes computer programs, experimental measurements, benchmark calculations, maintenance and updating of nuclear cross-section data, nuclear physics data and codes, coolants and corrosion, structural materials, and pursuit of international collaborations to support technology decisions on reactor-and accelerator-assisted transmutation systems.

In FY 2005 a Materials Test Station (MTS) at the Los Alamos Neutron Science Center is being designed to fire high energy protons from the existing linear accelerator into a spallation target to create a large fast neutron flux for irradiating fuel and material targets to learn more about their behavior in a fast reactor. The University of Nevada – Las Vegas (UNLV) and the Idaho Accelerator Center at Idaho State University are also actively engaged in experiments on lead alloy coolants and targets in accelerator-based systems with potential application to fast reactor systems as well.

Through international cooperation, the AFCI program remains involved in Accelerator Driven System (ADS) research and development activities performed overseas. AFCI is cooperating with France, Switzerland, and the European Union on an accelerator-driven system spallation target test called MEGAPIE (Megawatt Accelerator Proton Irradiation Experiment) and a reactor-accelerator coupling experiment called TRADE (TRIGA Reactor Accelerator Driven Experiment), and is planning additional collaborations with Japan and the Republic of Korea. These activities will help inform future decisions on the need for an ADS to supplement fast reactors in the destruction of minor actinides.

Systems Analysis

The primary function of the AFCI systems analysis activity is to develop and apply evaluation tools to formulate, assess, and guide program activities to meet programmatic goals and objectives. The focus of this activity is the evaluation and eventual down selection of the most promising spent fuel treatment technologies, fuels technologies, and advanced fuel cycle deployment strategies in light of the steadily-increasing knowledge acquired from parallel AFCI and Generation IV research and development activities. These activities are aimed at integrating the results of the AFCI and Generation IV research programs and the programs themselves. Additionally, the systems analysis activity will identify optimal systems to reduce the burden on the geologic repository by removing the uranium and major heat-generating components of spent nuclear fuel from the repository, and optimizing the destruction of actinides to reduce the radiotoxicity of the waste from 300,000 years to less than 1,000 years. Cost-benefit, proliferation resistance, safety and sustainability analyses will be performed for each promising option. The systems analysis activity, by determining the optimum mix of facilities and systems, will enable the Department to effectively prioritize program research and development.

Transmutation Education

Transmutation Education activities include the successful university fellowship program established to support the development of new U.S. scientists and engineers studying science and technology issues related to transmutation and advanced nuclear fuel cycle systems. Managed by the University Research Alliance, the ongoing AFCI Fellowships program will augment its current master degree fellowships with the award of Ph.D. fellowships in FY 2006. AFCI will continue to support the Nuclear Energy Research Initiative through which competitively selected university researchers and students collaborate with national laboratories in AFCI R&D activities. Finally, AFCI will continue to support student research activities directly related to the program at UNLV and the Idaho Accelerator Center.

Detailed Justification

	(dollars in thousands)		
	FY 2004	FY 2005	FY 2006
Separations Technology Development	**32,703**	**26,456**	**29,088**

The primary goal of the separations activities is to develop and demonstrate advanced aqueous and pyrochemical separations technologies and to inform a recommendation by the Secretary of Energy as early as 2007 on the technical need for a second repository.

- **Proliferation-Resistant Fuel Treatment Experiments** **7,650** **8,456** **11,088**

  In FY 2004, the Department continued laboratory-scale hot testing of the UREX+ processes. In addition, the Department performed a scoping study of a commercial spent fuel processing plant, including cost and schedule estimates.

  In FY 2005, the Department is continuing laboratory-scale hot testing of advanced aqueous processes at INL, ANL and ORNL, (including plutonium/neptunium, cesium/strontium and americium/curium extraction) that will provide additional data for developing an optimized UREX+ flowsheet, and provide further verification of the AMUSE computer code (used to predict performance of various flowsheets and reagent flows). Further work is being performed on development of adequate dry storage and waste forms for the separated products, helping to reach the objective of only dry product streams of minimum volume.

  In FY 2006, final hot tests at a laboratory scale of the various UREX+ flowsheet variations will be carried out, to allow a final selection of the optimum flowsheet in FY 2007. The Department will also begin the scale-up of hot laboratory testing of UREX+ to an engineering scale experiment. The scale-up will provide for cold testing of individual advanced unit operations. Cold testing of advanced dissolvers will begin, providing the potential for large increases in head-end throughput. Scaled-up precipitators will be cold-tested using surrogate materials, and calciners approaching engineering scale will be evaluated. Waste qualification experiments and data analysis will be conducted on spent fuel processing to provide data to the Office of Civilian Radioactive Waste Management. A pre-conceptual design for an advanced fuel cycle research laboratory at the Idaho National Laboratory (INL) will be developed. A collaboration will be pursued with the French Atomic Energy Commission, Commissariat à l'Energie Atomique (CEA), to conduct a group actinide extraction test (GANEX) at the CEA Atalante facility.

- **Generation IV Fuel Treatment Process Development** **25,053** **18,000** **18,000**

  In FY 2004, the Department continued electrorefiner operations in support of pyroprocessing development. Waste qualification experiments and data analysis were continued. The Department also supported engineering scale-up design on a prototype ceramic waste furnace to handle the output from the electrorefiner operations. As reflected in the "Report on the Preferred Treatment Plan for EBR-II Sodium-Bonded Spent Nuclear Fuel" (October 2003), the program focused on treating highly-enriched, sodium-bonded driver fuel while investigating alternatives to more cost-effective technologies for processing sodium-bonded blanket fuel.

	(dollars in thousands)	
FY 2004	FY 2005	FY 2006

In FY 2005, advanced alternative separations experiments applying the Actinide Crystallization Process (ACP) technology are being investigated. The Department continues development and testing of methods to separate lanthanides from trivalent actinides and americium from curium. The feasibility of ACP will be tested with cold spent fuel surrogates dissolved in nitric acid, and work will begin on the use of a carbonate-based crystallization process. Security systems for materials accountability within batch and continuous separations processes are under development. The Department is continuing pyrochemical treatment of EBR-II spent driver fuel and investigating more cost-effective alternative technologies for processing the blanket fuel. Based on experience in the treatment of EBR-II spent fuel, advanced pyrochemical process development is continuing in support of Generation IV fuel types including ceramic-ceramic and ceramic-metallic designs. These processes include molten salt dissolution and electrochemical oxidation-reduction steps.

In FY 2006, the Department will expand its research into alternative advanced separation technologies, specifically advanced crystallization process and ionic liquids. It will begin a series of advanced separations tests involving combined aqueous/pyrochemical hybrid processes which offer increased versatility compared with either aqueous or pyrochemical processes operated separately. Pyrochemical tests on the separation of cesium and strontium from molten salts will be initiated along with tests of the separation of individual and group transuranic elements, including americium/curium from other actinides and americium from curium. A new separations activity involving the use of continuous, countercurrent extraction systems based on molten salts and metals flowing in opposite directions through a multistage separations unit will also be explored. Development of high-throughput electrorefiners and metal waste forms will continue. This research could significantly improve the economics of pyrochemistry applied to Generation IV systems. The Department will also continue pyrochemical treatment of EBR-II spent driver fuel and investigate more cost-effective alternative technologies for processing the blanket fuel.

Advanced Fuels Development	**15,517**	**12,151**	**19,250**

The AFCI fuels development effort will develop proliferation-resistant transmutation fuels for use in advanced fuel cycles for current LWRs, advanced LWRs, and gas-cooled reactors. It will develop ultra-high burn-up fuels for use in existing LWRs and also develop and demonstrate prototypic and transmutation fuels for Generation IV nuclear energy systems.

▪ **LWR Oxide Fuel Development and Testing**	**3,739**	**3,500**	**7,000**

In FY 2004, the Department performed irradiations in the Advanced Test Reactor (ATR) of the first LWR mixed-oxide transmutation test fuel and initiated its post irradiation examination (PIE)

In FY 2005, the Department is completing the PIE of the first mixed-oxide transmutation test fuel, and preparing oxide and inert matrix test fuels for irradiation in FY 2006.

In FY 2006, the Department will complete an inert matrix fuel irradiation test in the ATR. Irradiation of a higher burn-up LWR mixed-oxide transmutation fuel will be initiated. The Department will also investigate ultra-high burn-up fuels for use in LWRs in order to extract more energy from the fuel without recycling.

	FY 2004	FY 2005	FY 2006
▪ **Generation IV Reactor Fuel Development and Testing**	**11,778**	**8,651**	**12,250**

In FY 2004, the Department screened fuel options for next-generation reactor concepts and completed plans for irradiation testing and PIE of possible Generation IV fuel forms. In support of the PHENIX fast spectrum reactor irradiation tests, initial irradiation testing of metal and nitride actinide-bearing transmutation fuels in the ATR were performed. A low burn-up gas-cooled fast reactor dispersion fuel materials irradiation test was also completed. In support of the advanced gas reactor fuel development and qualification activities, coated particle fuel for the first fuel irradiation shakedown test was fabricated and the preliminary capsule and test train designs for the test were finalized.

In FY 2005, the Department is conducting post-irradiation examination (PIE) on the actinide-bearing metal and nitride fuel forms in support of the PHENIX test. In addition, high burn-up ATR irradiation tests containing metal and nitride actinide-bearing transmutation fuels and a high burn-up gas cooled fast reactor dispersion fuel test will be initiated. In support of the advanced gas reactor fuel development and qualification activities, the Department in FY 2005 will complete the fabrication of a multi-cell capsule for ATR irradiation tests and produce the fuel particle fuel test specimens for the first ATR irradiation test, scheduled in FY 2006. In addition, "deep-burn" fuel concepts for advanced gas-cooled reactors will be studied by AFCI program participants led by UNLV.

In FY 2006, the Department will complete and report on the analysis of results of the PIE of the advanced actinide-bearing fuels tests, initiate medium burn-up inert matrix fuel tests in the ATR and complete the medium burn-up gas cooled fast reactor dispersion fuel test. CERCER/CERMET fuels will be investigated as potentially promising dispersion fuels for the gas-cooled fast reactor. Commitments to the French Atomic Energy Commission, Commissariat à l'Energie Atomique (CEA) will be met, including the fabrication and shipment of all fast reactor transmutation fuel samples to the Institute for Transuranic Research (ITU) in Karlsruhe, Germany for the FUTURIX FTA test to be conducted in the French PHENIX fast reactor starting in FY 2007. Payment of the annual U.S. cost share of this U.S.-France cooperative program will be made. Collaboration with Japan will be initiated and transmutation fuel test samples prepared for irradiation in the JOYO fast test reactor in Japan. A trilateral collaboration with Japan and France will be initiated for a Global Actinide Cycle International Demonstration project on transmutation fuel irradiations, possibly leading to a full fuel assembly irradiation at the MONJU fast test reactor in Japan.

Transmutation Engineering	**8,675**	**18,834**	**10,000**

Transmutation engineering provides critical research and development in the areas of physics, materials, and accelerator-driven systems (ADS).

In FY 2004, the Department continued analytical work on physics cross section measurements of selected minor actinides (americium-241 and -242) required for advanced transmutation reactor design

	(dollars in thousands)	
FY 2004	FY 2005	FY 2006

The Department also continued to engage in international collaborations with France, Switzerland, and the European Union on accelerator-driven system spallation target (MEGAPIE) tests and a reactor-accelerator coupling experiment (TRADE) to leverage transmutation program funds in the areas of transmutation materials and science, respectively.

In FY 2005, the Department is continuing transmutation physics measurement and analysis work to reduce uncertainties in minor actinide cross sections required for advanced transmutation reactor designs. This includes the completion of americium measurements initiated in FY 2004. In FY 2005, a Materials Test Station (MTS) at the Los Alamos Neutron Science Center is being designed for research into the behavior of transmutation systems and Generation IV reactor system fuel and structural materials in a large fast neutron flux. UNLV and the Idaho Accelerator Center (IAC) are also conducting experiments on lead alloy coolants and targets in accelerator-based systems with potential application to fast reactor systems as well. The Department continues to engage in international collaborations with France, Switzerland, and the European Union on accelerator-driven system spallation target (MEGAPIE) tests and a reactor-accelerator coupling experiment (TRADE).

In FY 2006, the Department will refine physics cross sections for advanced transmutation and Generation IV reactor designs and provide design support for advanced transmutation reactors. Additionally the Department will perform mechanical testing of structural material samples irradiated in the Fast Flux Test Facility, update the AFCI Materials Handbook and commence development of a lead-alloy coolant materials research capability at the Idaho National Laboratory. Transmutation engineering research will continue at UNLV and IAC. To further leverage research and development dollars, the Department will continue to engage in international collaborations with France, Switzerland, and the European Union on accelerator-driven system spallation target (MEGAPIE) tests and a reactor-accelerator coupling experiment (TRADE).

Systems Analysis	**4,330**	**4,736**	**5,000**

The systems analysis function develops and applies tools to formulate, assess, and steer program activities to meet programmatic goals and objectives. Activities include broad system studies, integrated nuclear fuel cycle system studies, transmutation system studies, and technology and facility assessments.

In FY 2004, the Department identified the nuclear fuel cycle technologies that offer the greatest promise for future use, developed the information necessary to conduct cost-benefit analyses for each of these technologies, and by determining the optimum mix of facilities and systems, prioritized program research and development. The results of this analysis are documented in the 2004 “AFCI Comparison Report” that the Department submitted to Congress in October 2004.

In FY 2005, the Department issued the 2004 “AFCI Comparison Report”, which quantitatively identifies the respective advantages and disadvantages of the technologies explored by the program as well as the additional research and development knowledge gained during the program as well as the additional

	(dollars in thousands)		
	FY 2004	FY 2005	FY 2006

research and development knowledge gained during the previous year. It will issue an annual update to the "AFCI Comparison Report". The Department will also issue a significant AFCI program report to Congress on quantitative goals for the program based on studies to identify the necessary capacities and time scales of implementation of advanced recycle technologies. Systems analysis is also evaluating cost/benefits of the program with regard to the development of proliferation-resistant, economic, sustainable nuclear energy for the remainder of the century and the extent to which technologies developed by the program can help optimize the use of the Yucca Mountain repository and indefinitely postpone the technical need for additional repositories.

In FY 2006, the Department will expand its cost-benefit analyses by conducting broad system studies, integrated nuclear fuel cycle system studies, transmutation system studies and technology and facility assessments. To support the preparation of a 2007-2010 Secretarial recommendation on the technical need for a second repository, the Department will complete analyses regarding the optimum mix of facilities and systems and associated R&D priorities. An update to the annual "AFCI Comparison Report" to Congress will be issued.

Transmutation Education...	**4,525**	**4,285**	**5,000**

Transmutation education supports the development of new U.S. scientists and engineers needed to develop transmutation and advanced nuclear energy technologies through university fellowships and applied research.

In FY 2004, the Department awarded eight Masters fellowships to assure that new engineers will enter the field of transmutation science, continued and expanded directed university research to support advanced fuel cycles, and continued the university student research programs at UNLV and IAC.

In FY 2005, directed university research to support advanced fuel cycles is funded by the technical program areas – separations, fuels development, transmutation engineering, and systems analysis. The university student research programs at UNLV and IAC are being continued. Eight new Masters fellowships are being awarded.

In FY 2006, the Department will continue its fellowship program with the awarding of eight Masters fellowships and two Ph.D. fellowships. Directed university research to support advanced fuel cycles will be continued within the technical program areas. University student research programs will be continued at UNLV and IAC.

Small Business Innovative Research and Small Business Technology Transfer Programs	**0**	**1,000**	**1,662**
Total, Advanced Fuel Cycle Initiative................................	**65,750**	**67,462**	**70,000**

Explanation of Funding Changes

	FY 2006 vs. FY 2005 ($000)
Separations Technology Development	
▪ **Proliferation-Resistant Fuel Treatment Experiments** Following successful laboratory scale separation of americium and curium from spent fuel in FY 2004, the AFCI program is continuing its research into advanced, proliferation-resistant aqueous treatment technologies, with emphasis on group actinide extraction techniques. As a result of these successes and other technical progress, the FY 2006 budget request includes an increase of $2,632,000 in FY 2006 to complete laboratory-scale hot testing of advanced aqueous processes, expand research on alternative advanced separation technologies, develop a pre-conceptual design for an advanced fuel cycle research laboratory at INL, and initiate collaboration with CEA to conduct a group actinide extraction test (GANEX)………..	+2,632
Advanced Fuels Development	
▪ **LWR Oxide Fuel Development and Testing** In FY 2004, the first LWR oxide transmutation fuel irradiation test was successfully completed in the ATR. Post-irradiation examination will be completed in FY 2005. Results of non-destructive examinations to date indicate satisfactory behavior of the fuel pellets under irradiation. Based on this success, higher burnup LWR oxide transmutation fuels will be prepared for irradiation in FY 2006. Systems analysis studies conducted in FY 2004 indicated that inert matrix oxide fuels (IMF) may provide better transmutation performance than uranium bearing oxide fuels, so IMF irradiation tests are planned for FY 2005-2006. As a result of these successes, the FY 2006 budget request includes an increase of $3,500,000 to complete LWR oxide transmutation fuel, inert matrix fuel and ultra-high burn-up fuel irradiations and post-irradiation examination...	+3,500
▪ **Generation IV Reactor Fuel Development and Testing** In FY 2004 transuranic-bearing metal and nitride fuel samples were successfully irradiated in the ATR. Post-irradiation examination of these fuels is in progress. Results of non-destructive examinations to date indicate the satisfactory behavior of the fuel pellets under irradiation. These successful results will allow the Department to participate in the French FUTURIX program to test advanced transmutation fuels in the Phenix fast reactor. Test fuels for FUTURIX will be fabricated in FY 2006 and additional higher burnup metal and nitride fuel irradiation tests will be conducted in ATR to gain additional performance data. As a result of these successes and other technical progress, the FY 2006 budget request includes an increase of $3,599,000 to complete ATR irradiation experiments on metal, nitride, dispersion and inert matrix fuels for transmutation and Generation IV fast reactor systems. Additional collaborative fuels testing efforts are being initiated with France and Japan. Funding	

	FY 2006 vs. FY 2005 ($000)
for the advanced gas reactor fuel development and qualification activities is fully funded in the Generation IV budget in FY 2006	+3,599
Total, Advanced Fuels Development	**+7,099**

Transmutation Engineering

The decrease of $8,834,000 reflects the expected FY 2005 completion of the design for the Materials Test Station at LANSCE.	-8,834

Systems Analysis

In FY 2004, the AFCI Systems Analysis team successfully developed a plan of action in collaboration with OCRWM to focus near-term research efforts on spent fuel treatment and transmutation technologies that will have the most impact on the AFCI waste management objective by improving geologic repository performance. Proliferation resistant fuel cycle studies were also successfully initiated in collaboration with NNSA safeguards experts and the Generation IV Proliferation Resistance and Physical Protection (PRPP) Evaluation Methodology Group. These analyses will be continued in FY 2005 and 2006 to enable technology decisions to be made sooner. As a result of these successes, the FY 2006 budget request includes an increase of $264,000 for broad systems studies, integrated fuel cycle system studies, and facility assessments, focusing principal activities on developing the information required to inform the 2007-2010 Secretarial recommendation on a second repository	+264

Transmutation Education

Based on the successful AFCI fellowship program for Masters level students over the past several years, the Department will continue this program and add Ph.D. fellowships as well. Many of the AFCI fellows have chosen careers in the nuclear science and engineering fields and some are now working at U.S. national laboratories. Student participation in the research conducted at UNLV and Idaho State University has contributed to these universities strong contribution to AFCI research. As a result of these successes, the FY 2006 budget request includes an increase of $715,000 for addition of Ph.D. level AFCI fellowships and an increased level of effort in university student research	+715

Small Business Innovative Research and Small Business Technology Transfer Programs

The increase of $662,000 is due to the increased funding for research and development activities	+662
Total Funding Change, Advanced Fuel Cycle Initiative	**+2,538**

Infrastructure
Funding Profile by Subprogram

(dollars in thousands)

	FY 2004 Comparable Appropriation	FY 2005 Original Appropriation	FY 2005 Adjustments	FY 2005 Comparable Appropriation	FY 2006 Request
Infrastructure					
Radiological Facilities Management	63,431	69,110	-547	68,563	64,800
Idaho Facilities Management	75,415	113,050	-897	112,153	97,862
Idaho Sitewide Safeguards and Security	56,343	58,103	-441	57,662	75,008
Total, Infrastructure	195,189[a]	240,263	-1,885	238,378	237,670

Funding Profile – Energy Supply

	FY 2004 Comparable Appropriation	FY 2005 Original Appropriation	FY 2005 Adjustments	FY 2005 Comparable Appropriation	FY 2006 Request
Infrastructure					
Radiological Facilities Management	63,431	69,110	-547	68,563	64,800
Idaho Facilities Management	54,119	92,164	-730	91,434	80,100
Total, Infrastructure	117,550	161,274	-1,277	159,997	144,900

Funding Profile – Other Defense Activities

	FY 2004 Comparable Appropriation	FY 2005 Original Appropriation	FY 2005 Adjustments	FY 2005 Comparable Appropriation	FY 2006 Request
Infrastructure					
Idaho Facilities Management	21,296	20,886	-167	20,719	17,762
Idaho Sitewide Safeguards and Security	56,343	58,103	-441	57,662	75,008
Total, Infrastructure	77,639	78,989	-608	78,381	92,770

[a] Includes $3.17M identified as use of prior year balances to fund the Environmental Management liability for OVEC in FY 2004.

Mission

The mission of the Infrastructure program is to manage the planning, acquisition, operation, maintenance, and disposition of nuclear facilities and infrastructure to meet the growing demand for isotopes used in medicine, scientific research and homeland security; to provide radioisotope power systems for space exploration and national security; to conduct advanced nuclear energy research; and to ensure the long term future of the domestic nuclear fuel supply.

The Infrastructure program provides for the stewardship of the vital field infrastructure maintained by the Office of Nuclear Energy, Science and Technology (NE). This infrastructure is required to accomplish the assigned missions in areas such as Generation IV nuclear energy research and development, Advanced Fuel Cycle Initiative, space nuclear power applications, production of isotopes for medicine and industry, and naval nuclear propulsion research and development.

Benefits

The Infrastructure program keeps unique DOE facilities and supporting infrastructure in a user-ready status. Facilities supported by this program include reactors, hot cells, and other vital infrastructure needed to carry out advanced nuclear energy technology research and development; construct power systems essential for important national security missions and space exploration; produce, package, and ship radioisotopes for medical and scientific applications; and test new fuels and core components for the Naval Nuclear Propulsion Program. DOE stimulates great advances in science by making its nuclear facilities available to a large user base. The Department does not subsidize direct operational costs related to users, but it does maintain unique radiological facilities and capabilities in a manner that supports their application to missions from various governmental and scientific users.

Beginning in the second quarter of FY 2005, the Idaho National Engineering and Environmental Laboratory (INEEL) will be merged with Argonne National Laboratory-West (ANL-W) to create the Idaho National Laboratory (INL). The Secretary of Energy has designated INL as the center for the Department's strategic nuclear energy research and development efforts. The INL will play a lead role in Generation IV nuclear energy systems development, advanced fuel cycle development, testing of naval reactor fuels and reactor core components, and space nuclear power applications. While the laboratory has transitioned its research and development focus to nuclear energy programs, it is also maintaining its multi-program national laboratory status to serve a variety of current and planned Department and national research and development missions.

Two important research reactors currently operating at this site are the Advanced Test Reactor (ATR) and its supporting ATR Critical Facility. ATR is one of the world's largest and most sophisticated test reactors. It will be a crucial facility in the development of the Generation IV reactor and the Advanced Fuel Cycle Initiative. In addition, ATR currently conducts virtually all irradiation testing of Navy reactor fuels and core components and is vital to achieving the Department's goal of providing the U.S. Navy with safe, militarily effective, nuclear propulsion plants and ensuring their continued safe and reliable operation. The Navy mission is projected to continue until at least mid-century.

The Infrastructure program supports "National Energy Policy" goals by maintaining and operating important landlord infrastructure required for the support of facilities dedicated both to advanced nuclear energy technology research and development and multi-program use. The Landlord manages common-use equipment, facilities, land, and support services that are not directly funded by programs. Key activities conducted under these programs include ensuring that all landlord facilities meet essential safety and environmental requirements and are maintained at user-ready levels. Other key activities include managing all special nuclear materials contained in these facilities and the disposition of DOE legacy waste materials under NE ownership.

In March 2000, the Nuclear Energy Research Advisory Committee (NERAC) led the creation of the "Nuclear Science and Technology Infrastructure Roadmap" for the entire Department. This study examined the capabilities of the DOE's accelerators, reactors, and hot cells. It also evaluated current nuclear technology missions and facility staffing levels. Finally, the Roadmap estimated future mission requirements and compared them to available and planned facility capabilities, highlighting capability gaps. The Department is refining this analysis with a series of more detailed, site-specific assessments that will not only highlight infrastructure gaps, but also identify requirements for maintenance and upgrade of existing facilities. As a first step, a NERAC task force examined the nuclear R&D infrastructure at the INL to identify the maintenance and upgrades required to meet the Department's nuclear R&D activities planned at Idaho. This assessment was completed in November 2003. Building on this assessment, NERAC created a Subcommittee on Nuclear Laboratory Requirements to identify what characteristics, capabilities, and attributes a world-class nuclear laboratory would possess. This Subcommittee became familiar with the practices, culture, and facilities of other world-class laboratories and used this knowledge in FY 2004 to recommend what needs to be implemented at Idaho. The objective of this activity was to help make Idaho National Laboratory the leading nuclear energy research laboratory in the world within ten years of its inception. DOE and INL are now working to implement the recommendations of both NERAC reports.

Strategic and Program Goals

The Department's Strategic Plan identifies four strategic goals (one each for defense, energy, science, and environmental aspects of the mission) plus seven general goals that tie to the strategic goals. The Infrastructure program supports the following goal:

Energy Strategic Goal

General Goal 4, Energy Security: Improve energy security by developing technologies that foster a diverse supply of reliable, affordable and environmentally sound energy by providing for reliable delivery of energy, guarding against energy emergencies, exploring advanced technologies that make a fundamental improvement in our mix of energy options, and improving energy efficiency.

The Infrastructure program has one program goal that contributes to General Goal 4 in the "goal cascade":

Program Goal 04.17.00.00: Maintain and enhance the national nuclear infrastructure to meet the Nation's energy, environmental, medical research, space exploration, and national security needs.

Contribution to Program Goal 04.17.00.00 (Maintain and enhance the Nation's nuclear infrastructure capability)

The Infrastructure program contributes to this goal by ensuring that the Department's unique facilities, required for advanced nuclear energy technology research and development, are maintained and operated such that they are available to support national priorities. The program manages site equipment, facilities, land, and supporting services that are not directly supported by other programs. Key activities conducted under this program include ensuring that all NE facilities meet essential safety and environmental requirements and are maintained at user-ready levels. Other key activities include managing all special nuclear materials contained in these facilities and the disposition of DOE legacy materials under NE ownership.

Annual Performance Results and Targets

FY 2001 Results	FY 2002 Results	FY 2003 Results	FY 2004 Results	FY 2005 Targets	FY 2006 Targets
Program Goal 04.17.00.00 (Energy Security)					
Infrastructure				*Consistent with safe operations, achieve cumulative variance of less than 10 percent from each of the cost and schedule baselines for the Radiological Facilities Management and Idaho Facilities Management programs.*	*Consistent with safe operations, achieve cumulative variance of less than 10 percent from each of the cost and schedule baselines for the Radiological Facilities Management and Idaho Facilities Management programs.*
Radiological Facilities Management					
	Complete 80 percent of the construction of the Los Alamos Isotope Production Facility, which is needed for the production of short-lived radioisotopes essential for U.S. medical research. (MET GOAL)	*Keep cost and schedule milestones for upgrades and construction of key nuclear facilities within 10 percent of approved baselines. (MET GOAL)*	*Keep cost and schedule milestones for upgrades and construction of key nuclear facilities within 10 percent of approved baselines, using the cost-weighted mean percent variance (+/-10 percent) approach. (MET GOAL)*		
		Safely operate each key nuclear facility within 10 percent of the approved plan, shutting down reactors if they are not operated within their safety envelope and expediting remedial action. (MET GOAL)	*Consistent with safe operations, maintain and operate key nuclear facilities so the unscheduled operational downtime will be kept to less than 10 percent, on average, of total scheduled operating time. (MET GOAL)*		
	Demonstrate the operational capability of radioisotope power systems infrastructure by fabricating quality products at each of the major facilities (i.e., at least eight iridium clad vent sets at ORNL and at least eight encapsulated Pu-238 fuel pellets at LANL). (MET GOAL)	Demonstrate the operational capability of radioisotope power systems infrastructure by fabricating flight quality products at each of the major facilities (i.e., at least eight iridium clad vent sets at ORNL and at least eight encapsulated Pu-238 fuel pellets at LANL), and by processing at least 2 kilograms of scrap Pu-238 at LANL. (MET GOAL)	*Maintain and operate radioisotope power systems facilities with less than 10 percent unscheduled downtime from approved baseline. (MET GOAL)*		

FY 2001 Results	FY 2002 Results	FY 2003 Results	FY 2004 Results	FY 2005 Targets	FY 2006 Targets
	Bring the full-scale scrap recovery line to full operation and begin processing Pu-238 scrap for reuse in ongoing and future missions requiring use of radioisotope power systems. (MIXED RESULTS)				
Idaho Facilities Management					
	Meet the milestones for legacy waste cleanup at Test Reactor Area (TRA) in the Voluntary Consent Order between the State of Idaho and DOE, and efficiently manage resources to limit growth in backlog of maintenance to no more than 10 percent. (MET GOAL)		*Keep cost and schedule milestones for upgrades and construction of key nuclear facilities within 10 percent of approved baselines, using the cost-weighted mean percent variance (+/-10 percent) approach. (same target used for Radiological Facilities Management) (MET GOAL)*		
					Validate the Asset Condition Index (ACI)—a corporate measure of the condition of facility assets based on industry inspection and deficiency standards—and achieve an ACI rating of good for 45-50 percent of active mission-critical INL-NE facilities.
Idaho Sitewide Safeguards and Security					
	During FY 2002, no national security incidents occurred within NE Idaho sitewide cyber systems and security areas that caused unacceptable risk or damage to the Department. (MET GOAL)	Complete the Idaho Integrated Safeguards and Security Plan to assure appropriate protective measures are taken commensurate with the risks and consequences for both the laboratories on the Idaho site. (MET GOAL)	Issue the Design Basis Threat Implementation Plan for the Idaho National Engineering and Environmental Laboratory and Argonne National Laboratory-West. (MET GOAL)	Complete FY 2005 actions at the Idaho Site required to implement the May 2003 Design Basis Threat (DBT) as defined in the Program Management Plan that remain consistent with the requirements of the October 2004 DBT.	Install all physical protective systems and augment the Security Police Officer force as outlined in the Integrated Design Basis Threat Implementation Plan.

Means and Strategies

NE will use various means and strategies to achieve its program goals. However, various external factors may impact the ability to achieve these goals. NE also performs collaborative activities to help meet its goals.

The Department will implement the following means:

- Ensure that mission essential systems, resources, and services are identified to conduct priority missions for the Department and are maintained and operated in compliance with DOE, Federal, and State safety and environmental requirements in a secure and cost-effective manner. For Idaho Facilities Management, this will be accomplished by the implementation of the "INL Ten Year Site Plan" that will be updated annually.

- Maintain isotope production facilities in a ready, safe and environmentally compliant condition and maintain the unique infrastructure and capability to deliver advanced radioisotope power systems for space and national security missions.

The Department will implement the following strategies:

- Idaho Facilities Management mission essential facilities will be identified in the "INL Ten Year Site Plan." Detailed work planning and funding requests will result from implementation of this Plan that will be updated annually.

- Efficient use of existing facilities and staff, backup supply agreements, upgrade of present facilities, purchase of needed equipment, and investing in new facilities as warranted by demand. The challenges to the program will continue as scientific and medical research result in increased demand for new isotope products.

The following external factors could affect NE's ability to achieve its strategic goal:

- Medical Isotope Infrastructure Key External Factors: The Department is working to fully address its customers' requirements and to forecast future trends. This is being done through frequent interactions between customers and Program staff; data obtained from site visits and attendance at society exhibitions (e.g., the Society of Nuclear Medicine); and coordination of isotope activities with stakeholders in the isotope community including other Federal agencies. Research on market sizes, pricing pressures, competition, and customer feedback also is being obtained through independent surveys and studies, as well as Program management assessments. For example, reports of both the NERAC Subcommittee and an Expert Panel convened by the Medical University of South Carolina in 1998 observed that the program's infrastructure cannot adequately keep pace with the changing needs of the research community.

- Idaho Facilities Management Key External Factors: Energy policy changes related to the emphasis on future nuclear energy R&D would impact the focus and direction of the Idaho Facilities Management Program, but not necessarily its overall cost and long-term liabilities. Increased nuclear energy R&D needs resulting from new mission initiatives could require accelerated recapitalization to support enhanced use of research facilities and earlier enhancement of the existing infrastructure. On the other hand, reduced nuclear energy R&D could generate a larger near-term inventory of excess facilities and shift funding needs from upgrades and improvements to disposition (e.g., clean-up and dismantlement).

With the award of the new Idaho National Laboratory contract, Idaho will become a truly multi-program national laboratory with NE being the lead program. Through their Idaho Operations Office, NE will integrate and oversee program activities and manage the Department of Energy and Work for Others contracts. The Office of Environmental Management (EM), in executing the Idaho Cleanup Project (ICP), will initially be the largest program at the site, but that will change rapidly over time as the clean-up progresses. As EM completes its cleanup activities, facilities will be returned to NE. Thus, the Idaho Facilities Management program will adjust its activities to accommodate needs of the ICP.

In carrying out the program's mission, NE performs the following collaborative activities:

- Coordinates with national security agencies and NASA to develop radioisotope power systems for their use to ensure proposed systems and technologies satisfy the necessary technical requirements identified by customers for identified mission scenarios.

- The Department finances all isotope production and distribution expenses through cash collections from both federal and non-federal customers. The program is working to fully address its customers' requirements and to forecast future trends. This is being done through frequent interactions between customers and program staff, data obtained from customer site visits and attendance at society conferences (*e.g.,* the Society of Nuclear Medicine), and coordination of isotope activities with stakeholders in the isotope community, including other Federal agencies.

Validation and Verification

To validate and verify program performance, NE will conduct various internal and external reviews and audits. NE's programmatic activities are subject to continuing review by the Congress, the General Accountability Office, the Department's Inspector General, the Nuclear Regulatory Commission, the U.S. Environmental Protection Agency, state environmental and health agencies, the Defense Nuclear Facilities Safety Board, and the Department's Office of Engineering and Construction Management (including DOE Real Property Management Order). In addition, NE provides continual management and oversight of its vital field infrastructure programs—the Radiological Facilities Management program, the Idaho Facilities Management program, and the Idaho Sitewide Safeguards and Security program. Periodic internal and external program reviews evaluate progress against established plans. These reviews provide an opportunity to verify and validate performance. Monthly, quarterly, semi-annual and annual reviews, consistent with program management plans, are held to ensure technical progress, cost and schedule adherence, and responsiveness to program requirements.

NERAC subcommittees evaluate progress of NE's research and development programs. NERAC similarly reviews specific program plans as they are being formulated. In early FY 2004, NERAC established a Subcommittee on Evaluations. The full NERAC and its subcommittees have provided independent evaluations in the past, but these evaluations never comprehensively covered the entire nuclear energy program. The new Subcommittee engages appropriate experts to monitor, on a continual basis designated NE programs and evaluate the progress of these programs against (a) direction and guidance provided by the full NERAC and (b) program plans and performance measures developed by the program under evaluation. This Subcommittee provides arm's length, independent assessments that are critical to OMB's evaluation of NE programs.

Program Assessment Rating Tool (PART)

The Department implemented a tool to evaluate selected programs. PART was developed by OMB to provide a standardized way to assess the effectiveness of the Federal Government's portfolio of programs. The structured framework of the PART provides a means through which programs can assess their activities differently than through traditional reviews. The Infrastructure program has incorporated feedback from OMB during the FY 2006 assessment into the FY 2006 Budget Request and has taken or will take the necessary steps to continue to improve performance.

The results of the FY 2006 review are reflected in the FY 2006 Budget Request as follows:

The assessment found that the program is effectively targeted through the formal Idaho National Laboratory Ten Year Site Plan that identifies the mission-essential infrastructure and facilities, planned annual work scope, and performance measures for the laboratory. An overall PART score of 49 was achieved with a perfect 100 score for Section I, Program Purpose & Design; a score of 89 for Section II, Strategic Planning; a perfect 100 score for Section III, Program Management; and a score of 0 for Section IV, Program Results/Accountability. This is a new program and accomplishments have yet to be demonstrated.

Funding by General and Program Goal

(dollars in thousands)

	FY 2004	FY 2005	FY 2006
General Goal 4, Energy Security			
Program Goal 04.17.00.00: Maintain and enhance the national nuclear infrastructure capability	195,189	238,378	237,670
Total, General Goal 4 (Infrastructure)	195,189	238,378	237,670

Radiological Facilities Management

Funding Schedule by Activity

(dollars in thousands)

	FY 2004	FY 2005	FY 2006	$ Change	% Change
Radiological Facilities Management					
Space and Defense Infrastructure	35,544	33,532	31,200	-2,332	-7.0%
Medical Isotopes Infrastructure	27,887	34,535	33,100	-1,435	-4.2%
Enrichment Facility Infrastructure	0	496	500	+4	+0.8%
Total, Radiological Facilities Management	63,431	68,563	64,800	-3,763	-5.5%

Description

The mission of the Radiological Facilities Management program is to maintain critical user facilities in a safe, environmentally-compliant and cost-effective manner to support national priorities. The Radiological Facilities Management program funds the management of the Department's vital resources and capabilities at Office of Nuclear Energy, Science and Technology (NE)-managed facilities at Oak Ridge National Laboratory (ORNL), Los Alamos National Laboratory (LANL), Sandia National Laboratories (SNL), Brookhaven National Laboratory (BNL), and Idaho National Laboratory (INL). In addition, the Radiological Facilities Management program assures appropriate oversight of the operations and maintenance of the Department's Paducah Gaseous Diffusion Plant (Paducah GDP) uranium enrichment facilities to assure that USEC Inc. (USEC) meets its commitments under the 2002 DOE-USEC Agreement for the maintenance of a domestic enriched uranium fuel supply.

Benefits

These funds assure that NE facilities meet essential safety and environmental requirements and are maintained at user-ready levels. Actual operations, production, research, or other additional activities are funded either by other DOE programs, by the private sector, or by other Federal agency users.

At INL, the Department is completing the transfer of the radioisotope heat source and power system assembly and testing program from the Mound Plant in Ohio. Following the events of September 11, 2001, the Department identified the need to enhance security at the Mound Site or to transfer operations to another site where security was already in place. The components and systems at Mound containing Plutonium-238 (Pu-238) were transferred to ANL-W on an interim basis for safe and secure storage pending a final decision. After completing an Environmental Assessment and cost evaluations on a range of alternative actions, the Department decided to permanently locate the operations at INL. The transfer of equipment was completed in FY 2003 and installation of this transferred equipment into building additions or modifications proceeded during FY 2004. The transferred capability will become operational in early 2005 and will be fully functioning throughout FY 2006. In addition, the Department will transfer its inventory of neptunium-237 (Np-237) from the Savannah River Site to the INL during FY 2005 and FY 2006.

At ORNL, the Radiological Facilities Management program maintains the unique infrastructure for iridium fabrication. Iridium is the cladding used to encapsulate Pu-238 for use in space and national security missions, and ORNL maintains the only U.S. capability to process and fabricate iridium into the necessary cladding configuration.

At ORNL, this program also maintains Building 3047 Hot Cells in a safe and environmentally compliant condition for the production, packaging, and shipment of radioisotopes used in medicine, homeland security applications, and scientific research. The Chemical and Materials Laboratories in Building 9204-3 are used for stable isotope processing. Stable isotopes are used as feed material for radioisotopes and in medical and scientific research.

Additionally, the Department maintains 1.5 metric tons of uranium at ORNL which contains 450 kilograms of U-233. This material is stored in ORNL's Building 3019, a Manhattan Project-era facility that presents fire safety and contamination hazards. The storage containers require close inspection to verify their integrity that is not possible in the current storage configuration. Further, the storage of this fissile material requires expensive security precautions. The Department, therefore, launched the Uranium-233 Disposition, Medical Isotope Production, and Building 3019 Complex Shutdown Preliminary Project (U-233 Project) to down-blend this material into a form not useable for weapons (thereby reducing the danger posed by excess fissile materials and reducing security costs) and resolve the safety issues associated with its storage. While the material is processed, the project will extract important medical isotopes that are needed by researchers developing new treatments for difficult and deadly cancers.

At LANL, this program maintains the Pu-238 encapsulation and scrap recovery facilities in the Plutonium Facility (designated PF-4) in Technical Area-55. These facilities provide the only U.S. capability to process, pelletize and encapsulate the Pu-238 making it safe to use in radioisotope power systems. Also at LANL is the newly constructed Isotope Production Facility. This facility is producing medical and scientific research isotopes sold world wide.

The Radiological Facilities Management program also maintains the Annular Core Research Reactor (ACRR) and associated hot cells at SNL; and the Brookhaven Linear Isotope Producer (BLIP) Building 931 and Hot Cell Building 801 which is used for isotope processing at BNL.

The DOE-owned Paducah GDP is the only operating domestic enriched uranium production facility. Its continued operation is essential to assure an adequate supply of nuclear fuel for the Nation's electric utilities. The Paducah GDP lessee, USEC, committed, in a DOE-USEC Memorandum of Agreement on June 17, 2002, to maintain the long-term operability of the Department-owned Paducah GDP until USEC deploys new centrifuge enrichment technology by the end of this decade. The Department will review and analyze operating and maintenance data, and observe industrial activities at the Paducah GDP, and validate GDP maintenance on site each year, in order to assure USEC is meeting its commitments under the DOE-USEC Agreement and that Government's rights and options are being preserved.

The FY 2006 budget requests funding to manage the Department's vital resources and capabilities at INL, ORNL, LANL, SNL, BNL, and the Department's Paducah GDP to ensure that DOE missions can be met in a safe, environmentally-compliant and cost effective manner.

Detailed Justification

	(dollars in thousands)		
	FY 2004	FY 2005	FY 2006
Space and Defense Infrastructure	**35,544**	**33,532**	**31,200**
▪ **Idaho National Laboratory (INL)**	**19,244**	**14,732**	**12,200**
• **Radioisotope Power Systems Assembly Operations**	**9,044**	**9,432**	**7,500**

Transfer of the capability to assemble and test radioisotope power systems from the Mound Plant in Ohio to the INL is essentially complete. Equipment transfer was completed in FY 2003 and efforts in FY 2004 focused on completing required building additions and modifications and on installing the transferred equipment in these buildings and on setting up an interim production line to support a near term national security application. During early FY 2005, the remaining transferred equipment will be installed and the transferred capability will become operational. Fueling operations for the Pluto/New Horizons mission will begin in mid-FY 2005. In addition, in FY 2005 the receipt and storage of Np-237 will become part of the radioisotope power systems infrastructure. In FY 2006, the effort will be reduced to that required to maintain the facilities in a fully operational mode so that the assembly and testing capabilities will be available to support two national security customers and the qualification of an advanced multi-mission radioisotope thermoelectric generator and a Stirling radioisotope power system for the National Aeronautics and Space Administration.

• **Capital Equipment for Radioisotope Power System Assembly Operations**	**800**	**800**	**200**

Though significant amounts of equipment were transferred from Mound, some new equipment is required to support the heat source test and assembly operations at INL. These equipment purchases will continue into FY 2005. In FY 2006, capital equipment for the assembly and testing activities will be reduced to the level required for routine maintenance and infrastructure support.

• **General Plant Project (GPP) for Modifying Building 792 and for related site infrastructure upgrades**	**5,100**	**0**	**0**

The GPP budget line included two major GPP projects. The first involved modifications to Building 792 that supported the transfer of the heat source and radioisotope power system assembly and testing operations transferred from the Mound Plant in Ohio. The second supported other site infrastructure projects not directly related to the Building 792 modifications. Both GPP projects will be completed with FY 2004 funding.

	(dollars in thousands)		
	FY 2004	FY 2005	FY 2006
• **Np-237 Transfer/Storage**	**1,000**	**0**	**0**

In late FY 2004, the Department decided to transfer its inventory of Np-237 (needed as the irradiation target material in future Pu-238 production) from the Savannah River Site to the INL. This Np-237 material is currently stored under the auspices of the Environmental Management program, and the Department has committed to complete stabilization of this material by the end of FY 2006. To accommodate that schedule, INL will begin to receive shipments of Np-237 in early FY 2005, continuing through FY 2006, and place the material in storage. Funding for the receipt and storage is included as part of Radioisotope Power Systems Assembly Operations beginning in FY 2005.

• **Safety/Program Analysis and Testing Infrastructure**	**3,300**	**4,500**	**4,500**

The Department maintains an analytical and testing infrastructure that enables the Department to analyze the performance and ensure the safety of its radioisotope power systems. This capability includes the operation and update of sophisticated analytical codes that can analyze the behavior of materials and systems under potential accident environments. In addition, this capability enables the conduct of specialized tests and maintenance of equipment that can simulate the environments that these materials and systems could be subjected to during potential extreme accident or operational scenarios. In FY 2006, analysis techniques and computer codes will be updated to incorporate more advanced capabilities that can provide more accurate and detailed projections in support of future missions. Effort will also proceed on establishing a consolidated safety and testing infrastructure at INL or other laboratories.

▪ **Los Alamos National Laboratory (LANL)**	**12,200**	**13,800**	**14,000**
• **Pu-238 Encapsulation and Scrap Recovery Facilities**	**10,200**	**12,500**	**12,700**

The Department maintains and operates dedicated Pu-238 processing, encapsulation, and scrap recovery facilities within the Plutonium Facility (PF-4) at Technical Area 55 at LANL. Operations in these facilities were suspended in July 2004 as part of a site wide stand down. Approval to resume operations in these facilities was received in November 2004 and the facilities should be in full operation early in the second quarter of FY 2006. This site wide stand down delayed activities related to startup of the new full-scale scrap recovery line so that it will not receive approval to start up operations until late in FY 2005. When operational, this line and the bench scale scrap recovery line will provide the plutonium-238 that will be used in the encapsulation lines to support missions over the next several years. In addition, the treatment of waste residues that have built up over several years will begin in mid FY 2005, with increased effort during FY 2006. This will put the material in a form suitable for long term storage or disposal.

	(dollars in thousands)		
	FY 2004	FY 2005	FY 2006
• **Capital Equipment for the Pu-238 Facilities**	**2,000**	**1,300**	**1,300**

Maintenance of the Pu-238 facilities requires regular upgrades and replacement of gloveboxes and equipment in the processing, encapsulation, and scrap recovery lines. During FY 2004, replacement of gloveboxes in the processing and encapsulation facilities continued and equipment was purchased to initiate consolidation of the Pu-238 chemical and isotopic analyses within the TA-55 complex at LANL. Installation of the new gloveboxes in FY 2005 and retrofits of existing gloveboxes in FY 2006 will continue in support of establishing the isotopic analysis capabilities within TA-55.

▪ **Oak Ridge National Laboratory (ORNL)**	**4,100**	**5,000**	**5,000**
• **Iridium Fabrication Facilities for Radioisotope Power Systems**	**3,900**	**4,500**	**4,500**

The Department maintains a unique infrastructure and capability at ORNL to fabricate iridium cladding and carbon insulators used to encapsulate and contain the Pu-238 pellets used in radioisotope power systems. These heat source components are necessary for the safe operation of the radioisotope power systems. FY 2006 funding will continue to ensure the operational capability of this facility.

• **Capital Equipment for Iridium Fabrication Facilities**	**200**	**500**	**500**

In FY 2006, ORNL will continue to upgrade and replace rolling mills to support iridium processing and fabrication at ORNL.

Medical Isotopes Infrastructure	**27,887**	**34,535**	**33,100**
▪ **Oak Ridge National Laboratory (ORNL)**	**20,300**	**26,350**	**25,028**
• **Building 3047 Hot Cells**	**2,650**	**2,664**	**2,900**

Maintain facility in a safe and environmentally compliant condition for processing, packaging, and shipment of radioisotopes and other related services needed in medical diagnostic and therapeutic applications and other scientific research used by Federal and non-Federal entities. Activities include maintenance, radiological monitoring, and facility inspections. Isotope customers will pay the full cost of isotope processing in this facility.

• **Building 5500 – Chemical and Materials Laboratories**	**1,250**	**1,675**	**1,800**

Maintain the two laboratories in a safe and environmentally compliant condition for the processing, packaging, and shipment of stable isotopes and other services needed in medical diagnostic and therapeutic applications and other scientific research used by Federal and non-Federal entities. Activities include maintenance, radiological monitoring, and facility inspections.

	FY 2004	FY 2005	FY 2006
• **Building 9204-3, Calutron Building Y-12**	**1,250**	**973**	**973**

Continue to fund surveillance and maintenance activities necessary for cold stand-by of the Calutrons at Y-12.

• **Other ORNL Facilities**	**1,900**	**0**	**0**

FY 2004 funding provided for infrastructure upgrades at various ORNL facilities.

• **Isotope Production**	**450**	**600**	**650**

In accordance with the "President's Management Agenda" goals, "Improved Financial Performance" and "Expand Electronic Government", in FY 2003, NE integrated and automated its isotope business management information and consolidated it from three national laboratories to one laboratory, thus reducing overall costs. Such activities include isotope order processing, billing, official quotations, shipping schedules, cash collections, advance payments, and accounting for products and services provided by all Department isotope producing sites. Also, the Department is continuing to apply a more formal process started in FY 2003 for the selection of research isotopes for production and distribution of research isotopes called the Nuclear Energy Protocol for Research Isotopes (NEPRI). The NEPRI process was also centralized at ORNL along with the new automated business system. This E-Government isotope business management information system not only expedites customer orders but also saves several hundreds of thousands of dollars of administration expenses annually.

• **Uranium-233 (U-233) Program**	**12,800**	**6,929**	**0**

The U-233 Program provides funding for traditional "Other Project Costs" including program planning, safety analysis, and conceptual design. It also funds building support costs prior to construction. The balance of FY 2004 funding was used to advance the preliminary design of the Facility Modification for U-233 Disposition project (05-E-203). Critical Decision-1 (CD-1) was approved in May 2004 with the condition that additional design work be completed and independently verified prior to the proposal of a performance baseline. No U-233 program funding is requested in FY 2006.

• **05-E-203, Facility Modification for ^{233}U Disposition**	**0**	**13,509**	**18,705**

The ^{233}U Disposition, Medical Isotope Production and Building 3019 Complex Shutdown project will increase the availability of medically valuable isotopes by processing the DOE ^{233}U inventory at Oak Ridge; and resolve legacy safety and security issues associated with the inventory and its storage facility. FY 2005 funding will fund the completion of the project engineering, design and analysis necessary to support a performance baseline. After the performance baseline is approved in Critical Decision-2, it will be used to complete a revised business case for the project and a recommendation relative to proceeding to construction of the building modifications. The FY 2006 request will fund the final design and the first year of construction for the building modifications project. The updated business case will be submitted to Congress prior to proceeding with the physical modifications in accordance language contained in the conference report of the House and Senate Committees on Appropriations (HR 107-681).

	(dollars in thousands)		
	FY 2004	FY 2005	FY 2006
▪ **Los Alamos National Laboratory (LANL)**	**3,012**	**3,160**	**2,922**
• **Isotope Production Facility/TA-48 Hot Cell, Building RC-1**	**1,750**	**2,850**	**2,922**

Maintain facilities in a safe and environmentally compliant condition for the production, processing, packaging, and shipment of radioisotopes and other services needed in medical diagnostic and therapeutic applications, and other scientific research used by Federal and non-Federal entities. Activities include maintenance, radiological monitoring, and facility inspections. Isotope customers will pay the full cost of isotope processing in these facilities.

• **Isotope Production Facility – Other Project and Start-up and Maintenance Costs**	**1,262**	**0**	**0**

Start-up expenses associated with the Isotope Production Facility (IPF) target station and beam line. This facility was completed in FY 2004 and will be in production in FY 2005.

• **Capital Equipment**	**0**	**310**	**0**

In FY 2005, procure type A and type B shipping containers needed to transport isotopes between the IPF and the hot cells and to customers.

▪ **Sandia National Laboratories (SNL)**	**1,750**	**1,900**	**2,000**
• **TA-5 ACRR & Hot Cells**	**1,750**	**1,900**	**2,000**

Support operations of the vital facilities in Sandia's Technical Area 5 (TA-5). Specifically, this activity includes maintaining the Annular Core Research Reactor (ACRR) in a safe, environmentally compliant condition and state of readiness, and maintaining the associated hot cells in a non-nuclear stand-by status. Activities include maintenance, radiological monitoring, and facility inspections.

▪ **Brookhaven National Laboratory (BNL)**	**2,373**	**2,673**	**2,650**
• **Brookhaven Linear Isotope Producer (BLIP) Building 931 and Hot Cell Building 801**	**2,075**	**2,558**	**2,650**

Maintain the BLIP Building 931 and Hot Cell Building 801 facilities in a safe, environmentally compliant condition and state of readiness for the production of radioisotopes and other services needed in medical diagnostic, therapeutic applications, and other scientific research used by Federal and non-Federal entities. Activities include maintenance, radiological monitoring, and facility inspections. Isotope customers will pay the full cost of isotope processing in this facility.

• **Capital Equipment**	**298**	**115**	**0**

In FY 2005, the program will purchase capital equipment, such as a hot cell manipulator and a fume hood ventilation system.

	(dollars in thousands)		
	FY 2004	FY 2005	FY 2006
▪ **Other Activities**	**452**	**452**	**500**
• **Associated Nuclear Support**	**452**	**452**	**500**

This funding provides for requirements applicable to isotope producing sites. Such items include annual Nuclear Regulatory Commission certification of isotope shipping casks, independent financial audits of the revolving fund, and other related expenses.

Enrichment Facility Infrastructure	**0**	**496**	**500**
▪ **Oak Ridge Operations Office**	**0**	**496**	**500**

Funding provides for oversight and monitoring of the maintenance of its leased assets at the Paducah Gaseous Diffusion Plant. Under the DOE-USEC Agreement of June 17, 2002, USEC is required to maintain the Paducah GDP in a certain operable condition. The Department has the right to inspect the facilities to verify the USEC maintenance program is meeting the terms of the Agreement. The program will inspect and analyze operating and maintenance data, and observe industrial activities at the Paducah GDP, and validate GDP maintenance each year, in order to assure that USEC Inc. is meeting its commitments and that the Government's rights and options are preserved.

Total, Radiological Facilities Management	**63,431**	**68,563**	**64,800**

Explanation of Funding Changes

	FY 2006 vs. FY 2005 ($000)
Space and Defense Infrastructure	
▪ **Idaho National Laboratory (INL)**	
• **Radioisotope Power Systems Assembly Operations**	
The decrease of $1,932,000 in operating funds reflects the completion of those activities associated with establishing the heat source and radioisotope power system assembly and testing operations at INL and the transition to infrastructure level funding	-1,932
• **Capital Equipment for Radioisotope Power System Assembly Operations**	
The decrease of $600,000 in capital equipment funds reflects reducing the level of equipment for the assembly and testing activities to the level required for routine maintenance and infrastructure support	-600
• **Total, INL**	**-2,532**

	FY 2006 vs. FY 2005 ($000)
▪ **Los Alamos National Laboratory (LANL)**	
• **Pu-238 Encapsulation and Scrap Recovery Facilities**	
The increase of $200,000 will be used to increase efforts to process residues stored from prior year operations	+200
Total, Space and Defense Infrastructure	**-2,332**
Medical Isotopes Infrastructure	
▪ **Oak Ridge National Laboratory (ORNL)**	
• **Building 3047 Hot Cells**	
The increase of $236,000 will permit needed minor repairs and keep the maintenance schedule current	+236
• **Building 5500 – Chemical and Materials Laboratories**	
The increase of $125,000 will permit keeping the maintenance schedule current and purchase of minor lab equipment and supplies	+125
• **Isotope Production**	
The increase of $50,000 will permit upgrades to the current system to accommodate electronic ordering, payments, and transfer of cash collections to the producing sites and maintain inventory control	+50
• **Uranium-233 Program**	
The decrease of $6,929,000 reflects the shift of operating funds to construction funds that are requested in the Facility Modification for 233U Disposition line item. Funds will be requested in FY 2007 in the Uranium-233 Program account for start-up testing and commissioning related activities	-6,929
• **Facility Modification for ^{233}U Disposition**	
The increase of $5,196,000 reflects costs for Building 3019 capital improvements and construction support activities needed for processing the Uranium-233 under the Uranium-233 Program	+5,196
▪ **Total, ORNL**	**-1,322**

	FY 2006 vs. FY 2005 ($000)
▪ **Los Alamos National Laboratory (LANL)**	
• **Isotope Production Facility/TA-48 Hot Cell, Building RC-1**	
The increase of $72,000 will be used to maintain the facility consistent with the FY 2005 funding level. Isotope customers will pay the full cost of isotope processing in these facilities	+72
• **Capital Equipment**	
The decrease of $310,000 reflects shipping containers purchased in FY 2005 for transportation of isotopes between facilities and customers	-310
▪ **Total, LANL**	**-238**
▪ **Sandia National Laboratories (SNL)**	
• **TA-5 ACRR & Hot Cells**	
The increase of $100,000 will support additional maintenance activities	+100
▪ **Total, SNL**	**+100**
▪ **Brookhaven National Laboratory (BNL)**	
• **Brookhaven Linear Isotope Producer Building 931 and Hot Cell Building 801**	
The increase of $92,000 will be used to address additional maintenance requirements	+92
• **Capital Equipment**	
The decrease of $115,000 reflects completing purchases and installation of equipment requested in FY 2004	-115
▪ **Total, BNL**	**-23**
▪ **Other Activities**	
• **Associated Nuclear Support**	
The increase of $48,000 provides level of funding for requirements applicable to isotope producing sites	+48
Total, Medical Isotopes Infrastructure	**-1,435**
Enrichment Facility Infrastructure	
▪ **Oak Ridge Operations Office**	
• **Enrichment Facility Infrastructure**	
The increase of $4,000 from FY 2005 to FY 2006 is due to the FY 2005 rescission	+4
Total Funding Change, Radiological Facilities Management	**-3,763**

Capital Operating Expenses and Construction Summary

Capital Operating Expenses

(dollars in thousands)

	FY 2004	FY 2005	FY 2006	$ Change	% Change
Capital Equipment	3,298	3,025	2,000	-1,025	-33.9%
General Plant Projects/General Purpose Equipment	5,100	0	0	+0	+0.0%
Total, Capital Operating Expenses	8,398	3,025	2,000	-1,025	-33.9%

Construction Projects

(dollars in thousands)

	Total Estimated Cost (TEC)	Prior-Year Appropriations	FY 2004	FY 2005	FY 2006	Unappropriated Balance
05-E-203, Facility Modification for ^{233}U Disposition, ORNL[a]	114,184	0	0	13,509[b]	18,705	81,970

[a] Planning and Design activities performed in FY 2003 and 2004 were funded from budgeted amounts ($9,408,000) for Building 3019 Complex operations as noted in the Preliminary Project Execution Plan (PEP).
[b] Reflects a rescission reduction in the amount of $107,393.

Isotope Production and Distribution Program Fund

Funding Schedule by Activity

No funds are requested for the Isotope Production and Distribution Fund. Isotopes are currently produced and processed at three facilities: LANL, BNL and ORNL. Each of the sites' production expenses associated with processing and distributing isotopes will be offset by revenue generated from sales. See the Radiological Facilities Management section for justification of appropriations request.

Description

The mission of the Department's Medical Isotope Infrastructure program is to maintain the infrastructure required to support the national need for a reliable supply of isotope products, services, and related technology used in medicine, industry, and research.

Benefits

This assures that critical isotope production infrastructure is operated in a safe, secure, environmentally-compliant and cost-effective manner, thus ensuring that the facilities are available to support users who need DOE-produced isotopes. A combination of an appropriation and revenues from isotope sales are deposited in the Isotope Production and Distribution Fund, which is a revolving fund. All isotope production costs are financed by revenues from sales of isotope products and services. The Fund's revenue and expenses are audited annually consistent with Government Auditing Standards and other relevant acts, such as the Chief Financial Officers Act of 1990 and the Government Performance and Results Act of 1993. Included in the Annual Financial Statements and Program Overview are the performance measures results.

The Department has supplied isotopes and related services to the public for more than 50 years. As the range of available isotopes and recognized uses has grown, isotope applications have become vital to continued progress in medical research and practice, new industrial processes, diagnosis, and therapies, which are an indispensable and a growing component of the U.S. health care system. The use of medical isotopes reduces health care costs and improves the quality of patient care.

As the range of available isotopes and the recognized uses for them have increased, new or improved isotope products have become essential for progress in medical research and practice, new industrial processes, and scientific investigation. A substantial national and international infrastructure has been built around the use of isotopes. It is estimated that one in every three people treated at a hospital makes use of a radioisotope in their laboratory tests, diagnoses, or therapy. Each day, over 40,000 medical patients receive nuclear medicine procedures in the United States. Such nuclear procedures are among the safest diagnostic tests available. They save many millions of dollars each year in health care costs and enhance the quality and effectiveness of patient care by avoiding costly exploratory surgery and similar procedures. For example, it has been demonstrated that the use of myocardial perfusion imaging in emergency department chest pain centers can reduce duration of stay on average from 1.9 days to 12 hours with a concomitant reduction in charges. Therefore, an adequate supply of medical and research isotopes is essential to the Nation's health care system, and to basic research and industrial applications that contribute to national economic competitiveness. The Department will continue to make new capital investments to replace, or enhance processing equipment and infrastructure in order to improve production and processing of isotopes to meet current and anticipated future increases in demand.

The isotopes scheduled for production are based on the Nuclear Energy Protocol for Research Isotopes (NEPRI) process. This protocol serves as a guide for the selection of research isotopes. The process is designed to assure DOE produces those isotopes that will return the most benefit to the research community and general public. Based on comments from researchers, the NEPRI application and review process has been streamlined. Also, a peer-review will be used for the selection of isotopes only when the DOE exceeds production capacity. NEPRI isotopes will be produced as long as sufficient funding commitments are received to cover direct production costs. Each isotope will be priced such that the customer pays its cost of production for that isotope. No Radiological Facilities Management program funds will be expended on the development or production of these isotopes.

The DOE will continue to sell commercial isotopes at full-cost recovery. The list of commercial isotopes will be issued in parallel with the NEPRI list. A portion of revenue from the sales of commercial isotopes contributes to defray facility infrastructure expenses that would otherwise require additional appropriation.

Generally, the program has functioned as a traditional vendor-purchaser relationship as found in any business, *e.g.* billing at the time of shipment and collection in 30 days. Since the annual Radiological Facilities Management appropriations will be restricted to isotope infrastructure expenses, no funds will be available as working capital. Hence, all isotope production costs will be financed by revenue from sales.

05-E-203 - Facility Modifications for ^{233}U Disposition, Oak Ridge National Laboratory, Oak Ridge, Tennessee

(Changes from FY 2005 Congressional Budget Request are denoted with a vertical line [|] in the left margin.)

Significant Changes

Since submittal of the FY 2005 Construction Project Data Sheet (CPDS), this project has been fully integrated with the requirements of DOE Order 413.3, " Program and Project Management for the Acquisition of Capital Assets", including the performance of two External Independent Reviews by the Office of Engineering and Construction Management, in order to ensure that the decision to proceed is based on an accurate cost estimate and classification of costs. The FY 2006 CPDS estimate is based on the design at the 60% completion level. This level of design detail now fully accounts for the actual conditions that exist in this sixty year old facility. Many of these conditions were not known or fully understood at the time of the conceptual estimate. As a result, the construction costs have increased from estimates submitted during the contractor selection process. Final cost estimates will be submitted in conjunction with the request for Critical Decision 2 (CD-2), Approve Performance Baseline, in accordance with DOE Order 413.3 and incorporated into the FY 2007 CPDS.

Following CD-2, Approve Performance Baseline, the final costs will be incorporated into an updated Program Business Case that will be submitted to Congress prior to proceeding with physical modifications in accordance with language contained in conference report of the House and Senate Committees on Appropriations (House Report 107-681). Although the project cost has significantly increased, the Program Business Case should show that the combined design/construction and uranium-233 (U-233) down-blending costs remain a prudent investment for the Department. The Program eliminates a significant liability at the Oak Ridge National Laboratory, mitigates the impact of rapidly increasing security costs associated with the new Design Basis Threat, and projects a cumulative net savings to the Department by 2030 of approximately $265,000,000.

The current Total Estimated Cost (TEC) of the project has increased from $40,134,000 to $114,184,000, an increase of $74,050,000. The TEC increase consists of (1) facility modifications/process equipment increase of $43,630,000 due to a better understanding of existing building conditions, development of additional design details, and Department direction to increase processing capacity; and
(2) reclassification of items previously included in the operating portion of the U-233 Program as project costs (TEC) in the amount of $30,420,000.

The Total Project Cost (TPC) went from $40,134,000 in FY 2005 to $138,923,000 in FY 2006. This includes the $74,050,000 TEC increase noted above and a $24,739,000 increase in "Other Project Costs" due to (1) the cost of reclassifying preliminary design, start up testing and commissioning costs as project costs; and (2) increased start-up and commissioning costs as a result of the mature equipment design.

The costs of implementing new security requirements demanded by the new Design Basis Threat in the post September 11, 2001, era are being evaluated and are not included in this CPDS at this time.

1. Construction Schedule History [a]

	Fiscal Quarter				Total Estimated Cost ($000)	Total Project Cost ($000)
	A-E Work Initiated	A-E Work Completed	Physical Construction Start	Physical Construction Complete		
FY 2005 Budget Request (Preliminary Estimate) [b]	1Q 2004	1Q 2005	1Q 2005	2Q 2007	40,134	40,134
FY 2006 Budget Request (Revised Estimate)[c]	1Q 2004	3Q 2005	3Q 2005	4Q 2008	114,184	138,923

2. Financial Schedule

(dollars in thousands)

Fiscal Year	Appropriations	Obligations	Costs
2005	13,509[d]	13,509	13,509
2006	18,705	18,705	18,705
2007	45,502	45,502	45,502
2008	36,468	36,468	36,468

[a] Planning and Design activities performed in FY 2003 and 2004 were funded from budgeted amounts for Building 3019 Complex operations as noted in the Preliminary Project Execution Plan (PEP) provided to Congress in May 2002. The remaining Planning and Design activities performed in FY 2005 will be funded from line item funding. This is consistent with the FY 2005 appropriation and the intent of DOE Order 413.3.

[b] FY 2005 TEC and TPC data reflected conceptual design estimates.

[c] FY 2006 TEC and TPC data estimates are based upon a 60% design. Prior year planning and design associated with the U-233 program are shown in the "Other Project Cost (OPC)" category. The $74,050,000 increase in TEC indicates a real increase of $43,630,000 and reclassified costs from the program to the project of $30,420,000. The $98,790,000 increase in TPC reflects a real increase of $50,650,000 and reclassified costs from the program to the project in the amount of $48,140,000. TEC/TPC numbers will be finalized for Critical Decision 2, Approve Performance Baseline, as defined in DOE Order 413.3, "Program and Project Management for the Acquisition of Capital Assets". No decisions on construction will be made until the performance baseline is approved by the Department and a revised business plan is submitted to Congress.

[d] Reflects a rescission reduction in the amount of $107,393.

3. Project Description, Justification and Scope

The "^{233}U Disposition, Medical Isotope Production and Building 3019 Complex Shutdown" project has been developed by the Department of Energy (DOE) to meet two major objectives: (1) to increase the availability of medically valuable isotopes by processing the DOE ^{233}U inventory at Oak Ridge; and (2) to resolve legacy safety and security issues associated with the inventory and its storage facility, including the safety issues that were identified by the Defense Nuclear Facilities Safety Board (DNFSB) in Recommendation 97-1, "Safe Storage of Uranium-233". Blending down this material will support National non-proliferation goals by making the material unsuitable for use in weapons and reduce security costs at the Oak Ridge National Laboratory.

The Project will be executed in accordance with the "Report to Congress on the Extraction of Medical Isotopes from Uranium-233**"**, submitted to Congress in May 2002. Accordingly, this project will:

- Extract thorium-229 (^{229}Th) for use as a source of medical isotopes to support research and potential treatment (*e.g*., actinium-225 (^{225}Ac)/bismuth-213 (^{213}Bi);.
- Render the entire ^{233}U inventory suitable for safe and economical long-term storage by eliminating nuclear criticality and proliferation concerns, through isotopic down blending with depleted uranium;
- Shutdown the Building 3019 Complex in preparation for final decontamination and decommissioning (D&D); and
- Meet the requirements of DNFSB Recommendation 97-1, which addresses the storage, inspection, and repackaging of the ^{233}U maintained at ORNL.

The Department developed a three-phased approach to allow for systematic decision-making and to increase the Department's flexibility. The base contract award consisted only of Phase I/Planning and Design. On October 9, 2003, a contract was awarded to Isotek Systems, LLC, a limited-liability corporation formed by Duratek Federal Services, Inc., Nuclear Fuel Services, Inc., and Burns and Roe Enterprises, Inc., to perform Phase I of the work. Phase II/Project Implementation and Phase III/Building 3019 Complex Shutdown are contract options that may be unilaterally exercised by the Department.

Completion of the "^{233}U Disposition, Medical Isotope Production and Building 3019 Complex Shutdown" project will save approximately $265 million over a 25 year time period over the cost of continued ^{233}U storage inside Building 3019. The costs of implementing new security requirements demanded by the new Design Basis Threat in the post September 11, 2001, era are being evaluated and are not included in this CPDS at this time**.**

This project data sheet has been revised to include the cost of design activities, building support costs during construction and other project costs, including start-up testing, commissioning, and Operational Readiness Reviews, as recommended by the External Independent Review (EIR) conducted by the Department's Office of Engineering and Construction Management in accordance with DOE Order 413.3, "Program and Project Management for the Acquisition of Capital Assets". This project data sheet addresses the funding requirements and projected schedule for capital improvements to the Building 3019 Complex that are necessary to accomplish program activities of processing (including medical isotope production), repackaging, and removal of the ^{233}U inventory. A more detailed description of each phase is below.

Phase I - Planning and Design:

Phase I will consist of detailed project planning, process and facility modification designs, development of safety documentation, and development of detailed Phase II cost estimates. Phase I will be conducted on a cost-plus-fixed-fee basis. The duration of Phase I has increased from 13 months to 18 months due to re-designing portions of the processing equipment in order to increase their through-put capacity (from 12 kg to 18 kg per week) and to address issues arising from the 60-year-old age of the facility. Concurrently, ORNL will operate the Building 3019 Complex and perform a portion of the ^{233}U container inspection program necessitated by DNFSB Recommendation 97-1.

Phase I, Planning and Design, activities performed in FY 2004 were funded from budgeted amounts for Building 3019 Complex operations as noted in the Preliminary Project Execution Plan (PEP) provided to Congress in May 2002. Critical Decision 1, Approve Preliminary Baseline Range, was approved on May 27, 2004, in accordance with DOE Order 413.3, "Program and Project Management for the Acquisition of Capital Assets". The remaining Phase I, Planning and Design, activities will be completed in FY 2005 using line-item funding.

At the end of Phase I of the project, DOE will determine whether to proceed with Phase II/Project Implementation based on the following:

- The acceptability of the safety analysis, security plan, management plans and final design;
- The acceptability of the detailed cost estimate to complete the project, as determined by an independent cost analysis ("should cost analysis") by DOE using the contractor's design and processing approach;
- The overall performance of the contractor in meeting the DOE cost, schedule, and safety requirements; and
- A National Environmental Policy Act (NEPA) review of the proposed action.

The Department's Office of Engineering and Construction Management will review and validate the "should cost analysis." Based on the evaluation of the work conducted under Phase I of the project (deliverables, contractor performance, and project costs) and the NEPA review, DOE can choose either to terminate the project or unilaterally exercise the option to implement Phase II.

Phase II - Project Implementation

During Phase II, the contractor would begin the necessary capital construction improvements (facility modifications and processing equipment installation plus contingency) estimated at $107,297,000. Total estimated cost and total project cost data reflect estimates for Phase I design costs and Phase II capital improvements to the Building 3019 Complex costs and are based on the estimates from the design at the 60% completion level and reflect adjustments made in response to the External Independent Review. These numbers will be updated during Phase I of the contract in conjunction with Critical Decision 2, Approve Performance Baseline, as defined in DOE Order 413.3, "Program and Project Management for the Acquisition of Capital Assets". Following the completion of the capital construction improvements, the contractor would begin the program activities of ^{229}Th extraction while down-blending the enriched ^{233}U with depleted uranium, and shipment of approximately 1,000 to 1,100 containers of down-blended material to an approved interim storage location at Oak Ridge. Execution of the program activities during Phase II would satisfy all of the requirements of the inspection and repackaging program that DOE agreed is necessary to resolve DNFSB Recommendation 97-1.

During Phase II, the contractor would also be responsible for operation of the Building 3019 Complex, including the characterization, packaging, transportation and disposal of secondary wastes (*e.g*., personal protection equipment, construction debris, liquid residues, etc.)

The extracted ^{229}Th, in conjunction with existing quantities of purified ^{229}Th, would be leased to the contractor if DOE proceeds with Phase II of the project. The lease would require transportation of ^{229}Th to the lessee's commercial facility, storage and processing of the leased ^{229}Th to extract ^{225}Ac, the marketing, sale, and distribution of ^{225}Ac for medical research and treatment, and continued supply of the DOE existing ^{225}Ac customers. All activities under the lease would be at no cost to the Government.

During Phase II, the contractor would also be required to develop transition plans to place the Building 3019 Complex in a safe and stable shutdown configuration prior to transfer to the DOE decommissioning program. The contractor would also be required to develop a post-transition surveillance and maintenance plan. These plans would ensure that any contamination present is adequately contained, and that potential hazards to workers, the public, and the environment are minimized and controlled.

Upon completion of Phase II/Project Implementation processing activities, the contractor would be required to clean up all processing systems and equipment, including the removal and disposal of unattached solid waste materials and residual process materials in accordance with criteria specified by DOE. After clean-up has been completed, the contractor would characterize these systems and equipment and provide the characterization data to DOE. The redesigned throughput capacity noted in Phase I above reduced the duration of Phase II from 84 months to 78 months.

Phase III - Building 3019 Complex Shutdown

Phase III would consist of performance of facility stabilization and transition activities to meet the criteria for transferring the facility to the Department's Office of Environmental Management (EM) program for decommissioning. The estimated duration of Phase III is 6 months.

4. Details of Cost Estimate

	(dollars in thousands) Current Estimate	Previous Estimate
Design Phase		
Planning and Design Costs (includes Design and Project Management costs)(6.0% of TEC)	6,887	n/a[a]
Total, Design Phase	6,887	n/a
Project Implementation		
Facility Modifications/Process Equipment (55.8% of TEC)	63,740	32,924
Building Support Costs During Construction (25.0% of TEC)	28,519	0
Project Management (7.3% of TEC)	8,298	1,975
Total, Project Implementation	100,557	34,899
Contingency (5.9% of TEC)	6,740	5,235
Total Line Item Cost	114,184	40,134
Less: Non-Agency Contribution	0	0
Total, Line Item Costs (TEC)[b]	114,184	40,134

5. Method of Performance

The DOE Oak Ridge Operations Office (ORO) will be responsible for implementation of the ^{233}U project (including selection of principal contractor) and approval of specified procurement actions. Project deliverables will be performed under a negotiated contract which will be awarded on the basis of competitive bidding. The selected contractor will manage the project. A dedicated Federal project manager at ORO will oversee the efforts of the selected contractor.

a Phase I, Planning and Design, activities performed in FY 2004 were funded from budgeted amounts for Building 3019 Complex operations as noted in the Preliminary Project Execution Plan (PEP) provided to Congress in May 2002.

b Based on recommendations from the External Independent Review conducted by the Office of Engineering and Construction Management, the FY 2006 TEC and TPC has been revised to include Phase I, Planning and Design, costs and Other Project Costs previously budgeted for the Uranium-233 Program account, as well as cost estimates based on the design at the 60% completion level. TEC/TPC numbers will be finalized for Critical Decision 2, Approve Performance Baseline, as defined in DOE Order 413.3, Program and Project Management for the Acquisition of Capital Assets

6. Schedule of Project Funding

(dollars in thousands)

	Prior Years	FY 2005	FY 2006	Outyears	Total
Project Cost					
Facility Cost					
Planning and Design	0	6,887	0	0	6,887
Project Implementation	0	6,622	18,705	81,970	107,297
Total, Line item TEC	0	13,509	18,705	81,970	114,184
Other project costs					
Conceptual Design costs[a]	9,408	0	0	0	9,408
NEPA documentation costs	100	0	0	0	100
Other project-related costs	715	0	0	14,516	15,231
Total other project costs	10,223	0	0	14,516	24,739
Total, Project Cost (TPC)	10,223	13,509	18,705	96,486	138,923

7. Related Annual Funding Requirements

	Current Estimate	Previous Estimate
Facility operating costs	*	*

*Narrative Explanation of Related Annual Funding Requirements

The Total Estimated Cost (TEC) and Total Project Cost (TPC) address only the facility modifications and procurement and installation of processing equipment necessary to begin the program activities of ^{229}Th extraction and uranium down-blending in the Building 3019 Complex. The majority of the programmatic costs are related to down blending operations and baseline security costs that will be required from award of Phase I to shutdown of the Building 3019 Complex during Phase III. The total funding estimate for all phases including these related annual funding requirements was approximately $250,000,000 based on the Preliminary PEP provided to Congress in May 2002. The total funding estimate, including the Annual Funding requirements, will be updated in a revised Business Case as requested by the House and Senate Committees on Appropriations (House Report 107-681) prior to award of Phase II of the contract. The revised Business Case will incorporate updated Total Project Cost data, costs associated with down blending and storage and security costs associated with the implementation of the new Design Basis Threat. These costs will be compared against the updated costs for continued storage of the ^{233}U in Building 3019 at the Oak Ridge National Laboratory.

a Planning and Design activities performed in FY 2003 and 2004 were funded from budgeted amounts for Building 3019 Complex operations as noted in the Preliminary Project Execution Plan (PEP) provided to Congress in May 2002.

Idaho Facilities Management

Funding Schedule by Activity

(dollars in thousands)

	FY 2004	FY 2005	FY 2006	$ Change	% Change
Idaho Facilities Management					
INL Operations	73,120	110,642	86,907	-23,735	-21.5%
INL Construction	2,295	1,511	10,955	+ 9,444	+625.0%
Total, Idaho Facilities Management	75,415	112,153	97,862	-14,291	-12.7%

Funding Schedule by Activity – Energy Supply

(dollars in thousands)

	FY 2004	FY 2005	FY 2006	$ Change	% Change
Idaho Facilities Management – Energy Supply					
INL Operations	51,824	89,923	69,145	-20,778	-23.1%
INL Construction	2,295	1,511	10,955	+9,444	+625.0%
Total, Idaho Facilities Management – Energy Supply	54,119	91,434	80,100	-11,334	-12.4%

Funding Schedule by Activity – Other Defense Activities

(dollars in thousands)

	FY 2004	FY 2005	FY 2006	$ Change	% Change
Idaho Facilities Management – Other Defense Activities					
INL Operations	21,296	20,719	17,762	-2,957	-14.3%
Total, Idaho Facilities Management – Other Defense Activities	21,296	20,719	17,762	-2,957	-14.3%

Description

Beginning in the second quarter of FY 2005, the research portion of the Idaho National Engineering and Environmental Laboratory will be merged with Argonne National Laboratory - West (ANL-W) to form the basis of the Idaho National Laboratory (INL). The INL is a multi-program national laboratory that employs its research and development assets to pursue assigned roles in a range of research and national security activities.

The purpose of the Idaho Facilities Management program is to provide the INL with the site-wide Landlord infrastructure required to support technical efforts such as research on the Advanced Fuel Cycle Initiative, Generation IV nuclear energy systems, the Space and Defense Power Systems program, and the Navy's nuclear propulsion research and development program.

Benefits

The Idaho Facilities Management program supports "National Energy Policy" goals by maintaining and operating important INL basic infrastructure that is required to support facilities dedicated to advanced nuclear energy technology research and many other Federal government activities. As the landlord of the INL, the Office of Nuclear Energy, Science and Technology (NE) manages common-use equipment, facilities, land, and support services that are not directly funded by programs. Key activities conducted under these programs include assuring that all landlord facilities meet essential safety and environmental requirements and are maintained, managing all special nuclear materials contained in these facilities, and the disposition of DOE legacy waste materials under NE ownership.

To address the requirements to support the missions at INL, NE has developed an INL Ten-Year Site Plan that presents a mission needs analysis of existing facilities and infrastructure and clearly identifies the investments needed at the site to support its projected mission profile. The Plan provides recommendations for short- and long-term recapitalization of existing mission essential facilities and infrastructure and presents a plan to upgrade laboratory facilities to support emerging and growing laboratory missions such as the Advanced Fuel Cycle Initiative, the Generation IV Nuclear Energy Systems Initiative, and a range of national security technology programs. The Plan identifies and prioritizes the projects, activities, and mission resource requirements for real property assets that cover a ten-year planning horizon.

The Plan includes a prioritized listing of maintenance, repair and recapitalization projects necessary to correct the maintenance backlog. The Plan is organized to assure the maintenance backlog is stabilized by 2007, and reduced to the industry benchmark of 2%-4% of Replacement Plant Value by 2013. The use of this industry benchmark was recommended by the National Research Council's Congressionally-sponsored 1998 study Stewardship of Federal Facilities. The Plan describes how NE could recapitalize INL, acquire new facilities, infrastructure systems and equipment, and dispose of facilities no longer needed. The Plan is the product of the detailed INL planning process and provides performance measures to show how the physical state of the complex is expected to change over time. The FY 2006 budget request has been based on this Plan. The Plan will be updated annually to reflect new program and infrastructure requirements as they emerge.

Detailed Justification

	(dollars in thousands)		
	FY 2004	FY 2005	FY 2006
INL Operations	**73,120**	**110,642**	**86,907**
▪ **Laboratory Transition and Restructuring**	**0**	**43,453**	**0**

The $43.8M requested for FY 2005 was intended to cover the one-time costs associated with workforce restructuring as the Idaho National Engineering and Environmental Laboratory contract was divided into separate laboratory and clean-up contracts. All restructuring associated with the establishment of the INL will be complete in FY 2005.

▪ **Infrastructure Operations**	**52,319**	**55,303**	**64,582**

Manage the operation of common use and user facilities at the INL, including operating and maintaining nuclear and radiological facilities, ensuring environmental compliance, and providing infrastructure program management and support for planning, managing, and administering the Idaho Facilities Management Program. The infrastructure includes 890 square miles of land, 298 buildings, associated support structures, a full complement of utilities, including communication and data transmission systems, approximately 800 miles of roads, 61 miles of electrical transmission lines and 14 miles of railroad lines. Operating activities include grounds inspection and maintenance; inactive facilities surveillance and maintenance; excess facility decommissioning and disposition; disposition of legacy materials at an off-site commercial facility; and general plant project, capital equipment, and line item projects. Management also includes various crosscutting contracts and obligations between the Department of Energy and other entities including the National Oceanic and Atmospheric Administration, the Shoshone and Bannock Indian Tribes, the State of Idaho, and payments in lieu of taxes for the four counties in which the INL is located.

The Advanced Test Reactor (ATR) is essential to ongoing and planned national security and energy research programs at the Idaho National Laboratory. Independent review teams of industry experts have found that ATR required engineering analysis, increased maintenance, and recapitalization of systems to remain a viable research tool for the next thirty to forty years. The current estimated incremental cost of repairs and upgrades is about $200 million dollars over a ten year period. This is a prudent investment since the replacement value of the reactor is about $2 billion dollars. This review prompted several projects, most notably an exhaustive Design Basis reconstitution. This project is in progress and results to date are favorable. In FY 2006 work should be complete on a Design Basis reconstitution that will verify the reactor meets modern nuclear safety standards. The recommendations of this review and other analyses will be incorporated into an INL Ten Year Site Plan (TYSP). This plan, updated annually, is the foundation for INL facilities and infrastructure strategic planning and the cornerstone of the Program's initiative to restore the INL and the facilities on the site. The INL TYSP is requirements based and clearly demonstrates the results that will be accomplished for the resources expended, consistent with the President's Management Agenda (PMA) and NE's performance and budget integration initiative. Specifically, the TYSP includes a prioritized list of recapitalization projects that is based upon a formal prioritization methodology that preferentially targets deferred maintenance reduction, particularly for mission-essential facilities and infrastructure. As a result, the FY 2006 Idaho Facilities Management budget request includes an

	(dollars in thousands)	
FY 2004	FY 2005	FY 2006

increase of $12.1 million in operations and maintenance. In FY 2006 there will be significant progress in developing a long term operating plan that will validate maintenance, staffing, and recapitalization needs. A long term analysis of fuel and beryllium components will also be completed to support long term requirement plans. Small-dollar-value projects, equipment, and critical component purchases will also be funded as they are identified in the long term operating plan.

	FY 2004	FY 2005	FY 2006
▪ **IT Investments**	**0**	**0**	**4,400**

The IT Investments includes activities such as:

Network Infrastructure Improvements: Provide the connectivity at INL required to facilitate engineering and research under the NE and national security mission areas. The INL network infrastructure supporting mission research and engineering is of minimal capacity. The 1 Gigabyte switches currently in place to control traffic between the engineering research buildings at the laboratory are insufficient for High Performance Computing (HPC). Implementation of a new HPC computing capability will further impact network capacities. Additionally, connectivity to off-site should be improved to facilitate collaborative research and file transfer between other DOE complex labs involved in the mission research. ($1.6M)

Engineering Workstation Replacements: Provide replacement of engineering workstations infrastructure in the R&D lead mission areas with state-of-the-art equipment, and provide follow-on budget in subsequent fiscal years, to support a shortened lifecycle (3 Year) infrastructure replacement program. The Engineering and Research workstations investment at the lab has had machine life-cycle timetables extended to well beyond the 5 year time frame over the last decade. Currently 2/3 of the engineering workstation assets are 5 years or older - with approximately 20% being in excess of 10 years old. ($1.3M)

High Performance Computing: Conduct a detailed computational infrastructure assessment and High Performance Computing strategy for the new INL. ($1.5M)

	FY 2004	FY 2005	FY 2006
▪ **General Plant Projects**	**10,637**	**9,033**	**8,907**

The GPP budget line includes projects such as:

- The Minimum Safe/Caretaker Upgrades Project - Most of the site infrastructure is 30 to 50 years old. Historically, between budget submission and the budget execution year, urgent infrastructure maintenance needs emerge that were not planned on. These problems typically pose a risk to the employees, the public or the environment or impact the ability of the site to meet its mission objectives. This annual project sets aside funds to address these unanticipated urgent infrastructure-related environment, safety, and health problems.

	(dollars in thousands)		
	FY 2004	FY 2005	FY 2006

- ATR Emergency Injection System Upgrade – ATR emergency core cooling water is currently supplied by the Test Reactor Area (TRA) site-wide firewater system. To meet new safety standards for the firewater emergency core cooling, the proposed modification and upgrade to the Emergency Core Cooling System (ECCS) will create a dedicated firewater system for ATR that is independent of the existing TRA firewater supply system. FY 2006 funding will be used to complete design and fabrication of the ATR Emergency Injection System Upgrade to meet new safety standards.

- Diesel Generator Feed to Deep Well Pump #4 – The deep well pumps supply site water, including firewater. Firewater is used for emergency cooling. All deep well pumps are supplied from commercial power. The design basis reconstitution project has identified lack of a diesel backup power supply as a vulnerability that results in increased risk assumed by DOE in the approved Safety Analysis Report for ATR.

	FY 2004	FY 2005	FY 2006
▪ **Capital Equipment**	**5,395**	**2,853**	**9,018**

Purchase equipment in accordance with the "INL Ten Year Site Plan". Much of the equipment currently in use at the INL is 30 to 50 years and failing. In many cases, replacement parts are unavailable from vendor stock and must be custom manufactured. This funding primarily provides upgrades and replacements for aged, deteriorated equipment and procurement of new equipment to meet emerging requirements. This includes such things as: shop and miscellaneous maintenance equipment, vehicles and heavy equipment, additional oscilloscopes, bandwidth capacity network upgrades and instrumentation/hardware.

Funding also provides for beginning replacement of ATR's five primary heat exchangers. Existing heat exchangers are more than 40 years old and are approaching the end of their useful life. The carbon steel shells of the heat exchangers exhibit pit corrosion so far resulting in one leak requiring shut down of the reactor for repair. General corrosion has reduced wall thickness of the heat exchangers to the extent that replacement is now required. Failure of one or more of the five heat exchangers would severely impact the ability of the ATR to accomplish its mission.

	FY 2004	FY 2005	FY 2006
▪ **Gas Test Loop Upgrade at the Advanced Test Reactor**	**4,769**	**0**	**0**

This upgrade will provide for the design, fabrication, assembly, start-up testing, and installation of a gas test loop assembly in the Advanced Test Reactor. Using FY 2004 funds, final preparation of pre-conceptual documentation for Critical Decision 0, "Approval of Mission Need" was completed on June 30, 2004. Project Engineering and Design (PED) funds are being requested through a PED datasheet (06-E-200) in FY 2006 to start preliminary design for the project. See the item, "06-E-200, Nuclear Energy Project Engineering and Design" under *INL Construction,* below.

	FY 2004	FY 2005	FY 2006
	(dollars in thousands)		
INL Construction	**2,295**	**1,511**	**10,955**
▪ **95-E-201, TRA Fire & Life Safety Improvements**	**490**	**0**	**0**

The highest priority remaining work scope will be completed in FY 2004 and the project closed out in FY 2005 using prior year funds.

▪ **99-E-201, TRA Electrical Utility Upgrade**	**1,805**	**1,511**	**0**

Complete the TRA Electrical Utility Upgrade Line Item Capital Project, which replaces most of the obsolete TRA high voltage electrical distribution system that had become inadequate for current tenant needs and unreliable due to age and dwindling availability of spare parts.

▪ **06-E-200, Nuclear Energy Project Engineering and Design**	**0**	**0**	**7,870**

- PED funding for the Gas Test Loop in the Advanced Test Reactor project will provide for the design and construction of a gas test loop to support the irradiation testing requirements of the Generation IV and Advanced Fuel Cycle Initiative Programs. Funding in FY 2006 provides for acceleration of the Architect-Engineering services for preliminary engineering design; final design and project management on this project. ($4.7M)
- PED funding for the Remote Treatment Project provides infrastructure necessary to carry out the near-term waste management needs stemming from the nuclear research legacy at the Idaho National Laboratory. This project would be designed to characterize, segregate, treat, repackage, and ship remote-handled wastes. Funding in FY 2006 will be used to proceed with Title I design. ($3.1M)

▪ **06-E-201, Gas Test Loop in the Advanced Test Reactor (ATR)**	**0**	**0**	**3,085**

This project will provide for a unique Gas Test Loop in the ATR to support the irradiation testing requirements of the Generation IV Reactor and Advanced Fuel Cycle Initiative Programs. This new facility in ATR will be a significant contributor to the accomplishment of the Department's new strategic nuclear energy mission for the Idaho National Laboratory. Funds were provided in FY 2004 for final preparation of pre-conceptual documentation for Critical Decision 0, "Approval of Mission Need" which was completed on June 30, 2004. Funding in FY 2006 will be used for initiation of construction activities including procurement of long lead items.

Total, Idaho Facilities Management	**75,415**	**112,153**	**97,862**

Explanation of Funding Changes

	FY 2006 vs. FY 2005 ($000)
INL Operations	
▪ **Laboratory Transition and Restructuring**	
The decrease of $43,453,000 reflects one-time costs in FY 2005 associated with restructuring the Idaho laboratory complex and supporting site infrastructure services.	-43,453
▪ **Infrastructure Operations**	
In working towards the goal of achieving and maintaining an expenditure rate of 2-4 percent of Replacement Plant Value, a level recommended by the National Academy of Sciences, for the facilities at INL, an increase of $9,279,000 is required to baseline routine maintenance and repair in FY 2006. This funding increase will also support an independent review team's recommendation to increase maintenance and recapitalization systems at the ATR, by the development of a long range operating plan for the ATR and by addressing small projects, equipment, and critical component purchases as they are identified in the plan. These increases are consistent with the prioritized list projects established in the Ten Year Site Plan that preferentially targets deferred maintenance reduction, particularly for mission-essential facilities and infrastructure.	+9,279
▪ **IT Investments**	
Consistent with the new mission of the INL to become the center for the Department's strategic nuclear energy research and development efforts, an increase of $4,400,000 reflects Network Infrastructure Improvements; Engineering Workstation Replacements; and High Performance Computing to support the national security and energy research programs	+4,400
▪ **General Plant Projects**	
Consistent with the prioritized list of recapitalization projects identified in the Ten Year Site Plan to achieve and maintain an expenditure rate of 2-4 percent of Replacement Plant Value, a decrease of $126,000 is required for facility upgrades	-126
▪ **Capital Equipment**	
Consistent with the prioritized list of recapitalization projects identified in the Ten Year Site Plan to achieve and maintain an expenditure rate of 2 to 4 percent of Replacement Plant Value, an increase of $6,165,000 is due to installation of a diesel generator backup power source for deep well pump #1	+6,165
Total, INL Operations	**-23,735**

	FY 2006 vs. FY 2005 ($000)

INL Construction

- **99-E-200, TRA Electrical Utility Upgrade**

  The decrease of $1,511,000 reflects completion of the project in FY 2005 in accordance with the project plan .... -1,511

- **06-E-200, Nuclear Energy Project Engineering and Design**

  Consistent with the regulatory requirements and the advanced experimental capabilities associated with the new nuclear energy missions at INL identified in the Ten Year Site Plan, the increase of $7,870,000 supports Architect-Engineering services for preliminary and final engineering design and project management for the Remote Treatment Project and the Gas Test Loop in the ATR .... +7,870

- **06-E-201, Gas Test Loop in the Advanced Test Reactor**

  The increase of $3,085,000 will be used for initiation of construction activities including procurement of long lead items... .... +3,085

Total, INL Construction .... **+9,444**

Total Funding Change, Idaho Facilities Management .... **-14,291**

Capital Operating Expenses

(dollars in thousands)

	FY 2004	FY 2005	FY 2006	$ Change	% Change
Capital Equipment	5,395	2,853	9,018	+6,165	+216.1%
General Plant Projects/ANL-W General Site Upgrades	10,637	9,033	8,907	-126	-1.4%
Total, Capital Operating Expenses	16,032	11,886	17,925	+6,039	+50.8%

Construction Projects

(dollars in thousands)

	Total Estimated Cost (TEC)	Prior-Year Appropriation	FY 2004	FY 2005	FY 2006	Unappropriated Balance
06-E-201, Gas Test Loop in the Advanced Test Reactor, Idaho	22,400	0	0	0	3,085	19,315
06-E-200, Nuclear Energy Project Engineering and Design. Idaho	32,070	0	0	0	7,870	24,200
95-E-201, TRA Fire & Life Safety Improvements Project, Idaho	14,768	14,278	490	0	0	0
99-E-200, TRA Electrical Utility Upgrade, Idaho	7,720	4,404	1,805	1,511	0	0
Total, Construction			2,295	1,511	10,955	

06-E-200, Nuclear Energy, Project Engineering and Design (PED), Idaho National Laboratory (INL), Idaho

Significant Changes

None

1. Construction Schedule

	Fiscal Quarter				Total Estimated Cost (Design Only) ($000)
	A-E Work Initiated	A-E Work Completed	Physical Construction Start	Physical Construction Complete	
FY 2006 Budget Request (*Preliminary and Final Design Only*)...	1Q 2006	3Q 2007	N/A	N/A	32,070

2. Financial Schedule

(dollars in thousands)

Fiscal Year	Appropriations	Obligations	Costs
2006	7,870	7,870	7,870
2007	16,900	16,900	15,900
2008	7,100	7,100	7,600
2009	200	200	700

3. Project Description, Justification and Scope

This construction project data sheet summarizes the Nuclear Energy requirements for architect-engineering services for Preliminary and Final Design for one subproject, Gas Test Loop 06-02. This data sheet also outlines one subproject which will be proceeding from conceptual design into Title I and Title II design, Remote Treatment Project 06-02. The design effort will be sufficient to assure project feasibility, define the scope, provide detailed estimates of construction costs based on the approved design and working drawings and specifications, and provide construction schedules including procurements.

Conceptual design studies are prepared for each project using operations and maintenance funds prior to receiving design funding under a PED line item. These conceptual design studies define the scope of the project and produce a rough cost estimate and schedule.

The use of project engineering and design funds will: 1) enable a project to proceed immediately upon completion of the conceptual design into Title I and Title II designs because only the design funds are requested; 2) provide a range for the construction cost and schedule; 3) permit acceleration of new facility projects, providing savings in construction costs based on current rates of inflation; and 4) permit more mature cost, schedule, and technical baselines for projects when the construction funds are requested from the Congress.

Following completion of preliminary design activities, Nuclear Energy personnel will determine preliminary project baselines and provide detailed funding and schedule estimates for physical construction and procurements. At completion of the preliminary design, the Department's Office of Engineering and Construction Management will provide external independent reviews of the project requirements, scope, schedule, cost and budget. Based upon the results of this assessment, and a review of the continuing programmatic requirement for the project, the acquisition executive will either approve the project baseline and authorize proceeding, defer the project or cancel the project.

The project baseline will be the basis for the request to Congress for authorization and appropriations for physical construction and procurement. The request will identify the project baseline and provide the acquisition executive approval to proceed with final design. For certain projects, in order to meet project schedules, construction and/or procurement activities may be required in the same year as the final design, Project Baseline, and Acquisition Executive approval is completed. For those projects, a report will be provided by, the Office of Engineering and Construction Management, to Congress with the results of preliminary design, project baseline, external independent reviews, and acquisition executive approval. Long-lead project and/or construction start will not proceed until 30 days after the report has been submitted to Congress. Each project that proceeds to physical construction will be separated into an individual construction line item, the total estimated cost of which will identify the costs of the engineering and design activities funded through the project engineering and design account.

4. Details of Cost Estimate

(dollars in thousands)

	Current Estimate	Previous Estimate
Design Phase		
Preliminary Design Costs	12,763	0
Final Design Costs	14,281	0
Preliminary Design Management Costs	693	0
Final Design Management Costs	736	0
Project Management (Preliminary Design) Costs	1,030	0
Project Management (Final Design) Costs	1,331	0
Total Design Costs	30,834	0
Design Contingency (Title I & Title II)	1,236	0
Total Design Costs	32,070	0

5. Method of Performance

Please refer to the individual subprojects for contract strategies.

6. Schedule of Project Funding

(dollars in thousands)

	Prior Years	FY 2004	FY 2005	FY 2006	Out years	Total
Facility Design Cost						
Preliminary Design	0	0	0	4,400	8,700	13,100
Final Design	0	0	0	1,594	13,100	14,694
Project & Design Management...	0	0	0	1,876	2,400	4,276
Total PED	0	0	0	7,870	24,200	32,070
Other Project Costs						
Conceptual Design Cost	610	707	8,214	0	0	9,531
NEPA Documentation Costs	50	50	0	0	0	100
Other Project-Related Costs	860	338	0	2,000	0	3,198
Total Other Project Costs	1,520	1,095	8,214	2,000	0	12,829
Total PED and Other Project Costs	1,520	1,095	8,214	9,870	24,200	44,899

FY 2006 Proposed Design Subprojects

Subproject 06-01, Gas Test Loop in the Advanced Test Reactor, Idaho National Laboratory, Idaho

Fiscal Quarter				Total Estimated Cost Design Only) ($000)	Full Total Estimated Cost Projection ($000)
A-E Work Initiated	A-E Work Completed	Physical Construction Start	Physical Construction Complete		
1Q 2006	4Q 2006	1Q 2007	2Q 2008	4,770	22,400

Fiscal Year	Appropriations	Obligations	Costs
2006	4,770	4,770	4,770

The Gas Test Loop in the Advanced Test Reactor (ATR) will provide for the design and construction of a gas test loop to support the irradiation testing requirements of the Generation IV Nuclear Energy Systems Initiative (Gen IV) and Advanced Fuel Cycle Initiative (AFCI) programs. This project is managed under the Idaho National Laboratory (INL) Nuclear Energy program.

The Department of Energy has initiated programs to help revitalize nuclear power generation growth in the United States, in support of the *National Energy Policy* (NEP). Two important programs to help implement the NEP are the Gen IV and AFCI. The programmatic goals are designed to stimulate research and development related to advanced reactor concepts and fuel cycles over the next 30 years.

Part of the Gen IV and AFCI programs focus is directed toward technologies that can reduce the commercial spent fuel burden on both the repository and the environment. In particular, one primary goal is the reduction and elimination of long-lived transuranic elements contained in commercial spent nuclear fuel. The neutron spectrum characteristic of fast reactors provides the most efficient way to transmute these highly toxic materials.

Transmutation and fission of these long-lived transuranic actinides into shorter-lived fission products has revived interest in fast spectrum irradiation testing of new transmuter fuels and materials. In order to assess the fuel performance of these candidate reactor fuels, such as the minor actinide fuel concentrates, these fuels must be irradiated under actual or prototypical fast reactor flux intensities and energy spectral characteristics. Unfortunately, there are no fast reactors or fast flux test facilities in the United States. These tests cannot be performed without the construction of a Gas Test Loop in the ATR.

Compliance with Project Management Order

- Critical Decision – 0: Mission Need completed June 30, 2004
- Critical Decision – 1: Conceptual Design/Preliminary Baseline September 2005
- Critical Decision – 2: Planned for March 2006
- Critical Decision – 3: Planned for September 2006
- External Independent Review: Planned for 3rd quarter 2005

4. Details of Cost Estimate

(dollars in thousands)

	Current Estimate	Previous Estimate
Design Phase		
Preliminary Design Costs (Design Drawings and Specifications)(4.3% of TEC)	963	0
Final Design Costs (Design Drawings and Specifications)(5.3% of TEC)	1,181	0
Preliminary Design Management[a] Costs (0.9% of TEC)	193	0
Final Design Management Costs (1.1% of TEC)	236	0
Project Management[b] (Preliminary Design) Costs (1.9% of TEC)	430	0
Project Management (Final Design) Costs (2.4% of TEC)	531	0
Total Design Costs (15.8% of TEC)	3,534	0
Design Contingency (Title I & Title II) (5.5% of TEC)	1,236	0
Total Design Costs (21.3% of TEC)	4,770	0

[a] Design Management consists of oversight and control of design activities, not the actual design costs.
[b] Project management includes activities for the project manager, design reviews, project document control, project manager supervision, cost estimating and conduct of operations.

5. Method of Performance

Design engineering will be performed utilizing INL engineering resources where feasible. If required, additional services will be obtained through competitive bid, cost-reimbursable subcontracts.

6. Schedule of Project Funding[a]

(dollars in thousands)

	FY 2004	FY 2005	FY 2006	Outyears	Total
Facility Design Cost					
Preliminary Design	0	0	1,300	0	1,300
Final Design	0	0	1,594	0	1,594
Project & Design Management...	0	0	1,876	0	1,876
Total PED	0	0	4,770	0	4,770
Other Project Costs					
Conceptual Design Cost	207	6,214	0	0	6,421
NEPA Documentation Costs	0	0	0	0	0
Other Project-Related Costs	338	0	2,000	0	2,338
Total Other Project Costs	545	6,214	2,000	0	8,759
Total PED and Other Project Costs	545	6,214	6,770	0	13,529

Subproject 06-02, Remote Treatment Project, Idaho National Laboratory, Idaho

Preliminary Design Fiscal Quarter				Total Estimated Cost (Prelim. Design Only) ($000)	Full Total Estimated Cost Projection ($000)
A-E and Support Work Initiated	A-E and Support Work Completed	Physical Construction Start	Physical Construction Complete		
1Q 2006	2Q 2007	1Q 2008	2Q 2010	12,900	92,700

Fiscal Year	Appropriations	Obligations	Costs
2006	3,100	3,100	3,100
2007	9,800	9,800	9,800

[a] This schedule reflects planned cash flow, not funding (appropriations), costs and other project costs supporting the Title I and Title II and FY 2005 Congressional earmark operating funds of up to $2,000,000 appropriated to Naval Reactors.

Final Design Fiscal Quarter				Total Estimated Cost (Final Design Only) ($000)	Full Total Estimated Cost Projection Range ($000)
A-E and Support Work Initiated	A-E and Support Work Completed	Physical Construction Start	Physical Construction Complete		
4Q 2006	3Q 2007	1Q 2008	2Q 2010	14,400	92,700

Fiscal Year	Appropriations	Obligations	Costs
2007	7,100	7,100	6,100
2008	7,100	7,100	7,600
2009	200	200	700

The Remote Treatment Project (RTP) is required to provide the infrastructure necessary to address waste management legacies arising from past nuclear research activities at the Idaho Site, as agreed between the Department and the State of Idaho. Meeting the Departments legacy waste management commitments and priorities requires the use of a facility in which the remote handling and treatment of highly radioactive materials may be conducted.

The current RTP facility is currently conceived as an annex to the Hot Fuel Examination Facility, consisting of a 28,000 ft^2, four-level facility built around a 56 ft long by 22 ft wide x 31 ft high air atmosphere hot cell. The hot cell would employ fourteen radiation-shielded work station windows with a set of sealed remote manipulators at each window, two floor penetrations and a roof hatch. To provide adequate safety from expected radiation levels, walls, roof, and sections of the air cell floor would be constructed of four foot thick high density concrete. The air cell would be designed to accommodate remote installation and repair of all process equipment. The RTP would also provide for design, fabrication, and installation of all required hot cell waste processing equipment as well as completion of all necessary activities to bring the facility to operational status.

Because the RTP facility is an annex to existing hot cell facilities at the INL, it would minimize capital expenditures by sharing existing infrastructure and capability. It would also integrate existing support capabilities, such as analytic chemistry laboratories, into its operation.

Over the years various DOE-sponsored programs undertaken at INL have produced radioactive wastes and other materials that are classified as remote-handled. These materials include Spent Nuclear Fuel (SNF), transuranic (TRU) waste, waste requiring geological disposal, mixed waste, and radioactively-contaminated reactor components. They were packaged and are presently stored at the Radioactive Scrap and Waste Facility (RSWF) at INL (349 cubic meters). There are other program remote handled (RH) legacy wastes (482 cubic meters) that may need processing in the RTP at the INL's Radioactive Waste Management Complex (RWMC), these waste streams also fall under the 2018 Site Treatment Plan and Settlement Agreement milestones. Portions of, or that entire waste stream could be processed through the RTP under a work-for-others agreement wherein the appropriate capital and operating costs would be charged for any services provided. The current design and scope of the RTP are for the worst-case RH waste (highest radioactivity) currently stored at the RSWF. No RTP design changes would be required to deal with any other program RH waste mentioned if it were decided and agreed by the program parties to include those wastes in the current RTP characterization, treatment and repackaging campaign.

The RTP would be designed to characterize, segregate, treat, repackage, and ship these RH wastes, as required by the RSWF RCRA permit, the INL Site Treatment Plan Consent Order, and the 1995 DOE/State of Idaho Settlement Agreement on TRU waste and spent fuel management. Characterization and treatment of mixed waste is required to ensure compliance with the Resource Conservation and Recovery Act (RCRA) storage permits, the Federal Facility Compliance Act and the RCRA Land Disposal Restriction (LDR) requirements. Characterization, treatment and repackaging are also required for licensed transportation of this waste. Following appropriate characterization, processing, and treatment, the wastes would be shipped out of Idaho to a designated DOE permanent disposal site.

<u>Compliance with Project Management Order</u>

- Critical Decision – 0: Completed December 2000
- Critical Decision – 1: Conceptual Design/Preliminary Baseline - Completed December 2004
- Critical Decision – 2: Planned for June 2006
- Critical Decision – 3: Planned for July 2007
- External Independent Review: Planned for March 2006

4. Details of Cost Estimate

(dollars in thousands)

	Current Estimate	Previous Estimate
Design Phase		
Preliminary Design Costs (Design Drawings and Specifications)	11,800	0
Final Design Costs (Design Drawings and Specifications)	13,100	0
Preliminary Design Management Costs (0.6% of TEC)	500	0
Final Design Management Costs (0.6% of TEC)	500	0
Project Management (Preliminary Design) Costs (0.7% of TEC)	600	0
Project Management (Final Design) Costs (0.9% of TEC)	800	0
Total Design Costs	27,300	0

(These Costs are based on compound escalation of 20.6% and 85% confidence level contingency of 23.9%) Escalation was compounded, commencing in FY2002 (when the original cost estimate was performed) from "Escalation Rate Assumptions, January 2004", obtained from the OECM web site.) The compounded escalation was applied over the duration of the design activity.

5. Method of Performance

Facility engineering and design will be performed under a negotiated A-E contract with guidance, review and monitoring by INL personnel. Process equipment engineering and design will be performed by INL personnel. All permit and safety assessment activities will be performed by INL personnel. Project management will be performed by INL personnel.

6. Schedule of Project Funding

(dollars in thousands)

	Prior Years	FY 2004	FY 2005	FY 2006	Out years	Total
Facility Design Cost						
Preliminary Design	0	0	0	3,100	8,700	11,800
Final Design	0	0	0	0	13,100	13,100
Project & Design Management...	0	0	0	0	2,400	2,400
Total PED	0	0	0	3,100	24,200	27,300
Other Project Costs						
Conceptual Design Cost	610	500	2,000	0	0	3,110
NEPA Documentation Costs	50	50	0	0	0	100
Other Project-Related Costs	860	0	0	0	0	860
Total Other Project Costs	1,520	550	2,000	0	0	4,070
Total PED and Other Project Costs	1,520	550	2,000	3,100	24,200	31,370

06-E-201, Gas Test Loop in the Advanced Test Reactor, Idaho National Laboratory (INL), Idaho

Significant Changes:

None.

1. Construction Schedule History

	Fiscal Quarter				Total Estimated Cost ($000)	Total Project Cost ($000)
	A-E Work Initiated	A-E Work Completed	Physical Construction Start	Physical Construction Complete		
FY 2006 Budget Request (PED/ Preliminary and Final Design Estimate…	1Q 2006	4Q2006	1Q 2007	2Q 2008	4,770	35,000
FY 2006 Budget Request (PDS, Pre-Conceptual Estimate)…	1Q 2006	4Q2006	1Q 2007	2Q 2008	22,400	35,000

2. Financial Schedule

(dollars in thousands)

Fiscal Year	Appropriations	Obligations	Costs
2006 (06-E-200)	4,770	4,770	4,770
2006	3,085	3,085	500
2007	10,765	10,765	11,600
2008	3,780	3,780	5,530

3. Project Description, Justification and Scope

Project Description

The Gas Test Loop Project will provide for the design, fabrication, assembly, start-up testing, and installation of a gas test loop assembly in the Advanced Test Reactor. The assembly will be installed in an existing flux trap and provide the capabilities to irradiate a wide variety of fuel and structural materials. These activities will be directed by the needs of the Advanced Fuel Cycle Initiative (AFCI) and Generation IV Nuclear Energy Systems (Gen IV) programs. Other nuclear fuels and materials testing programs (e.g., the Naval Reactors program) have expressed an interest in such a facility. Design and construction phases of the project will rely on the combined expertise of research and development and operations personnel at the INL.

Justification

Proper research and development of advanced nuclear fuels and materials requires an adequate irradiation facility to test candidate samples, uncover the underlying physical processes, and explore operational limits. In the world today, there exists no high flux gas environment testing facility capable of meeting the needs of the Department of Energy's proposed advanced fuel and reactor programs. Foreign testing capabilities lack required technical capabilities, require significant costly modifications, or are not projected to have availability and flexibility to support DOE's programs. A modification to an existing DOE test facility will best meet the needs of the programs. The Advanced Test Reactor (ATR) at the INL appears to be the best candidate to provide the required testing capability.

The system must meet certain requirements for test volume, instrumentation, radiation spectrum, and physical conditions characteristic of the anticipated operating environment. For the fuels and materials being explored as part of the AFCI and Gen IV initiatives, specific requirements include a fast neutron spectrum and the ability to achieve a wide range of temperatures under tightly controlled conditions. Certain materials testing reactors can provide proof-of-principle experimental capability as a step toward proof-of-performance testing with a prototypic spectrum. Studies have shown that fast-spectrum transmutation is most effective to meet the transmutation objectives for reducing minor-actinide inventories. A fast spectrum is also required to achieve desired damage rates in fuels without overheating the samples. The high fast flux levels of a fast spectrum irradiation system are also necessary to perform structural materials testing in a short enough period to meet program milestones.

Scope

A new Gas Test Loop (GTL) installed in a flux trap in the INL's Advanced Test Reactor (ATR) would provide a tightly controlled gaseous environment with the spectral characteristics and damage rates typical of a fast reactor. Features of the GTL include: gas-cooled test regions with user-specified temperature, pressure, and gas composition; enhanced neutron flux for simulating a fast reactor spectrum and accelerated neutron damage rates; sufficient volume to test a wide range of geometries; and sophisticated instrumentation for precise control of test conditions and on-line test monitoring.

Project scope includes the design, fabrication, and assembly of the GTL apparatus, and installation into ATR during an outage. Also included are Safety Analysis Report modifications, operating procedures, system testing, nuclear fuel procurement (if required), and project management and oversight.

FY 2006 funds will be used for initiation of construction activities including procurement of long lead items.

4. Details of Cost Estimate

	(dollars in thousands)	
	Current Estimate	Previous Estimate
Design Phase[a]		
Preliminary and Final Design Costs (Design Drawings and Specifications) (9.6% of TEC)..........	2,144	0
Design Management Costs (1.9% of TEC)........	429	0
Project Management Costs (4.3% of TEC)….	961	0
Total, Engineering Design Inspection and Administration of Construction Costs (15.8% of TEC)………..	3,534	0
Construction Phase		
Building Modifications & Equipment………..	12,230	0
Construction Management (0% of TEC)……….	N/A	N/A
Project Management (5.1% of TEC)……….	1,140	0
Total Construction Costs……….	13,370	0
Contingencies		
Design Phase (5.5% of TEC)………..	1,236	0
Construction Phase (19.0% of TEC)………..	4,260	0
Total, Contingencies (24.5% of TEC)……….	5,496	0
Total, Line Item Cost (TEC) ……….	22,400	0

5. Method of Performance

Based on the unique aspects of ATR and oversight requirements for all activities at ATR, the operating contractor will need to be integrated into the project performance. Subcontracting will be utilized wherever feasible. The initial strategy is proposed as follows:

Design and inspection are performed via a joint effort by the operating contractor and outside negotiated subcontracts; if feasible, execution and procurement will be accomplished by fixed-price contracts and subcontracts awarded on the basis of competitive bidding, with the operating contractor completing the installation in ATR during required reactor outages.

[a] The design funds have been requested in a separate PED budget request (06-E-200).

6. Schedule of Project Funding

(dollars in thousands)

	FY 2004	FY 2005	FY 2006	Outyears	Total
Project Cost					
Facility Cost					
Design	0	0	4,770	0	4,770
Construction	0	0	500	17,130	17,630
Total, Line Item TEC	0	0	5,270	17,130	22,400
Other Project Costs					
Conceptual design costs	207	6,214**	0	0	6,421
NEPA Documentation Costs	0	0	0	0	0
Other project-related costs	338	0	2,000	3,841	6,179
Total, Other Project costs	545	6,214	2,000	3,841	12,600
Total, Project Costs	545	6,214	7,270	20,971	35,000

** Note: This includes a Congressional earmark of up to $2,000,000 of operating funds appropriated to the Naval Reactors Program.

7. Related Annual Funding Requirements

(FY 2006 dollars in thousands)

	Current Estimate	Previous Estimate
Average Annual Facility Operating Costs (includes escalation & contingency)	9,000	N/A
Total Related Annual Funding	9,000	N/A
Total Operating Costs (operating from FY 2009 through FY 2028)	180,000	N/A

Program Direction

Funding Profile by Category

(dollars in thousands/whole FTEs)

	FY 2004	FY 2005	FY 2006	$ Change	% Change
Program Direction					
Salaries and Benefits	45,088	45,826	46,673	+847	+1.8%
Travel	2,011	2,167	2,167	+0	+0.0%
Support Services	3,953	2,700	2,700	+0	+0.0%
Other Related Expenses	8,946	9,342	9,569	+227	+2.4%
Total Program Direction, Energy Supply and Other Defense Activities	59,998	60,035	61,109	+1,074	+1.8%
Headquarters FTEs	142	146	151	+5	+3.4%
Field FTEs	224	217	211	-6	-2.8%

Funding Profile by Category - Energy Supply

(dollars in thousands/whole FTEs)

	FY 2004	FY 2005	FY 2006	$ Change	% Change
Program Direction – Energy Supply					
Salaries and Benefits	20,347	21,457	22,881	+1,424	+6.6%
Travel	1,036	1,167	1,192	+25	+2.1%
Support Services	3,106	1,830	1,853	+23	+1.3%
Other Related Expenses	1,530	2,062	4,080	+2,018	+97.9%
Total Program Direction – Energy Supply	26,019	26,516	30,006	+3,490	+13.2%
Headquarters FTEs	142	146	151	+5	+3.4%
Field FTEs	23	14	14	+0	+0.0%

Funding Profile by Category - Other Defense Activities

(dollars in thousands/whole FTEs)

	FY 2004	FY 2005	FY 2006	$ Change	% Change
Program Direction – Other Defense Activities					
Salaries and Benefits	24,741	24,369	23,792	-577	-2.4%
Travel	975	1,000	975	-25	-2.5%
Support Services	847	870	847	-23	-2.6%
Other Related Expenses	7,416	7,280	5,489	-1,791	-24.6%
Total Program Direction – Other Defense Activities	33,979	33,519	31,103	-2,416	-7.2%
Headquarters FTEs	0	0	0	+0	+0.0%
Field FTEs	201	203	197	-6	-3.0%

Program Direction
Funding Profile by Category

(dollars in thousands/whole FTEs)

	FY 2004	FY 2005	FY 2006	$ Change	% Change
Idaho Operations Office					
Salaries and Benefits	25,920	24,369	23,792	-577	-2.4%
Travel	1,061	1,000	975	-25	-2.5%
Support Services	925	870	847	-23	-2.6%
Other Related Expenses	5,469	5,996	5,489	-507	-8.5%
Total, Idaho Operations Office	33,375[a]	32,235	31,103	-1,132	-3.5%
Full Time Equivalents	210	203	197	-6	-3.0%
Oak Ridge Operations Office					
Salaries and Benefits	1,661	1,729	1,800	+71	+4.1%
Travel	49	50	51	+1	+2.0%
Support Services	73	58	53	-5	-8.6%
Other Related Expenses	113	120	128	+8	+6.7%
Total, Oak Ridge Operations Office	1,896	1,957	2,032	+75	+3.8%
Full Time Equivalents	14	14	14	+0	+0.0%
Headquarters					
Salaries and Benefits	17,507	19,728	21,081	+1,353	+6.9%
Travel	901	1,117	1,141	+24	+2.2%
Support Services	2,955	1,772	1,800	+28	+1.6%
Other Related Expenses	3,364	3,226	3,952	+726	+22.5%
Total, Headquarters	24,727	25,843	27,974	+2,131	+8.2%
Full Time Equivalents	142	146	151	+5	+3.4%
Total Program Direction					
Salaries and Benefits	45,088	45,826	46,673	+847	+1.8%
Travel	2,011	2,167	2,167	+0	+0.0%
Support Services	3,953	2,700	2,700	+0	+0.0%
Other Related Expenses	8,946	9,342	9,569	+227	+2.4%
Total, Program Direction, Energy Supply and Other Defense Activities	59,998	60,035	61,109	+1,074	+1.8%
Full Time Equivalents	366	363	362	-1	+0.3%

[a] For comparability purposes, funding for 6 FTEs at the Chicago and 1 FTE at the Oakland Operations Offices have been included in the Idaho Operations Office.

Mission

Program Direction provides the Federal staffing resources and associated costs required to provide overall direction and execution of the Office of Nuclear Energy, Science and Technology (NE). NE promotes secure, competitive, and environmentally responsible nuclear technologies to serve the present and future energy needs of the country. NE carries out this mission in several ways. As the central organization with the Federal Government's core expertise in nuclear technology, NE directs the Nation's investment in nuclear science and technology by sponsoring research at the national laboratories, U.S. universities, and private industry. Through its support of innovative, higher risk science and by helping to preserve the national research and development infrastructure, NE works to advance the responsible use of nuclear technology. NE also manages the safe operation and maintenance of critical nuclear infrastructure and provides nuclear technology goods and services to industry and government.

In addition to our appropriated funds, NE also manages over $230 million dollars annually in work for others and reimbursable funding. For example, NE manages over $110 million annually from the National Aeronautics and Space Administration and the Department of Defense for the development of advanced radioisotope power systems for space exploration and national security missions. In addition, NE manages the High Flux Isotope Reactor for the Office of Science.

NE is one of the most programmatically diverse organizations in the Department of Energy (DOE) and is faced with critical human capital challenges to pursuing its mission. Extensive downsizing several years ago resulted in numerous skill imbalances and particularly affected NE's retention of technical and scientific specialists. Wherever possible, employees were redeployed from lower priority programs to higher priority programs to meet mission needs. At this point, with expanding programs, limited resources, and skill imbalances, NE faces a variety of staffing challenges as it works to meet the requirements set for it by the President and the Secretary of Energy.

NE's human capital vision is to develop, recruit, and maintain a diverse organization of highly skilled professionals with the competency and motivation to contribute to the development and implementation of national energy policies and programs and help lead the Nation in achieving its nuclear technology goals for the twenty-first century.

In May 2003, NE assumed the role of Lead Program Secretarial Officer (LPSO) of the Idaho site. NE Headquarters and the Idaho Operations Office (NE-ID) reorganized in January 2005 to more effectively support the new nuclear energy missions and prepare for the oversight and management of the new contracts for the operation of the Idaho site. This new structure will carry out all programmatic, project, and landlord responsibilities assigned to NE now and in the future, both as LPSO and Contracting Officer for DOE's operations in Idaho, and as responsible PSO for programs, projects, facilities, and operations at other DOE sites. In addition, NE is aggressively addressing the mismatch between the growth in its national responsibilities and the decline in its skilled personnel. The Office of Nuclear Energy, Science and Technology Workforce Plan was updated in December 2004 to reflect mission changes and skills imbalances. Like the rest of the Federal Government, NE is planning for workforce changes that are engendered by an aging workforce. The average age of the NE workforce is 48 years, just slightly higher than the 47.5 year average age of the Federal workforce overall. Out of the current workforce, over one-third of the workforce will be eligible to retire within five years. Over the past several years, NE has been trying to address the issue of an aging workforce through the recruitment of entry-level engineering, scientific, and administrative positions. Continuation of this effort is essential. The NE Workforce Plan indicates that, especially in the area of program and project management, and mission-critical positions (engineers and scientists), NE has a skills mix problem that must be addressed in the near term, as well as a need to increase staffing. In accordance with the NE Workforce Plan, NE plans a moderate increase in the Headquarters workforce over the next five years. The required staffing level is restrained because NE expects to continue its successful practice of aggressive matrix management and assuring the fullest possible utilization of staff resources. The proposed actions from the NE Workforce Plan plus NE's evolving mission create small, additional requirements for Program Direction funds. However, as in the past, NE's Program Direction budget is developed to cover special programs and circumstances such as A-76/competitive outsourcing; special incentive programs to retain necessary/essential skills; succession planning; train and/or retrain; and participate in special employment programs.

OMB allocated funds to ask the National Academy of Sciences to undertake a comprehensive, independent evaluation of the nuclear energy program's goals, plans, and to validate the process of establishing program priorities and oversight (including the method for determining the relative distribution of budgetary resources). The evaluation will result in a comprehensive and detailed set of policy and research recommendations and associated priorities (including performance targets and metrics) for an integrated agenda of research activities that can best advance NE's fundamental mission of securing nuclear energy as a viable, long-term commercial energy option to provide diversity in energy supply. An interim evaluation will be completed in time to inform NE's 2008 budget planning, with a final report completed before May 2006.

Detailed Justification

(dollars in thousands)

	FY 2004	FY 2005	FY 2006
Salaries and Benefits	**45,088**	**45,826**	**46,673**

NE Headquarters has retrained and redeployed staff to reduce dependence on contractors; and continuously redirected and realigned staff to accomplish program goals efficiently and effectively. However, NE's expanding role in the Department to support the *National Energy Policy* and to improve the proliferation-resistance of civilian nuclear energy systems will require additional staff. In addition, staff will be needed to assure the safe operation of the Department's various reactor facilities and provide adequate Federal oversight of essential programs. NE believes that it is essential to hire not only senior engineers and project managers for new and changing programs, but also to recruit junior staff for succession planning purposes; efforts to hire additional junior staff are continuing. NE Headquarters currently has a staff of 129. As nearly one-third of the staff will be eligible to retire within five years, it is essential that program direction resources are available to compete for needed skills. In addition to the Headquarters staff, NE also supports one employee who serves on the staff of the U.S. mission to the Organization for Economic Cooperation and Development; and field employees in two locations: the Idaho Operations Office (197), and Oak Ridge Operations Office (14). Additionally, in support of the

	(dollars in thousands)		
	FY 2004	FY 2005	FY 2006

Department's efforts to consolidate information technology activities, one NE employee was permanently reassigned to the Office of the Chief Information Officer. NE agreed to continue funding for this position/employee through FY 2005. Also, in FY 2006 NE will assume responsibility for two FTEs transferred from the Office of Defense Nuclear Nonproliferation in support of the International Nuclear Safety activities.

Travel...	**2,011**	**2,167**	**2,167**

Travel includes funding for transportation of Headquarters and operations office personnel associated with NE programs, their per diem allowances while in authorized travel status, and other expenses incidental to travel.

Support Services...	**3,953**	**2,700**	**2,700**

Support Services includes funding for technical and management support services provided to NE Headquarters and Operations Office employees. NE requires its senior technical managers to be Federal employees with significant experience necessary to accomplish program objectives. NE does not rely on support service contractors to manage NE programs in place of Federal staff. To reduce support services costs, NE has retrained and redeployed staff to reduce dependence on contractors while meeting growing needs in programs such as Generation IV Nuclear Energy Systems Initiative and Nuclear Hydrogen Initiative. In this manner, NE has minimized support service costs over the last five years.

Other Related Expenses...	**8,946**	**9,342**	**9,569**

The major expenditure in the other related expenses category is $2,232,000 million in FY 2006 and is earmarked for the Headquarters Working Capital Fund (WFC). The Department's Office of Management, Budget, and Evaluation established a WCF to provide funding for mandatory administrative costs, such as building occupancy and telephone services, copying, printing and graphics, networking, desktop support, procurement management, payroll and personnel, corporate training services, and project management career development program. The Other Related Expense category also includes support for the Nuclear Energy Research Advisory Committee and funding for the National Academy of Sciences to undertake a comprehensive, independent evaluation of NE's research programs, including their relationship to the Idaho Facilities Management program.

Also included in other expenses are costs associated with the one employee who serves on the staff of the Organization for Economic Cooperation and Development such as housing, training, office communications, supplies, miscellaneous expenses and International Cooperative Administrative Support Services (ICASS).

Total, Program Direction...	**59,998**	**60,035**	**61,109**

Explanation of Funding Changes

	FY 2006 vs. FY 2005 ($000)
Salaries and Benefits	
▪ The increase of $847,000 is the net of an additional $750,000 for new hires at Headquarters to manage expanding research and development programs, such as the Nuclear Hydrogen Initiative and Generation IV Nuclear Energy Systems Initiative to support the Department's nuclear non-proliferation objectives, while simultaneously preparing for a significant number of retirements over the coming five years; an additional $893,000 for a 2.5 percent escalation in accordance with established guidelines and funds for promotions and within-grade salary increases; and a decrease of $796,000 for a reduction of 6 field FTEs at Idaho.	+847
Other Related Expenses	
▪ The increase of $227,000 in other related expenses is primarily due to an increase of $1,000,000 in funding for the National Academy of Sciences to undertake a comprehensive, independent evaluation of NE's research programs; an increase of $121,000 for utilities, training, supplies and materials, and communications; offset by a reduction of $889,000 at Idaho for completing the purchase of telecommunications equipment in FY 2005, and reduced medical expense and mailroom services.	+227
Total Funding Change, Program Direction	**+1,074**

Support Services by Category

(dollars in thousands)

	FY 2004	FY 2005	FY 2006	$ Change	% Change
Technical Support					
System Definition	25	0	0	+0.0	+0.0%
System Review and Reliability Analyses	58	150	150	+0.0	+0.0%
Trade-off Analyses	145	138	138	+0.0	+0.0%
Economic and Environmental Analyses	230	135	135	+0.0	+0.0%
Test and Evaluation	50	50	50	+0.0	+0.0%
Surveys or Reviews of Technical Operations	300	0	0	+0.0	+0.0%
Total, Technical Support	808	473	473	+0.0	+0.0%
Management, Support					
Automated Data Processing	1,632	1,540	1,540	+0.0	+0.0%
Preparation of Program Plans	71	37	37	+0.0	+0.0%
Training and Education	425	0	0	+0.0	+0.0%
Reports and Analyses Management and General Administrative Services	1,017	650	650	+0.0	+0.0%
Total, Management Support	3,145	2,227	2,227	+0.0	+0.0%
Total, Support Services	3,953	2,700	2,700	+0.0	+0.0%

Other Related Expenses by Category

(dollars in thousands)

	FY 2004	FY 2005	FY 2006	$ Change	% Change
Other Related Expenses					
Working Capital Fund	2,068	2,237	2,232	-5	-0.2%
Advisory and Assistance Services	400	200	1,200	+1,000	+500.0%
Operations and Maintenance of Equip	4,148	4,240	3,556	-684	-16.1%
Printing and Reproduction	33	33	33	+0	+0.0%
Training	304	316	331	+15	+4.8%
Rent and Utilities	963	1,217	1,225	+8	+0.6%
Communications	541	433	528	+95	+21.9%
Supplies and Materials	400	447	450	+3	+0.7%
Other Services	89	219	14	-205	-93.6%
Total, Other Related Expenses	8,946	9,342	9,569	+227	+2.4%

Environment, Safety and Health

Environment, Safety and Health

Energy Supply
Office of Environment, Safety and Health

Overview

Appropriation Summary by Program

(dollars in thousands)

	FY 2004 Comparable Appropriation	FY 2005 Original Appropriation	FY 2005 Adjustments	FY 2005 Comparable Appropriation	FY 2006 Request
Energy Supply					
Environment, Safety & Health (non-defense)	6,867	8,000	-64 [a]	7,936	9,100
Program Direction........................	15,697	20,000	-158 [a]	19,842	20,900
Subtotal, Energy Supply.................	22,564	28,000	-222	27,778	30,000
Use of Prior Year Balances...........	0	-285	0	-285	0
Total, Energy Supply......................	22,564	27,715	-222	27,493	30,000
Other Defense Activities					
Environment, Safety & Health (defense)	120,213	109,105	-753 [a]	108,352	56,483 [b]
Program Direction........................	22,953	20,414	-163 [a]	20,251	20,546
Subtotal, Other Defense Activities.	143,166	129,519	-916	128,603	77,029
Use of Prior Year Balances...........	-500	-15,000	0	-15,000	0
Total, Other Defense Activities.....	142,666	114,519	-916	113,603	77,029
Total, Energy Supply and Other Defense Activities...........................	165,230	142,234	-1,138	141,096	107,029

[a] Reflects distribution of 0.80% rescission required by the FY 2005 Consolidated Appropriations Act.
[b] The Employee Compensation Program will be funded in FY 2006 using prior-year carryover.

Preface

The Office of Environment, Safety and Health (EH) is committed to ensuring that the safety and health of the DOE workforce and members of the public, and the protection of the environment are integrated into all Departmental activities.

Within the Energy Supply appropriation, the Office of Environment, Safety and Health has two programs: Policy, Standards and Guidance, and DOE-wide Environment, Safety and Health Programs (two subprograms) and Program Direction (three subprograms).

This overview will describe Strategic Context, Mission, Benefits and Significant Program Shifts. These items together put this appropriation in perspective.

Strategic Context

Following publication of the Administration's National Energy Policy, the Department developed a Strategic Plan that defines its mission, four strategic goals for accomplishing that mission, and seven general goals to support the strategic goals. As stated in the Departmental Strategic Plan, DOE's Strategic and General Goals will be accomplished not only through the efforts of the major program offices in the Department but with additional effort from offices which support the programs in carrying out the mission. The Office of Environment, Safety and Health performs critical functions which directly support the mission of the Department. These functions include:

- Environment – Ensure the protection of the environmental resources affected by DOE activities.

- Safety – Operate to industry standards where they are relevant and available and provide regulations for those operations that are unique to DOE; perform at a level equal to or better than private industry.

- Health – Improve DOE health protection programs through medical surveillance to identify potential health issues, health studies to understand cause, and policies and programs to protect the safety and health of workers at DOE facilities and the communities that surround them.

- Corporate Performance Assessment -- These programs are necessary DOE-wide environment, safety, and health functions. Specifically these programs are the accreditation program for worker radiation protection monitoring, DOE's Voluntary Protection Program, and the collection and maintenance of DOE and contractor personnel radiation exposure records, as required by law. Provide the necessary policy, guidance, and corporate direction.

- Nuclear/Occupational Safety and Health Enforcement – Carry out the statutory mandate of the Atomic Energy Act to enforce compliance with nuclear safety regulations as well as new occupational safety and health regulations.

Mission

The mission of EH is to provide the corporate leadership, performance goals, assistance, policies, programs and feedback to enable the Department of Energy to excel in mission performance while achieving excellence in safety and environmental stewardship.

Following publication of the Administration's National Energy Policy, the Department developed a Strategic Plan that defines its mission, four strategic goals for accomplishing that mission, and seven general goals to support the strategic goals.

As stated in the Departmental Strategic Plan, DOE's Strategic and General Goals will be accomplished not only through the efforts of the major program offices in the Department but with additional effort from offices which support the programs in carrying out the mission. Environment, Safety and Health performs critical functions which directly support the mission of the Department. These functions include providing technical support and assistance; assessing performance; ensuring quality assurance is properly applied; developing corporate policy, guidance, rules, orders and standards; and supporting an effective collaborative radiological and non radiological health studies program.

Benefits

DOE environment, safety and health performance expectations are communicated in Policies, Standards and Guidance, and DOE-wide ES&H Programs are developed to achieve the expected level of performance. A consistent and stable safety infrastructure is provided that leads to credible, reliable and defensible operations and programs.

EH leverages its resources and personnel to provide DOE's line management programs with essential environment, safety and health performance expectations: environment, safety and health performance measures and analysis; management tools to promote the safe conduct of work; and guidance for pollution prevention and the protection of the environment in and around DOE sites. Integral to the Department's success is EH's skill in fostering increased awareness and providing support to line management throughout the Department, using open communications, coordinating with other industry and governmental organizations, and performance feedback on environmental, safety, and health activities, to provide the safety infrastructure that allows for and promotes the safe and environmentally responsible conduct of work.

Energy Supply
Office of Environment, Safety & Health
Funding by Site by Program

	(dollars in thousands)				
	FY 2004	FY 2005	FY 2006	$ Change	% Change
Chicago Operations Office					
Argonne National Lab..................................	290	340	379	39	11.5%
Brookhaven Nat'l Laboratory........................	70	70	70	0	0.0%
Total, Chicago Operations Office…………..	360	410	449	39	9.5%
Idaho Operations Office.................................	250	180	250	70	38.9%
Livermore Site Office					
Lawrence Livermore Nat'l Laboratory..........	70	70	70	0	0.0%
Oak Ridge Operations Office					
Oak Ridge Associated Universities...............	20	155	195	+40	+25.8%
Oak Ridge Nat'l Laboratory..........................	1,290	983	1,264	281	28.6%
Pacific Northwest Nat'l Laboratory...............	460	125	139	14	11.2%
Total, Oak Ridge Operations Office...............	1,770	1,263	1,598	+335	+26.5%
Washington Headquarters					
Program Direction...	15,697	19,842	20,900	+1,058	+5.3%
Other Washington Headquarters..................	4,417	6,013	6,733	+720	12.0%
Total, Washington Headquarters...................	20,114	25,855	27,633	+1,778	+6.9%
Total, Energy Supply	22,564	27,778	30,000	2,222	+8.0%

Site Description

Chicago Operations Office

Chicago Operations Office, Chicago, Illinois, is responsible for overseeing the operation of contractor-operated, multi-program laboratories such as Argonne National Laboratory and Brookhaven National Laboratory.

Argonne National Laboratory

Argonne National Laboratory (ANL) is 25 miles southwest of Chicago's Loop. Argonne provides support in resolving the Nation's environmental, safety, and health problems and promotes environmental, safety and health stewardship. Argonne provides specialized technical expertise on environmental and public protection issues, including analysis of emerging environmental rulemakings; develops input for inclusion in environmental guidance materials and implementation tools; and provides specialized technical expertise for the development of DOE performance summaries on air resource protection and environmental releases. Argonne also provides technical expertise for water resource analyses, human and ecological risk assessments, and modeling capabilities for the analysis of radiological releases to the environment related to DOE operations. In addition, ANL provides technical support in the review of environmental impact statements (EIS) and other National Environmental Policy Act (NEPA)-related documents. It also provides technical expertise for pollution prevention opportunity assessments.

Brookhaven National Laboratory

Brookhaven National Laboratory (BNL) is located in Upton, New York, on Long Island. As a non-defense research institution, BNL is dedicated to basic and applied investigation in a multitude of scientific disciplines. BNL also provides specialized subject matter technical expertise in conducting reviews of safety analysis and risk assessment documents such as Safety Analysis Reports (SARs), and Basis for Interim Operations (BIO). BNL provides specialized technical expertise input to be used by the Federal staff to develop rules, orders, safety guides, and standards. These documents may include SARs, technical safety requirements, waste disposal standards, fire protection standards, lightning and wind protection standards, and facility operation.

Idaho Operations Office

Idaho Operations Office, Idaho Falls, Idaho, executes a multi-program mission, and leverages the Idaho National Laboratory's expertise with emerging technology to meet the Nation's needs. The Radiological and Environmental Sciences Laboratory, which administers the DOE Worker Dosimetry Laboratory Accreditation Program, administratively reports to the Idaho Operations Office.

Livermore Site Office

The Livermore Site Office provides liaison between the National Nuclear Security Administration services center and the site contractor.

Lawrence Livermore National Laboratory

Lawrence Livermore National Laboratory (LLNL), located in California's Tri-Valley region east of San Francisco provides software quality assurance expertise support to maintain the code registry that is important for nuclear safety analysis throughout the complex. LLNL provides specialized expertise in seismic analysis, structural response, natural phenomena hazards standards and energy security safety analysis.

Oak Ridge Operations Office

Oak Ridge Operations Office, Oak Ridge, Tennessee, is responsible for research and development, defense programs, environmental management, and environment, safety, and health activities. There are three major plant complexes on the Oak Ridge Reservation: Oak Ridge National Laboratory; Y-12 Plant; and the East Tennessee Technology Park, as well as the Oak Ridge Institute for Science and Education and the American Museum of Science and Energy. Together, these facilities represent a technological and educational resource and a major component of the East Tennessee Technology Corridor.

Oak Ridge National Laboratory

Oak Ridge National Laboratory (ORNL) is a multi-program science and technology laboratory. Scientists and engineers at the laboratory provide specialized technical expertise in environment, safety, and health activities; criticality codes and standards; and restoration and protection of the environment. ORNL provides specialized technical expertise in the operational reviews of the DOE Technical Standards Program and development of web-based platforms for environmental guidance materials and compliance tools. The laboratory provides specialized technical expertise in the development of risk-based, integrated worker safety programs through the development of input and resource information for various technical standards and guides. ORNL also supports technical reviews of the potential impacts of proposed environmental regulations on DOE operations and EH efforts to promote cultural resource protection. ORNL is also involved in project development, protocol development, and input to developmental needs to revise or update worker protection requirements. On behalf of the Office of Environment, ORNL also supports technical reviews of EISs and other NEPA-related documents.

Oak Ridge Associated Universities/Oak Ridge Institute for Science and Education (ORISE)

The Oak Ridge Institute for Science and Education (ORISE), operated by Oak Ridge Associated Universities (ORAU), is located on a 150-acre site in Oak Ridge, Tennessee. On behalf of the Department, the Radiological Exposure Monitoring System (REMS) collects and maintains radiation exposure records for DOE and contractor personnel, as required by law.

Pacific Northwest National Laboratory

Pacific Northwest National Laboratory (PNNL), Richland, Washington, develops and delivers new and effective environment, safety, and health technologies. PNNL provides specialized technical expertise on environmental and public protection issues, including analysis of emerging rulemakings and input for the development of environmental guidance materials and implementation tools. This specialized support includes input for the development of DOE performance summaries on air resource protection and implementation of Clean Air Act requirements, water resources, and human and ecological risk assessments related to DOE releases. PNNL provides specialized technical expertise in all aspects of radiological operations at DOE sites with Radiological Control Programs. This expertise involves knowledge of radiological operations, radiological practices, processes, and systems across the DOE complex. Specialized technical expertise provides input for health physics, development of implementation guides, technical standards and technical solutions for specific radiological control problems. PNNL's specialized technical expertise supports the development and implementation of the DOE Laboratory Accreditation Program, and other DOE corporate safety programs. PNNL provides technical support in the review of EISs and other National Environmental Policy Act (NEPA) and related documents. It also provides specialized support for the affirmative procurement of environmentally preferable products.

Washington Headquarters

The Office of Environment, Safety and Health (EH) Headquarters, located in the Washington, D.C. area, supports the EH mission by funding Federal staff responsible for directing, administering, and supporting the EH program in the areas of facility safety, corporate performance assessment, environment, health, and enforcement. In addition, Federal staff is responsible for management, policy, personnel, technical/administrative support activities, budget, finance, and contracts. Also, the Office of Environment requires contractor support in reviewing cost and technical issues relating to implementing the requirements of proposed and new environmental legislation and regulations at DOE operations; in the development of models and other tools to perform quantitative and trending analysis of DOE's environmental performance; and in updating standards for radiation protection and waste management. The Office of Health requires contractor support for the development of worker-based safety programs, collection of lessons learned and best practices, review of the literature and knowledge of standards setting bodies to assure a sound scientific basis for worker protection policies and programs, and program development strategies for each of the organizational elements in the Office of Health. The Office of Information Management requires contractor support to ensure that information technology is acquired and information resources are managed in a manner that implements the policies and procedures of legislation, the President's Management Agenda, the Paperwork Reduction Act and the Clinger-Cohen Act. This Office establishes, implements, and maintains a comprehensive and effective cyber/computer security, capital planning and investment control, and Federal Enterprise Architecture programs in support of the President's Management Agenda initiative to Expand Electronic Government. The Office of Environment requires contractor support in reviewing Environmental Impact Statements and other NEPA-related documents and in developing pollution prevention strategies for the reduction of waste generation and environmental releases during DOE operations.

.

Environment, Safety and Health (non-defense)

Funding Profile by Subprogram

	(dollars in thousands)				
	FY 2004 Comparable Appropriation	FY 2005 Original Appropriation	FY 2005 Adjustments	FY 2005 Comparable Appropriation	FY 2006 Request
Environment, Safety and Health (non-defense)					
Policy, Standards & Guidance.........	1,799	3,265	-26	3,239	3,827
DOE-Wide ES&H Programs...........	5,068	4,735	-38	4,697	5,273
Total, Environment Safety and Health (non-defense)........................	6,867	8,000	-64	7,936	9,100

Public Law Authorizations:
Public Law 95-91, "Department of Energy Organization Act"
Public Law 91-190, "The National Environmental Policy Act of 1969"
Public Law 103-62, "Government Performance and Results Act of 1993"
Public Law 83-703, "Atomic Energy Act of 1954"

Mission

The mission of the Office of Environment, Safety and Health (EH) is to provide the corporate infrastructure and technical resources that enable work to be performed in a safe and environmentally sound manner. EH provides corporate environment, safety and health performance expectations in the form of policy and standards, technical expertise to support line management's implementation of those expectations, and corporate programs that contribute directly to advancing work activities in support of the Department's mission.

Benefits

Within the Energy Supply appropriation, EH plays a key role in achieving the Department's mission. EH develops and maintains a stable and predictable safety infrastructure by establishing Departmental policy and expectations that help ensure safe and secure workplaces across the complex. EH identifies and addresses emerging safety vulnerabilities and partners with line management to resolve nuclear, radioactive, chemical, and industrial hazards. Many of the activities involve performing crosscutting DOE-wide environment, safety, and health functions similar to those performed by any corporate safety office. These programs are necessary DOE-wide environment, safety, and health functions. Specifically these programs are the accreditation program for worker radiation protection monitoring, DOE's Voluntary Protection Program, and the collection and maintenance of DOE and contractor personnel radiation exposure records, as required by law. Necessary policy, guidance, and corporate direction are provided.

EH also ensures compliance with the National Environmental Policy Act of 1969, which is a prerequisite to program mission implementation. EH maintains close contacts with private industry, regulatory agencies, independent standard-setting groups, and national and international environment, safety and health organizations, and facilitates information exchanges between DOE line management and their counterparts in the private sector. EH staff also provides corporate advice and consultation to DOE managers in developing improved strategies for including environment, safety and health in planning and conducting work; on implementing external regulations affecting DOE operations (e.g., providing implementation guidance on Environmental Protection Agency (EPA) regulations); and promulgating DOE policy, requirements, and implementation guidance. EH actions encourage line program efforts to prevent injuries and illnesses; establish environment, safety, and health budget priorities; participate in advocating cost-effective regulation from external sources; establish protective, cost-effective internal environment, safety, and health policies and guidance; and avoid risks attendant to the unprecedented hazards that must be managed effectively across DOE.

EH activities funded within the Energy Supply appropriation are concentrated into two programmatic areas: Policy, Standards and Guidance and DOE-Wide ES&H Programs. This alignment serves to characterize EH as a corporate resource to advance the DOE mission while promoting the establishment of effective and efficient environment, safety, and health programs. In addition, a program direction decision unit includes funding for a portion of EH Federal staff and the EH Working Capital Fund.

Policy, Standards and Guidance

Funding Schedule by Activity

(dollars in thousands)

	FY 2004 Comparable Appropriation	FY 2005 Comparable Appropriation	FY 2006 Request	$ Change	% Change
Policy, Standards and Guidance........	1,799	3,239	3,827	+588	+18.2%
Total, Policy, Standards and Guidance.	1,799	3,239	3,827	+588	+18.2%

Description

Policy, standards and guidance are issued to assure that workers and the public, property and the environment are adequately protected from the hazards of DOE activities.

Benefits

The policies and standards being applied at DOE facilities reasonably assure that personnel and property are afforded at least the same level of protection as that in the private sector. For most DOE facilities, DOE assumes direct regulatory/enforcement authority for safety and health as provided by the Atomic Energy Act of 1954, as amended. Safety policy, standards and guidance must therefore take into account the unique nuclear, chemical and industrial hazards posed by DOE operations and must be current with worldwide technologies, knowledge and experience.

Detailed Justification

	(dollars in thousands)		
	FY 2004	FY 2005	FY 2006
Policy, Standards and Guidance...............	**1,799**	**3,239**	**3,827**

EH's Nuclear and Facility Safety Policy programs establish the nuclear and facility safety requirements and expectations when working with workplace hazards and safety issues such as nuclear materials, criticality, fire, seismic, tornados, flooding, electrical, explosives, construction, maintenance, nuclear training, and conduct of operations. In FY 2006, DOE nuclear and facility safety policies and standards will be enhanced to reflect updated commercial codes and standards, changing DOE missions and work environments, and emerging safety issues that are encountered continuously when working with hazardous materials or in aging facilities.

Included in the Nuclear and Facility Safety Policy Programs are the DOE Technical Standards Program (TSP) and DOE's annual fee to the Institute of Nuclear Power Operations (INPO). INPO is a non-profit organization established by the commercial nuclear power industry to promote the highest levels of safety and reliability in the operation of nuclear power plants. For an annual membership fee, the Department maintains access to INPO methodologies, standards and information databases. Additionally, INPO provides direct technical assistance to DOE and its operating contractors. INPO's annual fee increased by $100,000 in FY 2004, with a 4% annual escalation in FY 2005 and FY 2006.

EH's Worker Safety and Health Policies promote the conduct of mission essential work in a safe manner while maintaining safety performance well above the national average. In FY 2006 greater focus will be provided in the review and approval of contactor requests for exemptions and the efficient and cost effective implementation of orders by the contractors across the DOE. DOE Order 440.1 "Worker Protection Management for DOE Federal and Contractor Employees" and its associated guides will require revision and updating to reflect emerging issues such as biosafety and nanotechnology. These funds will also be used for the conduct of activities to enhance chemical management across the DOE and hazard specific activities of particular interest to DOE, such as beryllium, hazards at the Gaseous Diffusion Plants, hazards faced by cleanup workers as well as hazards posed by new technologies (e.g., nanotechnology).

Also, 29 CFR 1960 requires a documented Federal Employee Occupational Safety and Health (FEOSH) program for Federal employees. In FY 2005, the FEOSH program focused on the conduct of facility and worker walkthroughs and inspections to identify opportunities to assure a safe work environment for Federal employees. In FY 2006 the program will focus on the correction of identified issues, further enhancements to worker and manager FEOSH training, and further refinements to the DOE Headquarters emergency preparedness and Continuity of Operations activities to assure the safety of the Federal workforce and the ability of DOE to function in the case of emergency.

(dollars in thousands)		
FY 2004	FY 2005	FY 2006

EH's Regulatory Liaison Program ensures that Department of Energy policies and standards relating to facility safety are consistent with other Federal and industry regulations. This liaison also ensures that DOE environment, safety, health, emergency management and safety management policies and standards are based on best available information. Regulatory Liaison interacts with the Occupational Safety and Health Administration (OSHA), the U.S. Nuclear Regulatory Commission (NRC), the National Aeronautics and Space Administration (NASA), and Federal Departments of Transportation, Health and Human Services, Homeland Security, the Defense Nuclear Facilities Safety Board, national and international standards and regulatory bodies, various industry groups, such as the Institute of Nuclear Power Operations and the Energy Facilities Contractors Group and other DOE offices on topics such as safety and health standards, statutes, regulatory reform, external regulation, emergency management, and privatized facilities.

EH's Environmental Protection Policy and Compliance Support programs ensure that the Department performs work in an environmentally sound and compliant manner and that the Department's policies, orders, and guides promote practices that are protective of natural and cultural resources. Through these programs, EH assists DOE elements in complying with external environmental protection requirements in a cost-effective manner. EH will continue to develop timely guidance to assure DOE-wide understanding of newly promulgated environmental requirements, and to respond to requests from DOE line management to assist in the development of cost-effective strategies for compliance with new environmental regulations. EH will continue to ensure that the unique circumstances posed by DOE operations and cleanups are accounted for in the regulatory development process of other agencies. EH will also continue to provide DOE's line managers and the public with information on the Department's compliance with environmental standards and progress towards meeting performance goals for radiation protection and pollution prevention. In FY 2005, EH completed guidance material and tools to assist sites in developing Environmental Management Systems throughout DOE, prepared a DOE-wide implementation plan pursuant to the President's Management Council's Environmental Compliance Management Improvement initiative, reviewed several DOE low-level waste disposal site performance assessments, improved property management and contamination control practices, supported development of international waste management and radiation protection guidelines for environmental protection, and completed guidelines to support response and recovery actions following a radiological or nuclear incident. In FY 2006, activities will include support to line management in completing implementation of Environmental Management Systems at DOE sites, updating of DOE public and environmental radiation protection requirements, continued support for the development of national and international consensus standards for radiation protection and waste management, assistance to line management in the effective implementation of authorized limits for control of property, and authorization reviews for waste disposal.

	FY 2004	FY 2005	FY 2006
Total, Policy, Standards and Guidance..............	**1,799**	**3,239**	**3,827**

Explanation of Funding Changes

	FY 2006 vs. FY 2005 ($000)
Policy, Standards and Guidance	
■ For Facility Safety activities, increase in annual fee for the Institute for Nuclear Power Operations. Also, DOE nuclear and facility safety policies and standards will be enhanced to reflect updated commercial codes and standards……	+218
■ For Health related activities, funding for projects in FY 2005 included the use of $200,000 carryover from FY 2004. These funds will be expended in FY 2005 and therefore the increase is needed to fully fund these projects in FY 2006……	+216
■ For Environment related activities, additional resources are required to enable EH to provide guidance and assistance to DOE programs and sites as they begin to shift from the development and documentation phase to the implementation phase of their Environmental Management Systems. Additional resources are needed for EH to provide assistance to DOE sites in implementing the Department's Environmental Compliance Management Improvement Plan. In addition, EH expects that additional modification of DOE's property release and control requirements will be needed in FY 2006 to ensure reasonable consistency to International recommendations and anticipated Nuclear Regulatory Commission Standards……	+154
Total Funding Change, Policy, Standards and Guidance……	**+588**

DOE-Wide Environment, Safety and Health Programs

Funding Schedule by Activity

	(dollars in thousands)				
	FY 2004 Comparable Appropriation	FY 2005 Comparable Appropriation	FY 2006 Request	$ Change	% Change
DOE-Wide Environment, Safety and Health Programs................................	5,068	4,697	5,273	+576	+12.3%
Total, DOE-Wide ES&H Programs	5,068	4,697	5,273	+576	+12.3%

Description

Environment, Safety and Health Programs improve worker and nuclear facility safety, and protect the public and the environment. EH's activities under these programs often require the development of state-of-the-art analysis tools and approaches, because the nature and mix of radioactive, hazardous, and toxic materials at DOE facilities are unique. EH's efforts span the design, construction, operation, maintenance, decontamination and decommissioning, and cleanup of nuclear weapons productions and research-related facilities. Efforts also include construction safety; work planning activities, including techniques to identify, evaluate and eliminate hazards; methods for reducing or eliminating release of pollutants; and the identification of technologies and innovative adaptations of existing practices.

Benefits

EH's DOE-Wide Environment, Safety and Health (ES&H) Programs improve worker and nuclear facilities safety and protect the public and the environment through the efficient management of several DOE-wide programs.

Detailed Justification

	(dollars in thousands)		
	FY 2004	FY 2005	FY 2006
DOE-Wide Environment, Safety and Health Programs..	**5,068**	**4,697**	**5,273**

DOE-Wide Environment, Safety and Health Programs have two fundamental goals: improving worker and nuclear facility safety, and protecting the public and the environment.

EH has responsibility for the Department of Energy Laboratory Accreditation Program (DOELAP). DOELAP is an accreditation (certification) program that provides assurance that worker radiation exposures are being accurately measured.

EH's Radiation Exposure Monitoring System (REMS) project is the collection, maintenance, and annual reporting of all DOE worker radiation exposures as required by Rule 10 CFR 835, "Occupational Radiation Protection."

EH's nationally recognized DOE Voluntary Protection Program (DOE-VPP) results in enhanced worker safety protection and cost savings. In FY 2006, DOE will continue to re-certify DOE contractor VPP status and evaluate new applications for VPP status.

Also in FY 2006, EH will develop and implement an enforcement policy to ensure compliance with the Congressionally mandated Occupational Safety and Health Rule (10 CFR 851).

EH will continue its programs related to environmental compliance. In FY 2006, EH will begin implementation of new strategic pollution prevention goals for waste minimization, recycling and toxic chemical use and release reductions established the previous fiscal year. EH will continue to provide guidance on a variety of issues related to Departmental responsibilities under Executive Orders related to pollution prevention, environmentally preferable purchasing, and environmental management systems.

In FY 2006, EH will enable the timely implementation of priority program missions by providing independent technical and policy reviews to ensure that the Department's proposed actions comply with the National Environmental Policy Act (NEPA), which is prerequisite to program and project implementation. As the Department's focal point of NEPA expertise, EH will guide programs in developing timely and compliant NEPA strategies for proposed projects, and will conduct compliance assurance reviews for more than 15 major Environmental Impact Statements and related documents. EH will also develop policy and guidance to streamline the environmental review process and help programs complete legally sufficient Environmental Impact Statements in time to meet mission needs.

In FY 2006, EH will also develop DOE-wide goals that promote pollution prevention as part of the planning and implementation of all DOE activities and provide assistance to line management in developing pollution prevention strategies for the reduction of waste generation and environmental releases at DOE sites.

	(dollars in thousands)		
	FY 2004	FY 2005	FY 2006

The EH Information Management Services Program provides cost-effective management of centralized environmental, safety, and health information. The program also conducts activities to support the President's Management Agenda to expand electronic government. Information services provided include on-line access to environment, safety and health related industry standards, programs, policies and activities; access to a commercial standards subscription service; and access to historical ES&H information for all DOE operations and sites.

	FY 2004	FY 2005	FY 2006
Total, DOE-Wide Environment, Safety and Health Programs...	**5,068**	**4,697**	**5,273**

Explanation of Funding Changes

	FY 2006 vs. FY 2005 ($000)
DOE-Wide Environment, Safety and Health Programs	
■ Increase for DOELAP will effectively perform DOE laboratory accreditation program. EH must ensure sites are compliant with 10 CFR 835. Slight increase for Radiation Exposure Monitoring System (REMS) is to support and maintain annual occupational radiation exposure reporting information and publish an Annual Report, as required by 10 CFR 835..……………..	+110
■ Increase to support EH's information management investment to develop, operate and maintain the suite of databases and tracking systems known as the ES&H Reporting Systems, such as: Occurrence Reporting and Processing System, Computerized Accident/Incident Reporting System, Noncompliance Tracking Systems, National Environmental Policy Act System, Corrective Actions Tracking Systems, and the Pollution Prevention Systems. These systems are relied heavily upon by DOE senior management for supporting decision-making and determining ES&H performance throughout the DOE complex………………………………	+233
■ Additional resources will be used to support EH's development of new DOE strategic pollution prevention goals. EH will assist DOE programs and sites in transitioning from complex-wide goals established for 2005, by waste type, to new performance goals to be integrated into sites' Environmental Management Systems implementation……………………………………………………………………..	+184
■ Slight increase for enforcement activities will fund development of noncompliance reporting tool…………………………………………………………………..	+49
Total Funding Change, DOE-Wide Environment, Safety and Health Programs...	**+576**

Program Direction

Funding Profile by Category

	(dollars in thousands/whole FTEs)				
	FY 2004 Comparable Appropriation	FY 2005 Comparable Appropriation	FY 2006 Request	$ Change	% Change
Headquarters					
Salaries and Benefits................	11,604	15,704	16,426	+722	+4.6%
Travel..	13	20	20	0	0.0%
Other Related Expenses...........	4,080	4,118	4,454	+336	+8.2%
Total, Program Direction............	15,697	19,842	20,900	+1,058	+5.3%
Full Time Equivalents.................	85	101	101	0	0.0%

Mission

Program Direction in this account provides overall direction and support for Environment, Safety and Health (EH) Energy Supply programs to ensure that all operations are conducted in the most efficient and effective manner. Program Direction in this account is as follows:

All costs of transportation, subsistence, and incidental expenses for EH's Federal employees are provided for in accordance with Federal Travel Regulations. Also, provided are the EH Working Capital Fund and training for Federal staff. The Working Capital Fund provides for non-discretionary prorated costs for items such as space utilization, computer and telephone usage, mail service, and supplies. Training includes course registration fees for EH Federal employees.

As stated in the Departmental Strategic Plan, DOE's Strategic and General Goals will be accomplished not only through the efforts of the major program offices in the Department but with additional effort from offices which support the programs in carrying out the mission. Environment, Safety and Health performs critical functions which directly support the mission of the Department. The Office of Environment, Safety and Health performs critical functions which directly support the mission of the Department. These functions include funding for a Federal staff that has the technical expertise to carry out the essential EH mission. The EH mission requires experts to develop overall environment, safety, and health policy for DOE sites and facility operations; to provide a central and coordinated source of technical expertise to all of the Department elements; to provide a central clearing house for information, analysis and feedback regarding new efforts, present activities, and unforeseen occurrences taking place at the multitude of diverse facilities within the DOE complex; to provide the Department with the capability to perform activities relative to environment, safety, and health programs across the DOE complex; and oversee the Department's health studies endeavors.

Detailed Justification

	(dollars in thousands)		
	FY 2004	FY 2005	FY 2006
Salaries and Benefits	**11,604**	**15,704**	**16,426**

In the Program Direction activity, salaries and benefits are reflective of the FTE split between Energy Supply and Other Defense Activities. This category funds full-time permanent and other than full-time permanent employees' salaries, overtime pay, cash incentive awards, lump sum leave payments, Senior Executive Service, other performance awards, and payments to the workman's compensation fund.

Travel	**13**	**20**	**20**

Overall, EH travel requirements are in line with the EH Federal staff levels and currently estimated mission essential travel needs.

Other Related Expenses	**4,080**	**4,118**	**4,454**

Provides for the Working Capital Fund, which covers non-discretionary prorated costs such as space utilization, computer and telephone usage, mail service, supplies and electronic services. Funding also supports EH office expenditures for printing and reproduction, telecommunication needs, ADP maintenance and training for Federal staff, including the training course registration fees for EH Federal employees.

Total, Program Direction	**15,697**	**19,842**	**20,900**

Explanation of Funding Changes

	FY 2005 vs FY 2006 ($000)
Salaries and Benefits	
▪ Reflects government-wide increase for pay and personnel related costs for EH full-time equivalent employees............	+722
Other Related Expenses	
▪ Reflects projected increase in the Working Capital Fund and higher estimated requirements for training and tuition costs............	+336
Total Funding Change, Program Direction............	**+1,058**

Other Related Expenses by Category

(dollars in thousands)

	FY 2004	FY 2005	FY 2006	$ Change	% Change
Other Related Expenses					
Training..	9	9	73	+64	711.1%
Working Capital Fund....................................	4,071	4,059	4,331	+272	6.7%
Other Services…… ……........................	0	50	50	0	0.0%
Total, Other Related Expenses..........................	4,080	4,118	4,454	+336	8.2%

Legacy Management

Legacy Management

Energy Supply
Office of Legacy Management

Overview

Appropriation Summary by Program

(dollars in thousands)

	FY 2004 Comparable Appropriation	FY 2005 Original Appropriation	FY 2005 Adjustments	FY 2005 Comparable Appropriation	FY 2006 Request
Energy Supply					
Legacy Management…………….	28,189	31,130	-247	30,883	33,522
Subtotal, Energy Supply……….….	28,189	31,130	-247	30,883	33,522
Less Use of Prior Year Balances…………………..……...	0	-266	0	-266	0
Total, Energy Supply…….……….	28,189	30,864	-247	30,617	33,522
Other Defense Activities					
Legacy Management…………….	35,472	46,895	-375	46,520	45,076
Subtotal, Other Defense Activities…………………………..	35,472	46,895	-375	46,520	45,076
Less Use of Prior Year Balances…………………..……..	-1,500	0	0	0	0
Total, Other Defense Activities……	33,972	46,895	-375	46,520	45,076
Total, Other Defense Activities and Energy Supply…………...……	62,161	77,759	-622	77,137	78,598

Preface
During FY 2006, the Department continues its efforts to reduce risk to human health and the environment at its contaminated sites and manage its pension and benefit commitments to former contractor personnel. By conducting the long-term surveillance and maintenance of remediated sites and ensuring pension and benefit continuity, the Office of Legacy Management allows Environmental Management to concentrate on further risk reduction and site closure.

Within the Energy Supply appropriation, the Office of Legacy Management (LM) has one subprogram: Legacy Management.

This Overview will describe Strategic Context, Mission, Benefits, Strategic Goals, and Funding by General Goals. These items together put the appropriation in perspective. The Annual Performance Results and Targets, Means and Strategies, and Validation and Verification sections address how the goals will be achieved and how performance will be measured. Finally, this Overview will address Significant Program Shifts.

Strategic Context

Following publication of the Administration's National Energy Policy, the Department developed a Strategic Plan that defines its mission, four strategic goals for accomplishing that mission, and seven general goals to support the strategic goals. Each appropriation has developed quantifiable goals to support the general goals. Thus, the "goal cascade" is the following:

Department Mission → Strategic Goal (25 yrs) → General Goal (10-15 yrs) → Program Goal (GPRA Unit) (10-15 yrs)

To provide a concrete link between budget, performance, and reporting, the Department developed a "GPRA Unit" concept. Within DOE, a GPRA Unit defines a major activity or group of activities that support the core mission and aligns resources with specific goals. Each GPRA Unit has completed or will complete a Program Assessment Rating Tool (PART). A unique program goal was developed for each GPRA Unit. A numbering scheme has been established for tracking performance and reporting.

The goal cascade accomplishes two things. First, it ties major activities for each program to successive goals and, ultimately, to DOE's mission. This helps ensure the Department focuses its resources on fulfilling its mission. Second, the cascade allows DOE to track progress against quantifiable goals and to tie resources to each goal at any level in the cascade. Thus, the cascade facilitates the integration of budget and performance information in support of the GRPA and the President's Management Agenda (PMA).

Mission

The mission of the Office of Legacy Management is to ensure protection of human health and the environment through effective long-term stewardship of land, structures, facilities, and records, and oversee the Department's pensions and post retirement benefits (PRB) i.e., retiree medical and life insurance) responsibilities for former contractor employees.

Benefits

The greatest benefit of the Office of Legacy Management is to serve as a visible demonstration of the Department's resolve to honor its long-term commitments to the communities near its remediated facilities and to the former contractor work force.

The Office of Legacy Management programs provide benefits to the Department following mission change or closure. For sites where cleanup is completed, Legacy Management programs ensure that the remediation measures implemented during closure are protecting human health and the environment and that labor commitments for the contractor work force are being satisfied. By managing the real and personal property assets that remain after mission completion, cleanup, and closure, Legacy Management helps the Department reduce the magnitude of its physical resource management, the costs associated with such management, and actively promotes the beneficial reuse of those mission excess properties.

Strategic, General, and Program Goals

The Department's Strategic Plan identifies four strategic goals (one each for defense, energy, science, and environmental aspects of the mission plus seven general goals that tie to the strategic goals. The Legacy Management appropriation supports the following goal:

Environment Strategic Goal: To protect the environment by providing a responsible resolution to the environmental legacy of the Cold War and by providing for the permanent disposal of high-level radioactive waste.

General Goal 6, Environmental Management: Accelerate cleanup of nuclear weapons manufacturing and testing sites, completing cleanup of 108 contaminated sites by 2025.

The programs funded one Program Goal that contributes to the General Goal in the "goal cascade". This goal is:

Program Goal 06.26.00.00: Legacy Management – By 2015, the Office of Legacy Management will be responsible for: the cost effective management of land, structures, facilities and/or records for over 120 sites; employee benefits for the Department's former contractor work force at seven sites; and the disposal of real property at ten sites.

Contribution to General Goal

Legacy Management programs contribute to this goal by managing the long-term surveillance and maintenance at sites where remediation has been essentially completed, allowing the Environmental Management program to concentrate its efforts on continuing to accelerate cleanup and site closure resulting in reduced risks to human health and the environment and reduced landlord costs.

The Legacy Management program is also now the manager of some pension and benefit programs to meet the Department's contractual commitments.

Funding by General and Program Goal

	(dollars in thousands)		
	FY 2004	FY 2005	FY 2006
General Goal 6, Environmental Management, Program Goal 06.26.01.00, Legacy Management…………………………..	28,189	30,883	33,522

Major FY 2004 Achievements

- Established the Office of Legacy Management as a focal point for post-remediation activities.

- Conducted site monitoring as specified in legal, regulatory, or other commitments for more than 30 sites.

Annual Performance Results and Targets

FY 2001	FY 2002	FY 2003	FY 2004	FY 2005	FY 2006
Legacy Management Program/Legacy Management Subprogram					
No comparable measures in FY 2001	No comparable measures in FY 2002	No comparable measures in FY 2003	No comparable measures in FY 2004	Ensure continued effectiveness of cleanup remedies through surveillance and maintenance activities at 65 sites funded under the Energy Supply appropriation in accordance with legal agreements	Ensure continued effectiveness of cleanup remedies through surveillance and maintenance activities at 72 sites funded under the Energy Supply appropriation in accordance with legal agreements

Means and Strategies
The LM Program will use various means and strategies to achieve its program goal. However, various external factors may impact the ability to achieve the goal. The program also performs collaborative activities to help meet its goal.

The Department will implement the following means:

- Long-term surveillance and maintenance will be performed in accordance with the regulatory decisions for each site. Activities range from maintaining records to active maintenance by on-site contractors.

- Adequate staffing will be maintained to oversee the program. A large portion of the surveillance and maintenance will be performed by contractors.

The Department will implement the following strategies:

- The Office of Legacy Management (LM) will only accept responsibility for a site after all remedies are in place and operating.

The following external factors could affect LM's ability to achieve its strategic goal:

- Significant changes in remedy performance could cause the site to be returned to EM for additional remediation.

In carrying out the program's surveillance and maintenance functions, LM performs the following collaborative activities:

- Evaluation of remedy performance, as determined by surveillance and maintenance activities, is coordinated with regulators, local communities, and other stakeholders.

Validation and Verification
The Department is operating a performance tracking system to measure performance. The Office of Management, Budget, and Evaluation has developed action plans for the primary functions. Quarterly updates for site inspections are reported using an automated system.

For payments of medical benefits not tracked by the automated system, the Office of Legacy Management will obtain quarterly updates to judge progress of the programs.

The Legacy Management program has not performed a Program Assessment Rating Tool (PART) evaluation to date but such a review and the measures resulting from it would also provide verification.

The observed results of surveillance and maintenance activities will be recorded as notes and retained as long as specified in Federal requirements for records retention.

Significant Program Shifts

- **Transfer of Post-Closure Responsibilities for the Laboratory for Energy-related Health Research (LEHR)**

  The Office of Environmental Management (EM) will transfer the post-closure responsibilities for the LEHR facility to the Office of Legacy Management (LM) at the beginning of FY 2006. Post-closure activities associated with LEHR include long-term surveillance and maintenance and records management. These activities are in accordance with the LM mission to ensure protection of human health and the environment.

Energy Supply
Office of Legacy Management

Funding by Site by Program

(dollars in thousands)

	FY 2004	FY 2005	FY 2006	$ Change	% Change
Grand Junction Office……………..……..………..	17,543	16,912	17,039	+127	+0.8%
Lexington Office……………………….………….	10,646	13,971	16,483	+2,512	+18.0%
Total, Energy Supply……….……….....................	28,189	30,883	33,522	+2,639	+8.5%

Site Description

Grand Junction Office
The Grand Junction Office is located in western Colorado. The oversight of the long term surveillance and maintenance program is the staff's primary function. The long-term surveillance and maintenance activities managed from this office include environmental monitoring, long-term treatment of contaminants, maintaining site security, preparation for the transfer of closure sites, and asset disposition.

Lexington Office
The Lexington Office, located in Lexington, KY, is the DOE office with management responsibility for the two gaseous diffusion plants at Paducah, KY, and Portsmouth, OH, which passed to private ownership in 1998. Under agreements with the United States Enrichment Corporation (USEC), the Department retains responsibility for pension and medical benefits for part of the former USEC work force.

Legacy Management

Funding Profile by Subprogram

(dollars in thousands)

	FY 2004 Comparable Appropriation	FY 2005 Original Appropriation	FY 2005 Adjustments	FY 2005 Comparable Appropriation	FY 2006 Request
Legacy Management Program					
Legacy Management……………..…	28,189	31,130	-247	30,883	33,522

Public Law Authorizations:

Public Law 95-91, "Department of Energy Organization Act (1977)
Public Law 95-604, Uranium Mill Tailings Radiation Control Act (1978)
Public Law 100-616, Uranium Mill Tailings Remedial Action Amendments Act of 1988
Public Law 103-62, Government Performance and Results Act of 1993
Public Law 106-398, National Defense Authorization Act for Fiscal Year 2001
Public Law 106-377, Energy and Water Development Appropriations Act, 2001
Public Law 107-66, Energy and Water Development Appropriations Act, 2002
Public Law 107-314, Bob Stump National Defense Authorization Act for Fiscal Year 2003
Public Law 108-136, National Defense Authorization Act for Fiscal Year 2004

Mission

The mission of the Office of Legacy Management is to accept transition of sites and to support the Department's commitments to protect the nearby communities and ensure former contractor personnel receive the benefits to which they are entitled. The activities that are used to accomplish this mission include: (1) conduct long-term surveillance and maintenance (also referred to as long-term stewardship) at DOE facilities where remediation measures have been substantially completed; (2) oversee the management of pensions and benefits for former contractor employees; and, (3) dispose of assets no longer needed for the Department's missions.

Benefits

The Legacy Management program contains important elements to assist the Office of Environmental Management achieve the strategic goal of providing a resolution to the environmental legacy of the Cold War. As the Office of Environmental Management completes its cleanup activities, there are still certain aspects of the Department's mission, such as, long-term pump and treat operations, surveillance and maintenance, records management, and long-term retirement pension and benefits for contractor personnel that require long-term commitments to manage resources and activities beyond the completion of active remediation. The activities of the Legacy Management program ensure that these Departmental responsibilities are addressed and the Office of Environmental Management is able to concentrate its efforts on cleanup and risk reduction.

Legacy Management
Funding Schedule by Activity

(dollars in thousands)

	FY 2004	FY 2005	FY 2006	$ Change	% Change
Legacy Management					
Long-Term Surveillance and Maintenance……	16,543	15,870	15,937	+67	+0.4%
Pension and Benefit Continuity………..…..…	11,646	15,013	17,585	+2,572	+17.1%
Total, Legacy Management……………..……..	28,189	30,883	33,522	+2,639	+8.5%

Description

The mission of the Legacy Management subprogram is to conduct long-term surveillance and maintenance (also referred to as long-term stewardship) at DOE facilities where remediation measures have been substantially completed, and oversee the management of pensions and benefits for former contractor employees. These activities support the Department's commitments as contained in regulatory decisions, contracts, and legal agreements.

Benefits

The Legacy Management subprogram enables the Office of Environmental Management to achieve the strategic goal of resolving the environmental legacy of the Cold War. The subprogram also ensures that the Department fulfills its long-term commitments to protect the environment and ensure the continuity of benefits to former contractor workers. By funding the long-term activities in the Legacy Management program, the Office of Environmental Management is able to concentrate its resources on risk reduction and site closure.

Detailed Justification

(dollars in thousands)

	FY 2004	FY 2005	FY 2006
Long-Term Surveillance and Maintenance……………	**16,543**	**15,870**	**15,937**

The funding requested for FY 2006 will allow the Office of Legacy Management to monitor and maintain environmental remedies at its sites in accordance with requirements contained in legal, contractual, and regulatory agreements. Sites in this program include those associated with the Uranium Mill Tailings Radiation Control Act, the Formerly Utilized Sites Remedial Action Program, the Weldon Springs site and early reactor sites, and the Laboratory for Energy-related Health Research (LEHR). Functions include soil, water, and air monitoring, long-term treatment of contaminants, maintenance of contaminant treatment structures, and maintaining security for the sites and other resources associated with the sites. If these activities are not performed, the Department will fail to comply with its legal and regulatory requirements.

	FY 2004	FY 2005	FY 2006
	(dollars in thousands)		
Pension and Benefit Continuity……………………..…	**11,646**	**15,013**	**17,585**
▪ USEC Facilities…………..…..……………...………	10,646	13,971	16,483

At Paducah, the project includes continued funding for activities and expenses associated with post-retirement life insurance and medical benefits applicable to retirees and contractor employees with service at the Paducah Gaseous Diffusion Plant prior to the lease agreement between USEC and DOE in July 1993. This scope has been expanded to include retired employees working at the Gaseous Diffusion Plant prior to the date of USEC privatization and as further defined by the Memorandum of Agreement (MOA) between the Office of Management and Budget (OMB) and USEC, dated April 6, 1998.

At Portsmouth, the project includes continued funding for activities and expenses associated with post-retirement life insurance and medical benefits applicable to retirees of the Lockheed Martin Energy Systems and contractor employees with service at the Portsmouth Gaseous Diffusion Plant prior to the lease agreement between USEC and DOE in July 1993. This scope has been expanded to include retired employees working at the Gaseous Diffusion Plant to the date of USEC privatization as further defined by the MOA between OMB and USEC, dated April 6, 1998.

This funding does not include benefits to former DOE contractor employees covered by the Uranium Enrichment Decontamination and Decommissioning Fund.

▪ Grand Junction Office……………………..………	1,000	1,042	1,102

The Department is providing retirees from the former DOE contractor Rust Geotech with medical insurance benefits in accordance with contractual requirements.

Total, Legacy Management…………………..……..	**28,189**	**30,883**	**33,522**

Explanation of Funding Changes

	FY 2006 vs. FY 2005 ($000)
Long-Term Surveillance and Maintenance	
No significant change…………………………………………………………	+67
Pension and Benefit Continuity	
▪ USEC Facilities	
Costs for medical benefits have increased significantly…………..…………	+2,512
▪ Grand Junction Office	
No significant change…………………………………………..…………	+60
Total, Pension and Benefit Continuity……………………………………...	**+2,572**
Total Funding Change, Legacy Management...............................……….......	**+2,639**