DOE/ME-0034
Volume 3

Department of Energy FY 2005 Congressional Budget Request

Energy Supply

Energy Efficiency and Renewable Energy

Electric Transmission and Distribution

Nuclear Energy

Civilian Radioactive Waste Management

Environment, Safety & Health

Future Liabilities

Legacy Management

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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 2003 Comparable Approp	FY 2004 Comparable Approp	FY 2005 Congress Request	FY 2005 vs. FY 2004	
Energy and Water Development					
Energy Programs					
Energy supply	730,215	788,620	835,266	+46,646	+5.9%
Non-Defense site acceleration completion	156,129	162,411	151,850	-10,561	-6.5%
Uranium enrichment D&D fund	320,563	414,027	500,200	+86,173	+20.8%
Non-Defense environmental services	161,852	306,439	291,296	-15,143	-4.9%
Science	3,322,244	3,500,169	3,431,718	-68,451	-2.0%
Nuclear waste disposal	144,058	188,879	749,000	+560,121	+296.6%
Departmental administration	89,219	93,720	122,611	+28,891	+30.8%
Inspector general	37,426	39,229	41,508	+2,279	+5.8%
Total, Energy Programs	4,961,706	5,493,494	6,123,449	+629,955	+11.5%
Atomic Energy Defense Activities					
National nuclear security administration:					
Weapons activities	5,961,345	6,233,503	6,568,453	+334,950	+5.4%
Defense nuclear nonproliferation	1,223,453	1,334,040	1,348,647	+14,607	+1.1%
Naval reactors	702,196	761,878	797,900	+36,022	+4.7%
Office of the administrator	330,314	336,826	333,700	-3,126	-0.9%
Total, National nuclear security administration	8,217,308	8,666,247	9,048,700	+382,453	+4.4%
Environmental and other defense activities:					
Defense site acceleration completion	5,496,409	5,576,760	5,970,837	+394,077	+7.1%
Defense environmental services	1,105,778	1,012,610	982,470	-30,140	-3.0%
Other defense activities	637,125	670,083	663,636	-6,447	-1.0%
Defense nuclear waste disposal	312,952	387,699	131,000	-256,699	-66.2%
Total, Environmental & other defense activities	7,552,264	7,647,152	7,747,943	+100,791	+1.3%
Total, Atomic Energy Defense Activities	15,769,572	16,313,399	16,796,643	+483,244	+3.0%
Defense EM privatization (rescission)	—	-15,329	—	+15,329	100%
Power marketing administrations:					
Southeastern power administration	4,505	5,070	5,200	+130	+2.6%
Southwestern power administration	27,200	28,431	29,352	+921	+3.2%
Western area power administration	167,760	176,900	173,100	-3,800	-2.1%
Falcon & Amistad operating & maintenance fund	2,716	2,625	2,827	+202	+7.7%
Total, Power marketing administrations	202,181	213,026	210,479	-2,547	-1.2%
Federal energy regulatory commission	—	—	—	—	—
Subtotal, Energy and Water Development	**20,933,459**	**22,004,590**	**23,130,571**	**+1,125,981**	**+5.1%**
Uranium enrichment D&D fund discretionary payments	-432,731	-449,333	-463,000	-13,667	-3.0%
Excess fees and recoveries, FERC	-22,669	-18,000	-15,000	+3,000	+16.7%
Colorado River Basins	-22,000	-22,000	-23,000	-1,000	-4.5%
Total, Energy and Water Development	**20,456,059**	**21,515,257**	**22,629,571**	**+1,114,314**	**+5.2%**

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

	FY 2003 Comparable Approp	FY 2004 Comparable Approp	FY 2005 Congress Request	FY 2005 vs. FY 2004	
Interior and Related Agencies					
Fossil energy research and development	611,149	672,771	635,799	-36,972	-5.5%
Naval petroleum and oil shale reserves	17,715	17,995	20,000	+2,005	+11.1%
Elk Hills school lands fund	36,000	36,000	36,000	——	——
Energy conservation	880,176	877,984	875,933	-2,051	-0.2%
Economic regulation	1,477	1,034	——	-1,034	-100.0%
Strategic petroleum reserve	171,732	170,948	172,100	+1,152	+0.7%
Strategic petroleum account	1,955	——	——	——	——
Northeast home heating oil reserve	5,961	4,939	5,000	+61	+1.2%
Energy information administration	80,087	81,100	85,000	+3,900	+4.8%
Subtotal, Interior Accounts	1,806,252	1,862,771	1,829,832	-32,939	-1.8%
Clean coal technology	-47,000	-98,000	-140,000	-42,000	-42.9%
Total, Interior and Related Agencies	**1,759,252**	**1,764,771**	**1,689,832**	**-74,939**	**-4.2%**
Total, Discretionary Funding	**22,215,311**	**23,280,028**	**24,319,403**	**+1,039,375**	**+4.5%**
Yucca mountain--mandatory collection to offset discretionary funding	——	——	-749,000	-749,000	n/a
Total, Discretionary Funding	**22,215,311**	**23,280,028**	**23,570,403**	**+290,375**	**+1.2%**

Energy Supply

Energy Supply

Energy Supply

Proposed 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, including two buses, $835,266,000, to remain available until expended. *(Energy and Water Development Appropriations Act, 2004.)*

Explanation of Change

The FY 2005 Congressional Request for the Energy Supply Appropriation does not tie back to the amount requested in the President's Budget ($834,284,000). The difference ($982,000) was inadvertently omitted from the Nuclear Energy request for Energy Supply and instead was included in the Nuclear Energy request for Other Defense Activities.

Energy Efficiency and Renewable Energy

Energy Efficiency and Renewable Energy

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Energy Supply
Office of Energy Efficiency and Renewable Energy

Overview
Appropriation Summary by Program

(dollars in thousands)

	FY 2003 Comparable Appropriation	FY 2004 Original Appropriation	FY 2004 Adjustments[a]	FY 2004 Comparable Appropriation	FY 2005 Request
Energy Supply (EERE)					
Hydrogen Technology	38,113	78,000	+3,991[b,c]	81,991	95,325
Solar Energy	82,330	85,000	-1,607[b]	83,393	80,333
Zero Energy Buildings	7,572	0	0	0	0
Wind Energy	41,640	41,600	-290[b,c]	41,310	41,600
Hydropower	5,016	5,000	-95[b]	4,905	6,000
Geothermal Technology	28,390	26,000	-492[b]	25,508	25,800
Biomass and Biorefinery Systems R&D	85,283	75,000	+11,471[b,c]	86,471	72,596
Intergovernmental Activities	14,449	15,000	-280[b]	14,720	16,000
Departmental Energy Management Program	1,445	2,000	-37[b]	1,963	1,967
Renewable Program Support	0	4,000	+919[b,c]	4,919	0
National Climate Change Technology Initiative Competitive Solicitation	0	0	0	0	3,000
Facilities and Infrastructure	5,297	13,200	-250[b]	12,950	11,480

[a] Programs in both the Energy Supply and the Energy Conservation appropriations were reduced by .59 percent as required by the Omnibus Appropriation Bill.

[b] Programs in the Energy Supply appropriation were proportionally reduced based upon the allocated General Reduction of $4,684,000.

[c] Selected programs in Energy Supply appropriation were provided increases by the Omnibus Appropriation Bill initially totaling $19,900,000. These were Hydrogen Technology at $5,500,000, Wind Energy at $500,000, Biomass and Biorefinery Systems R&D at $12,900,000, and the Renewable Program Support at $1,000,000. Each of these amounts was subject to the .59 percent reduction required by the Omnibus Appropriation Bill.

(dollars in thousands)

	FY 2003 Comparable Appropriation	FY 2004 Original Appropriation	FY 2004 Adjustments[a]	FY 2004 Comparable Appropriation	FY 2005 Request
Program Direction	12,615	12,600	-236 [b]	12,364	20,711
Subtotal, Energy Supply (EERE)	322,150	357,400	+13,094	370,494	374,812
Use of prior year balances	0	-13,000	0	-13,000	0
General Reduction	0	-4,684	+4,684	0	0
Total, Energy Supply (EERE)	322,150	339,716	+17,778	357,494	374,812
Energy Conservation					
Vehicle Technologies	174,171	179,059	-1,057	178,002	156,656
Fuel Cell Technologies	53,906	65,574	-387	65,187	77,500
Weatherization and Intergovernmental Activities	314,155	310,444	-1,832	308,612	364,067
Distributed Energy Resources	60,054	61,385	-362	61,023	53,080
Building Technologies	58,327	60,221	-355	59,866	58,284
Industrial Technologies	96,824	93,620	-552	93,068	58,102
Biomass and Biorefinery Systems R&D	24,050	7,551	-45	7,506	8,680
Federal Energy Management Program	19,299	19,833	-117	19,716	17,900
Program Management	76,950	85,508	-504	85,004	81,664
Energy Efficiency Science Initiative	2,440	0	0	0	0
Total, Energy Conservation	880,176	883,195	-5,211	877,984	875,933
Total, Energy Supply and Energy Conservation	1,202,326	1,222,911	+12,567	1,235,478	1,250,745

Preface

It is in the nation's long term national and economic security interest to use our energy resources wisely. Energy Efficiency and Renewable Energy (EERE) pursues a balanced portfolio of research, development, demonstration, and deployment, investing in: 1) the technologies that allow us to harvest domestic solar, wind, hydropower, geothermal, and biomass energy; 2) the technologies to use those resources efficiently in our homes, schools, businesses, factories, and vehicles; and 3) the tools, processes and methods to help consumers fully and productively use these new energy opportunities.

EERE comprises 12 main programs:

Hydrogen Technology, Solar Energy Technology, Wind Energy Technology, Hydropower Technologies, Geothermal Technologies, Biomass and Biorefinery Systems R&D Technology, Intergovernmental Activities Technology, and Departmental Energy Management Program Technology, Vehicle Technologies, Distributed Energy Resources, Building Technologies, and Industrial Technologies. In addition, EERE supports Renewable Program Support, National Climate Change Technology Initiative Competitive Solicitation, Facilities and Infrastructure, Program Direction, and Energy Efficiency Science Initiative. Two appropriation accounts, Energy Supply (EERE) and Energy Conservation, fund these activities. Four programs have complementary funding in Energy Supply (renewables) and Energy Conservation. They are: Biomass; Federal Energy Management; Hydrogen, Fuel Cells, and Infrastructure Technologies; and the Weatherization and Intergovernmental Program.

Within the Energy Supply (EERE) appropriation, EERE currently supports eight programs: Hydrogen Technology (five subprograms) Solar Energy Technology (three subprograms), Wind Energy Technology (two subprograms), Hydropower Technologies Technology (two subprograms), Geothermal Technologies (two subprograms), Biomass and Biorefinery Systems R&D Technology (three subprograms), Intergovernmental Activities Technology (three subprograms), and Departmental Energy Management Program Technology (two subprograms). (The Zero–energy Building component of the Building Technology Program was supported by this appropriation in FY2003.)

This Overview will describe Strategic Context, Mission, Benefits, Strategic Goals, and Funding by General Goal. These items together put the appropriation in perspective. This Overview also addresses the R&D Investment Criteria, the 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 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

[a] Government Performance and Results Act of 1993

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

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).

The FY 2005 Congressional Request integrates FY 2004 and FY2005 budget and performance into one document. The Annual Performance Results and Targets sections in the individual Program budgets encompass the FY 2004 targets which were included in the FY 2004 Annual Performance Plan (APP) as amended to reflect final appropriations. These targets are representative of all Energy Supply (EERE) and accommodate the PMA to submit a performance budget.

Mission

EERE strengthens 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 mix of research, development, demonstration and deployment efforts which improve the energy efficiency of our economy and increase the use of domestic renewable energy resources. Making greater use of our abundant, clean domestic renewable energy resources and using all of our energy resources more productively provides a number of economic, environmental, and security benefits to the United States. Energy bills are lower and consumers are less susceptible to energy price fluctuations. Emissions of Clean Air Act criteria pollutants (sulfur dioxide, nitrogen oxide, carbon monoxide, and particulates), mercury, and carbon dioxide are lower. Energy security is enhanced as dependence on imported petroleum (and, increasingly in the future, natural gas) is reduced and the mix of domestic energy resources increases. Security is also enhanced as the loads on our energy infrastructure are reduced, reducing the potential for wide-spread energy outages, and the development of distributed energy resources increases the reliability of energy supplies, even during emergencies.

Based on its modeling efforts, EERE estimates that U.S. consumption of non-renewable energy resources would, given current policies and a business-as-usual energy future, be about 10 quads lower in 2025 and over 30 quads lower in 2050 as a result of being able to realize these efficiency and renewable improvements, off-setting 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.

Strategic 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 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 General Goal in the "goal cascade":

Program Goal 04.01.01.00: Hydrogen. The Hydrogen, Fuel Cells and Infrastructure Technologies Program goal is to develop hydrogen production, storage, and delivery technologies to the point that they are cost and performance competitive and are being used by the Nation's transportation, energy, and power industries. As such, the Program will expand and 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 both large-scale usage across the Nation and to make 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. The Hydropower Program's goal is to conduct the R&D necessary to improve hydropower's operational and environmental performance so that hydropower generation is increased because of its affordability, abundance, reliability and environmental benefits. In accomplishing this goal, the Program will increase the viability of hydropower, the Nation's most widely used renewable energy source, without construction of new dams.

Program Goal 04.07.00.00: Geothermal. The Geothermal Program goal is to improve performance and reduce market entry costs of geothermal energy to competitive levels. In quantitative terms, the goal is to reduce the levelized cost of power generated from conventional geothermal sources from 5-8 cents per kWh (kilowatt hour) in 2000 to 3-5 cents per kWh by 2010.

Program Goal 04.08.01.00: Biomass. Develop biorefinery-related technologies to the point that they are cost- and performance-competitive and are used by the Nation's transportation, energy, chemical and power industries to meet their 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 04.11.01.00: 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 04.13.01.00: DEMP. The Federal Energy Management Program's goal is to provide the efficiency and renewable energy-related technical assistance Federal agencies need to lead the Nation by example through government's own actions, expressly increasing Federal renewable energy use by 2.5 percent by 2005 and reducing energy intensity in Federal buildings by 35 percent by 2010 (using 1985 as a baseline).

Contributions to General Goal

Hydrogen Technology, Solar Energy Technology, 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 contributions include (1) reducing demand-side pressure on our energy markets, (2) reducing energy imports; (3) diversifying the mix of domestic energy production; (4) providing smaller, non-fuel based sources of electricity generation that are inherently less susceptible to interdiction, attack or large losses; and (5) increasing our ability to adjust demand loads as needed, particularly during emergencies.

Clean distributed generation can reduce transmission and distribution bottle-necks, and can help maintain critical electricity functions during an outage without adding to the unhealthy air quality that often accompanies peak electricity days. Solar photovoltaic systems provide distributed, fuel-free, and portable electricity demand. These technologies cannot replace the need to maintain well-functioning energy infrastructure. They can, however, improve the inherent security of our energy systems, as well as reduce the need for costly expansions of our transmission lines, pipelines, and other infrastructure.

Given current expectations about future energy technologies and markets, and assuming no changes in energy policies, EERE's integrated portfolio, including activities funded by the Energy Conservation Appropriation, can be expected to: (1) reduce future demand for traditional energy sources by approximately 10 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 150 gigawatts (GW) in 2025. Oil savings would be roughly 2 million barrels per day (MBD) in 2025 and over 10 MBD 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 contributes to this goal by developing lower cost means of producing hydrogen in large quantities from natural gas and biomass-based renewable sources which will, in conjunction with the development of fuel cells, enable the production of hydrogen displacing 0.4 mbd of oil in 2025 and 6 mbd in 2050 under business-as-usual conditions, while providing the country with the option for substantially faster growth in hydrogen use if circumstances warrant.

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

Solar Energy Technology contributes to this goal by developing advanced, lower-cost solar photovoltaic modules and grid application technologies; application of lightweight polymer materials to solar heating; and development of solar light distribution systems which will enable the development of 17 GW of solar energy capacity by 2025 and 23 GW in 2050 while affording the country a source of clean, fuel-free, and portable electricity.

Wind Energy contributes 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 will extend wind production to most of the United States, which will result in additional wind capacity of nearly 60 GW by 2025 and 120 GW by 2050 beyond what is expected to be developed without these program efforts.

Hydropower Technologies contributes to this goal by developing by 2010 advanced turbine designs and other water management and environmental mitigation techniques necessary to increase production by 10 percent at existing plants will increase hydropower electricity generation capacity by 5 GW by 2025.

Geothermal Technologies contributes to this goal by reducing the cost of geothermal energy production to 3-5 cents/kWh by 2010 and the developing commercial Enhanced Geothermal Systems by 2015 which will significantly expand the amount of geothermal resources that can be competitively developed in the United States, allowing for an increase in geothermal electricity capacity of 6 GW by 2025 and more than 35 GW by 2050.

Biomass and Biorefinery Systems R&D contributes to this goal by developing by 2010 advanced technologies for producing fuels, chemicals, materials, and power from biomass via biochemical and thermochemical processes which will increase direct biomass energy production by 1.2 quads by 2050 and potentially more with integrated approaches.

Intergovernmental Activities contributes to this goal by supporting domestic and international access to U.S. renewable technologies, through Tribal and international technical assistance to support sustainable development, providing early market aggregation and economies of production for renewable energy technologies for U.S. companies, while reducing the stress on global energy markets by reducing the world's overall demand for oil and other traditional energy sources.

Departmental Energy Management Program contributes to this goal by providing project financing, technical assistance, and evaluation which will demonstrate in the Department methods to reduce energy intensity in Federal buildings by 35 percent in 2010 from 1985 levels.

These technology and market improvements also help prepare the nation for potential 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 energy markets.

Funding by General Goal

(dollars in thousands)

	FY 2003	FY 2004	FY 2005	$ Change	% Change
General Goal 4, Energy Security					
Program Goal 04.01.01.00, Hydrogen	27,517	40,024	95,325	+55,301	+138.2%

(dollars in thousands)

	FY 2003	FY 2004	FY 2005	$ Change	% Change
Technology					
Program Goal 04.03.00.00, Solar Energy	76,921	82,265	80,333	-1,932	-2.3%
Program Goal 04.04.01.00, Zero-Energy Buildings	7,572	0	0	0	0.0%
Program Goal 04.05.00.00, Wind Energy	41,640	41,310	41,600	+290	+0.7%
Program Goal 04.06.00.00, Hydropower	5,016	4,905	6,000	+1,095	+22.3%
Program Goal 04.07.00.00, Geothermal Technology	27,427	24,527	25,800	+1,273	+5.2%
Program Goal 04.08.01.00, Biomass and Biorefinery Systems R&D	58,683	45,775	72,596	+26,821	+58.6%
Program Goal 04.11.01.00, Intergovernmental Activities	13,486	13,003	16,000	+2,997	+23.0%
Program Goal 04.13.01.00, Departmental Energy Management Program	1,445	1,963	1,967	+4	+0.2%
Total General Goal 4, Energy Security	259,707	253,772	339,621	+85,849	+33.8%
All Other					
Hydrogen Technology/Congressionally Directed Activities	10,596	41,985	0	-41,985	-100.0%
Solar Energy/Congressionally Directed Activities	5,409	1,128	0	-1,128	-100.0%
Geothermal Technology/ Congressionally Directed Activities	963	981	0	-981	-100.0%
Biomass and Biorefinery Systems R&D/Congressionally Directed Activities	26,600	40,696	0	-40,696	-100.0%
Intergovernmental Activities/ Congressionally Directed Activities	963	1,717	0	-1,717	-100.0%
Renewable Program Support	0	4,919	0	-4,919	-100.0%
National Climate Change Technology Initiative Competitive Solicitation	0	0	3,000	+3,000	
Facilities and Infrastructure	5,297	12,950	11,480	-1,470	-11.4%

	(dollars in thousands)				
	FY 2003	FY 2004	FY 2005	$ Change	% Change
Program Direction	12,615	12,364	20,711	+8,347	+67.5%
Total, All Other	62,443	116,722	35,191	-81,549	-69.9%
Subtotal, General Goal 4 (Energy Supply (EERE)	322,150	370,494	374,812	+4,318	+1.2%
Use of Prior Year Balances	0	-13,000	0	+13,000	-100.0%
Total, General Goal 4 (Energy Supply (EERE)	322,150	357,494	374,812	+17,318	+4.8%

R&D Investment Criteria

The President's Management Agenda identified the need to tie R&D investment to performance and well-defined practical outcomes. One criterion by which the Department's performance is assessed involves using a framework in the R&D funding decision process and then referencing the use and outcome of the framework in budget justification material.

The goal is to develop analytical justifications for applied research portfolios in future budgets. This will require the development and application of a uniform cost and benefit evaluation methodology across programs to allow meaningful program comparisons.

This process is underway in several key areas; 1) common, consistent, and integrated analysis (modeling grounded in the EIA basecase); 2) development of a more complete and robust framework for describing program benefits -- provided in the Expected Integrated Program Outcomes section of the overviews and in the individual program Expected Program Outcomes section; and 3) development of sound analytic tools to better estimate and link potential impacts, support budget justification and describe how the R&D Investment Criteria (RDIC) influenced budget decisions.

EERE used the RDIC to support determination of relative areas of strength and weakness in the program and in selected areas of technology development. Programs have made improvements using the individual criteria as a guide to opportunities to improve program strategic management and planning, incorporating key RDIC criteria into their multi-year planning and PART (Program Assessment Rating Tool) documentation. Pilot application of the RDIC to DOE Energy Applied R & D programs was somewhat different than that used for other government programs that underwent PART; there were evidence requirements, a two-tier scoring system, and unique portfolio questions and support requirements that made scoring well on the PART more challenging. That EERE's program generally scored well reflects the quality of EERE's programs. DOE and OMB are working to resolve the requirements and process so they productively meet the intent of the President's Management Agenda.

Program Assessment Rating Tool (PART)

In addition to the use of RDIC, 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 2005 Budget , and the Department will take the necessary steps to continue to improve performance.

Program responsiveness to the President's Management Agenda/PART criteria is reflected in the improved scoring between FY 2004 and FY 2005. For example, three of the four weighted overall scores for the renewable energy program portfolio improved from last year and all were rated Moderately Effective, the second highest rating category. This was achieved while the programs managed the changes in questions and evidence requirements, a two-tier scoring system and unique portfolio questions and support requirements being applied to DOE Energy R&D programs, as distinct from what was required from other government programs that underwent PART.

In the FY 2005 PART review, OMB assessed the Hydrogen Technologies, Solar Energy Technology, Wind Energy, and Geothermal Technologies Programs within the Energy Supply account. Additionally, all EERE programs have completed an internal RDIC review. EERE program and corporate management have incorporated PART items into program planning, performance and management. In FY 2005 all the Energy Supply account R&D programs reviewed received the second highest rating possible, Moderately Effective. Improvements in scores were largely due to development of acceptable annual performance measures, a weakness identified in most of last year's PARTs. The Hydrogen Technologies Program received a score of 73 compared to last year's 64. The Solar Energy Technology Program received a score of 71 compared to last year's score of 78 (the reduction was an artifact of changes in the scoring system). The Wind Energy Program received a score of 72 compared to last year's score of 70. The Geothermal Energy Technologies Program received a score of 71 compared to last year's score of 65. All EERE Programs reviewed have directly addressed or have begun to address FY 2004 PART findings and recommendations within their control. FY 2005 performance hierarchy, goals, targets and program indicators are consistent in PART and program budgets. EERE has corporately addressed common items. One common item that remains a challenge is improving consistency of benefits estimates. EERE has begun to address this challenge through the consolidation of these analyses in its new organization and the addition of a corporate wide program efficiency measure, contributed to by all programs. EERE also addressed those findings outside of EERE's direct program control such as Departmental allocation of costs by providing full internal accounting allocation of program direction by program, and is working with Departmental and OMB staff to 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

Hydrogen Technology: Additional and realigned resources provided in the FY 2005 budget will allow the program to successfully reach key milestones that enable the goals of the FreedomCAR and Hydrogen Fuel Initiative to be achieved. To this end, research and production of hydrogen from renewables will be expanded; the infrastructure validation activities under the Hydrogen Fleet, and Infrastructure Technology Demonstration and Validation Project will be continued; and power park projects will be reduced. Additionally, an increase in safety, codes and standards research will allow for systematic analysis of safety that could lead to new standards, and life cycle and systems analysis to identify key cost and technology gaps will be performed.

Solar Energy: As the Concentrating Solar Power (CSP) effort develops a comprehensive program plan for coming fiscal years, in FY 2005 CSP will be maintained at a lower $2 million level that supports essential facilities and work underway with States to establish 1,000 MW of CSP in the Southwest.

Hydropower: Building on the fish-friendly turbine development started in FY 1995, the program is expanding its focus to developing technologies that will enable hydropower plant operators to increase generation levels by as much as 10 percent with enhanced environmental performance.

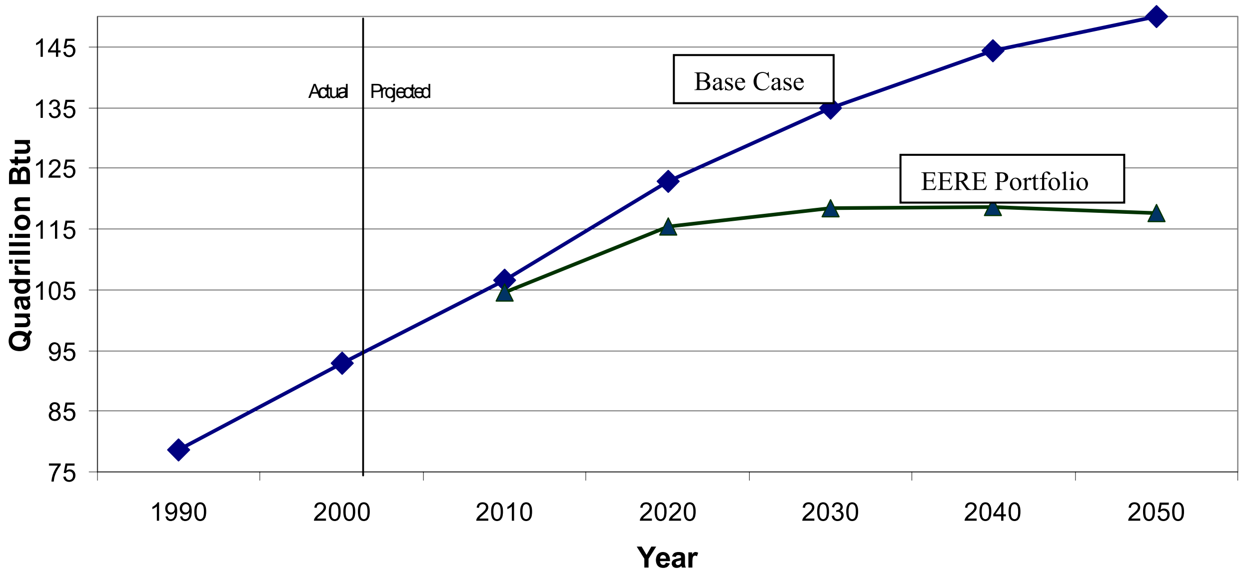
Biomass and Biorefinery Systems R&D: The Program proposes a State/Regional Partnerships activity ($4.0 million) involving collaboration with States on technology transfer, research, development, field testing, and other needed efforts to overcome market barriers in order to achieve common goals of increasing domestic, clean energy supplies and reducing oil imports.

Intergovernmental Activities: Within Intergovernmental Activities, the International Renewable Energy Program is increased by $3.8 million to promote energy innovations that meet growing energy requirements and climate change mitigation objectives in a sustainable manner. This will include support for World Summit on Sustainable Development (WSSD) projects as well as activities with the Asian Pacific Economic Cooperation (APEC).

Expected Integrated Program Outcomes

The program pursues its mission through an integrated portfolio of Research, Development, Demonstration and Deployment activities which improves the energy efficiency and productivity of our economy. 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 programs 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. The assumptions and methods underlying the modeling efforts have significant impact on the expected benefits, the resulting point estimates could also vary significantly based upon market interactions and commodity prices. A summary of the methods, assumptions, sensitivities, 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.

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 depend 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 would be expected in the absence of continued funding of EERE's programs.

Mid-term Benefits

(calendar year)

		2010	2015	2020	2025
Economic	Energy bill savings (billion 2001$)	27	51	90	134
Environment	CO2 emissions reductions (mmtce)	35	74	139	213
Security	Oil savings (mmbpd)	0.2	0.5	1.1	2.1
	Natural gas savings (quads)	0.7	1.0	1.9	1.9
	Reduced need for additions to central conventional power (GW)	24	65	102	153

Under these assumptions, EERE's programs could provide mid-term benefits in 2025 of over $100 million in annual energy bill savings; a reduction of about 200 million metric tons of annual carbon emissions; a savings of about 2 million barrels of oil per day; and a reduction of over 1.5 quads of natural gas consumption. A combination of reduced peak demand for electricity and additional renewable and DG capacity reduces the need for some 150 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 we will produce, and the ways we 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 of over $200 billion; reductions in annual carbon dioxide emissions of nearly 600 mmtce; reductions in oil demand of over 10 million barrels per day; and annual savings in natural gas demand of over 4 quads.

Long-Term Benefits

		(calendar year)		
		2030	2040	2050
Economic	Overall Energy cost savings (billion 2001$)	88	171	236
Environment	CO2 emissions reductions (mmtce)	334	471	593
Security	Oil savings (mbpd)	4.7	9.0	11.6
	Natural gas savings (quads)	2.8	5.2	4.5

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. Uncertainties also increase for the longer-term estimates. Long term estimates should be considered preliminary as EERE refines its analytical approaches for the 2030-2050 timeframe. Nonetheless, they provide a useful picture of growing national benefits over time. A summary of the methodologies, sensitivities and assumptions which are important to the development and understanding of these estimates can be found at http: www.eere.energy.gov/office_eere/budget-gpra.html.

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 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 allow us, if desired, to make substantially larger reductions in our oil use and convert a larger portion of our electricity system to decentralized capacity and renewable energy source.

Energy Supply
Office of Energy Efficiency and Renewable Energy

Funding by Site by Program

(dollars in thousands)

	FY 2003	FY 2004	FY 2005	$ Change	% Change
Atlanta Regional Office					
Solar Energy	50	50	50	0	0.0%
Wind Energy	140	75	75	0	0.0%
Total, Atlanta Regional Office	190	125	125	0	0.0%
Bonneville Power Administration					
Wind Energy	95	300	300	0	0.0%
Hydropower Technologies	50	0	50	+50	
Total, Bonneville Power Administration	145	300	350	+50	+16.7%
Boston Regional Office					
Solar Energy	50	50	50	0	0.0%
Wind Energy	70	75	75	0	0.0%
Total, Boston Regional Office	120	125	125	0	0.0%
Chicago Operations Office					
Argonne National Lab					
Hydrogen Technology	640	985	1,000	+15	+1.5%
Biomass & Biorefinery Systems R&D	188	115	90	-25	-21.7%
Intergovernmental Activities	0	150	150	0	0.0%
Total, Argonne National Lab	828	1,250	1,240	-10	-0.8%
Brookhaven National Laboratory					
Solar Energy	400	400	400	0	0.0%
Geothermal Technology	845	420	400	-20	-4.8%
Biomass and Biorefinery Systems R&D	40	40	40	0	0.0%
Total, Brookhaven National Laboratory	1,285	860	840	-20	-2.3%

	(dollars in thousands)				
	FY 2003	FY 2004	FY 2005	$ Change	% Change
National Renewable Energy Laboratory					
Hydrogen Technology	8,491	7,962	16,890	+8,928	+112.1%
Solar Energy	58,000	58,000	57,000	-1,000	-1.7%
Zero Energy Buildings	7,572	0	0	0	0.0%
Wind Energy	30,883	30,500	31,300	+800	+2.6%
Hydropower Technologies	210	149	149	0	0.0%
Geothermal Technology	3,102	2,320	2,300	-20	-0.9%
Biomass and Biorefinery Systems R&D	32,949	26,100	26,100	0	0.0%
Intergovernmental Activities	1,800	2,300	2,400	+100	+4.3%
Facilities and Infrastructure	5,297	12,950	11,480	-1,470	-11.4%
Total, National Renewable Energy Laboratory	148,304	140,281	147,619	+7,338	+5.2%
Total, Chicago Operations Office	150,417	142,391	149,699	+7,308	+5.1%
Chicago Regional Office					
Solar Energy	50	50	50	0	0.0%
Wind Energy	100	75	75	0	0.0%
Total, Chicago Regional Office	150	125	125	0	0.0%
Denver Regional Office					
Solar Energy	50	50	50	0	0.0%
Wind Energy	389	250	250	0	0.0%
Total, Denver Regional Office	439	300	300	0	0.0%
Golden Field Office					
Solar Energy	2,450	3,885	2,850	-1,035	-26.6%
Hydropower Technologies	0	200	200	0	0.0%
Geothermal Technology	8,004	11,469	10,000	-1,469	-12.8%
Intergovernmental Activities	9,724	8,895	9,775	+880	+9.9%
Program Direction	1,990	2,602	4,587	+1,985	+76.3%
Total, Golden Field Office	22,168	27,051	27,412	+361	+1.3%

	(dollars in thousands)				
	FY 2003	FY 2004	FY 2005	$ Change	% Change
Idaho Operations Office					
Idaho National Engineering & Environment Lab					
Hydrogen Technology	600	199	1,500	+1,301	+653.8%
Wind Energy	125	100	100	0	0.0%
Hydropower Technologies	965	791	850	+59	+7.5%
Geothermal Technology	3,139	2,177	2,100	-77	-3.5%
Biomass & Biorefinery Systems R&D	680	580	280	-300	-51.7%
Total, Idaho National Engineering & Environment Lab	5,509	3,847	4,830	+983	+25.6%
Idaho Operations Office					
Hydropower Technologies	1,600	0	0	0	0.0%
Total, Idaho Operations Office	1,600	0	0	0	0.0%
Total, Idaho Operations Office	7,109	3,847	4,830	+983	+25.6%
Livermore Site Office					
Lawrence Livermore National Laboratory					
Hydrogen Technology	1,750	630	2,000	+1,370	+217.5%
Geothermal Technology	1,200	671	650	-21	-3.1%
Total, Lawrence Livermore National Laboratory	2,950	1,301	2,650	+1,349	+103.7%
Total, Livermore Site Office	2,950	1,301	2,650	+1,349	+103.7%
Los Alamos Site Office					
Los Alamos National Laboratory					
Hydrogen Technology	415	1,490	1,000	-490	-32.9%
National Energy Technology Lab					
Hydrogen Technology	200	400	2,200	+1,800	+450.0%
Biomass and Biorefinery Systems R&D	15	0	0	0	0.0%
Total, National Energy Technology Lab	215	400	2200	+1,800	+450.0%

	FY 2003	FY 2004	FY 2005	$ Change	% Change
	(dollars in thousands)				
National Nuclear Security Administration's (NNSA) Service Center					
Lawrence Berkeley National Laboratory					
Wind Energy	250	250	250	0	0.0%
Geothermal Technology	900	880	800	-80	-9.1%
Intergovernmental Activities	400	300	400	+100	+33.3%
Total, Lawrence Berkeley National Lab	1,550	1,430	1,450	+20	+1.4%
NNSA Service Center					
Solar Energy	2,000	2,000	2,000	0	0.0%
Wind Energy	581	350	350	0	0.0%
Hydrogen Technology	5,195	0	0	0	0.0%
Geothermal Technology	4,500	0	0	0	0.0%
Total, NNSA Service Center	12,276	2,350	2,350	0	0.0%
Total, NNSA Service Center	13,826	3,780	3,800	+20	+0.5%
Oak Ridge Operations Office					
Oak Ridge National Laboratory					
Hydrogen Technology	410	1,896	1,000	-896	-47.3%
Solar Energy	400	280	250	-30	-10.7%
Wind Energy	152	150	150	0	0.0%
Hydropower Technologies	1,053	960	1,150	+190	+19.8%
Biomass and Biorefinery Systems R&D	2,486	1,700	1,400	-300	-17.6%
Intergovernmental Activities	600	1,100	1,100	0	0.0%
Total, Oak Ridge National Laboratory	5,101	6,086	5,050	-1,036	-17.0%
Oak Ridge Operations Office					
Solar Energy	500	500	500	0	0.0%
Total, Oak Ridge Operations	500	500	500	0	0.0%
Total, Oak Ridge Operations Office	5,601	6,586	5,550	-1,036	-15.7%

(dollars in thousands)	FY 2003	FY 2004	FY 2005	$ Change	% Change
Philadelphia Regional Office					
Solar Energy	50	50	50	0	0.0%
Wind Energy	100	100	100	0	0.0%
Total, Philadelphia Regional Office	150	150	150	0	0.0%
Richland Operations Office					
Pacific Northwest National Laboratory					
Hydrogen Technology	100	1,148	220	-928	-80.8%
Hydropower Technologies	1,078	875	950	+75	+8.6%
Biomass and Biorefinery Systems R&D	3,679	2,800	2,500	-300	-10.7%
Intergovernmental Activities	550	650	650	0	0.0%
Total, Pacific Northwest National Laboratory	5,407	5,473	4,320	-1,153	-21.1%
Total, Richland Operations Office	5,407	5,473	4,320	-1,153	-21.1%
Sandia Site Office					
Sandia National Laboratories					
Hydrogen Technology	2,613	3,867	3,900	+33	+0.9%
Solar Energy	10,000	10,100	9,000	-1,100	-10.9%
Wind Energy	3,760	3,700	3,900	+200	+5.4%
Geothermal Technology	6,425	4,690	4,540	-150	-3.2%
Intergovernmental Activities	375	525	525	0	0.0%
Biomass and Biorefinery Systems R&D	30	30	0	-30	-100.0%
Total, Sandia National Laboratories	23,203	22,912	21,865	-1,047	-4.6%
Total, Sandia Site Office	23,203	22,912	21,865	-1,047	-4.6%
Seattle Regional Office					
Solar Energy	50	50	50	0	0.0%
Wind Energy	352	150	150	0	0.0%
Total, Seattle Regional Office	402	200	200	0	0.0%

	FY 2003	FY 2004	FY 2005	$ Change	% Change
	(dollars in thousands)				
Washington Headquarters					
Office of Scientific & Technical Information					
Solar Energy	20	0	0	0	0.0%
Wind Energy	10	10	10	0	0.0%
Hydropower Technologies	11	11	11	0	0.0%
Geothermal Technology	10	10	10	0	0.0%
Biomass and Biorefinery Systems R&D	22	0	0	0	0.0%
Total, Office of Scientific & Technical Information	73	31	31	0	0.0%
Washington Headquarters					
Hydrogen Technology	17,699	63,414	65,615	+2,201	+3.5%
Solar Energy	8,260	7,928	8,033	+105	+1.3%
Wind Energy	4,553	4,825	4,115	-710	-14.7%
Hydropower Technologies	49	1,919	2,590	+671	+35.0%
Geothermal Technology	265	2,871	5,000	+2,129	+74.2%
Biomass and Biorefinery Systems R&D	45,194	55,106	42,186	-12,920	-23.4%
Intergovernmental Activities	1,000	800	1,000	+200	+25.0%
Departmental Energy Management Program	1,445	1,963	1,967	+4	+0.2%
Program Direction	10,625	9,762	16,124	+6,362	+65.2%
National Climate Change Technology Initiative	0	0	3,000	+3,000	
Renewable Program Support	0	4,919	0	-4,919	-100.0%
Total, Washington Headquarters	89,090	153,507	149,630	-3,877	-2.5%
Total, Washington Headquarters	89,163	153,538	149,661	-3,877	-2.5%
Western Area Power Administration					
Wind Energy	80	400	400	0	0.0%
Hydropower Technologies	0	0	50	+50	
Total, Western Area Power Administration	80	400	450	+50	+12.5%

	(dollars in thousands)				
	FY 2003	FY 2004	FY 2005	$ Change	% Change
Subtotal, Energy Supply (EERE)	322,150	370,494	374,812	+4,318	+1.2%
Use of prior year balances	0	-13,000	0	+13,000	-100.0%
Total, Energy Supply (EERE)	322,150	357,494	374,812	+17,318	+4.8%

Site Description

Atlanta Regional Office

Introduction

The Atlanta 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 Solar Energy, Wind energy and Biomass and Biorefinery R&D.

Solar Energy

Atlanta Regional Office helps to administer the Million Solar Roofs Initiative.

Wind Energy

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

Bonneville Power Administration

Introduction

The Bonneville Power Administration is located in Portland, Oregon. It supports the Wind and Hydropower programs.

Wind Energy

The Bonneville Power Administration is supporting the Wind Energy program's integration and wind plant forecasting efforts by providing operational data on the integration of wind into its electric power grid.

Hydropower Technologies

The Bonneville Power Administration provides technical support and assistance for hydropower/ renewable integration studies.

Boston Regional Office

Introduction

The Boston 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 Solar Energy, Wind Energy and Biomass and Biorefinery Systems R&D.

Solar Energy

Boston Regional Office helps to administer the Million Solar Roofs Initiative.

Wind Energy

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

Chicago Operations Office

Argonne National Laboratory

Introduction

Argonne National Laboratory is located in Argonne, Illinois. It is a multi-discipline laboratory providing support to Hydrogen Technology and Biomass and Biorefinery Systems R&D.

Hydrogen Technology

The Argonne National Laboratory (ANL) is conducting research and development of advanced hydrogen storage concepts such as nanostructured materials.

Biomass and Biorefinery Systems R&D

Argonne National Laboratory (ANL) conducts environmental benefits analysis for several EERE programs, including energy balance and emissions for biofuels in conventional and advanced vehicles with and without fuel cells.

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.

Brookhaven National Laboratory

Introduction

Brookhaven National Laboratory is located in Upton, New York. It is a multi-discipline laboratory providing support to the Solar Energy, Geothermal Technology, and Biomass and Biorefinery Systems.

Solar Energy

Brookhaven National Laboratory (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.

Geothermal Technology

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

Biomass and Biorefinery Systems R&D

Brookhaven National Laboratory conducts analysis of market penetration for EERE technologies, including biomass technologies, in support of all the programs, using the internationally acclaimed energy technology model MARKAL.

National Renewable Energy Laboratory

Introduction

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

Hydrogen Technology

National Renewable Energy Laboratory (NREL), located in Golden, CO, 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 Technology

National Renewable Energy Laboratory (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.

Zero Energy Buildings

The National Renewable Energy Laboratory (NREL) conducts research and development for the Zero Energy Building Consortia and Building Technology Program, including Building America.

Wind Energy

National Renewable Energy Laboratory (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 is required for sales and operation in many overseas markets. NWTC staff also conducts the Department's cost-shared Wind Turbine Research partnerships with industry.

Hydropower Technologies

The National Renewable Energy Laboratory conducts hydropower/renewable energy integration studies and hydropower outreach activities.

Geothermal Technology

The National Renewable Energy Laboratory (NREL) serves as the lead laboratory for heat transfer research under Systems Development. The laboratory also supports the Geothermal Technology Program in the Deployment areas of education, outreach and systems analysis.

Biomass and Biorefinery Systems R&D

The National Renewable Energy Laboratory (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.

Intergovernmental Activities

The National Renewable Energy Laboratory (NREL), located in Golden, Colorado, 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 interagency program 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.

Facilities and Infrastructure

The Facilities and Infrastructure program provides funding for General Plant Projects (GPP) and General-Purpose Equipment (GPE), which provides for maintenance and 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 is beginning construction in FY 2004.

Chicago Regional Office

Introduction

The Chicago Operations 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 Biomass and Biorefinery Systems R&D.

Solar Energy

Chicago Regional Office helps to administer the Million Solar Roofs Initiative.

Wind Energy

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

Denver Regional Office

Introduction

The Denver 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; (3) provides direction, guidance, and support deployment and outreach programs on a local and regional level; and Denver Regional Office is located in Denver, Colorado. It provides support to Solar Energy, Wind Energy and Biomass and Biorefinery Systems R&D.

Solar Energy

Denver Regional Office helps to administer the Million Solar Roofs Initiative.

Wind Energy

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

Golden Field Office

Introduction

The Golden Field Office(GO) is located in Golden, Colorado. It provides project management and procurement support for Hydrogen Technology, Wind Energy, Hydropower Technologies, Geothermal Technologies, Biomass and Biorefinery Systems R&D, Intergovernmental Activities, and Program Direction.

Solar Energy

Golden Field Office develops competitive procurements for the Solar Program and manages the resulting contracts and grants. These procurements include solar conferences, standards and certifications for solar systems, and solar education and outreach. Golden also manages the Georgia Institute of Technology photovoltaic Center of Excellence.

Hydropower Technologies

The Golden Field Office administers contracts, grants, and interagency agreements under the Hydropower subprogram.

Geothermal

Golden Field Office provides management of research at National Renewable Energy Laboratory, administers financial assistance awards to universities, and oversees projects in Enhanced Geothermal Systems under Resource Development. Activities previously conducted at the Idaho Operations Office were transferred to the Golden office in 2004.

Intergovernmental Activities

Golden Field Office (GO) is responsible for the management of awards to Native American Tribes for renewable energy projects. GO also manages SEP special project grants a crosscutting Gateway activity. GO also administers the Renewable Energy Production Incentive (REPI) program. 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 from appropriations.

Program Direction

Provides program direction, guidance, and support. 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 & Environmental Laboratory

Introduction

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

Hydrogen Technology

The Idaho National Environmental and Engineering Laboratory (INEEL), is performing 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 energy efficiencies than standard water electrolysis for the production of hydrogen. INEEL is also involved in hydrogen storage research and development.

Wind Energy

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

Hydropower Technologies

INEEL performs research and development for the Hydropower subprogram. INEEL has been the principal DOE laboratory for the Hydropower subprogram since its inception. 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 resource and economic assessments.

Geothermal Technology

INEEL serves as the lead laboratory for research in Resource Development. INEEL studies fluid flow and solute transport modeling in hydrothermal reservoirs and conducts site investigations of geothermal resource potential. INEEL also conducts research on instrumentation and other ancillary technologies for energy conversion systems.

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.

Idaho Operations Office

Introduction

Idaho Operations office solicits, awards, and administers research and development contracts, cooperative agreements, and grants with industry, academia, and other Government organizations and provides contract administration for grants and cooperative agreements for university research for Hydropower.

Hydropower Technologies

Idaho National Engineering and Environmental Laboratory (INEEL) performs research and development for the Hydropower subprogram. INEEL has been the principal DOE laboratory for the Hydropower subprogram since its inception. INEEL serves as the engineering technical monitor for the Advanced Hydro Turbine Technology subprogram and the Tribal Energy hydropower projects located in Alaska.

Livermore Site Office

Lawrence Livermore National Laboratory

Introduction

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

Hydrogen Technology

The Lawrence Livermore National Laboratory (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.

Geothermal Technology

Lawrence Livermore National Laboratory performs Resource Development research on problems related to Enhanced Geothermal Systems and exploration technology, including isotope and geochemical studies. The laboratory also conducts research on brine chemistry.

Los Alamos Site Office

Introduction

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

Hydrogen Technologies

The Los Alamos National Laboratory (LANL) is conducting research and development of advanced hydrogen storage concepts such as polymer micro-spheres. It is a multi-discipline laboratory providing support to Hydrogen Technology.

National Energy Technology Laboratory

Introduction

National Energy Technology Laboratory (NETL) is located in Morgantown, West Virginia. It provides procurement support to the Hydrogen Technology Programs.

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 are developing separation and purification methods critical to producing high quality hydrogen used in fuel cells.

Biomass and Biorefinery Systems R&D

National Energy Technology Laboratory coordinates with biomass projects funded under Energy Supply appropriation in view of NETL's extensive involvement with biomass/black liquor gasification work funded by Energy Conservation Appropriations.

National Nuclear Security Administration's (NNSA) Service Center

Lawrence Berkeley National Laboratory

Introduction

Lawrence Berkeley National Laboratory is located in Berkeley, California. It is a multi-discipline laboratory providing support to the Wind Energy, Geothermal Technology, and Intergovernmental Activates.

Wind Energy

Lawrence Berkeley National Laboratory (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

Lawrence Berkeley National Laboratory performs research on geoscience problems related to Enhanced Geothermal Systems and exploration technology including studies of reservoir dynamics and seismic, isotopic, and electromagnetic exploration techniques. These activities are under Resource Development.

NNSA Service Center

Solar Energy

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

Wind Energy

NNSA Service Center (USDA Agricultural Research Center) is located Bushland, Texas. It performs research on agricultural applications of Wind Energy including irrigation and small hybrid power systems.

Hydrogen

The National Nuclear Security Administration's Service Center administered cooperative agreements for the Hydrogen program.

Geothermal Technology

NNSA Service Center administers financial assistance awards to cost-sharing industry partners for geothermal resources exploration and definition activities under Technology Verification for Geothermal Technology.

Oak Ridge Operations Office

Oak Ridge National Laboratory

Introduction

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

Hydrogen Technology

The Oak Ridge National Laboratory performs research and development activities in photobiology and storage in support of the lead labs, NREL and Sandia National Laboratories, respectively. 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

Oak Ridge National Laboratory 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.

Wind Energy

Oak Ridge National Laboratory (ORNL) provides analysis and support to wind integration studies and applications.

Hydropower Technologies

Oak Ridge National Laboratory (ORNL) provided the environmental analysis for the DOE Hydropower Energy environmental mitigation study, and the lab's environmental scientists and fisheries biologists perform hydropower environmental impact studies for the Federal Energy Regulatory Commission. Currently, ORNL has the primary responsibility for environmental analysis and as environmental technical monitor for the Advanced Hydro Turbine Technology program.

Biomass and Biorefinery Systems R&D

Oak Ridge National Laboratory (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.

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 as well as establishing joint implementation offices and identifying and developing joint implementation projects.

Oak Ridge Operations Office

Oak Ridge Operations Office is located in Oak Ridge, Tennessee. It provides technical support for the Solar Energy program. It provides procurement support and provides support to the R&D programs by administering grants and cooperative agreements to regional, State and local organizations, both public and private.

Solar

Oak Ridge Operations Office helps to administer the Million Solar Roofs Initiative.

Philadelphia Regional Office

Introduction

The Philadelphia 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 Solar Energy and Wind Energy.

Solar Energy

Philadelphia Regional Office helps to administer the Million Solar Roofs Initiative.

Wind Energy

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

Richland Operations Office

Pacific Northwest National Laboratory

Introduction

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

Hydrogen Technology

For the Hydrogen Technology, the Pacific Northwest National Laboratory (PNNL) is the lead laboratory in the development of safety materials and systems for various end use applications. PNNL performs research and development tasks and other technical support to address safety issues involved with various technologies, including underground storage, pipeline transmission and hydrogen sensing.

Hydropower Technologies

PNNL is providing biological testing support for the Advanced Hydropower Technology program. PNNL has designed and fabricated test equipment to simulate turbine-induced physical stresses on fish, and is currently conducting experiments on shear stresses. These experiments are conducted under ORNL technical direction and oversight.

Biomass and Biorefinery Systems R&D

PNNL provides thermochemical research and development in support of the syngas platform and related products. Major components include thermocatalysts for fuels and chemicals and wet biomass for syngas production.

Intergovernmental Activities

PNNL performs on-going research and technical assistance for the International Renewable Energy Program, including technical assistance for the International Renewable Energy Program to transition countries for emission trading and developing joint implementation projects. In addition, PNNL participates in the evaluation of joint implementation proposals and in preparing reports on the U.S. Joint Implementation program.

Sandia Site Office

Sandia National Laboratories

Introduction

Sandia National Laboratories is located in Albuquerque, New Mexico. It is a multi-discipline laboratory providing support to Hydrogen Technology, Solar Energy, Wind Energy, Geothermal Technology, Biomass and Biorefinery Systems R&D, and Intergovernmental Activities.

Hydrogen Technology

The Sandia National Laboratories 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 Technology

Sandia National Laboratories 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 that are part of the Zero Energy Building efforts.

Wind Energy

The 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

Sandia National Laboratories (SNL) serves as the lead laboratory for coordination of geothermal drilling research under Systems Development. In cooperative projects with the U.S. geothermal industry, SNL performs research on advanced drilling systems including 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.

Intergovernmental Activities

Sandia National Laboratories provide 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 is a major laboratory for the International Renewable

Energy interagency program seeking to mobilize private investment in clean energy technologies identified as climate change and development priorities by key developing and transition countries.

Biomass and Biorefinery Systems R&D

Sandia National Laboratories (SNL) provides technical and field management support to the systems development task associated with small modular biopower.

Seattle Regional Office

Introduction

The Seattle 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. Seattle Regional Office is located in Seattle, Washington and provides support to Solar Energy, Wind Energy, and Biomass and Biorefinery Systems R&D.

Solar Energy

Seattle Regional Office helps to administer the Million Solar Roofs Initiative.

Wind Energy

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

Washington Headquarters

Office of Scientific and Technology Information

Introduction

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

Solar Energy Technology

The Office of Scientific and Technology Information (OSTI) publishes and maintains on-line full text of eight electronic current awareness Solar Program publications and produces CD-ROM disks containing photovoltaic reports.

Wind Energy

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

Hydropower Technologies

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

Geothermal Technology

OSTI performs standard distribution of information for multiple EERE programs including Geothermal Technology. This distribution consists of publishing and maintaining on-line full text of eight electronic current awareness publications.

Biomass and Biorefinery Systems R&D

In FY 2003, OSTI performed distribution of information for Biomass and Biorefinery Systems R&D. The Office of Scientific and Technology Information (OSTI) distributes technical information for the program, including publishing and maintaining on-line full text of several technical publications sponsored by the Program.

Washington Headquarters

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 solicitations are planned and implemented through Headquarters. It provides support to Hydrogen Technology, Solar Energy, Wind Energy, Hydropower, Geothermal Technology, Biomass and Biorefinery Systems R&D, Intergovernmental Activities, Departmental Energy Management Program, Program Direction, National Climate Change Technology Initiative Competitive Solicitation, and Renewable Program Support.

Western Area Power Administration

Introduction

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

Wind Energy

The Western Area Power Administration is conducting analysis of integrating wind into its power system, including assessment of opportunities for coordinating operation with its hydropower assets.

Hydropower Technologies

The Western Area Power Administration provides technical support and assistance for hydropower/ renewable integration studies.

Hydrogen Technology

Funding Profile by Subprogram[a]

(dollars in thousands)

	FY 2003 Comparable Appropriation	FY 2004 Original Appropriation	FY 2004 Adjustments[b,c]	FY 2004 Comparable Appropriation	FY 2005 Request
Hydrogen Technology					
Production and Delivery R&D	11,215	23,000	- 436	22,564	25,325
Storage	10,790	30,000	- 568	29,432	30,000
Infrastructure Validation	9,680	13,160	+5,219[d]	18,379	15,000
Safety, Codes & Standards, and Utilization	4,531	6,018	- 114	5,904	18,000
Education and Cross-Cutting Analysis	1,897	5,822	- 110	5,712	7,000
Total, Hydrogen Technology	38,113	78,000	+3,991	81,991	95,325

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 $421,976 was transferred to the Science appropriation in FY 2003. Estimates for SBIR/STTR budgeted in FY 2004 and FY 2005 are $2,181,014 and $1,549,100 respectively.

[b] Programs in Energy Supply appropriations were reduced by .59 percent as required by the Omnibus Appropriation Bill.

[c] Programs in the Energy Supply appropriation were proportionally reduced based upon the allocated General Reduction of $4,684,000.

[d] Hydrogen Technology Program increases by the Omnibus Appropriation Bill of $5,500,000. This amount was subject to the .59 percent reduction required by the Omnibus Appropriations Bill.

Mission

The Hydrogen Technology Program 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 for transportation and stationary applications. The program aims to have Hydrogen from diverse domestic resources used in a clean, safe, reliable, and affordable manner in fuel cell vehicles, central station electric power production and distributed thermal electric and combined heat and power applications.

Benefits

The Hydrogen Technology Program is a key component of both the President's Hydrogen Fuel Initiative, which allows the Nation to aggressively move forward to achieve the vision of a diverse, secure, and emissions-free energy future. To the extent that hydrogen is produced from domestic resources in an environmentally sound manner, the Hydrogen Technologies Program will provide a significant environmental benefit for the Nation. Research undertaken by the Hydrogen Technology Program is targeted to reduce the cost of distributed production of hydrogen from natural gas by a factor of 3-4, enable cost competitive production from renewables, and provide storage technology that enables greater than 300 mile driving range for vehicles. Together, the FreedomCAR Partnership and the Hydrogen Fuel Initiative 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 to our reliance on oil.

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

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

Program Goal 04.01.01.00: Hydrogen Technology. The Hydrogen, Fuel Cells and Infrastructure Technologies Program goal is to develop hydrogen production, storage, and delivery technologies to the point that they are cost and performance competitive and are being used by the Nation's transportation, energy, and power industries. As such, the program will expand clean domestic energy supplies to dramatically reduce or even end dependence on oil.

Contribution to Program Goal 04.01.01.00 (Hydrogen Technology)

By 2010, the Hydrogen Technology Program will contribute to General Goal 4, Energy Security, through its Production and Delivery activities by developing market based technologies that will reduce the cost of producing hydrogen from natural gas and renewables. Specific goals are to:

- Complete research for distributed hydrogen generation technology that will reduce the cost of producing hydrogen from natural gas from $5.00 per gallon of gasoline equivalent (gge) untaxed in 2003 to $1.50/gge (at 5000 pounds per square inch [psi]) untaxed at the station with mature production volumes (e.g. 100 units/year).
- Complete research for hydrogen production from renewables to achieve $3.90/gge untaxed at the station (5000 psi).

The program also contributes to General Goal 4, Energy Security, through its storage activities by developing and validating a market based hydrogen storage technology that enables greater than 300-mile vehicle driving range. Specifically, a hydrogen storage technology with capacity of 2.0 kWh/kg (6 weight percent) and 1.5 kWh/L (kilowatt-hours per liter) will be developed and validated by 2010.

The Hydrogen Technology Program will contribute to General Goal 4, Energy Security, through Education activities which 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 2010 (relative to the 2004 baseline) thus accelerating the market adoption of hydrogen-based technology. [a]

The program also contributes to General Goal 4, Energy Security, through its Systems Analysis activities which define and implement a fully functional systems integration capability to establish and validate the DOE Hydrogen integrated baseline requirements and schedule by 2005, enabling improved planning and management of this complex initiative.

The Hydrogen Technology Program will contribute to General Goal 4, Energy Security, through Infrastructure Validation activities which will validate the technology at full scale to achieve the cost of hydrogen production and delivery at the station. The indicator of performance expected is to validate infrastructure and vehicle interface technologies in 2009 at full scale with a cost of $3.00 per gallon gasoline equivalent (excludes co-production of electricity).

The program also will contribute to General Goal 4, Energy Security, through its Safety, Codes and Standards, and Utilization activities by drafting technical specifications that will enable preparation of a global technical regulation for hydrogen fuel cell vehicles and infrastructure beginning in 2008.

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[a] This modification to the education contribution was made to better differentiate between the goals for certain target audiences, based on their educational needs and roles in a hydrogen economy (end-users vs. teachers, students, and governments).

Standardization is critical for infrastructure development necessary for market growth of this new energy carrier.

Annual Performance Results and Targets

FY 2000 Results	FY 2001 Results	FY 2002 Results	FY 2003 Results	FY 2004 Targets	FY 2005 Targets
Program Goal 04.01.01.00 (Hydrogen Technology)					
Production & Delivery R&D					
No targets established.	No targets established.	Non-renewables: Completed construction of a prototype hydrogen generator with ceramic membrane for production and purification of hydrogen from natural gas.	Non-renewables: Completed the design of a distributed natural gas-to- hydrogen production and dispensing system.	Non-renewables: 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.	Non-renewables: 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.
No targets established.	No targets established.	No targets established.	No targets established.	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.	Renewables: Model cost of hydrogen produced from renewables for $5.70 /gge (untaxed) at the station at 5000 psi.
Storage/Tanks					
No targets established.	No targets established	Completed certification of a 5000 pounds per square inch (psi) hydrogen storage tank achieving 1.7 kilo watt-hour per kilogram (kWh/kg) and 0.8 kilo watt-hour per liter (kWh/L) (tank-only).	Completed design of the 5,000 psi cryogenic-gas tank and 10,000 psi compressed gas tank achieving 1.3 kWh/kg and 1.0 kWh/L.	Complete development of 5,000 psi cyro-gas tank and 10,000 psi compressed gas tank achieving 1.3 kWh/kg and 1.0 kWh/L.	Tanks: Complete testing and validation of 10,000 psi hydrogen storage tank achieving the 2005 hydrogen storage system targets of 1.5 kWh/kg (4.5 weight percent), 1.2 kWh/L, and $6/KWh.

FY 2000 Results	FY 2001 Results	FY 2002 Results	FY 2003 Results	FY 2004 Targets	FY 2005 Targets
Storage/Solid State					
No targets established.	No targets established.	Developed materials enabling system targets of 0.8 kWh/kg and 0.5 kWh/L.	Designed sub-scale solid state system meeting targets of 0.8 kWh/kg and 0.5 kWh/L.	Solid State: Complete draft of standard test protocol and construction of test facility for solid-state hydrogen storage materials in support of the 2005 targets of 1.2 kWh/L and 4.5 wt% and the 2010 targets of 2.0kWh/kg (6 wt. %), 1.5 kWh/L at $4/kWh.	Identify materials with the potential to meet 2010 targets of 2.0 kWh/kg (6 weight percent), 1.5 kWh/L, at $4/kWh.
Education and Cross-Cutting Analysis					
No targets established.	No targets established.	No targets established.	No targets established.	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)	
No targets established.	No targets established.	No targets established.	No targets established.	Define requirements for system analysis integration to link the program's technical objectives to cost and schedule.	
Infrastructure and Validation					
No targets established.	No targets established.	Completed hydrogen refueling station from renewable sources.	Completed development of an integrated refueling station that can produce 5,000 psi hydrogen from natural gas for $3.60 per gallon of gasoline equivalent (gge) (including co-production of electricity), untaxed at the station.	Identify and complete feasibility and system design of an isothermal compressor to be incorporated in hydrogen refueling stations to produce hydrogen at $3.00/gge by 2009.	Complete validation of an integrated refueling 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 production volumes (e.g., 100 units/year).

FY 2000 Results	FY 2001 Results	FY 2002 Results	FY 2003 Results	FY 2004 Targets	FY 2005 Targets
Safety, Codes and Standards, and Utilization					
No targets established.	No targets established.	No targets established.	No targets established.	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.	
Management of Funds					
				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 uncosteds to a range of 20-25 percent by reducing program annual uncosteds by 10 percent in 2005 relative to the program uncosted baseline (2003) until the target range is met.

Means and Strategies

The Hydrogen Technology 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 Hydrogen Technology Program will implement 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 safety, codes and standards, and utilization activities, focused on ensuring the safety aspects of hydrogen technologies and developing widely accepted codes and standards. Code developers will be assisted by experimental data from hydrogen refueling demonstration sites.
- Invest in technical program and market analyses and performance assessments, in order to direct effective strategic planning.
- Develop and distribute educational materials and training to facilitate the transition to a hydrogen economy.

The Hydrogen Technology Program will implement the following strategies:

- Utilize the Multi-year Research, Development and Demonstration Plan, developed by the HFCIT program. The Plan identifies barriers, technical targets, and schedule for carrying out the program mission. Focus on addressing the high risk, critical technology barriers as described in the Plan.
- Utilize the National Hydrogen Energy Roadmap, released in November 2002 by Energy Secretary Abraham. This document developed by over 200 technical experts from public and private organizations, lays out research and development pathways, and serves as a guide to public and private investment in hydrogen and fuel cell technologies.
- Coordinate with the FreedomCAR Partnership, which was announced by the Secretary of Energy and senior executives of DaimlerChrysler, Ford, and General Motors in January 2002.
- Coordinate with other DOE programs and with other Federal agencies involved in hydrogen-related research and development. (See list of collaborative activities below)
- Align the program to the goals of the Hydrogen Fuel Initiative. The Hydrogen Fuel Initiative, along with the FreedomCAR Partnership, aims to facilitate an industry decision to commercialize hydrogen-powered fuel cell vehicles by the year 2015. Program strategies are also aligned with the FreedomCAR Partnership goals (see below).
- Perform formal merit reviews, closely coordinated with those supported within the Fuel Cell Technologies Program (funded under the Energy Conservation Appropriation), to develop and

demonstrate highly efficient, integrated hydrogen technologies for stationary and transportation applications. The merit review evaluation incorporates the principles of the Administration's R&D investment criteria.

- Participate in the development of uniform codes and standards at the international level to ensure that the U.S. industry can compete globally.
- Centers of Excellence for R&D on chemical hydrides, metal hydrides and carbon-based materials will be used to support the solid state storage goal and enable independent, standardized testing and evaluation of storage materials under development.
- 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).

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 taxpayer's dollars to more productive use.

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

- Congressionally-directed projects that do not contribute to the program's goals.
- Once a commercialization decision is made by industry in 2015, the price and availability of alternative technologies (such as gasoline hybrid vehicles) 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.
- Public acceptance and concerns regarding the safe use of hydrogen.

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

- Collaborating with other DOE offices and Federal agencies, including closely coordinating vehicle related activities with the DOE's FreedomCAR and Vehicles Technologies Program.
- For activities that support transportation applications, cooperating with the U.S. Council for Automotive Research (USCAR) and energy companies. This collaboration, implemented through technical teams, provides a mechanism for developing requirements, industry consensus, and recommendations for program direction. These technical teams are composed of government and industry experts that meet on a periodic basis to review and provide guidance on projects.
- Working with the Department of Transportation (DOT), the Environmental Protection Agency (EPA) and the National Institute for Standards and Technology (NIST) on safety, codes and standards activities.

- Developing and publishing a comprehensive planning document in collaboration with the Department's Offices of Science, Fossil Energy, and Nuclear Energy, Science and Technology (and with input by DOT).

Hydrogen Fuel Initiative (HFI)

(dollars in thousands)

Hydrogen Fuel Initiative	FY 2005 Budget Request
EERE	172,825
FE	16,000
NE	9,000
SC	29,183
Total, DOE	227,008
DOT	832
Total, Hydrogen Fuel Initiative	227,840

- Participating in the Hydrogen R&D Interagency Task Force involving all Federal agencies that have hydrogen-related activities.
- Conducting R&D and demonstration activities through competitive, cost-shared contracts with industry, as well as collaborating with national laboratories and universities.
- Initiating and implementing an International Partnership for a Hydrogen Economy to leverage R&D capabilities in other countries.
- Through the Department's newly formed partnership with the energy industry, expand upon FreedomCAR's 2010 technology specific goals initially formed with the U.S. automotive industry partners. These additional technology goals will more specifically address hydrogen technology barriers.

FreedomCAR Partnership 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 Drivetrain 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) that achieves a 325 W/kg power density and 220 W/L 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.
- 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 weight 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, the Hydrogen Technology Program 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 HFCIT 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 are used to validate technical targets.

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

- non-renewable production (delivered) (2003): $5.00/gge
- renewable production (delivered) (2003): $6.20/gge
- compressed hydrogen storage (2003): 1.3 kWh/kg and 1.0 kWh/L
- solid state materials for storage systems (2002): 0.8 kWh/kg and 0.5 kWh/L

- education (2004): Survey[a]

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

Data Storage: EE Strategic Management System

Verification: Evaluation -- Merit reviews and peer evaluations by energy, hydrogen, and fuel cell experts from outside of the U.S. Department of Energy are used to ensure that the directions and priorities of the program are focused on long term research. The program conducts peer review meetings and supports the development of industry-driven technology roadmaps.[b] The National Academy of Sciences also conducts Program peer review. 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.

The National Laboratories receive direct funds for hydrogen and fuel cell technology research and development of a very high risk and basic nature, based on their capabilities and performance. Hydrogen and fuel cell industry experts review each laboratory and industry project at the annual Merit Review 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. Principles of the Administration R&D investment criteria for research have been incorporated into this evaluation. The panel also evaluates the strengths and weaknesses of each project, and recommends additions to or deletions from the scope of work. The program organization facilitates supplier-customer relationships to ensure that R&D results from federally sponsored laboratories are transferred to industry suppliers and that industry supplier developments are made available to automakers, energy industry and stationary power producers.

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. Based on the FY 2004 PART review, the Hydrogen Technology Program has incorporated feedback from OMB into the FY 2005 Budget Request and has taken or will take the necessary steps to continue to improve performance.

The FY 2004 PART review of the Hydrogen Technologies Program contained a recommendation to establish a new partnership with the energy industry to complement the Administration's FreedomCAR Partnership, which will accelerate the Nation's transition to a hydrogen-based economy. A partnership that was launched to develop initial plans for coordinating hydrogen research activities with automotive

[a] A survey is currently underway to determine the 2004 baseline.

[b] See the following reports. 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.

and energy industry partners.

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 will lead to cooperative agreements with universities and industry, and field work proposals with national laboratories to develop high-risk hydrogen production from renewables and hydrogen storage technologies. Another FY 2004 PART recommendation suggested the development of adequate annual performance measures, and annual performance measures have been included in annual budget requests that correlate with multi-year program plan technical targets. 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 of nine points to seventy three, 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 and with industry in establishing a plan to achieve the goals of President's Hydrogen Fuel Initiative. The PART noted that significant earmarks in FY 2004, of nearly half of the program's budget, jeopardize progress on the President's initiative by reducing program funding available for competitive solicitations and core national laboratory research designed to contribute toward program goals.

Funding by General and Program Goal

(dollars in thousands)

	FY 2003	FY 2004	FY 2005	$ Change	% Change
General Goal 4, Energy Security					
Program Goal 04.01.01, Hydrogen					
Production and Delivery R&D	6,398	10,344	25,325	+14,981	+144.8%
Storage R&D	10,790	13,981	30,000	+16,019	+114.6%
Infrastructure Validation	5,864	5,849	15,000	+9,151	+156.5%
Safety, Codes & Standards, and Utilization	2,568	5,904	18,000	+12,096	+204.9%
Education and Cross-Cutting Analysis	1,897	3,946	7,000	+3,054	+77.4%
Total, Program Goal 04.01.01.00, Hydrogen	27,517	40,024	95,325	+55,301	+138.2%
All Other					
Congressionally Directed Activities, Production and Delivery R&D [a]					
Fuel Cell Development for DG & CO2 sequestration – Northwest Indiana	0	1,962	0	-1,962	-100.0%
EVermont Hydrogen Electrolyzer Project	0	937	0	-937	-100.0%

[a] The Hydrogen Technology Program is working with the recipients of the congressionally directed funding to attempt to develop statements of work that address technology barriers and support program goal.

(dollars in thousands)

	FY 2003	FY 2004	FY 2005	$ Change	% Change
Startech Hydrogen Production Project	0	491	0	-491	-100.0%
Solar-powered Thermo-chemical Production of Hydrogen from Water Project	1,927	2,943	0	-2,943	-100.0%
Hawaii Hydrogen Ctr. for Dev. and Deploy. of Distrib. Energy System	0	491	0	-491	-100.0%
Shared Technology Transfer Program by Nicholls State Univ.	0	981	0	-981	-100.0%
Production & Delivery/HI-Way Initiative in New York State	0	1,962	0	-1,962	-100.0%
Production & Delivery/SOFC Solicitation	0	2,453	0	-2,453	-100.0%
PEM Fuel Cell and Purification	2,890	0	0	0	0.0%
Total, Production and Delivery R&D	4,817	12,220	0	-12,220	-100.0%
Congressionally Directed Activities, Storage R&D[a]					
Florida Hydrogen Partnership	0	1,962	0	-1,962	-100.0%
Fuel Cell Research by Univ. of South Florida	0	1,962	0	-1,962	-100.0%
Hydrogen Futures Park at University of Montana	0	736	0	-736	-100.0%
Fuel Cell Mine Loader and Prototype Locomotive	0	1,962	0	-1,962	-100.0%
Univ. of Nevada-Las Vegas for Renewable H2 Fueling Station System	0	2,943	0	-2,943	-100.0%
Edison Materials Technology Center	0	2,943	0	-2,943	-100.0%
National Center for Manufacturing Sciences	0	2,943	0	-2,943	-100.0%
Total, Storage R&D	0	15,451	0	-15,451	-100.0%
Congressionally Directed Activities, Infrastructure Validation[a]					
Hydrogen Regional Infrastructure Program in Pennsylvania	0	2,943	0	-2,943	-100.0%
Expanding Clean Energy Research and Education Univ. South Carolina	0	2,158	0	-2,158	-100.0%
Hydrogen Regional Fuel Cell Project - Washoe County, Nevada	0	1,962	0	-1,962	-100.0%

[a] The Hydrogen Technology Program is working with the recipients of the congressionally directed funding to attempt to develop statements of work that address technology barriers and support the program goal.

	(dollars in thousands)				
	FY 2003	FY 2004	FY 2005	$ Change	% Change
Enterprise Center for Chattanooga Fuel Cell Demo	0	2,485	0	-2,485	-100.0%
Hawaii Hydrogen Ctr. for Dev. and Deploy. of Distrib. Energy System	0	2,982	0	-2,982	-100.0%
Ohio University Fuel Pilot Project	2,853	0	0	0	0.0%
Fuel Cell Project – Gallatin County, Montana	963	0	0	0	0.0%
Total, Infrastructure Validation	3,816	12,530	0	-12,530	-100.0%
Congressionally Directed Activities, Safety, Codes & Standards and Utilization[a]					
Ohio University Fuel Pilot Project	1,000	0	0	0	0.0%
Fuel Cell R&D at South AL Energy	963	0	0	0	0.0%
Total, Safety Codes & Standards and Utilization	1,963	0	0	0	0.0%
Congressionally Directed Activities, Education and Cross-Cutting Analysis[a]					
Residential Fuel Cell Demo by the Delaware County Electric Coop	0	294	0	-294	-100.0%
Smart Energy Management Control Systems	0	491	0	-491	-100.0%
Lansing Community College Alternative Energy Center	0	981	0	-981	-100.0%
Total, Education and Cross-Cutting Analysis	0	1,766	0	-1,766	-100.0%
Total, All Other	10,596	41,967	0	-41,967	-100.0%
Total, General Goal 4 (Hydrogen Technology)	38,113	81,991	95,325	+13,334	+16.3%

Expected Program Outcomes

The Hydrogen Program 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 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 Hydrogen Program goals would provide the technical potential to reduce conventional energy use even further if warranted by future energy needs.

[a] The Hydrogen Technology Program is working with the recipients of the congressionally directed funding to attempt to develop statements of work that address technology barriers and support program goal.

Estimates for energy savings, energy expenditure savings carbon emission reductions, oil savings, and natural gas savings that result from the realization of the integrated Hydrogen, Fuel Cells and Infrastructure Technologies 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. Achievement of the program goals could result in mid-term oil savings of 0.4 million barrels per day (MBPD) in 2025 (based on the GPRA05-NEMS model) and in the long term ramp up to savings of 6 MBPD in 2050 (based on preliminary estimates using the GPRA05–MARKAL model).

The full long-term potential for renewable-based hydrogen is not reflected in this FY05 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 2005 GPRA Benefits Estimates for Hydrogen, Fuel Cells and Infrastructure Technologies Program[a]

Mid-term benefits[b]

	2010	2015	2020	2025
Primary Non-Renewable Energy Savings (Quads)	ns	0.1	0.1	0.5
Energy Expenditure Savings (Billion 2000$)	ns	0.3	1	5
Carbon Emission Réductions (MMT)	ns	1	4	12
Oil Savings (MBPD)	ns	ns	0.1	0.4
Natural Gas Savings (Quads)[c]	ns	ns	-0.13	-0.42

[a] Benefits reported are annual, not cumulative, for the year given. Estimates reflect the benefits associated with program activities from FY 2005 to the benefit year or to program completion (whichever is nearer), and are based on program goals developed in alignment with assumptions in the President's Budget.

[b] Mid-term program benefits were estimated utilizing the GPRA05-NEMS model, based on the Energy Information Administration's (EIA) National Energy Modeling System (NEMS) and utilizing the EIA's Annual Energy Outlook (AEO) 2003 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.

Long-term benefits[a]

	2030	2040	2050
Primary Non-Renewable Energy Savings (Quads)	2.8	6.4	9.2
Energy System Cost Savings (Billion 2000$)	16	51	79
Carbon Emission Reductions (MMT)	54	105	138
Oil Savings (MBPD)	2.0	4.3	6.2
Natural Gas Savings (Quads)	-0.56	-0.09	0.40

[a] Long-term benefits were estimated utilizing the GPRA05 - 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 2003	FY 2004	FY 2005	$ Change	% Change
Production and Delivery R&D					
Production and Delivery R&D..................................	6,398	10,344	25,325	+14,981	+144.8%
Congressionally Directed Activities	4,817	12,220	0	-12,220	-100.0%
Total, Production and Delivery R&D	11,215	22,564	25,325	+2,761	+12.2%

Description

The activity includes research and development of advanced technologies for producing and delivering hydrogen. Activities encompass a diversity of feedstocks such as natural gas, petroleum, and renewable sources including biomass, wind, and solar, to convert to hydrogen, with the majority of funding focused on renewables. Work involving other feedstocks are largely funded by, and coordinated with, other offices (i.e. Fossil Energy and Nuclear Energy). Technology areas include an array of processes and techniques such as reforming, separating, purifying, compressing, and delivering hydrogen.

Benefits

The Production and Delivery R&D activity 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 activity support the achievement of fuel costs on a cents/mile basis 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.

Hydrogen Production Costs (modeled)[a]: Non-renewable and Renewable delivered at 5000 psi

	2003	2004	2005	2006	2007	2008	2009	2010
Non-renewables ($/gge)...............................	5.00			3.00			2.50	1.50
Renewables ($/gge) [b]	6.20		5.70	5.30			4.60	3.90

Detailed Justification

(dollars in thousands)

	FY 2003	FY 2004	FY 2005
Production and Delivery R&D......................................	**6,398**	**10,344**	**25,325**

Increase emphasis on renewable feedstocks and energy sources. Continue developing advanced electrolyzer concepts that address cost, energy efficiency, and durability issues that will achieve a hydrogen cost of $3.90 per gasoline gallon equivalent (untaxed) at 5000 psi by 2010 using renewable electricity sources. Conduct research using biomass feedstocks to integrate steam methane reforming with gasification processes toward achieving a cost of $4.60/gge at the station by 2009. In photoelectrochemical water splitting production, complete development of semiconductor material that achieves 7.5 percent photon-to-hydrogen efficiency with 1000 hour durability by 2006. Continue conducting research in photobiological micro-organism systems to improve photon absorption of sunlight for water splitting production. Conduct research in high and ultra-high temperature water splitting chemical cycles using solar concentrators.

Complete the research of natural gas-to-hydrogen production systems that can verify the production and delivery of 5000 psi gaseous hydrogen for $3.00 per gasoline gallon equivalent (untaxed) at the station, with mature production volumes (e.g. 100 units/year) in 2006. Continue developing separation membrane technologies toward improving flux rates from 60 to 200 standard cubic feet per hour per square foot and reducing material costs from $200 to less than $100 per square foot by 2010.

Complete the initial analysis on various hydrogen delivery technology and infrastructure options relative to advantages and trade-offs for the transition to, and long term use of hydrogen for transportation and stationary power. Continue research to reduce capital costs and increase energy efficiency of delivery systems from central production facilities including lower pipeline material costs, higher compression and liquefaction energy efficiencies, and liquid and solid carrier technologies.

Conduct economic and environmental analyses and technical assessments for technologies being

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[a] Hydrogen production costs are based on estimates that use laboratory data to project the cost of hydrogen produced at mature production volumes.

[b] Central biomass-based hydrogen costs at the plant gate are $4/gge in 2003, $3.60/gge in 2005, $3.30/gge in 2006, and $2.60/gge in 2009. Hydrogen delivery costs are based on estimates for a central plant within 30 miles of a large city using liquid hydrogen delivered via truck at hydrogen quantities need to fuel 20% of the total light duty fleet.

(dollars in thousands)

developed. Analysis activities will focus on diverse energy feedstocks for hydrogen production in the near (2015), mid (2030) and long term (post 2050). These energy sources will be evaluated based upon economic, environmental, and technological factors to identify viable pathways for producing and delivering hydrogen.

In conjunction with the DOE Office of Fossil Energy and the Department of Transportation, initiate analysis and research on lower cost transport and delivery of hydrogen from central production facilities to the point of use at refueling stations and stationary power operations. This will include initiating research on lower cost and more energy efficient hydrogen compression and liquefaction, lower costs and better materials for hydrogen pipelines, and new liquid or solid carriers for hydrogen transport. In FY 2003 this activity was reduced by $113,932 for SBIR/STTR and transferred to the Science Appropriation.

Participants include: NETL, NREL, ANL, PNNL, TIAX, Iowa State University, Praxair, Air Products and Chemicals, Inc., InnovaTek, G.E., INEEL, Technology Management, Inc., LLNL, Giner Electrochemical, Proton Energy, Teledyne Energy, SRI International, University of California - SB, ORNL, University of California - Berkeley, University of Hawaii, and SNL.

	FY 2003	FY 2004	FY 2005
Congressionally Directed Activities, Production and Delivery R&D	**4,817**	**12,220**	**0**

Funding for the following projects was directed by Congress to be included in this activity:

PEM Fuel Cell and Purification (FY 2003 $2,890,117); Competitive Solicitation for Solid Oxide Fuel Cells (FY 2004 $2,453,000); HI-Way Initiative in New York State (FY 2004 $1,962,140); Shared Technology Transfer Program by Nicholls State University (FY 2004 $981,070); Fuel Cell Development for Distributed Generation and Carbon Sequestration in Northwest Indiana (FY 2004 $1,962,140); EVermont Hydrogen Electrolyzer Project (FY 2004 $936,920); Evaluation of Solar-Powered Thermo-Chemical Production of Hydrogen from Water (FY 2003 1,926,744; FY 2004 $2,943,210); Startech Hydrogen Production Project (FY 2004 $490,540); and Hawaii Hydrogen Center for Development and Deployment of Distributed Energy Systems (FY 2004 $490,540).

	FY 2003	FY 2004	FY 2005
Total, Production and Delivery R&D	**11,215**	**22,564**	**25,325**

Explanation of Funding Changes

	FY 2005 vs. FY 2004 ($000)
Production and Delivery R&D	
Accelerate and expand research on renewable-based hydrogen. Increases development of electrolysis technologies using renewable energy sources.	+14,981
Congressionally Directed Activities, Production and Delivery R&D	
No funds are requested because funds are being allocated to other activities more closely aligned with the Program's goal.	-12,220
Total Funding Change, Production and Delivery R&D	**+2,761**

Storage

Funding Schedule by Activity

(dollars in thousands)

	FY 2003	FY 2004	FY 2005	$ Change	% Change
Storage					
Storage	10,790	13,981	30,000	+16,019	+114.6%
Congressionally Directed Activities, Storage	0	15,451	0	-15,451	-100.0%
Total, Storage	10,790	29,432	30,000	+568	+1.9%

Description

The Hydrogen Storage activity will focus primarily on the research and development of on-board vehicular hydrogen storage systems that allow for a driving range of greater than 300 miles. The activity will develop and demonstrate compressed gas and cryogenic hydrogen tanks for near-term storage of hydrogen capable of meeting 2005 on-board hydrogen storage targets. The activity will also develop and demonstrate solid-state materials and conformable tank technologies for hydrogen storage systems capable of meeting 2010 and 2015 on-board hydrogen storage targets. In addition, the activity will develop hydrogen storage systems for off-board applications such as the hydrogen delivery and refueling infrastructure.

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, and efficient storage systems to achieve a driving range of greater than 300 miles.

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

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

Compressed Gas

	2003	2004	2005	2006	2007	2008	2009	2010
Volumetric (kWh/L)......................................	1.0	1.0	1.2			1.4		1.5
Gravimetric (kWh/kg).................................	1.3	1.3	1.5			1.8		2.0
Gravimetric (weight percent)........................	4.0	4.0	4.5			5.5		6.0

Solid State

	2003	2004	2005	2006	2007	2008	2009	2010
Volumetric (kWh/L)	0.5	0.6	1.2			1.3		1.5
Gravimetric (kWh/kg)..................................	0.7	1.0	1.5			1.8		2.0
Gravimetric (weight percent)........................	2.3	3.0	4.5			5.5		6.0

Detailed Justification

(dollars in thousands)

	FY 2003	FY 2004	FY 2005
Storage...	**10,790**	**13,981**	**30,000**

Complete testing and validation of 10,000 psi hydrogen storage tank achieving the 2005 hydrogen storage system targets of 1.5 kWh/kg (4.5 weight percent) and 1.2 kWh/L. Investigate materials that allow novel tank geometries for conformable tank design.

Initiate research and development at Hydrogen Storage Centers of Excellence directed at meeting the 2010 hydrogen storage 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 hydrogen storage system targets of 3.0 kWh/kg (9 weight percent), 2.7 kWh/L, and $2/kWh.

Enhance existing R&D in reversible storage materials, such as carbon nanotubes and metal hydrides, and address regeneration issues related to chemical hydrogen storage, such as sodium borohydride. Expansion of 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 - to work toward 2015 goals. Advanced concepts include novel carbon nanostructures (other than nanotubes), metal-organic materials and polymers.

Explore options for hybrid approaches that combine compressed gas storage with reversible materials to reduce pressure requirements and increase vehicle range.

Complete verification of a standard test protocol and independent test facility to compare the capacities of hydrogen storage materials under development.

Focus analysis activities on advanced storage options for hydrogen with special attention to the energy efficiency of the storage system. Assess regenerative chemical storage for efficiency, emissions, and

	FY 2003	FY 2004	FY 2005
(dollars in thousands)			

the cost of chemical regeneration, and carbon nanotube storage for economic and technological potential to provide the needed breakthrough in hydrogen storage technology. Hydrogen storage analysis will assist the programmatic decision process in 2006 to down-select to storage options that have the potential to meet long-term targets. In FY 2003 this activity was reduced by $130,804 for SBIR/STTR and transferred to the Science Appropriation. *Participants include: NREL, Air Products, SNL, University of Hawaii, UTRC, SRTC, UOP, Safe Hydrogen, Millennium Cell, Cleveland State University, SwRI, LLNL, Quantum, LANL, INEEL, and ANL.*

	FY 2003	FY 2004	FY 2005
Congressionally Directed Activities, Storage..................	**0**	**15,451**	**0**

The following projects were directed by Congress to be included in this activity: Edison Materials Technology Center to Develop Improved Materials to Support the Hydrogen Economy (FY 2004 $2,943,210); National Center for Manufacturing Science to Develop Advanced Manufacturing Technologies for Renewable Energy Applications (FY 2004 $2,943,210); Florida Hydrogen Partnership (FY 2004 $1,962,140); Fuel Cell Research by the University of South Florida (FY 2004 $1,962,140); Hydrogen Future Park at the University of Montana (FY 2004 $735,800); Fuel Cell Mine Loader and Prototype Locomotive (FY 2004 $1,962,140); and Renewable Hydrogen Fueling Station System (FY 2004 $2,943,210).

	FY 2003	FY 2004	FY 2005
Total, Storage	**10,790**	**29,432**	**30,000**

Explanation of Funding Changes

	FY 2005 vs. FY 2004 ($000)
Storage	
Research and development of on-board vehicular hydrogen storage systems that allow for a driving range of greater than 300 miles…………………	+16,019
Congressionally Directed Activities, Storage	
No funds are requested because funds are being allocated to other activities more closely aligned with the Program's goal…………………	-15,451
Total Funding Change, Storage	**+568**

Infrastructure Validation

Funding Schedule by Activity

(dollars in thousands)

	FY 2003	FY 2004	FY 2005	$ Change	% Change
Infrastructure Validation					
Infrastructure Validation.....	2,974	5,849	15,000	+9,151	+156.5%
Congressionally Directed Activities, Infrastructure Validation	6,706	12,530	0	-12,530	-100.0%
Total, Infrastructure Validation...	9,680	18,379	15,000	-3,379	-18.4%

Description

This activity includes the validation of advanced hydrogen technologies using full-scale demonstrations. Validation of hydrogen technology targets under real world conditions 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

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 the HFCIT program'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. Technology Validation also provides information so that standards can be written 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.

	2003	2004	2005	2006	2007	2008	2009
Validate cost of hydrogen production ($/gge)[a]			$3.60 per gge[b]				$3.00 per gge[c]

Detailed Justification

(dollars in thousands)

	FY 2003	FY 2004	FY 2005
Infrastructure Validation	**2,974**	**5,849**	**15,000**

Continue the Controlled Hydrogen Fleet and Infrastructure Technology Demonstration and Validation Project. Continue to design and construct hydrogen refueling stations to support demonstrations of hydrogen fuel cell fleet vehicles. Three of the refueling stations and several maintenance facilities will be commissioned to service hydrogen vehicles provided by major automobile companies. These first generation stations will validate the ability to produce hydrogen for $3.60 per gallon gasoline equivalent (untaxed) at 5000 psi hydrogen (with mature production volumes e.g. 100 units/year) and at least two stations will incorporate renewable systems. By 2009, this activity will validate the ability to produce the hydrogen for $3.00 per gallon gasoline equivalent (untaxed) at 5000 psi hydrogen when produced in quantity with 68% well to pump efficiency. Data will be collected on scheduled and unscheduled maintenance, and on the operation of the refueling stations.

Power park projects will be operated and maintained. Data on reliability, safety and operating costs will be collected. In FY 2003 this activity was reduced by $67,515 for SBIR/STTR and transferred to the Science Appropriation. *Participants include: Clark University, UOP/SunLine, Air Products and Chemicals, Inc., Praxair/LAX, Sunline, Collier Technologies, DTE, APS/Pinnacle West, DBEDT (formerly NEHLA), State of Texas, Apollo, Proton, NEXT Energy, Zoot Enterprises, SNL, Fuel Cell Propulsion Institute, GTI, LLNL, TIAX, and, NREL.*

Congressionally Directed Activities, Infrastructure Validation...	**6,706**	**12,530**	**0**

The following projects were directed by Congress to be included in this activity: Ohio University Fuel Cell Pilot Project (FY 2003 $2,853,489); NEXT ENERGY Fuel Cell Demonstration project

[a] The validation activity validates the 2006 laboratory data for estimated hydrogen production costs for non-renewables in real world conditions. Hydrogen production costs are based on estimates that use the real world data to project the cost of hydrogen produced at mature production volumes.

[b] Including the co-production of electricity.

[c] Cost without co-producing electricity.

(FY 2003 $1,926,744); Gallatin County (FY 2003 $963,372); University of Nevada Las Vegas Hydrogen Filling Station (FY 2003 $963,372); Hydrogen Regional Infrastructure Program in Pennsylvania (FY 2004 $2,943,210); Expanding Clean Energy Research and Education Program at the University of South Carolina (FY 2004 $2,158,360); Hydrogen Fuel Cell Project Washoe County, Nevada (FY 2004 $1,962,140); Hawaii Hydrogen Center for Development and Deployment of Distributed Energy Systems (FY 2004 $2,982,300) (Included in the Omnibus Appropriation Bill.); and the Chattanooga Fuel Cell Demonstration Project (FY 2004 $2,485,250) (Included in the Omnibus Appropriation Bill.)

Total, Infrastructure Validation	**9,680**	**18,379**	**15,000**

Explanation of Funding Changes

	FY 2005 vs. FY 2004 ($000)
Infrastructure Validation	
In FY 2005, the Hydrogen Fleet and Infrastructure Demonstration and Validation Project will be increased and the power park and infrastructure activities will be reduced	+9,151
Congressionally Directed Activities, Infrastructure Validation	
No funds are requested because funds are being allocated to other activities more closely aligned with the Program's goal.	-12,530
Total Funding Change, Infrastructure Validation	**-3,379**

Safety, Codes & Standards, and Utilization

Funding Schedule by Activity

(dollars in thousands)

	FY 2003	FY 2004	FY 2005	$ Change	% Change
Safety, Codes & Standards, and Utilization					
Safety, Codes & Standards, and Utilization..	2,568	5,904	18,000	+12,096	+204.9%
Congressionally Directed Activities, Safety, Codes & Standards, and Utilization..	1,963	0	0	0	0.0%
Total, Safety, Codes & Standards, and Utilization..........	4,531	5,904	18,000	+12,096	+204.9%

Description

This activity includes identifying critical failure modes and safety issues for hydrogen and fuel cell technologies, development of the technical data required for 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. 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, published 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 lead to new Federal Motor Vehicle Safety Standards for fuel cell vehicles by the Department of Transportation.

Activities under Safety, Codes & Standards, and Utilization will facilitate the establishment of a global technical regulation for hydrogen and fuel cell vehicles and infrastructure.

	2006	2007	2008	2009	2010
Global technical regulation	ISO Standards for hydrogen refueling and storage		Draft U.S. Technical standards for preparation of draft regulation.		Finalize U.S. technical standards for preparation of a Global Technical Regulation (GTR).

Detailed Justification

	(dollars in thousands)		
	FY 2003	FY 2004	FY 2005
Safety, Codes & Standards, and Utilization	**2,568**	**5,904**	**18,000**

Continue the development of standards 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 vehicles that will 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. Coordinate and develop new building codes and equipment standards for hydrogen technologies. Assist code developers by providing experimental data from hydrogen refueling demonstration sites.

Design a test system to simulate bulk storage, fuel dispensing and distribution piping systems based on the work conducted in FY 2004 and initiate the construction of the system in FY 2005. 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. Provide system safety requirements which have to be demonstrated for production, storage and utilization program elements. Initiate the development of a new intrinsically safe, hand held optical sensor 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 2003 this activity was reduced by $80,174 for SBIR/STTR and transferred to the Science Appropriation. *Participants include: NREL, , SNL, PNNL, LANL, SAE, and LLNL, Gas Technology Institute, International Code Council, National Fire Protection Association, Underwriters Laboratory, Compressed Gas Association, Canadian Standards Association of America, American Society of Mechanical Engineers, American National Standards Institute, DOT Centers, Environmental Protection Agency Laboratories, National Institute of Standards and Testing.*

	FY 2003	FY 2004	FY 2005
	(dollars in thousands)		
Congressionally Directed Activities, Safety, Codes & Standards, and Utilization	**1,963**	**0**	**0**

The following projects were directed by Congress to be included in this activity: Ohio University Fuel Cell Pilot Project (FY 2003 $1,000,000); and Fuel Cell R&D So. Alabama (FY 2003 $963,372).

	FY 2003	FY 2004	FY 2005
Total, Safety, Codes & Standards, and Utilization	**4,531**	**5,904**	**18,000**

Explanation of Funding Changes

	FY 2005 vs. FY 2004 ($000)
Safety, Codes and Standards, and Utilization	
Increase systematic safety studies including evaluation of hydrogen release scenarios from piping, storage systems, equipment failures and sabotage; determine fire and explosion potential; develop engineering practices leading to new standards; and support focused research testing and certification for hydrogen components	+12,096
Total Funding Change, Safety, Codes and Standards, and Utilization	**+12,096**

Education and Crosscutting Analysis

Funding Schedule by Activity

(dollars in thousands)

	FY 2003	FY 2004	FY 2005	$ Change	% Change
Education and Crosscutting Analysis					
Education and Crosscutting Analysis.........	1,897	3,946	7,000	+3,054	+77.4%
Congressionally Directed Activities, Education and Crosscutting Analysis.........	0	1,766	0	-1,766	-100.0%
Total, Education and Crosscutting Analysis	1,897	5,712	7,000	+1,288	+22.5%

Description

The activity includes development and distribution of educational materials and training to serve the specific needs of target audiences that can facilitate the transition to a hydrogen economy, such as teachers and students; state and local governments, including safety and code officials; potential end-users; and the public. Materials include films, manuals, lesson plans and modules, and instruction books/booklets about hydrogen production, delivery, storage, and safety processes, as well as technology applications. This activity also includes development of an independent systems analysis and integration function consistent with recommendations by the National Academy of Sciences.

Benefits

The Education and Cross Cutting Analysis activities support the HFCIT program's mission and the National Energy Policy recommendation to communicate hydrogen benefits, safety, and utilization information to key stakeholders. The activities supporting education and cross cutting analysis aid in overcoming the institutional barriers to a hydrogen economy. Cross-cutting analysis will be used to assess the potential impact and benefits of hydrogen technology in society.

Activities in Education and Crosscutting Analysis will increase the number of people in each target audience who understand the concept of a hydrogen economy and how it may affect them, and also help establish within the HFCIT program a fully functional systems integration capability. Independent systems analysis on the energy, economic and environmental implications of the technology development will drive key program decisions.

Education

	2004	2005	2006	2007	2008	2009	2010
Students, teachers, etc	Survey[a]				two fold increase		four-fold increase
End users	Survey[a]				one fold increase		two fold increase

	2004	2005
Systems Analyses	Define system analysis requirements	Publish requirements and assumptions

Detailed Justification

(dollars in thousands)

	FY 2003	FY 2004	FY 2005
Education and Cross-Cutting Analysis	**1,897**	**3,946**	**7,000**

The program will develop and pilot test materials for use in middle and high schools; develop a teacher training program; develop a hydrogen education program for state and local government representatives; and publish and distribute safety codes and standards training materials.

Education activities will include collaboration with other DOE education initiatives, national laboratories, and industry partners to implement a training program for teachers. The effort will pair teachers with technology experts and feature lesson plans and materials that have been pilot tested in the classroom. Critical components of this effort will be a training and professional development program for teachers to build their knowledge of and experience with hydrogen technology and its applications, as well as an assessment and evaluation mechanism with which to measure the effectiveness of the program. Regional, State, and local networks will be established to involve code officials, building engineers, energy regulators, and consumers in regional hydrogen technology demonstrations including education on installation, codes and standards, and safety issues. These regional programs will provide information exchange and networking to seek solutions to local hydrogen implementation barriers and ensure an understanding of the hydrogen economy among the community. In addition, the library of educational materials will be expanded to provide interested stakeholders, including the public, with greater access to current and objective information about hydrogen technology.

[a] A survey is currently underway to determine the 2004 baseline.

	(dollars in thousands)		
	FY 2003	FY 2004	FY 2005

Cross-cutting analysis activity to establish systems integration capability will include publishing a Technical Requirements document and Systems Analysis Planning Assumptions document.

Perform cross-cutting analysis on the impact of hydrogen technologies to the economy and energy markets and evaluate transition strategies for low-cost hydrogen infrastructure development. On a well-to-wheels basis, determine the impacts on energy efficiency, costs, and the environment from potential pathways and technologies to be pursued. Analyze synergies between automotive and stationary applications and the related infrastructure requirements.

In collaboration with industry stakeholders, continue development of robust modeling tools capable of analyzing options and trade-offs of multiple scenarios for the transition from liquid hydrocarbons to a hydrogen-based transportation system. This will include modeling of 1) infrastructure – all energy sources, conversion technologies, distribution and retailing options; 2) demand – representing vehicle manufacturing decisions, consumer demand, and potential stationary power uses; and 3) time-space economics – a methodology for integrating the infrastructure build-up strategy and market demands in specific regions and times. This modeling effort will be used, in collaboration with industry, to provide direction for research and development efforts, and to provide insight into issues regarding timing of infrastructure investment, large-scale vs. small-scale hydrogen production facilities, and hydrogen delivery infrastructure needs for the transition to a hydrogen economy. As part of systems engineering and analysis activities, implement a fully functional system integration capability that establishes and validates integrated baseline requirements. Conduct analysis to identify the impacts of various technology pathways, to assess associated cost elements and drivers, to identify key cost and technological gaps, to respond to any specific recommendation(s) of the National Academy of Sciences, and to assist in prioritizing R&D. In FY 2003 this activity was reduced by $29,551 for SBIR/STTR and transferred to the Science Appropriation. *Participants include: ANL, NREL, ORNL, LLNL, TIAX, Central WA University, University of ND, NC State University, RSIS, Inc., and University of California – Davis.*

Congressionally Directed Activities, Education and Cross-Cutting Analysis	**0**	**1,766**	**0**

The following projects were directed by Congress to be included in this activity: Lansing Community College Alternative Energy Center (FY 2004 $981,070); Residential Fuel Cell Demonstration by the Delaware County Electric Cooperative (FY 2004 $294,320); and Smart Energy Management Control System (FY 2004 $490,540).

Education and Cross-Cutting Analysis	**1,897**	**5,712**	**7,000**

Explanation of Funding Changes

	FY 2005 vs. FY 2004 ($000)
Education and Cross-Cutting Analysis	
Increase funding for cross-cutting life cycle analysis and systems integration analysis to identify key cost and technological gaps.	+3,053
Congressionally Directed Activities, Education and Cross-Cutting Analysis	
No funds are requested because funds are being allocated to other activities more closely aligned with the Program's goal	-1,765
Total Funding Change, Education and Cross-Cutting Analysis	**+1,288**

Solar Energy

Funding Profile by Subprogram[a]

(dollars in thousands)

	FY 2003 Comparable Appropriation	FY 2004 Original Appropriation	FY 2004 Adjustments[b,c]	FY 2004 Comparable Appropriation	FY 2005 Request
Solar Energy					
Photovoltaic Energy Systems	73,249	76,500	-1,447	75,053	75,433
Solar Heating and Lighting	3,783	3,000	-56	2,944	2,900
Concentrating Solar Power	5,298	5,500	-104	5,396	2,000
Total, Solar Energy	82,330	85,000	-1,607	83,393	80,333

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. 104-271, "Hydrogen Future Act" (1996)

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.

[a] SBIR/STTR funding in the amount of $1,480,717 was transferred to the Science appropriation in FY 2003. Estimates for SBIR/STTR budgeted in FY 2004 and FY 2005 are $2,210,912 and $2,136,884 respectively.

[b] Programs in the Energy Supply appropriation were reduced by .59 percent as required by the Omnibus Appropriation Bill.

[c] Programs in the Energy Supply appropriation were proportionally reduced based upon the allocated General Reduction of $4,684,000.

Benefits

Through its research and development activities, the Solar Program develops solar energy technologies -- such as photovoltaic systems, concentrating solar power, and solar water heating systems -- that are reliable, affordable, and environmentally sound. Transforming our Nation's vast supply of free and available solar energy into a widely available energy resource will increase energy security by diversifying its domestically available energy supply options for use in both normal and emergency situations.

The Solar Program provides additional types of public benefits in the areas of reliability, security, and environment not reflected in the quantified benefits reported below. Photovoltaic (PV) systems can either be integrated with the electricity grid or work independently as distributed systems, which increases our national energy security by providing a widely available and flexible source of power not dependant on our aging and vulnerable electricity grid system. 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. Finally, solar energy displaces electricity demand most during the hottest, sunniest days of the year when demand for space cooling is high, helping to avoid blackouts while reducing 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 of Energy's Strategic Plan identifies four Strategic Goals (one each for defense, energy, science, and environmental aspects of the Department's mission) in addition to seven General Goals that tie to the Strategic Goals. The Solar Program supports the following goals:

Energy Strategic Goal: To protect our National and economic security by promoting a diverse supply and delivery 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 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 both large-scale usage across the Nation and to make a significant contribution to a clean, reliable and flexible U.S. energy supply.

Contribution to Program Goal 04.03.00.00 (Solar Energy)

The Solar Program contributes to the Department's General Goal 4 through Program Goal 04.03.00.00 by developing next generation technologies with improved performance and by reducing system, manufacturing, and installation costs of solar energy technologies to levels competitive with fossil and nuclear 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 $0.12/kWh for CSP to $0.24/kWh for certain PV applications. The long-term user cost goal for electricity from PV systems is $0.06/kWh.

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

- by 2006, reduce the 30-year user cost for PV electric energy to $0.16 - $0.21/kWh from $0.19 - $0.24/kWh in 2003.
- by 2006, reduce the cost of solar water heating in non-freezing climates to $0.04/kWh from $0.08/kWh in 2003.

In response to the lessons learned from the DOE FY 2003 performance audit and consistent with production cost measures developed for the FY 2005 PART, the solar PV subprogram is transitioning its performance target from actual manufacturer production costs (external outcomes) to engineering estimates of production costs (program outputs), based on the impacts of annual R&D progress. This new engineering-based cost estimation model will incorporate the portfolio of program R&D factors described in the Solar Program's Multi-Year Technical Plan that impact the price of electricity from PV. While transitioning to this new model, in FY 2004 one key component in production cost, conversion efficiency, will be used as a measure of progress as the program develops and vettes the model.

Note that FY 2004 PV targets refer to conversion efficiencies of PV <u>modules</u>, while FY 2000 and FY 2001 targets refer to conversion efficiencies of PV <u>cells</u>.

Annual Performance Results and Targets

FY 2000 Results	FY 2001 Results	FY 2002 Results	FY 2003 Results	FY 2004 Targets	FY 2005 Targets
Program Goal 04.03.00.00 (Solar Energy)					
Photovoltaic Energy Systems, Solar Heating and Lighting, and Concentrating Solar Power.					
Developed a 13-percent-efficient stable prototype thin-film photovoltaic cell.	Developed a 14-percent-efficient stable prototype thin-film photovoltaic cell.	Reduced 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).	Reduced the 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).	Verify, with standard laboratory measurements, U.S.-made commercial production crystalline silicon PV modules with a 12.5-percent conversion efficiency. Verify with standard laboratory measurements, U.S.-made commercial production thin-film PV modules with a 10-percent conversion efficiency. Develop conceptual designs of a low-cost polymer solar water heater capable of operation in freezing climates.	Based upon the FY 2004 development of an engineering-based cost estimation model, provide a production cost target for PV modules that reflects planned FY 2005 R&D activities. The cost target is expected to be in the range of $1.85-1.95 per Watt. This engineering-based cost estimate will be validated through market surveys and reported not later than FY 2007. Complete evaluation of conceptual designs of a low-cost polymer solar water heater capable of operation in freezing climates.
Management of Funds					
				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 uncosteds to a range of 20-25 percent by reducing program annual uncosteds by 10 percent in 2005 relative to the program uncosted baseline (2004) until the target range is met.

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 enhances our Nation's energy security through solar energy technology advances that increase PV cell efficiency, system reliability, and manufacturing capability and efficiency, and by reducing the production cost of PV, CSP, and solar water heating systems. These technical advances are intended to lower the cost of solar technologies in the marketplace and therefore increase their usage across the Nation.

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

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

- economic growth
- labor costs
- the price and availability of alternative technologies and conventional fuels
- State and international R&D and deployment efforts
- financial incentives and other policies.

In carrying out its mission, the Solar Program collaborates with several groups on its key activities including:

- industrial manufacturers, National Laboratories, and universities.
- solar energy experts outside of the Department, who:
  - help ensure that the Solar Program's research directions and priorities address the needs of manufacturers, utilities, State agencies, consumers, and other stakeholders and that these activities are within the realm of technical feasibility and properly aligned with market forces.
  - collaborate on technology roadmaps and peer reviews, which have been completed within the last three years for each of the primary subprogram and activity.

Validation and Verification

To validate and verify program performance, the Solar Program 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:	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); Peer Review of the DOE Photovoltaic Program (2003).
Baselines:	The Solar Program's 2003 baselines for system production cost reduction goals are as follows: \$0.19 – \$0.24/kWh for PV electric energy; \$0.08/kWh for solar water heating in non-freezing climates (see the Solar Program Multi-Year Technical Plan (2003)).
Frequency:	Annual.
Data Storage:	EIA and other data sources, such as National Laboratories (National Renewable Energy Laboratory (NREL) and Sandia National Laboratories (Sandia)), store the data on computer servers.
Verification:	Trade association reviews; National Laboratory survey of PV manufacturing cost/capacity data from U.S. industry; EIA survey of solar manufacturers; peer reviews.

Program Assessment Rating Tool (PART)

The Department implemented a tool to evaluate selected programs. The Program Assessment Rating Tool (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. Based on the FY 2004 PART Review, the Solar Program has incorporated feedback into the FY 2005 Budget Request and has taken or will take the 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 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, 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.[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

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[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).

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]

In light of these studies, the Department is funding CSP activities in FY 2005. The Solar Program believes that the technical potential exists for great benefits through CSP. A more thorough investigation, however, of the proper R&D course necessary to realize those benefits needs to be conducted in light of these studies. The program is requesting $2 million to maintain essential facilities, support work with several States on the establishment of 1,000 MW of CSP solar power in the Southwest, and develop a comprehensive program plan for the coming fiscal years.

Last year's PART review and score provided suggestions that resulted in refined long-term and annual measures incorporated in this FY 2005 budget request. The FY 2005 PART showed Solar Program improvement in accountability scoring (+7 points) and the PART findings reflect recognition of that improvement. While the findings recognize the program's clear purpose and strength in planning, overall changes in the scoring system and unique scoring standards for EERE resulted in reduced scores in those areas. Although the net result was a lower overall weighted score in the FY 2005 PART, the Solar Program maintained its rating of "Moderately Effective," the second highest rating category. The PART review also found the 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. The PART also found that congressionally-directed activities reduce the program funding available for competitive solicitations and core National Laboratory research designed to support program goals.

Funding by General and Program Goal

(dollars in thousands)

	FY 2003	FY 2004	FY 2005	$ Change	% Change
General Goal 4, Energy Security					
Program Goal 04.03.00.00, Solar Energy					
Photovoltaic Energy Systems	67,840	73,925	75,433	+1,508	+2.0%
Solar Heating and Lighting	3,783	2,944	2,900	-44	-1.5%
Concentrating Solar Power	5,298	5,396	2,000	-3,396	-62.9%
Total, Program Goal 04.03.00.00, Solar Energy	76,921	82,265	80,333	-1,932	-2.3%
All Other					
Congressionally Directed Activity, Photovoltaic Energy Systems					
Navajo Electrification Project	2,408	0	0	0	0.0%
Power Modules	1,445	0	0	0	0.0%

[a] National Academy of Sciences, "Letter Report: Critique of the Sargent and Lundy Assessment of Concentrating Solar Power Cost and Performance Forecasts" (2002).

	(dollars in thousands)				
	FY 2003	FY 2004	FY 2005	$ Change	% Change
Palo Alto Photovoltaic Demonstration Project	1,445	0	0	0	0.0%
Hard Bargain Farm	111	0	0	0	0.0%
Yucca Valley Project	0	245	0	-245	-100.0%
Center for Ecological Technology	0	392	0	-392	-100.0%
Hackensack Univ. Green Building Medical Center	0	491	0	-491	-100.0%
Total, All Other	5,409	1,128	0	-1,128	-100.0%
Total, General Goal 4 (Solar Technology)	82,330	83,393	80,333	-3,060	-3.7%

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 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 Solar Program goals would provide the technical potential to reduce conventional energy use even further if warranted by future energy needs. 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.

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 reflect market experience with consumer demand for "green" power. They do not, however, reflect the additional demand consumers may have 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. 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 estimated to be completed and posted by March 15, 2004. Uncertainties are larger for longer term estimates. 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 growing national benefits over time.

FY 2005 GPRA Benefits Estimates for Solar Energy Program[a]

Mid-Term Benefits[b]

	2010	2015	2020	2025
Primary Non-Renewable Energy Savings (Quads)	0.04	0.12	0.23	0.42
Energy Expenditure Savings (Billion 2001$)	0.2	1.2	6.6	4.9
Carbon Emission Reductions (MMTCE)	1	2	5	9
Natural Gas Savings (Quads)	0.00	0.10	0.10	0.15
Program Specific Electric Capacity Additions (GW)	1	4	11	17

Long-Term Benefits[c]

	2030	2040	2050
Primary Non-Renewable Energy Savings (Quads)	0.4	1.5	1.6
Energy System Cost Savings (Billion 2001$)	0.1	0.3	0.3
Carbon Emission Reductions (MMTCE)	5	22	29
Natural Gas Savings (Quads)	0.3	1.4	1.2
Program Specific Electric Capacity Additions (GW)	11	22	23

[a] Benefits reported are annual, not cumulative, for the year given. Estimates reflect the benefits associated with program activities from FY 2005 to the benefit year or to program completion (whichever is nearer), and are based on program goals developed in alignment with assumptions in the President's Budget.

[b] Mid-term program benefits were estimated utilizing the GPRA05-NEMS model, based on the Energy Information Administration's (EIA) National Energy Modeling System (NEMS) and utilizing the EIA's Annual Energy Outlook (AEO) 2003 Reference Case.

[c] Long-term benefits were estimated utilizing the GPRA05 - 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 2003	FY 2004	FY 2005	$ Change	% Change
Photovoltaic Energy Systems					
Fundamental Research	27,186	29,341	30,000	+659	+2.2%
Advanced Materials and Devices	26,874	29,230	29,000	-230	-0.8%
Technology Development	8,883	10,350	12,433	+2,083	+20.1%
Congressionally Directed Activity, Photovoltaic Energy Systems/Navajo Electrification Project	2,408	0	0	0	0.0%
Congressionally Directed Activity, Photovoltaic Energy Systems/Power Modules	1,445	0	0	0	0.0%
Congressionally Directed Activity, Photovoltaic Energy Systems/Palo Alto Photovoltaic Demonstration Project	1,445	0	0	0	0.0%
Congressionally Directed Activity, Photovoltaic Energy Systems/Hard Bargain Farm	111	0	0	0	0.0%
Congressionally Directed Activity, Photovoltaic Energy Systems/Yucca Valley Project	0	245	0	-245	-100.0%
Congressionally Directed Activity, Photovoltaic Energy Systems/Million Solar Roofs	2,489	2,551	2,000	-551	-21.6%
Congressionally Directed Activity, Photovoltaic Energy Systems/Southeast and Southwest Experimentation Stations	2,408	2,453	2,000	-453	-18.5%
Congressionally Directed Activity, Photovoltaic Energy Systems/Center for Ecological Technology	0	392	0	-392	-100.0%
Congressionally Directed Activity, Photovoltaic Energy Systems/Hackensack University Green Building Medical Center	0	491	0	-491	-100.0%
Total, Photovoltaic Energy Systems	73,249	75,053	75,433	+380	+0.5%

Description

Photovoltaic (PV) technologies are 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 of approximately $0.06/kWh. 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 percent of the cost of an installed system and presents the greatest opportunity for cost savings. The current state-of-the-art modules are made of crystalline silicon cells that are approximately 12 percent efficient and produce electricity at 19 to 24 cents/kWh (lifetime system user cost over 30 years). 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 2005, 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, affordable, and environmentally sound. 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.

Key indicators of progress toward achieving these benefits include:

Historical and Expected Contributions

Cost	2000	2001	2002	2003	2004	2005	2006	2007	2008	2009	2010
PV[a] ($/Watt)	2.50	2.35	2.25	2.10	1.95	1.85	1.75	1.65	1.60	1.55	1.50
CSP ($/kWh)...........	0.13	0.13	0.12	0.12	0.12	0.12	0.12	0.12	0.12	0.12	0.12

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 target from actual manufacturer production costs (external outcomes) to engineering estimates of production costs (program outputs), based on the impacts of annual R&D progress. This new engineering-based cost estimation model will incorporate the portfolio of program R&D factors described in the Solar Program's Multi-Year Technical Plan that impact the price of electricity from PV.

While transitioning to this new model, in FY 2004 one key component in production cost, conversion efficiency, will be used as a measure of progress as the program develops and vettes the model. PV technology cost reductions are achieved in part through increases in PV module conversion efficiencies. These efficiencies are fairly simple to measure in the laboratory; such measurements also provide valuable feedback on progress toward R&D goals. Note that FY 2004 PV targets refer to conversion efficiencies of PV <u>modules</u>, while FY 2000 and FY 2001 targets refer to conversion efficiencies of PV <u>cells</u> (see Annual Performance Results and Targets table).

Efficiency levels differ for the two main types of PV modules. Crystalline silicon (c-Si) 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.

PV Module Efficiency Projections

Conversion Efficiency (percentage)	2004	2005	2006	2007	2010	2020
Crystalline Silicon	12.5	13.5	14	14.5	16	20
Thin Films	10	11	12	12.5	14	18

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 performance goals and targets. As a result, this budget request for this subprogram redirects requested funding from congressionally-directed activities in FY 2003 and FY 2004 to R&D that better supports the program's performance goals.

[a] PV module manufacturing cost.

Detailed Justification

	(dollars in thousands)		
	FY 2003	FY 2004	FY 2005
Fundamental Research	**27,186**	**29,341**	**30,000**

Fundamental research is critical to continued advancement of photovoltaic technology to meet the Solar Program's long-term goal of $0.06/kWh electricity by 2020. There are three focus areas within Fundamental Research: Measurements and Characterization, Basic Research and University Program, and the High Performance Initiative.

The Measurements and Characterization capabilities at the National Laboratories provide an important contribution to industry and universities. In partnership with the laboratories, industry and university researchers are focused on improving the efficiency of cell materials and devices by investigating their fundamental properties and operating mechanisms. This teamed research approach works to identify efficiency-limiting defects in cell materials and analyzes their electrical and optical properties. In FY 2005, the Measurements and Characterization activity will expand its effort to identify degradation mechanisms and intrinsic instabilities in thin-film materials and devices that affect reliability.

The Basic Research and University Program investigates innovative ideas and leap-frog technologies through laboratory and university research. This high-risk research opens the door to non-conventional concepts that could dramatically improve cost effectiveness in the long term. In support of thin films, research in FY 2005 will focus on processing methods to improve large-area deposition techniques and growth mechanisms such as non-vacuum deposition processes that can achieve better uniformity, fewer defects, and faster throughput. In support of this research, $2,100,000 from this subactivity will be used in FY 2005 to purchase laboratory instrumentation to equip the new Science and Technology Facility (S&TF) at the National Renewable Energy Laboratory (NREL). [The remainder of the $6,480,000 anticipated for equipment expenditures at the S&TF will be funded by the Solar Program in this and other subactivities in future years.]

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 continued in FY 2005 is aimed at increasing, by 2010, the conversion efficiency of thin films from 8-10 percent to 14 percent and multi-junction concentrating cell efficiency from 30 percent to 40 percent.

In FY 2003 this activity was reduced by $1,157,129 for SBIR/STTR and transferred to the Science Appropriation.

Advanced Materials and Devices	**26,874**	**29,230**	**29,000**

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

Development of thin films is a major thrust of the program and receives strong industry support. Many PV technologists agree that thin-film technologies have the best chance for attaining the Solar

(dollars in thousands)

Program's long-term goal of $0.06/kWh by 2020. 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 are comprised of laboratory, industry, and university researchers who work to solve generic issues as well as industry specific problems. In FY 2005, the program will begin the first full year of three-year cost-shared contracts under the Thin Film Partnership solicitation issued in FY 2004. Efforts will be continued by the new thin-film module reliability team to address degradation mechanisms and intrinsic instabilities of pre-commercial modules. In support of this research, $1,000,000 from this subactivity will be used in FY 2005 to purchase laboratory instrumentation to equip the S&TF at NREL. [The remainder of the $6,480,000 anticipated for equipment expenditures at the S&TF will be funded by the Solar Program in this and other subactivities in future years.]

Crystalline silicon (c-Si) is the workhorse of the U.S. industry, comprising 90 percent of the modules sold in the market today. The Crystalline Silicon R&D strategy is to use a small amount of Federal funding to leverage continued industry research to improve module efficiencies to 14 percent by 2006. In FY 2005, the university contracts that support the crystalline silicon R&D effort will be re-competed. Efforts will focus on the most innovative silicon crystal growth methods with improved throughput, conversion efficiency, and lower energy and materials costs.

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 leadership in the development and manufacture of PV modules. Many areas of manufacturing R&D are critical to further reduce the cost of PV. In collaboration with university researchers and industry, the National Laboratories 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 the ability to consistently produce more efficient modules. 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 2005, the program will begin the first full year of new manufacturing cost-shared contracts to improve reliability of products in addition to reducing costs.

In FY 2003 this activity was reduced by $253,588 for SBIR/STTR and transferred to the Science Appropriation.

	FY 2003	FY 2004	FY 2005
Technology Development	**8,883**	**10,350**	**12,433**

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 National Laboratory and is implemented in

(dollars in thousands)

FY 2003	FY 2004	FY 2005

close partnership with industry and the Southeast and Southwest Regional Experiment Stations. 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 2005, funding will decrease slightly for systems engineering and reliability research, while the program maintains an emphasis on inverter reliability and completes Phase 2 of the inverter initiative. The program will work through 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. While traditional applications such as remote telecommunications and rural infrastructure will continue to grow, industry's new emphasis is 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 2005, the program will continue BIPV research to more fully integrate PV into buildings.

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 2005, core technology analysis and outreach activities will continue, as well as the systems-driven approach activity to help identify research priorities.

Congressionally Directed Activity, Photovoltaic Energy Systems/Navajo Electrification Project	**2,408**	**0**	**0**

In FY 2003, the U.S. Congress set aside funds for activities to assist the Navajo Nation in providing power to homes that lack electric power, primarily for power line extension.

Congressionally Directed Activity, Photovoltaic Energy Systems/Power Modules......................................	**1,445**	**0**	**0**

In FY 2003, the U.S. Congress set aside funds to develop high-reliability photovoltaic inverters.

Congressionally Directed Activity, Photovoltaic Energy Systems/Palo Alto Photovoltaic Demonstration Project...	**1,445**	**0**	**0**

In FY 2003, the U.S. Congress set aside funds to install PV systems on city-owned buildings to reduce utility costs and educate utility customers.

	(dollars in thousands)		
	FY 2003	FY 2004	FY 2005
Congressionally Directed Activity, Photovoltaic Energy Systems/Hard Bargain Farm	**111**	**0**	**0**

In FY 2003, the U.S. Congress set aside funds to install PV systems on a 350-acre farm for student and teacher education on renewable energy.

Congressionally Directed Activity, Photovoltaic Energy Systems/Yucca Valley Project	**0**	**245**	**0**

In FY 2004, the U.S. Congress set aside funds to assist solar energy activities in Yucca Valley, California.

Congressionally Directed Activity, Photovoltaic Energy Systems/Million Solar Roofs	**2,489**	**2,551**	**2,000**

In FY 2003 and FY 2004, the U.S. Congress set aside funds for the Million Solar Roofs project.

Congressionally Directed Activity, Photovoltaic Energy Systems/Southeast and Southwest Experimentation Stations	**2,408**	**2,453**	**2,000**

In FY 2003 and 2004, the U.S. Congress set aside funds for activities to support the Southeast and Southwest PV experimentation stations.

Congressionally Directed Activity, Photovoltaic Energy Systems/Center for Ecological Technology	**0**	**392**	**0**

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

Congressionally Directed Activity, Photovoltaic Energy Systems/Hackensack University Green Building Medical Center	**0**	**491**	**0**

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

Total, Photovoltaic Energy Systems	**73,249**	**75,053**	**75,433**

Explanation of Funding Changes

	FY 2005 vs. FY 2004 ($000)
Fundamental Research	
Increase long-term research on leap-frog technologies that show potential for meeting Program goals	+659
Advanced Materials and Devices	
Focus on those activities and contracts that show substantial progress under the Thin Film Partnership Program	-230
Technology Development	
Increase systems engineering evaluations on fielded systems through improved coordination of activities at National Laboratories	+2,083
Congressionally Directed Activity, Photovoltaic Energy Systems/Yucca Valley Project	
No funds are requested because funds are being allocated to other activities more closely aligned with the Program's goal.	-245
Congressionally Directed Activity, Photovoltaic Energy Systems/Million Solar Roofs	
Funding is being requested at an appropriate level based on anticipated activities in FY 2005 and after consultation with the program's multi-year plan	-551
Congressionally Directed Activity, Photovoltaic Energy Systems/Southeast and Southwest Experimentation Stations	
Funding is being requested at an appropriate level based on anticipated activities in FY 2005 and after consultation with the program's multi-year plan	-453
Congressionally Directed Activity, Photovoltaic Energy Systems/Center for Ecological Technology	
No funds are requested because funds are being allocated to other activities more closely aligned with the Program's goal.	-392
Congressionally Directed Activity, Photovoltaic Energy Systems/Hackensack University Green Building Medical Center	
No funds are requested because funds are being allocated to other activities more closely aligned with the Program's goal.	-491
Total Funding Change, Photovoltaic Energy Systems	+380

Solar Heating and Lighting

Funding Schedule by Activity

(dollars in thousands)

	FY 2003	FY 2004	FY 2005	$ Change	% Change
Solar Heating and Lighting					
Solar Heating and Lighting	3,783	2,944	2,900	-44	-1.5%
Total, Solar Heating and Lighting	3,783	2,944	2,900	-44	-1.5%

Description

The Solar Heating and Lighting (SHL) subprogram develops solar technologies that provide hot water and space heating for residential and 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 uses new formulations of lightweight polymer materials to modernize solar water heaters, making them easier to install, while lowering the cost of solar water heating in non-freezing climates by 50 percent from an equivalent of $0.08/kWh in 2003 to $0.04/kWh in 2006, which is expected to expand the market. The initial emphasis on systems designed for mild climates is expected to determine which polymeric materials will be able to withstand ultraviolet radiation for twenty years or more. SHL also provides technical support to the building industry and manufacturers in designing solar water heaters. In addition, SHL develops lighting systems that could increase the productivity of workers by bringing sunlight into interior rooms of office buildings, industrial and government facilities, hospitals, and schools.

The SHL subprogram contributes to the overall program goal by developing energy supply technologies that are reliable, affordable, and environmentally sound. SHL technologies use free and available solar energy to provide hot water and space heating in homes, commercial buildings, industry, government facilities, and many other applications. Using solar energy to provide this 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 addition, the use of natural light in buildings has been shown to improve student performance and worker productivity, as well as increase the proclivity of shoppers to purchase goods.

Key indicators of progress toward achieving these benefits include:

Historical and Expected Contributions

Cost	2000	2001	2002	2003	2004	2005	2006	2007	2008	2009	2010
Water Heating (Non-Freezing Climates) ($/kWh)	0.08	0.08	0.08	0.08	0.07	0.05	0.04[a]	--	--	--	--
Water Heating (Freezing Climates) ($/kWh)	--	--	--	--	0.10[b]	0.10	0.10	0.10	0.10	0.05	0.05

Detailed Justification

(dollars in thousands)

	FY 2003	FY 2004	FY 2005
Solar Heating and Lighting	**3,783**	**2,944**	**2,900**

Starting in FY 2004, the emphasis on solar water heater research shifted to development of systems that can withstand hard-freeze climates, which includes all of the U.S. north of the sunbelt states. In FY 2005, SHL will evaluate the conceptual designs developed in FY 2004 of low-cost solar water heating systems suitable for cold climates. SHL will continue to evaluate systems appropriate for non-freeze climates being field tested at numerous locations around the country.

In the area of solar lighting systems, the subprogram continues to support work at Oak Ridge National Laboratory (ORNL) in developing the second generation of hybrid solar lighting systems. ORNL is preparing the prototype systems for a lighting manufacturer to develop. Research concentrates on a solar concentrating dish and tracking system that focuses sunlight onto large-core optical fibers, which transfer the sunlight into interior rooms. This reduces energy requirements for artificial light and improves the quality of indoor lighting. In FY 2005, data from the hybrid solar lighting system installed at a commercial site in FY 2004 will be evaluated and modifications made to the design as needed.

In FY 2003 this subprogram was reduced by $70,000 for SBIR/STTR and transferred to the Science Appropriation.

Total, Solar Heating and Lighting	**3,783**	**2,944**	**2,900**

[a] Conclude development of the solar water heater suitable for non-freezing climates.
[b] Begin development of the solar water heater suitable for freezing climates.

Explanation of Funding Changes

	FY 2005 vs. FY 2004 ($000)
Solar Heating and Lighting	-44
Total Funding Change, Solar Heating and Lighting	**-44**

Concentrating Solar Power

Funding Schedule by Activity

(dollars in thousands)

	FY 2003	FY 2004	FY 2005	$ Change	% Change
Concentrating Solar Power					
Concentrating Solar Power	5,298	5,396	2,000	-3,396	-62.9%
Total, Concentrating Solar Power	5,298	5,396	2,000	-3,396	-62.9%

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 are used to run heat engines or steam turbines for generating power or producing fuels such as hydrogen.

In light of a May 2003 report by Sargent and Lundy, Inc., a draft of which was reviewed by the National Research Council (NRC), the Department believes that cost and technical barriers associated with CSP can be overcome, and that deployment and associated public benefits can be achieved. A more thorough investigation, however, of the proper R&D course necessary to realize those benefits needs to be conducted in light of this study.

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 domestically available energy supply options for use both in normal and emergency situations.

Detailed Justification

(dollars in thousands)

	FY 2003	FY 2004	FY 2005
Concentrating Solar Power	**5,298**	**5,396**	**2,000**
Essential CSP facilities at Sandia National Laboratories will be funded. Analytical support will be provided to several States (e.g., Nevada, California, Arizona, and New Mexico) that have expressed an interest in establishment of a CSP solar plant in their State. The program will develop a new comprehensive program plan for CSP. This plan is scheduled to be completed in calendar year 2004 and will help to inform the FY 2006 budget development process.			
Total, Concentrating Solar Power	**5,298**	**5,396**	**2,000**

Explanation of Funding Changes

	FY 2005 vs. FY 2004 ($000)
Concentrating Solar Power	
Focus resources on analytical support to the States. R&D activities will be suspended during an assessment of evolving technological opportunities and development of a program plan	-3,396
Total Funding Change, Concentrating Solar Power	**-3,396**

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Zero Energy Buildings

Funding Profile by Subprogram[a]

(dollars in thousands)

	FY 2003 Comparable Appropriation	FY 2004 Original Appropriation	FY 2004 Adjustments	FY 2004 Comparable Appropriation	FY 2005 Request
Zero Energy Buildings					
Zero Energy Buildings Design	7,572	0	0	0	0
Total, Zero Energy Buildings	7,572	0	0	0	0

Public Law Authorizations:

P.L. 93-410, "Geothermal Energy Research, Development and Demonstration Act" (1974)
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. 96-294, "Energy Security Act" (1980)
P.L. 100-357, "National Appliance Energy Conservation Amendments" (1988)
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)

Mission

The Zero Energy Buildings activities (ZEB) develop strategies to effectively integrate renewable energy technologies into high energy-efficient buildings. This involves research, development, demonstration, and technology transfer activities in partnership with industry, government agencies, universities, and national laboratories. The goal is to develop design strategies for buildings that are marketable and produce as much energy as they consume on an annual basis.

Benefits

In 2002, residential and commercial buildings accounted for 39 percent of the Nation's total energy consumption,[b] which cost the Nation $240 billion annually. The growth in the economy, as well as the Nation's rising population is leading to more, larger, and better equipped homes and commercial buildings, resulting in increasing energy consumption. Introduction of new energy efficient technologies and designs, including those supported by the ZEB activity, can have significant economic and environmental benefits.

[a] SBIR/STTR funding in the amount of $136,171 was transferred to the Science appropriation in FY 2003. Estimates for SBIR/STTR budgeted in FY 2004 and FY 2005 are $0 and $0 respectively.

[b] Energy Information Agency, Monthly Energy Review, Aug. 2003, Table 2.1.

Funding Schedule by Activity

(dollars in thousands)

	FY 2003	FY 2004	FY 2005	$ Change	% Change
Zero Energy Buildings					
Zero Energy Buildings Design	3,719	0	0	0	0.0%
Congressionally Directed Activity, National Center for Energy Management & Buildings Technology	3,853	0	0	0	0.0%
Total, Zero Energy Buildings	7,572	0	0	0	0.0%

Description

In the next decade, it will be possible to build affordable homes and cost-effective commercial buildings that are able to produce as much energy as they use. These buildings can be designed so that they are affordable, durable, healthy, comfortable, and more conducive to higher productivity. This is the basis of a vision statement that has been developed in partnership with industry in 2001 for the Zero Energy Buildings concept. The Zero Energy Buildings activities facilitates the whole building optimization and integration of advanced energy efficiency and site generation technologies never before considered for mainstream construction.

As a result of program management and the PART review the Building Technologies Program FY 20005 budget proposal specifically is requesting funds to combine the necessary renewable energy R&D with ongoing activities in the energy conservation portion of the program funding to reduce redundancies.

Detailed Justifications

(dollars in thousands)

	FY 2003	FY 2004	FY 2005
Zero Energy Buildings Design	**3,719**	**0**	**0**

In FY 2003, ZEB teams developed prototype designs for broader geographic and economic market diversity and develop designs to integrate solar electric and solar thermal systems. Beginning in FY 2004, integration of energy supply technologies, developed under the Energy Supply appropriation, into buildings will be accomplished using funds from Energy Conservation Appropriations. In FY 2003 this activity was reduced by $136,171 for SBIR/STTR and transferred to the Science Appropriation.

	(dollars in thousands)		
	FY 2003	FY 2004	FY 2005
Congressionally Directed Activity, National Center for Energy Management & Buildings Technology	**3,853**	**0**	**0**

In FY03 the National Center for Energy Management and Building Technologies (NCEMBT) conducted four projects at the University of Nevada at Las Vegas: an IAQ survey and short term monitoring of 30 buildings; a survey of buildings with underfloor air distribution systems and laboratory studies of these systems; laboratory studies of variable air volume terminal air distribution systems to compare them to conventional air distribution systems; and the development of design data and a study of waste heat recovery in commercial buildings. In FY2004, funds for these activities were provided in the EERE Facilities and Infrastructure Budget.

Total, Zero Energy Buildings Design.................................	**7,572**	**0**	**0**

Wind Energy

Funding Profile by Subprogram[a]

(dollars in thousands)

	FY 2003 Comparable Appropriation	FY 2004 Original Appropriation	FY 2004 Adjustments[b,c]	FY 2004 Comparable Appropriation	FY 2005 Request
Wind Energy					
Technology Viability..........	28,209	29,800	-565[d]	29,235	31,000
Technology Application	13,431	11,800	+275	12,075	10,600
Total, Wind Energy	41,640	41,600	-290	41,310	41,600

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 wind power development, and to address barriers to the use of wind energy in coordination with stakeholders, resulting in 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 by addressing the President's National Energy Policy call for increasing the diversity of our Nation's energy resources. Achieving the Wind Program's mission will enhance the competitiveness of wind energy in conventional electricity markets, growing the domestic energy supply resource, yielding environmental benefits by avoiding pollutant emissions

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[a] SBIR/STTR funding in the amount of $748,889 was transferred to the Science appropriation in FY 2003. Estimates for SBIR/STTR budgeted in FY 2004 and FY 2005 are $1,003,618 and $1,000,160 respectively.

[b] Programs in the Energy Supply Appropriation were reduced by .59 percent as required by the Omnibus Appropriations Bill.

[c] Programs in the Energy Supply appropriation were proportionally reduced based upon the allocated General Reduction of $4,684,000.

[d] Wind was provided increases by the Omnibus Appropriation Bill of $500,000. This amount was subject to the .59 percent reduction required by the Omnibus Appropriation Bill.

and benefiting the Nation's infrastructure posture by diminishing economic and system reliability effects of fuel price or supply disruptions.

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 Program contributes to General Goal 4, Energy Security, by focusing 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: 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) or 5 cents/kWh for offshore systems (from a baseline of 7.5 cents in FY2005).

- Distributed Wind Technology: 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 2005, provide the technical assistance needed to increase the number of States with at least 20 MS of wind power installed from 13 states in FY 2003 to 32 states; and by 2010, facilitate the installation of at least 100 MW in at least 30 States.

Annual Performance Results and Targets

FY 2000 Results	FY 2001 Results	FY 2002 Results	FY 2003 Results	FY 2004 Targets	FY 2005 Targets
Program Goal 04.05.00.00 (Wind Energy)					
Technology Viability					
4.0 cents per kilowatt-hour in Class 6 wind.	Advanced wind hybrid control system technology developed jointly with USDA Agricultural Research Center became commercially available.	Initiated development of an improved resolution national wind resource atlas, focusing first on new maps for high priority regions for commercial projects.	Completed low wind speed turbine conceptual design studies, and fabricated and began testing advanced wind turbine components optimized for low wind speed application initiated under industry partnership projects.	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.	1) LWST: Complete fabrication and begin testing advanced variable speed power converter. Test first advanced blade, incorporating improved materials and manufacturing techniques. Field test an advanced 100-meter self-erecting tower and the first full-scale Low Wind Speed Technology prototype turbine. Contributing to the Annual LWST COE Target: 4.3 cents per kWh in Class 4 winds 2) 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. Contributing to the Annual DWT COE Target: 12-18 cents per kWh in Class 3 winds. 3) Technology Acceptance: 32 states with over 20 MW installed; 16 states with over 100 MW installed.
Management of Funds					
				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 uncosteds to a range of 20-25 percent by reducing program annual uncosteds by 10 percent in 2005 relative to the program uncosted baseline (2004) until the target range is met.

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 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 is including offshore systems 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 icemaking. 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.[b] 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[a] wind speed areas.

These means and strategies will result in 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 --- thus putting the taxpayers' dollars to more productive use.

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

- the availability of conventional supplies;
- the cost of competing technologies;

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[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 (%)	100	81	66	49

[b] 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.

- state and international efforts to support wind energy;
- 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 Technologies program collaborates in several important activities including:

- peer review of the Wind Program's overall strategies and its activities by academia, manufacturers and National Laboratories and with independent experts
- technological validation, systems integration and design with users.

Validation and Verification

To validate and verify program performance, the Wind Program 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, and the Department's Inspector General. The table below summarizes validation and verification activities.

Data Sources:	Low Wind Speed Turbine Technology Characterization, Migliore and Cohen, presented at Windpower 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 and FY 2003 Wind Program Peer Reviews. American Wind Energy Association (AWEA)/Global Energy Concepts Wind Plant Database, reviewed by EIA, contains proprietary data. Various published and confidential data on wind projects economics. AWEA Small Wind Turbine Industry Roadmap.
Baselines:	WindPACT Final Report, National Renewable Energy Laboratory, documenting baseline cost of typical 1.5 MW wind turbine. AWEA's Small Wind Turbine Roadmap. Low Wind Speed Technology: 5.5 cents/KWh in FY 2002, Distributed Wind Technology : 17-22 cents/KWh in FY 2002, and Technology Application: 8 states with at least 20 MW installed wind in FY 2000, and 8 states with at least 100 MW installed wind in FY 2002.
Frequency:	Annual. As needed.
Data Storage:	Web, paper publications and on-line storage
Verification:	Wind Program Peer Reviews, industry experience, EIA Renewables Data group, meetings with State stakeholders, energy officials and technical groups.

Program Assessment Rating Tool (PART)

The Department implemented a tool to evaluate selected programs. The 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 2005 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 Technology Program contained a recommendation to continue emphasis on wind technology development for low wind-speed areas, and Low Wind Speed Technologies are the FY 2005 Wind Program's budget focus. Another PART recommendation suggested the development of practical but meaningful annual performance measures, and the Wind Energy Program has developed annual performance targets for its 3 goals, covering over 90% 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 of two points to seventy two, and a moderately effective rating, the second highest rating possible.

The FY2005 PART found that the program has a clear purpose and strong planning and management, the apparently contradictory lower scores in those areas were an artifact of a changed scoring system. The PART acknowledged the role of the program in commercial success of high wind-speed and transition to greater focus on low wind-speed area, reflected in the budget priorities. The PART also found that Congressional earmarks reduced program funding available for competitive solicitations and core national laboratory research designed to contribute toward program goals.

Funding by General and Program Goal

(dollars in thousands)

	FY 2003	FY 2004	FY 2005	$ Change	% Change
General Goal 4, Energy Security					
Program Goal 04.05.00.00, Wind Energy					
Technology Viability	28,209	29,235	31,000	+1,765	+6.0%
Technology Application	13,431	12,075	10,600	-1,475	-12.2%
Total, Program Goal 04.05.00.00, Wind Energy	41,640	41,310	41,600	+290	+0.7%
Total, General Goal 4 (Wind Energy)	41,640	41,310	41,600	+290	+0.7%

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 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 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 table 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. 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 estimated to be completed and posted by March 15, 2004. Uncertainties are larger for longer term estimates. 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 growing national benefits over time.

FY 2005 GPRA Benefits Estimates for Wind Program[a]

Mid-Term Benefits[b]

	2010	2015	2020	2025
Primary Non-Renewable Energy Savings (Quads)	0.18	0.64	1.47	1.61
Energy Expenditure Savings (Billion 2001$)	0.6	3.8	10.1	3.7
Carbon Emission Reductions (MMTCE)	3.6	12.7	28.5	35.7
Natural Gas Savings (Quads)	0.08	0.32	0.80	0.48
Program Specific Electric Capacity (GW) Additions	7	24	55	59

[a] Benefits reported are annual, not cumulative, for the year given. Estimates reflect the benefits associated with program activities from FY 2005 to the benefit year or to program completion (whichever is nearer), and are based on program goals developed in alignment with assumptions in the President's Budget.

[b] Mid-term program benefits were estimated utilizing the GPRA05-NEMS model, based on the Energy Information Administration's (EIA) National Energy Modeling System (NEMS) and utilizing the EIA's Annual Energy Outlook (AEO) 2003 Reference Case.

Long-Term Benefits[a]

	2030	2040	2050
Primary Non-Renewable Energy Savings (Quads)	1.81	2.35	4.01
Energy System Cost Savings (Billion 2001$)	4.3	5.8	5.7
Carbon Emission Reductions (MMTCE)	35	46	85.0
Oil Savings (MBPD)	0.03	0.05	0.02
Natural Gas Savings (Quads)	0.84	1.31	1.56
Program Specific Electric Capacity (GW) Additions	50	61	121

[a] Long-term benefits were estimated utilizing the GPRA05 - 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 2003	FY 2004	FY 2005	$ Change	% Change
Technology Viability					
Low Wind Speed Technology (Large Systems)	11,560	11,772	12,000	+228	+1.9%
Distributed Wind Technology (DWT – Small Systems)	1,927	1,962	2,000	+38	+1.9%
Supporting Research and Testing (SR&T)	14,722	15,501	17,000	+1,499	+9.7%
Total, Technology Viability	28,209	29,235	31,000	+1,765	+6.0%

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 activity focuses on the 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.

The following table provides expected annual indicators of progress for the LWST and DWT activities:

Fiscal Year	02	03	04	05	06	07	08	09	10	11	12
Low Wind Speed Technology[a]											
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	4.5									
Distributed Wind Technology[b]											
Target	17-22	14-20	13-19	12-18	11-16	10-15					
Actual		14-20									

The Wind Program also has developed a methodology for demonstrating performance. Levelized cost of energy (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 incremental improvement opportunities presented by the various LWST, DWT, and Supporting Research and Testing (SR&T) efforts. Estimating cost of energy 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.

Detailed Justification

	(dollars in thousands)		
	FY 2003	FY 2004	FY 2005
Low Wind Speed Technology (Large Systems)	**11,560**	**11,772**	**12,000**

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¢/kWh for onshore systems or 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 is planned to begin in FY 2004, and Phase III is planned to commence in FY 2007. These

[a] cents/kilowatt hour in Class 4
[b] cents/kilowatt hour in Class 3

(dollars in thousands)

	FY 2003	FY 2004	FY 2005

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 has offered the opportunity for supporting offshore wind energy system technology development. 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 the basis for funding and planning adjustments needed to optimize the portfolio for success.

In 2005, three major milestones are expected under this effort: 1) Complete fabrication and begin testing of an advanced variable speed power converter; 2) Testing of the first advanced blade incorporating improved materials and manufacturing techniques; and 3) Field testing of the first full-scale LWST proof-of-concept turbine.

	FY 2003	FY 2004	FY 2005
Distributed Wind Technology (DWT - Small Systems).....	**1,927**	**1,962**	**2,000**

The Distributed Wind Technology (DWT) project supports public-private partnerships for multiple small wind system (less than 100 kilowatts) pathways for achieving the program goal of 10-15 cents per kilowatt-hour in Class 3 resources by 2007. The DWT strategy is patterned after the LWST project in its low wind speed focus and project structures. Public-private partnerships selected through DWT project competitive solicitations in FY 2003 for concept studies, component development, and full turbine prototype development will be coordinated with Supporting Research and Testing activities, and periodically reviewed against established project milestones to assure performance.

In FY 2005, the program will complete final designs and commence fabrication of distributed wind technology components and subsystems under public-private partnerships for projects that were competitively selected in 2003; complete design and commence fabrication of components for prototype turbine systems; complete prototype testing of 1.8 kW and 50 kW Small Wind Turbine (SWT) projects; finish the International Electrotechnical Commission suite of tests for acoustics, power, durability, and safety to enable industry to begin commercialization activity; and issue a new solicitation in FY 2005 for further development of conceptual designs and components resulting from the Distributed Wind Solicitation of FY 2003.

	FY 2003	FY 2004	FY 2005
Supporting Research and Testing (SR&T)	**14,722**	**15,501**	**17,000**

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

(dollars in thousands)

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 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 Small Business Innovation Research (SBIR) support, and 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 FY05, $350,000 falls under SR&T.) Capital equipment expenditures of approximately $450,000 are expected by the National Renewable Energy Laboratory in FY 2005. 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.

In FY 2005, begin testing of one component under DWT cooperative agreement. Initiate Great Plains long-term inflow and structural dynamics test of a 1.5 MW machine in a joint public/private partnership with industries. Release several control paradigms for load reduction strategies for very large machines; begin new R&D efforts to support offshore and Great Plains deployment with advanced atmospheric inflow monitoring sensor development and analysis and simulation enhancements to support turbine/ocean platform integration; and complete the Small Wind Research Turbine Field Test. In FY 2003 this activity was reduced by $500,000 for SBIR/STTR and transferred to the Science Appropriation.

	FY 2003	FY 2004	FY 2005
Total, Technology Viability	**28,209**	**29,235**	**31,000**

Explanation of Funding Changes

	FY 2005 vs. FY 2004 ($000)
Low Wind Speed Technology	
Increase restores activity to a level of effort consistent with FY 2004 appropriation levels prior to general reductions, and will allow accelerating support for competitively selected public-private partnerships	+228
Distributed Wind Technology	
No significant change	+38
Supporting Research and Testing	
Increase supports additional laboratory and field testing requirements for component and system prototypes developed under LWST and DWT public/private partnership projects	+1,499
Total Funding Change, Technology Viability	**+1,765**

Technology Application

Funding Schedule by Activity

(dollars in thousands)

	FY 2003	FY 2004	FY 2005	$ Change	% Change
Technology Application					
Systems Integration	3,083	3,637	3,200	-437	-12.0%
Resource Assessment	964	981	0	-981	-100.0%
Technology Acceptance	3,467	3,532	4,000	+468	+13.3%
Supporting Engineering and Analysis					
Supporting Engineering and Analysis	4,472	2,996	3,400	+404	+13.5%
Congressionally Directed Activities, Supporting Engineering and Analysis	1,445	929	0	-929	-100.0%
Total, Supporting Engineering and Analysis	5,917	3,925	3,400	-525	-13.4%
Total, Technology Application	13,431	12,075	10,600	-1,475	-12.2%

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 that 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. Technology Application also includes resource assessment as required to support Systems Integration and Technology Acceptance activities as core natural resource assessment and mapping are being completed in FY 2004.

Benefits

Technology Application helps the program achieve its mission by focusing on the non-energy cost barriers that are impeding wind energy's use in the United States.

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

Technology Acceptance

(fiscal year)

	00	01	02	03	04	05	06	07	08	09	10
# of states with 20 MW Target	8	10	13	19	25	32					
# of state with 20 MW Actual	8	12	13	17							
# of states with 100 MW Target			8	10	12	16	19	22	25	27	30
# of states with 100 MW Actual.............	4	7	8	10							

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 20 MW installed capacity is a critical introductory threshold whereby initial barriers to development are overcome, and further wind development on a greater scale can proceed and thus contribute to the goal of increasing domestic energy supplies. 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 2003	FY 2004	FY 2005
Systems Integration	**3,083**	**3,637**	**3,200**

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. Systems Integration includes the monitoring and analysis of existing wind systems in user settings to assess and validate factors such as energy savings, voltage stability, power regulation and other power system performance issues. The scope of the activity includes integration of large wind farms in utility grid systems, small wind turbines in stand-alone applications such as hybrid diesel systems, and wind turbines in distributed applications, often close to customers. Technical assistance is provided to electric utilities, regulators, and other stakeholders to address issues such as system impacts from wind plant power variations, and appropriate treatment for an intermittent source such as wind power to allow such plants to participate in the competitive marketplace. Systems Integration also includes coordinated assessment and analysis of integration of wind with hydropower, other renewable energy systems, and emerging energy-related needs, such as production of hydrogen, and desalination, purification and delivery of water. This activity includes $497,050 in FY04 for the Wind Energy Transmission Study, as provided for in the Omnibus Appropriations Bill.

In FY 2005, real time performance data will be collected from wind plants operating in different regions of the country to provide expanded data for assessment of power system impacts, control measures and mitigation options. Staff in at least two regional transmission organizations will be engaged to identify problems with the treatment of wind energy and opportunities for mitigation through wind plant forecasting, wind plant control, coordination with hydropower and energy storage. Through stakeholder groups, the program will facilitate consideration of regional transmission upgrades to support wind and other resources. Also, a wind/hydropower pilot test to validate models for improved coordination of wind and hydropower will be completed. Cooperative research will be conducted with National Oceanic and Atmospheric Administration (NOAA) Laboratories in adapting numerical weather prediction models for use in wind energy forecasting.

Resource Assessment	**964**	**981**	**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 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.

In FY 2005, no funds are requested for this activity since core resource assessment and mapping efforts will be completed in FY 2004. The program intends to transfer 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	**3,467**	**3,532**	**4,000**

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 ($3.1 million) 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 agencies, and citizen stakeholder groups to provide technical support, guidance, information, and limited cost-shared funding to 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 information and to provide data on technical and institutional barriers to wind power development and other topical issues. Performance for this activity is measured by tracking the number of states that have installations of 20 MW and 100 MW, respectively, indicating the level of acceptance of wind power in these states.

In FY 2005, activities will focus on continuing support for existing and emerging state wind working groups, expanding tribal wind outreach on wind resource assessment and technical assistance, strengthening partnership activities with agriculture-sector national organizations, and expanding small wind system support activities. FY 2005 performance targets for this activity: 32 states with over 20 MW installed; and 16 states with at least 100 MW installed.

Supporting Engineering and Analysis	**5,917**	**3,925**	**3,400**
▪ **Supporting Engineering and Analysis**	**4,472**	**2,996**	**3,400**

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); market analyses leading to benefits assessments to support the Government Performance and Results Act (GPRA); 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 for the NWTC, $1.45 million falls under SE&A.]

In FY 2005, the Program will complete certification testing of two industry turbines at the NWTC;

complete 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; and support program annual outreach publications and website maintenance. In FY 2003 this activity was reduced by a transfer to the Science Appropriation of $248,889 for SBIR/STTR.

▪ **Congressionally Directed Activities, Supporting Engineering and Analysis**	**1,445**	**929**	**0**

Vermont-Department of Public Service - for a public education and outreach project to reduce barriers to wind energy use in the State. FY 2003 ($482,000), FY 2004 ($490,536); Wind Generation Facility for St. Paul Island and Unalaska, Alaska. FY 2003 ($963,000); St. Francis, Pennsylvania Wind Farm Feasibility Study. FY 2004 ($144,218); Saginaw, Michigan Chippewa Wind Project. FY 2004 ($294,321)

Total, Technology Application	**13,431**	**12,075**	**10,600**

Explanation of Funding Changes

	FY 2005 vs. FY 2004 ($000)
Systems Integration	
No funds requested for the Wind Energy Transmission study as directed in the FY 2004 Omnibus Appropriation bill	-437
Resource Assessment	
No funds requested since core resource mapping activities completed in FY 2004	-981
Technology Acceptance	
Increase due to expanded scope of State collaborative activities, particularly those focused on tribes and small wind installations	+468
Supporting Engineering and Analysis	

- **Supporting Engineering and Analysis**

	FY 2005 vs. FY 2004 ($000)
Decrease due to reduced funding requirements for Regional Field Verification projects and related support as project installations are completed and operational periods of prior projects are completed	+404
▪ **Congressionally Directed Activities, Supporting Engineering and Analysis**	
No funds are requested because funds are being allocated to other activities more closely aligned with the Program's goal	-929
Total, Supporting Engineering and Analysis	-525
Total Funding Change, Technology Application	**-1,475**

Hydropower Technologies

Funding Profile by Subprogram[a]

(dollars in thousands)

	FY 2003 Comparable Appropriation	FY 2004 Original Appropriation	FY 2004 Adjustments[b,c]	FY 2004 Comparable Appropriation	FY 2005 Request
Hydropower Technologies					
Technology Viability..........	3,811	3,555	-68	3,487	4,400
Technology Application	1,205	1,445	-27	1,418	1,600
Total, Hydropower Technologies	5,016	5,000	-95	4,905	6,000

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 Technologies Program ("Hydropower Program") is 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.

Benefits

The Hydropower Program's mission and activities contribute directly to EERE's and DOE's mission of improving National, Energy, and Economic security in responding to the President's National Energy Policy Supply Goal, which stated:

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[a] SBIR/STTR funding in the amount of $90,201 was transferred to the Science appropriation in FY 2003. Estimates for SBIR/STTR budgeted in FY 2004 and FY 2005 are $130,446 and $159,600 respectively.

[b] Programs in the Energy Supply appropriation were reduced by .59 percent as required by the Omnibus Appropriation Bill.

[c] Programs in the Energy Supply appropriation were proportionally reduced based upon the allocated General Reduction of $4,684,000.

A primary goal of the National Energy Policy is to add supply from diverse sources. This means domestic oil, gas, and coal. It also means ***hydropower*** *and nuclear power.*[a]

Achieving the Program's mission to develop and test new technologies will enable an additional increment of power to be safely developed in the United States without the need for new dams, and allow hydropower to continue its role as an important part of the Nation's renewable energy portfolio.

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 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 one program goal which contributes to General Goal 4 in the "goal cascade":

Program Goal 04.06.00.00: Hydropower. The Hydropower Program's goal is to conduct the R&D necessary to improve hydropower's operational and environmental performance so that hydropower generation is increased because of its affordability, abundance, reliability and environmental benefits. In accomplishing this goal, the Program will increase the viability of hydropower, the Nation's most widely used renewable energy source, without construction of new dams.

[a] National Energy Policy, Report of the National Energy Policy Development Group, p. xiii, 2001 (emphasis added).

Contribution to Program Goal 04.06.00.00 (Hydropower)

The Hydropower Program will contribute to the General Goal 4, Energy Security, through development of Advanced Hydropower Technology. The key technology pathway that contributes to achievement of these benefits is developing new technology that will enable 10 percent growth from FY 2005 in hydropower generation at existing plants with enhanced environmental performance, compared to an expected average loss of 6 percent[a] at all non-Federal plants up for relicensing before 2015 as well as 6 percent loss from all Federal plants. The performance progress indicators for this mid-term goal are plant adoptions of the technologies which are presented in greater detail in the technology viability section.

[a] The EIA 2003 Annual Energy Outlook currently projects that hydropower capacity will remain level through 2025. Because a significant number of non-Federal facilities are up for relicensing during that period, and because Federal facility operations will face continuing scrutiny, the AEO projection to presumed to already reflect the success of the hydropower program's efforts. The 2005 baseline, above which program benefits are measured, was therefore set by reducing the AEO 2003 projection for hydropower generation by 6% of the sum of the generation from the non-Federal facilities to be relicensed and the generation from all Federal facilities. In the program benefits case, this amount of generation is restored as a program benefit. In addition, the program anticipates that increased reservoir operational efficiency can result in additional generation from existing reservoir systems. The program's long-term goal of enabling a 10% increase in efficiency is represented in the benefits estimate for GPRA2005 as 1% of total generation, a small portion of the total targeted benefit. The two sources of benefits) relicensing and operation efficiency) are summed to give the total program benefit.

Annual Performance Results and Targets

FY 2000 Results	FY 2001 Results	FY 2002 Results	FY 2003 Results	FY 2004 Targets	FY 2005 Targets
Program Goal 04.06.00.00 (Hydropower)					
Technology Validation, Technology Application					
N/A	Test facility completed for pilot-scale testing of the innovative turbine design developed by the Alden Research Laboratory team.	Pilot-scale biological and hydraulic testing initiated.	Completed pilot-scale testing, providing the basis for future full-scale testing at an operational site. Successful testing would provide industry with a proven design, helping attain the 2 percent mortality goal. Completed study of regulatory approaches for addressing dissolved oxygen concerns at hydropower facilities. Completed low-head/ low-power resource assessment for the lower 48 States.	Complete report comparing field tests and model results for the effects of blade strike on turbine-passed fish.	Complete prototype testing at the Osage project that demonstrates 2 percent improvement in oxygen content of water downstream of the hydropower plant.
Management of Funds					
				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 uncosteds to a range of 20-25 percent by reducing program annual uncosteds by 10 percent in 2005 relative to the program uncosted baseline (2004) until the target range is met.

Means and Strategies

The Hydropower 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 Program conducts research, development, testing, and field verification of hydropower systems through laboratory and public-private partnerships. In pursuing these activities, the Program regularly obtains inputs from hydropower experts from outside of the Department. The perspectives of hydropower practitioners help to ensure that the Program's research directions and priorities are properly aligned with the needs of equipment manufacturers, electric utilities, regional organizations, State and other Federal agencies, and other stakeholders and does not displace private sector investment (*i.e.,* investments should be long-term and high-risk to ensure an appropriate Federal role).

These strategies will result in these means and strategies improving energy security by increasing the generation of reliable, affordable, and environmentally sound hydropower energy, adding to the diversity of the Nation's energy supply.

The following external factors could affect Hydropower Technologies ability to achieve its strategic goal:

- Regulatory licensing and water use constraints associated with dam operations. Also, increasing hydropower generation at existing sites is dependent on incremental technology improvements that build on each other over several years.
- For undeveloped hydropower resources at new sites to be added to the energy mix, cost-effective and environmentally safe technologies need to be available for hydropower developers.

In carrying out the program's mission, Hydropower Technologies performs the following collaborative activities:

- peer reviewing the Program and its activities with academia, manufacturers and National laboratories, and with independent experts; and
- collaborates with users for technological validation systems integration and design.

Validation and Verification

To validate and verify program performance, the Hydropower Program 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, and the Department's Inspector General. The table below summarizes validation and verification activities.

Data Sources:	DOE Final Report, US Hydropower Resource Assessment (1998); DOE Low Head/Low Power Hydropower Resource Assessment (2003); Energy Information Administration Annual Energy Outlook, Annual Energy Review.

Baselines:	The baseline for total electricity net generation of conventional hydroelectric power is 260 billion kWh (2002), according to the EIA Annual Energy Review 2004. Dissolved Oxygen: 1.8 mg/l in 2002, Fish survivability: 5% for the best existing turbines, Generation Improvements from Advanced Turbine: 2005 is base year, Generation Improvements from Optimization: 2005 is base year.
Frequency:	Annual.
Data Storage:	Computer storage and available on DOE/EERE and EIA websites.
Verification:	DOE Hydropower Resource Assessment based on Federal Energy Regulatory Commission data and developed in coordination with state energy offices. DOE Low Head/Low Power Resource Assessment based on U.S. Geological Survey stream data and models.

Funding by General and Program Goal

(dollars in thousands)

	FY 2003	FY 2004	FY 2005	$ Change	% Change
General Goal 4, Energy Security					
Program Goal 04.06.00.00, Hydropower					
Technology Viability..	3,811	3,487	4,400	+913	+26.2%
Technology Application	1,205	1,418	1,600	+182	+12.8%
Total, Program Goal 04.06.00.00, Hydropower	5,016	4,905	6,000	+1,095	+22.3%
Total, General Goal 4 (Hydropower Technology)......	5,016	4,905	6,000	+1,095	+22.3%

Expected Program Outcomes

The Hydropower Program pursues its mission through integrated activities designed to increase the use of domestic renewable resources. We expect these improvements to help 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 Hydropower Program goals would provide the technical potential to reduce conventional energy use even further if warranted by future energy needs.

Estimates of annual energy savings, energy expenditure savings, carbon emission reductions, natural gas savings, and electricity capacity that result from the realization of Hydropower Program goals are shown in the table below through 2025.

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. 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 estimated to be completed and posted by March 15, 2004.

FY 2005 GPRA Benefits Estimates for Hydropower Program[a]

Mid-Term Benefits[b]

	2010	2015	2020	2025
Primary Non-Renewable Energy Savings (Quads)	0.10	0.15	0.18	0.16
Energy Expenditure Savings (Billion 2001$)	0.5	0.4	1.9	0.2
Carbon Emission Reductions (MMTCE)	2	3	4	3
Natural Gas Savings (Quads)	0.04	0.05	0.03	0.09
Program Specific Electric Capacity (GW)*	4	4	5	5

[a] Benefits reported are annual, not cumulative, for the year given. Estimates reflect the benefits associated with program activities from FY 2005 to the benefit year or to program completion (whichever is nearer), and are based on program goals developed in alignment with assumptions in the President's Budget.

[b] Mid-term program benefits were estimated utilizing the GPRA05-NEMS model, based on the Energy Information Administration's (EIA) National Energy Modeling System (NEMS) and utilizing the EIA's Annual Energy Outlook (AEO) 2003 Reference Case.

Technology Viability

Funding Schedule by Activity

(dollars in thousands)

	FY 2003	FY 2004	FY 2005	$ Change	% Change
Technology Viability					
Advanced Hydropower Technology (formerly Advanced Hydro Turbine Technology	2,761	1,987	3,000	+1,013	+51.0%
Supporting Research and Testing (formerly Biologically-Based Criteria Development).....................	1,050	1,500	1,400	-100	-6.7%
Total, Technology Viability.........	3,811	3,487	4,400	+913	+26.2%

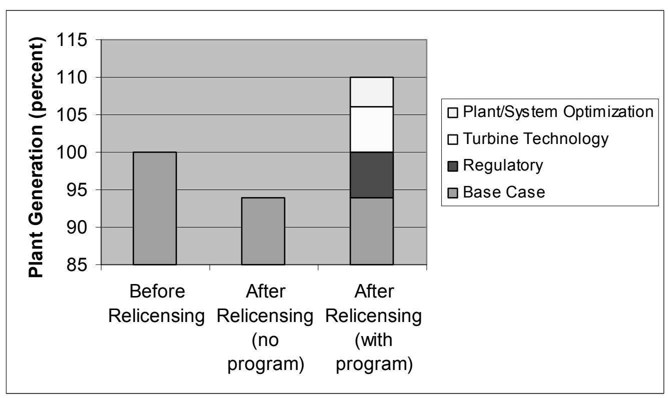
Description

The Technology Viability key activity focuses on development of advanced technologies that will have enhanced environmental performance and greater energy efficiencies.

The program is being reoriented to add to the prior emphasis on fish survivability and improved oxygen levels. The reoriented program's effect on generation is made up of three components:

- Regulatory
- Turbine Technology
- Plant/System Optimization

The chart to the side summarizes the components. The regulatory component is based on historical licensing trends. Typically, there has been a 6 percent plant generation reduction after relicensing due to new regulatory constraints aimed at environmental protection, like increased spill levels to protect fish. Fish-friendly turbines that have survival rates similar to spill provide a technology option to the hydropower operator that may allow them to avoid the regulatory generation loss. The second component is due to the performance characteristics of advanced turbines and being able to achieve 5 to 6 percent more generation from the given water supply. The third component is due to better water management and optimization of plants and systems. When implemented, these technologies will enable a 10 percent growth in hydropower generation at existing plants that implement these technologies, compared to an expected loss of 6 percent at all non-Federal plants up for relicensing before 2015 as well as 6 percent loss from all Federal plants.



The EIA 2003 Annual Energy Outlook currently projects that hydropower capacity will remain level through 2025. Because a significant number of non-Federal facilities are up for relicensing during that period, and because Federal facility operations will face continuing scrutiny, the AEO projection to presumed to already reflect the success of the hydropower program's efforts. The 2005 baseline, above which program benefits are measured, was therefore set by reducing the AEO 2003 projection for hydropower generation by 6% of the sum of the generation from the non-Federal facilities to be relicensed and the generation from all Federal facilities. In the program benefits case, this amount of generation is restored as a program benefit. In addition, the program anticipates that increased reservoir operational efficiency can result in additional generation from existing reservoir systems. The program's long-term goal of enabling a 10% increase in efficiency is represented in the benefits estimate for GPRA2005 as 1% of total generation, a small portion of the total targeted benefit. The two sources of benefits) relicensing and operation efficiency) are summed to give the total program benefit.

Research and Development conducted under Advanced Hydropower Technology directly contributes to increased hydropower generation. The turbine technology component is supported by the development and testing of improved hydropower turbines. The plant/system optimization component is supported by the development of operations tools that improve water management practices. Supporting Research and Testing provides the necessary basic research that is needed by industry and regulators to evaluate hydropower licensing options, which directly supports the regulatory component of increased generation.

Benefits

Technology Viability focuses on that part of the Hydropower Program's mission having to do with research and development into new advanced technologies, which is important both to achieving environmental improvements and to increasing overall electricity generation.

At selected sites where technology is implemented, the Program will measure the operational and environmental improvements. The program currently has large turbine testing planned at four sites to be completed in FY 2005-2008. As the technology improves, the results of plant testing are expected to improve so that by the end of the turbine testing projects in FY 2008, the program will have shown that at least a 6 percent generation increase is achievable. In FY 2009 and 2010, the program plans to evaluate the performance of water-use optimization technologies. The specific technologies to be implemented and sites to be studies will be determined at a later date. The following table shows annual indicators of progress toward achieving those benefits:

Year	Project	Dissolved Oxygen	Measured Fish Survivability	Generation Improvement from Advanced Turbines	Generation Improvement from Optimization
FY 2002	Baseline	1.8 mg/l	93%		
	Actual	1.8 mg/l	93%		
FY 2003	Target	4 mg/l	95%		
	Actual	4.2 mg/l	95%		
FY 2004		4 mg/l	95%[a]		
FY 2005	Osage Dam	2 mg/l improvement	95%[a]		
FY 2006	Wanapum Dam		96%	3%	
FY 2007	Box Canyon Dam		97%	4.5%	
FY 2008	Ice Harbor Dam		98%	6%	
FY 2009	Plant Optimization #1				1.5%
FY 2010	Plant Optimization #2				4%

As noted in the table above, by 2010, the program expects a 10% improvement in generation, a 3% improvement in fish survival and a 2 mg/l improvement in dissolved oxygen.

Detailed Justification

(dollars in thousands)

	FY 2003	FY 2004	FY 2005
Advanced Hydropower Technology	**2,761**	**1,987**	**3,000**

The Advanced Hydropower Technology project supports the development of technologies that will enable hydropower operators at existing plants to generate more electricity with less environmental impact. This will be done through environmentally enhanced, improved efficiency turbines, as well as with new methods for optimizing unit, plant, and reservoir systems to increase energy production per unit water (i.e., water-use efficiency).

In FY 2005, the program will continue with competitively selected fish-friendly turbine testing projects of large turbines (greater than 1 MW) at the Wanapum, Box Canyon, and Osage hydropower

[a] No measurements planned for FY 2004 or FY 2005 because turbine installation not completed until FY 2006.

	(dollars in thousands)		
	FY 2003	FY 2004	FY 2005

plants. The program will also work with the U.S. Army Corps of Engineers on laboratory scale modeling tests of the Ice Harbor hydropower plant. The program will continue research on methods to optimize water use efficiencies at the turbine unit and plant levels, and develop new public-private partnerships to test and demonstrate these new methods. The program will also begin developing integrated systems models for optimizing the operation of a series of plants in a river basin for enhanced energy and environmental quality. The program will initiate studies to evaluate the effectiveness of environmental mitigation practices, with emphasis on instream flow requirements at hydropower projects.

In FY 2003 this activity was reduced by $90,201 for SBIR/STTR and transferred to the Science Appropriation.

Supporting Research and Testing (formerly called Biologically-Based Criteria Development).......................	**1,050**	**1,500**	**1,400**

This activity addresses the need to fill significant gaps in the scientific understanding of fish response to the physical stresses experienced in passage through turbine systems. The research directly supports advanced technology development by producing biological design criteria. Research under this activity includes studies of fish passage through the hydropower system as a whole, including the cumulative effects of several injury mechanisms. The Department's research approach involves a unique combination of computer modeling, instrumentation, lab testing, and field-testing that is improving the design and operation of the next generation of hydropower technology.

In FY 2005, the program will continue studies on the cumulative effects of stresses on fish and the modeling and quantification of hydraulic forces within a turbine system. The program will complete physical modeling of turbulence, and computer models will be validated against new physical data sets from field and physical model systems. Development and testing of advanced instrumentation and measurement technology, such as the sensor fish device and imaging/monitoring methods, will also continue.

Total, Technology Viability...	**3,811**	**3,487**	**4,400**

Explanation of Funding Changes

	FY 2004 vs. FY 2005 ($000)
Advanced Hydropower Technology	
Increased funding is due to the ramping up of the large turbine testing projects at Wanapum Dam and Box Canyon Dam, and cost-shared large turbines testing at Ice Harbor Dam with the Corps of Engineers. Will also be increasing research in water-use optimization technologies, an effort that was started in FY 2004	**+1,013**
Supporting Research and Testing	
Decreased funding is due to the completion of some hydropower turbulence measuring and modeling work	**-100**
Total Funding Change, Technology Viability	**+913**

Technology Application

Funding Schedule by Activity

(dollars in thousands)

	FY 2003	FY 2004	FY 2005	$ Change	% Change
Technology Application					
Systems Integration and Technology Acceptance (formerly part of Advanced Hydro Turbine Technology)	800	1,025	1,300	+275	+26.8%
Supporting Engineering and Analysis (formerly Low Head/Low Power Resource Assessment)......	405	393	300	-93	-23.7%
Total, Technology Application ...	1,205	1,418	1,600	+182	+12.8%

Description

The focus of Technology Application is Systems Integration and Technology Acceptance, a set of projects that are designed to assess technology requirements for and address barriers to undeveloped hydropower, and Supporting Engineering and Analysis, which focuses on technology characterization and analysis.

Benefits

By focusing on that part of the Hydropower Program that has to do with assessing technology requirements for and addressing barriers to undeveloped hydropower, the Technology Application subprogram can help to develop new sources of hydropower without building new dams.

Detailed Justification

	(dollars in thousands)		
	FY 2003	FY 2004	FY 2005
Systems Integration and Technology Acceptance (formerly part of Advanced Hydro Turbine Technology)..	**800**	**1,025**	**1,300**

This activity addresses reducing the barriers to hydropower development, and includes the integration of hydropower with other renewables, an activity that was started in FY 2004. With many renewable energies being intermittent in nature, hydropower represents an important stored energy asset that can enable the larger scale deployment of renewable power plants such as wind. Systems Integration and Technology Acceptance also addresses Program outreach, working with hydropower stakeholders to address their issues and concerns.

In FY 2005, the program will conduct case studies of wind-hydropower integration opportunities in the United States and from these, develop lessons learned for distribution to industry. The program will also continue to work with international hydropower integration experts and apply international experience to the U.S. market. Additionally, the program will continue outreach activities with hydropower stakeholders, such as providing technical analysis, preparing reports, coordinating peer reviews and program reviews, maintaining a web site, and participating in technology advisory panels.

Supporting Engineering and Analysis (formerly called Low Head/Low Power Resource Assessment)......	**405**	**393**	**300**

This activity addresses the characterization of hydropower technologies for developing currently undeveloped hydropower resources, including those resources identified in the Department's Low Head/Low Power Resource Assessment. It also includes the development of new analysis methods to quantify hydropower benefits and values that will provide better understanding of hydropower's role within renewable energy portfolios.

In FY 2005, as a follow-on to the Low Head/Low Power Resource Assessment, which was completed in FY 2004, the program will characterize the low head hydropower technologies available in the market and identify technology gaps. The program will initiate efforts to identify and develop low head technologies that are cost-effective, environmentally friendly, and could be used for development of low head hydropower resources. The program will also initiate new research to develop and test methods for measuring the economic and environmental value of hydropower, including net greenhouse gas emissions.

Total, Technology Application..	**1,205**	**1,418**	**1,600**

Explanation of Funding Changes

	FY 2004 v FY 2005 ($000)
Systems Integration and Technology Acceptance	
Increased funding supports more detailed follow-on studies of hydropower and wind power integration, based on the scoping study recommendations completed in FY04, under the Systems Integration and Technology Acceptance effort	+275
Supporting Engineering and Analysis	
Decreased funding reflects the completion of the Low Head/Low Power Resource Assessment in FY 2004	-93
Total Funding Change, Technology Application	**+182**

Geothermal Technology

Funding Profile by Subprogram[a]

(dollars in thousands)

	FY 2003 Comparable Appropriation	FY 2004 Original Appropriation	FY 2004 Adjustments[b,c]	FY 2004 Comparable Appropriation	FY 2005 Request
Geothermal Technology					
Technology Development	18,656	19,600	-1,695	17,905	19,750
Technology Application	9,734	6,400	+1,203	7,603	6,050
Total, Geothermal Technology	28,390	26,000	-492	25,508	25,800

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

[a] SBIR/STTR funding in the amount of $510,598 was transferred to the Science appropriation in FY 2003. Estimates for SBIR/STTR budgeted in FY 2004 and FY 2005 are $590,334 and $605,815 respectively.

[b] Programs in the Energy Supply appropriation were reduced by .59 percent as required by the Omnibus Appropriation Bill.

[c] Programs in the Energy Supply appropriation were proportionally reduced based upon the allocated General Reduction of $4,684,000.

United States. The technologies developed by this program will 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. Geothermal electricity generation is not subject to price volatility and supply disruptions from changes in global energy markets. Geothermal energy systems use a domestic and renewable source of energy.

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 Geothermal program supports the following goals:

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 program 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 performance and reduce market entry costs of geothermal energy to competitive levels. In quantitative terms, the goal is to reduce the levelized cost of power generated from conventional geothermal sources from 5-8 cents per kWh (kilowatt hour) in 2000 to 3-5 cents per kWh by 2010.

Contribution to Program Goal 04.07.00.00 (Geothermal Technology)

The Geothermal Program 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 2000	FY 2001	FY 2002	FY 2003	FY 2004	FY 2005
Program Goal 04.07.00.00: (Geothermal Technology)					
Technology Development/Systems Development					
Completed two designs of advanced air-cooled condensers for geothermal applications.	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.	Begin construction of a small-scale geothermal power plant in the State of New Mexico, adding a new State to those with commercial power facilities and providing field verification of a new energy conversions system. Terminated as a result of partner failure to secure cost share financing.	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 for drilling.
Management of Funds					
				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 uncosteds to a range of 20-25 percent by reducing program annual uncosteds by 10 percent in 2005 relative to the program uncosted baseline (2004) until the target range is met.

Means and Strategies

The Geothermal 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 Geothermal Program will use various means and strategies to achieve its program goal to improve performance and reduce market entry costs of geothermal energy technologies to competitive levels. Consequently, the Program has adopted a two-fold strategy: (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 cost.

Four areas in which technology advances are vital to the success of a geothermal project include: resource discovery; resource access; resource production; and resource utilization. In resource discovery the program works to improve exploration tools while collaborating with stakeholders to expand the useful amounts of geothermal resources. In resource access the program seeks to reduce drilling costs and expand drilling capabilities through the adoption of an innovative drilling system. The program's approach in production focuses on making marginal resources (low-temperature, low-permeability, unsaturated) economic. And in resource utilization the program improves conversion technologies to increase efficiencies and decrease costs. Beyond the unique expertise resident at the National Laboratories, virtually all research projects are awarded via cost-shared competitive solicitations.

Besides advances in technology, the strategy is to reduce or eliminate institutional, regulatory, and other non-technical barriers that hamper the expanded use of geothermal energy in the United States. To do so the Program provides comprehensive and timely information about geothermal resources and how they are developed to interested stakeholders from the public and private sectors.

These means and strategies will result in improving 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 influence the extent to which the Geothermal Program can achieve its strategic goal:

- Partner cost share (ability of research partners from other Federal and state agencies, such as U.S. Geological Survey, Department of Defense, and the California Energy Commission, to secure funding).
- demand for electricity
- availability of conventional energy supplies
- regulatory requirements
- market incentives
- cost of competing technologies
- continuation of Federal tax incentives and implementation of other policies at the national level

In carrying out its mission, the program performs the following collaborative activities:

- New geothermal resources are sought through teaming efforts involving a variety of public and private organizations such as universities and government agencies.
- Collaborating with stakeholders to expand the useful amounts of geothermal resources.
- Technical and programmatic input is provided from academia, National Laboratories, Federal and State government agencies, industry, and other stakeholder organizations through forums, working groups, and oversight committees.
- A broad cross section of stakeholders participates in planning future work and reviewing current activities.
- Emphasis has shifted in the research program from laboratory-based studies to field applications projects with cost-sharing collaborators.

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. 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 independent 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).

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; International Geothermal Association Newsletter; Peer Reviews of the U. S. Department of Energy's Geothermal Technology Program August 23-24, 2001, March 25-27, 2002, and July 29-August 1, 2003; Program Briefing March 20, 2003.
Baselines:	The Geothermal Program's baselines for cost reduction goals are contained in the draft Geothermal Technology Program's Multi-Year Technical Program Plan, April 2003. At higher grade geothermal resource areas, the cost of geothermal power in 2000 was 3.8 cents/kWh for flash power and 5.6 cents/kWh for binary power.
Frequency:	Annual
Data Storage:	Corporate Planning System

Verification: Trade association and educational association reviews; Geothermal Resources Council Annual Conference; personal contacts with the U.S. geothermal industry; Energy Information Administration's survey of geothermal heat pumps.

Program Assessment Rating Tool (PART)

In response to one of the FY 2004 PART recommendations, the Geothermal Program developed a set of 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, the amount of developable geothermal resources confirmed by resource assessment. A Multi-Year Program Plan is being generated that describes the technical pathways the program will follow to achieve the performance measures and the programmatic goal.

In response to one of the FY 2005 PART recommendations, the program continues to emphasize the Enhanced Geothermal Systems R&D that focuses on high-grade engineered geothermal systems. These improvements in planning, management and accountability were reflected in the program's significantly improved FY 2005 PART score in those three areas, resulting in an overall score improvement of six points to 71 and a rating improvement from “adequate” to “moderately effective”, the second highest rating possible.

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 Congressional earmarks reduced program funding available for competitive solicitations and core national laboratory research designed to contribute toward program goals.

Funding by General and Program Goal

(dollars in thousands)

	FY 2003	FY 2004	FY 2005	$ Change	% Change
General Goal 4, Energy Security					
Program Goal 04.07.00.00, Geothermal Technology					
Technology Development	18,656	17,905	19,750	+1,845	+10.3%
Technology Application	8,771	6,622	6,050	-572	-8.6%
Total, Program Goal 04.07.00.00, Geothermal Technology	27,427	24,527	25,800	+1,273	+5.2%
All Other					
Congressionally Directed Activity, Technology Application/Lake County Basin Geothermal Project	963	981	0	-981	-100.0%
Total, All Other	963	981	0	-981	-100.0%
Total, General Goal 4 (Geothermal Technology)	28,390	25,508	25,800	+292	+1.1%

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. 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 Geothermal 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, geothermal energy expenditure savings, carbon emission reductions, natural gas savings, and electricity capacity additions that result from the realization of Geothermal Program goals are shown in the table 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. 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 estimated to be completed and posted by March 15, 2004. Uncertainties are larger for longer term estimates. 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 growing national benefits over time.

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

Mid-Term Benefits[b]

	2010	2015	2020	2025
Primary Non-Renewable Energy Savings (Quads)	0.2	0.2	0.2	0.3
Energy Expenditure Savings (Billion 2001$)	1	2	2	2
Carbon Emission Reductions (MMTCE)	3	2	4	7
Natural Gas Savings (Quads)	0.08	0.18	0.16	0.20
Program Specific Electric Capacity Additions (GW)	3	4	4	6

Long-Term Benefits[c]

	2030	2040	2050
Primary Non-Renewable Energy Savings (Quads)	0.4	1.5	2.1
Energy System Cost Savings (Billion 2001$)	4	5	9
Carbon Emission Reductions (MMTCE)	9	27	50
Program Specific Electric Capacity Additions (GW)	7	22	36

[a] Benefits reported are annual, not cumulative, for the year given. Estimates reflect the benefits associated with program activities from FY 2005 to the benefit year or to program completion (whichever is nearer), and are based on program goals developed in alignment with assumptions in the President's Budget.

[b] Mid-term program benefits were estimated utilizing the GPRA05-NEMS model, based on the Energy Information Administration's (EIA) National Energy Modeling System (NEMS) and utilizing the EIA's Annual Energy Outlook (AEO) 2003 Reference Case.

[c] Long-term benefits were estimated utilizing the GPRA05 - 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 2003	FY 2004	FY 2005	$ Change	% Change
Technology Development					
Resource Development					
Resource Development	3,200	2,019	3,200	+1,181	+58.5%
Congressionally Directed Activity, Resource Development	963	981	0	-981	-100.0%
Total, Resource Development	4,163	3,000	3,200	+200	+6.7%
Enhanced Geothermal Systems	5,915	6,680	8,000	+1,320	+19.8%
Systems Development	8,578	8,225	8,550	+325	+4.0%
Total, Technology Development	18,656	17,905	19,750	+1,845	+10.3%

Description

This subprogram examines processes affecting the economical production capacity of geothermal systems with the intent of providing technology to increase that capacity substantially. The three components of this activity involve: (1) finding resources; (2) creating new techniques for improving geothermal reservoirs; and (3) developing advanced technology in drilling and energy conversion, the two major cost elements of a geothermal facility.

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 make 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	2015
Drilling ($/ft)								
Goal	300	291	282	273	264	255	215	200
Actual	300	291	282	273	--	--	--	--
Surface Systems ($/kW)								
Goal	2000	1960	1920	1880	1840	1800	1600	1500
Actual	2000	1960	1920	1880	--	--	--	--

Detailed Justification

(dollars in thousands)

	FY 2003	FY 2004	FY 2005
Resource Development	**4,163**	**3,000**	**3,200**
▪ **Resource Development**	**3,200**	**2,019**	**3,200**

Resource Development deals with finding, characterizing, and assessing the geothermal resource through understanding the formation and evolution of geothermal systems.

This activity subsumes portions of the former subactivities of Core Research, University Research, and Detection and Mapping. The work builds on continuing research that investigates seismicity, isotope geochemistry, 3-D magnetotellurics, and remote sensing 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 2005, the program will develop a suite of improved remote sensing, geophysical, and geochemical techniques and test them in collaboration with industry as reliable means to locate hidden geothermal resources. Cost-shared investigations of promising new sites will be conducted to verify the presence of resources. The program will continue to collaborate with the U.S. Geological Survey (USGS) on a national geothermal resource assessment by providing data, equipment, and personnel. An interagency report will be issued on geothermal resources in the Great Basin, based in part on FY 2004 assessment work with the USGS.

	FY 2003	FY 2004	FY 2005
▪ **Congressionally Directed Activity, Resource Development**	**963**	**981**	**0**

Congressionally directed funds for geothermal research at the University of Nevada-Reno (FY 2003 $963,000; FY 2004 981,072).

	(dollars in thousands)		
	FY 2003	FY 2004	FY 2005
Enhanced Geothermal Systems..	**5,915**	**6,680**	**8,000**

This activity includes portions of the former subactivities of Core Research and University Research as well as Enhanced Geothermal Systems.

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 Department estimates that the application of EGS technology can more than double the amount of viable geothermal resources in the West. The objective is to increase the amount of economic geothermal resources to 40,000 MW from about 19,000 MW as estimated by the Geothermal Energy Association in 1999.

The program will broaden our understanding of natural geothermal processes, such as fluid flow, fracture dynamics, and rock-water interaction, while continuing EGS research with industry partners at three project sites. In FY 2005, the program will conduct the following major activities: long-term flow testing of the enhanced reservoir at the Coso Hot Springs geothermal field on the U.S. Naval Weapons Air Station (China Lake, California); preliminary flow testing of the reservoir enhanced in FY 2004 at Desert Peak, Nevada; and evaluation of wellbore stimulation experiments conducted in FY 2004. The program will conduct analyses of flow tests at The Geysers and perform chemical stimulation of a well at Glass Mountain.

Systems Development	**8,578**	**8,225**	**8,550**

Systems Development subsumes the former subactivities of Innovative Drilling Subsystems and Advanced Heat and Power Systems. 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 25 percent by 2008 compared to year 2000 costs. Systems Development also focuses on improved energy conversion technologies. These include better heat exchangers and condensers, which enable exploitation of lower temperature resources. Use of advanced materials and innovative energy conversion technologies can substantially improve the economics of geothermal energy generation. The objective is to reduce the capital costs of geothermal surface systems by 20 percent by 2010 compared to year 2000 costs.

In FY 2005, the program will demonstrate a robust Diagnostics-While-Drilling subsystem in geothermal wells, including a high-speed data link, a downhole instrumented sub-assembly for controlling a drag cutter drill bit, and a software package to assist the driller in controlling the drilling

	FY 2003	FY 2004	FY 2005

(dollars in thousands)

operation. This demonstration builds on previous research on the Diagnostics-While-Drilling subsystem, advanced drill bits, a bit vibration suppression subsystem, and an improved lost circulation subsystem. The program will complete a computational model to predict the limits of stability for drag bits as a function of bit/drillstring design, operating conditions, and control methodologies; complete laboratory development of various technologies for augmenting drag bits such as hydraulic or particle-assisted drilling; and reduce polyurethane well grouting technology to common practice within the geothermal industry.

For energy conversion technologies, in FY 2005 the program will field test coatings suitable for 300°C applications such as wellheads; complete a database on silica scale properties; demonstrate condenser enhancements yielding a 25% improvement in overall heat transfer for the same capital cost as in 2002; and establish a commercially viable design for a high-resolution, steam purity monitor. Condenser enhancements are based on prior year testing at an operating geothermal power plant. Improvements to these systems will have the highest likelihood of increasing efficiency while reducing costs for energy conversion facilities.

In FY 2003 Technology Development was reduced by $510,598 for SBIR/STTR which was transferred to the Science Appropriation.

	FY 2003	FY 2004	FY 2005
Total, Technology Development	**18,656**	**17,905**	**19,750**

Explanation of Funding Changes

	FY 2005 vs. FY 2004 ($000)
Resource Development	
▪ **Resource Development**	
The increase provides for expanded efforts in resource assessment with the U.S. Geological Survey	+1,181
▪ **Congressionally Directed, Resource Development**	
No funds are requested because funds are being allocated to other activities more closely aligned with the Program's goal	-981
Total, Resource Development	+200

	FY 2005 vs. FY 2004 ($000)
Enhanced Geothermal Systems	
The increase provides support for the continued testing of EGS-related technologies in cost-shared projects at Coso, Desert Peak, Glass Mountain and The Geysers	+1,320
Systems Development	
The increase reflects the high priority placed on accelerating the integration of the Diagnostics-While-Drilling (DWD) subsystem. The funding allows a field test of the fully integrated DWD advanced drilling system in a high temperature geothermal well .	+325
Total Funding Change, Technology Development.	**+1,845**

Technology Application

Funding Schedule by Activity

(dollars in thousands)

	FY 2003	FY 2004	FY 2005	$ Change	% Change
Technology Application					
Technology Verification......	5,250	3,500	4,000	+500	+14.3%
Technology Deployment					
Technology Deployment..................	3,521	3,122	2,050	-1,072	-34.3%
Congressionally Directed Activity, Technology Deployment..................	963	981	0	-981	-100.0%
Total, Technology Deployment.......................	4,484	4,103	2,050	-2,053	-50.0%
Total, Technology Application ...	9,734	7,603	6,050	-1,553	-20.4%

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. A large element 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.

Historical and expected contributions within Technology Application include:

	2000	2001	2002	2003	2004	2005	2010	2015
Resources (GW)								
Goal	5	5	5	5.2	5.3	5.4	10	20
Actual	5	5	5	5.2	--	--	--	--
New Geo Fields (#)								
Goal	0	0	0	2	4	6	20	40
Actual	0	0	0	2	--	--	--	--

Detailed Justification

(dollars in thousands)

	FY 2003	FY 2004	FY 2005
Technology Verification	**5,250**	**3,500**	**4,000**

Technology Verification subsumes a portion of the former key subactivity of Detection and Mapping, and includes cost-shared projects and deployment of near 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 US 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 2005, the program will collaborate with 10 new industry partners chosen from a FY 2004 competitive solicitation 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 substantial new resources in the western United States. The program will also test innovative energy conversion technology with an industry partner at a new power plant whose construction began in FY 2004.

	FY 2003	FY 2004	FY 2005
Technology Deployment	**4,484**	**4,103**	**2,050**
▪ **Technology Deployment**	**3,521**	**3,122**	**2,050**

The widespread use of new advancements in geothermal technology or the adoption of geothermal applications often encounter problems or barriers of a non-technical nature. These institutional issues, such as complex regulations, can often stymie the smooth transition from a prototype of new technology to a commercial product. This activity addresses the factors affecting the deployment of geothermal systems. The scope is broad and includes education and outreach, technical support, and systems analysis. Interested parties come from the public and private

	(dollars in thousands)		
	FY 2003	FY 2004	FY 2005

sectors working in concert to raise awareness levels and solve problems of common interest. The objective of Technology Deployment is to double the number of States generating geothermal electricity to eight by 2006.

Activities under Technology Deployment are conducted in part through the former key subactivity of GeoPowering the West (GPW) which is subsumed herein. GPW ($1.5 million) contributes to the overall use of domestic geothermal resources by facilitating partnerships with the geothermal industry, power companies, energy consumers, and public officials at all levels, with the goal of removing barriers to geothermal deployment. GPW usually takes a grass roots approach in which stakeholders at the State and local levels use GPW and its resources as a vehicle to come up with acceptable solutions to problems. GPW has sponsored the formation of State working groups throughout the West as the means of implementing this approach.

In FY 2005, the program will conduct outreach activities focused on key state and regional development issues. Those activities include: (1) continue support of the National Geothermal Collaborative that brings together involved stakeholders from all sectors to deal with institutional issues; (2) gather and disseminate information about geothermal resources, including the completion of the geothermal leasing workbook; and (3) add two new State working groups, bringing the total number of groups to nine. In addition, analytical work will continue on the performance and economics of geothermal systems.

	FY 2003	FY 2004	FY 2005
▪ **Congressionally Directed Activity, Technology Deployment**	**963**	**981**	**0**

Congressionally directed funds for the Lake County Basin geothermal project in California (FY 2003 $963,000; FY 2004 $981,072).

Total, Technology Application	**9,734**	**7,603**	**6,050**

Explanation of Funding Changes

	FY 2005 vs. FY 2004 ($000)
Technology Verification	
The increase supports a solicitation in 2004 which will result in awarding 10 new exploration projects to find and evaluate new geothermal resources using DOE-sponsored technology improvements	+500
Technology Deployment	
▪ **Technology Deployment**	
The decrease reflects completion of the congressionally-directed project and funding for GeoPowering the West to a level needed to continue GPW as a beneficial component of the Geothermal Technologies Program	-1,072
▪ **Congressionally Directed Activity, Technology Deployment**	
No funds are requested because funds are being allocated to other activities more closely aligned with the Program's goal	-981
Total, Technology Deployment	-2,053
Total Funding Change, Technology Application	**-1,553**

Biomass and Biorefinery Systems R&D

Funding Profile by Subprogram[a]

(dollars in thousands)

	FY 2003 Comparable Appropriation	FY 2004 Original Appropriation	FY 2004 Adjustments[b,c]	FY 2004 Comparable Appropriation	FY 2005 Request
Biomass and Biorefinery Systems R&D					
Feedstock Infrastructure	2,405	2,000	+212	2,212	2,000
Platforms Research and Development	44,841	42,000	-509	41,491	43,000
Utilization of Platform Outputs	38,037	31,000	+11,768[d]	42,768	27,596
Total, Biomass and Biorefinery Systems R&D	85,283	75,000	+11,471	86,471	72,596

Public Law Authorization:

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)

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[a] SBIR/STTR funding in the amount of $1,421,337 was transferred to the Science appropriation in FY 2003. Estimates for SBIR/STTR budgeted in FY 2004 and FY 2005 are $2,160,452 and $1,815,184 respectively.

[b] Programs in the Energy Supply appropriation were reduced by .59 percent as required by the Omnibus Appropriation Bill.

[c] Programs in the Energy Supply appropriation were proportionally reduced based upon the allocated General Reduction of $4,684,000.

[d] Biomass was provided increases by the Omnibus Appropriation Bill of $12,900,000. This amount was subject to the .59 percent reduction required by the Omnibus Appropriation Bill.

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 transform our nation's biomass resources into affordable, and domestically-produced biofuels, biopower, and high-value bioproducts.

The 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 transportation fuels and power from biomass feedstocks. 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[a], Platforms R&D for reducing the cost of outputs and byproducts from biochemical and thermochemical processes; 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 on integrating those technologies and processes in biorefinery configurations.

The next generation of biorefinery[b], being developed by the program and U.S. industry, will produce value-added chemicals and materials together with fuels and/or power from non-conventional, lower cost feedstock such as agricultural and forest residues and other biomass materials. Using our diverse biomass resources in future biorefineries will accelerate economic development and increase energy supply options and energy security.

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 Biomass program supports the following goals:

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

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[a] Biomass includes agricultural crops and trees, wood and wood wastes and residues, plants, grasses, residues, fibers, and animal wastes, municipal solid wastes, and other waste materials.

[b] Biorefineries are processing facilities that extract carbohydrates, oils, lignin, and other materials from biomass, convert them into multiple products such as transportation fuel, chemicals, and materials. Corn wet and dry mills, and pulp and paper mills are examples of existing biorefinery facilities that produce some combination of food, feed, power, and industrial and consumer products.

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 04.08.01.00: Biomass. Develop biorefinery-related technologies to the point that they are cost- and performance-competitive and are used by the Nation's transportation, energy, chemical and power industries to meet their 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 04.08.01.00 (Biomass)

The Program directly supports General Goal 4, Energy Security; 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:

Feedstock Infrastructure

- Reduce biomass harvesting and storage costs so that the delivered cost will be reduced from $53 per dry ton in 2003 to $38 per dry ton by 2015. Indicators of progress toward that goal include developing a conceptual, novel harvesting system and testing a dry storage system by 2010.

Platforms Research and Development

- Reducing the cost of cleaned and reformed biomass-derived synthesis gas produced, from a mature gasification plant, from $9.80 per million Btu in 2003 to $7.58 per million Btu by 2010. Indicators of progress toward that goal include successful bench-scale studies by 2007 and pilot-scale studies by 2010.

- Reducing the cost of a mixed, dilute sugar stream suitable for fermentation to ethanol, in a mature biochemical plant, from $0.15 per lb. in 2003 to $0.10 per lb. by 2010. Indicators of progress toward that goal include successful bench-scale studies by 2007 and pilot-scale studies by 2010.

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. Thermochemical systems integrated within a biorefinery will realize additional cost reductions due to the synergies resulting from co-producing chemicals, materials and fuels.

Sugar cost reduction will be achieved as a result of (a) developing advanced pretreatment, hydrolysis and fermentation technologies, and (b) validating their integration into biorefinery configurations. Biochemical systems integrated within a biorefinery will realize additional reductions in the cost of producing ethanol due to the synergies resulting from co-producing chemicals, materials and fuels.

Utilization of Platform Outputs R&D:

- Accelerating the use of cellulosic feedstock in existing corn ethanol plants. Indicators of progress toward that goal include the completion of a pilot plant project in partnership with a corn ethanol producer by 2008 and another by 2012.
- Increasing partnering activities with states, industry, universities, other Federal agencies, etc. Indicators of progress toward that goal include annual intensities of collaborative activities.

The performance indicators used in the FY 2004 budget were the costs of ethanol and bio-power. In view of the integrated bio-refinery emphasis, the current budget request focuses on sugars and syngas, the bio-refinery intermediate products from which fuels (including ethanol), heat and power, and various chemicals would be produced. The program's progress, as measured using the FY 2004 indicators, is reflected by the estimated reduction in cellulosic ethanol production cost by a factor of at least 2 over the past 6 years, to $2.75 per gallon in 2003. The more near term technology for converting corn kernel fiber to ethanol should be much less expensive, although corn residues would be a much more significant feedstock source than corn fiber. The program is partnering with industry to develop the technologies that reduce costs further. The recent success in reducing the cost of required enzymes by a factor of 10 contributed to the largest drop in estimated production costs to date.

Annual Performance Results and Targets

FY 2000 Results	FY 2001 Results	FY 2002 Results	FY 2003 Results	FY 2004 Targets	FY 2005 Targets
Program Goal 04.08.01.00 (Biomass and Biorefinery Systems R&D)					
Utilization of Platforms Outputs					
Demonstrated conversion of agricultural wastes to ethanol at a small commercial scale using a genetically engineered fermentative microorganism.			Established 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.	Demonstrate clean syngas production in three thermochemical conversion systems. 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.	Complete a technical and economic evaluation of integrated biomass to fuels systems to validate the sugar cost of $0.15 per pound and syngas cost of $9.80 per million Btu.
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 a prototype yeast capable of fermenting multiple biomass-derived sugars to meet cost goals for the ethanol/gasoline blend markets.	Completed the thermochemical options analysis to assess various process pathways to fuels (e.g., F-T, gasoline, diesel, alcohols). Developed an improved enzyme preparation for reducing the cost of producing ethanol from biomass. Evaluated its impact on production costs using an updated computer model of the production process.		Develop a prototype yeast capable of fermenting multiple biomass-derived sugars for ethanol production to achieve $2.75 per gallon of ethanol.
Management of Funds					
				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 uncosteds to a range of 20-25 percent by reducing program annual uncosteds by 10 percent in 2005 relative to the program uncosted baseline (2004) until the target range is met.

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 the planned investments, means and strategies, and to addressing external factors.

America's diverse biomass resources, and favorable climates offer many opportunities for using domestic, sustainable biomass to meet our needs for fuel, power and products made from plants and plant-derived resources. The program focuses on industrial biorefineries that co-produce fuels and/or power along with high-value chemicals and materials by forming R&D partnerships to advance processing and conversion technologies, improve the efficiency and effectiveness of harvesting, storage and handling of biomass feedstock, and condition markets by increasing consumer awareness of, and acceptance for bio-based products, fuels and power.

The strategy consists of improving the cost-competitiveness of biomass technologies (including feedstock collection and storage subsystems) through research, development, and partnerships with industry, USDA, farmers, states and local communities. The program uses competitive solicitations to attract innovation and ensure investment value for industry’s and universities’ contracts; manages National Laboratory research to overcome technical barriers, and coordinates biomass activities at a local level through the State and Regional Partnership Activity. Funding for public-private collaborative R&D is made on a cost shared basis; managed by a series of objectives and milestones; and reviewed under the industrially developed “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). Technical oversight of the R&D portfolio and planning and analysis for the program is based at DOE Headquarters, and individual project management is provided by field office staff. Finally, the program conducts analysis and performance assessments in order to direct effective strategic planning.

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

In carrying out the program’s mission, the Biomass Program collaborates with several groups on its key activities including:

- Partnerships with industry, USDA, farmers, states and local communities.
- Program decisions about research directions and priorities are guided by the Biomass Technical Advisory Committee and the Biomass R&D Board established under the Biomass R&D Act of 2000.

- The program also relies on input from peer reviews, several of which have been completed in the last three years.[a]

External factors affecting performance include availability of conventional fossil resources, consumer acceptance, and the 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.

Validation and Verification

To validate and verify program performance, the Biomass Program 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:	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.
Baselines:	The following are the key baselines used in the Biomass Program: ▪ Biomass delivered cost: \$53 per dry ton ▪ cleaned and reformed syngas (2003): \$9.80/million btu (\$0.082 per kwh power) ▪ mixed, diluted, unfermented sugars (2003): \$0.15/lb (\$2.75 per gallon ethanol)
Frequency:	GPRA 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:	EE Strategic Management System, and other computer-based data systems.
Verification:	Various trade associations review the data and the modeling processes (e.g. REPIS renewable and Distributed Energy Resources), and the EIA verifies the

[a] August 2002 Biomass Program Review, Washington, DC; August 2002 Biomass Advisory Committee Meeting; Washington, DC.; Documentation of Biopower Roadmapping Workshop, August 30-31, 2000, Washington, DC, attendance by Gas Technology Institute, EPRI, industry, DOE, TVA, NREL, and ORNL; Enzyme Sugar Platform Plan, July 2001, NREL and ORNL.

REPIS database. Stage-gate, peer and program reviews of technology development and economic modeling efforts are independently conducted by personnel from industry, academia and governmental agencies other than the U.S. Department of Energy. These efforts help to focus the program's investments on activities that are within the Federal Government's role and that address top priority needs.

The national laboratories receive direct funds for technology research and development, based on their capabilities and performance. Independent panels consisting 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. OMB's R&D investment criteria have been incorporated into this evaluation. 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.

Funding by General and Program Goal

(dollars in thousands)

	FY 2003	FY 2004	FY 2005	$ Change	% Change
General Goal 4, Energy Security					
Program Goal 04.08.01.00, Biomass					
Feedstock Infrastructure	1,924	982	2,000	+1,018	+103.7%
Platforms Research and Development	27,907	31,275	43,000	+11,725	+37.5%
Utilization of Platform Outputs	28,852	13,518	27,596	+14,078	+104.1%
Total, Program Goal 04.08.01.00, Biomass	58,683	45,775	72,596	+26,821	+58.6%
All Other					
Congressionally Directed Activities, Feedstock Infrastructure					
Hybrid Poplar Tree Research	481	0	0	0	0.0%
University of Tennessee Switchgrass Demonstration Project	0	981	0	-981	-100.0%
Eastern NV Landscape Coalition	0	249	0	-249	-100.0%
Total, Congressionally Directed Activities, Feedstock Infrastructure	481	1,230	0	-1,230	-100.0%

(dollars in thousands)

	FY 2003	FY 2004	FY 2005	$ Change	% Change
Congressionally Directed Activities, Platforms Research and Development					
Thermochemical Platform R&D					
Vermont Biomass Energy Center	481	392	0	-392	-100.0%
Biomass Gasification Research Center AL	1,927	0	0	0	0.0%
Iowa Switchgrass Project - Chariton Valley	2,582	1,962	0	-1,962	-100.0%
Winona, MS Biomass Project	2,889	0	0	0	0.0%
Clean Energy from Gasification of Switchgrass - IA State University	481	736	0	-736	-100.0%
Agricultural Mixed Waste Biorefinery	2,408	0	0	0	0.0%
Combined Heat and Power Green Institution	1,927	0	0	0	0.0%
Center for Biomass Utilization at University of North Dakota	385	491	0	-491	-100.0%
Biomass Cogeneration Project at North Country Hospital	0	245	0	-245	-100.0%
Mount Wachusett Community College	0	942	0	-942	-100.0%
White Pine County Schools Heating	0	249	0	-249	-100.0%
Total, Thermochemical Platform R&D	13,080	5,017	0	-5,017	-100.0%
Bioconversion Platform R&D for Sugars					
Ethanol Production from Biomass – Univ. of Louisville	0	294	0	-294	-100.0%
Michigan Biotechnology Initiative	1,927	1,962	0	-1,962	-100.0%
Consortium for Plant Biotechnology Research	1,927	2,943	0	-2,943	-100.0%
Total, Bioconversion Platform R&D for Sugars	3,854	5,199	0	-5,199	-100.0%
Total, Congressionally Directed Activities, Platforms Research and Development	16,934	10,216	0	-10,216	-100.0%
Congressionally Directed Activities, Utilization of Platform Outputs					
Integration of Biorefinery Technologies					
On-Farm Small Scale Waste Energy Demonstration Project	0	736	0	-736	-100.0%

(dollars in thousands)

	FY 2003	FY 2004	FY 2005	$ Change	% Change
North Central Texas Dairy Waste Control Pilot Project	0	196	0	-196	-100.0%
Corn Bioproducts Research with the National Corn Growers Association	1,000	0	0	0	0.0%
Oxygenated Diesel Emissions Testing in CA and NV, AAE Technologies	963	981	0	-981	-100.0%
New Uses Information and Entrepreneur Development Center	0	981	0	-981	-100.0%
Gridley Rice Straw Project	0	2,943	0	-2,943	-100.0%
Biorefinery at Louisiana State University	0	491	0	-491	-100.0%
Iroquois Bioenergy Cooperative	2,889	0	0	0	0.0%
Total, Integration of Biorefinery Technologies	4,852	6,328	0	-6,328	-100.0%
Products Development					
Regional Biomass Energy Program	2,889	1,962	0	-1,962	-100.0%
Fibrowatt Biomass Project	481	0	0	0	0.0%
Ag-Based Industrial Lubricants Located at the University of Northern Iowa	963	981	0	-981	-100.0%
Missouri Soybean Association	0	294	0	-294	-100.0%
Mississippi State Biodiesel Production Project	0	981	0	-981	-100.0%
Research in Nebraska on Improved Soybean Oil for Biodiesel Fuel	0	491	0	-491	-100.0%
McMinnville Biodiesel Project	0	981	0	-981	-100.0%
Bio-Based Products and Energy with Midwest Consortium	0	1,962	0	-1,962	-100.0%
Maine Forest Bio-Products R&D	0	981	0	-981	-100.0%
Iowa State Univ. Catalysis Research	0	981	0	-981	-100.0%
E-Diesel Research with NCGA	0	981	0	-981	-100.0%
Fuels from Agricultural and Animal Wastes	0	12,327	0	-12,327	-100.0%
Total, Products Development	4,333	22,922	0	-22,922	-100.0%
Total, Congressionally Directed Activities, Utilization of Platform Outputs	9,185	29,250	0	-29,250	-100.0%
Total, All Other	26,600	40,696	0	-40,696	-100.0%

(dollars in thousands)

	FY 2003	FY 2004	FY 2005	$ Change	% Change
Total, Biomass and Biorefinery Systems R&D..........	85,283	86,471	72,596	-13,875	-16.0%

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 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 cellulosic ethanol production expected as a result of realizing the program goals is also reported through 2025.

These estimates are 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 Bioproducts 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. 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 15, 2004. Uncertainties are larger for longer term estimates. 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 growing national benefits over time.

FY 2005 GPRA Benefits Estimates for Biomass Program[a]

Mid-Term Benefits[b]

	2010	2015	2020	2025
Cellulosic Ethanol Production (Million Gallons per year)	90	300	710	1,410
Primary Non-Renewable Energy Savings (quads)	0.04	0.06	0.09	0.15
Carbon Emission Reductions (mmtce)	1	1	1	3
Energy Expenditure Savings (Billion 2001$)	ns	ns	1	2
Oil Savings (MBPD)	0.012	0.015	0.019	0.027
Natural Gas Savings (quads)	0.01	0.02	0.02	0.04

Long-Term Benefits[c]

	2030	2040	2050
Primary Non-Renewable Energy Savings (Quads)	0.4	0.7	1.2
Energy System Cost Savings (Billion 2001$)	3	2	0
Carbon Emission Reductions (MMTCE)	4	11	23
Oil Savings (MBPD)	0.03	0.18	0.36
Natural Gas Savings (Quads)	0.3	0.3	0.4

[a] Benefits reported are annual, not cumulative, for the year given. Estimates reflect the benefits associated with program activities from FY 2005 to the benefit year or to program completion (whichever is nearer), and are based on program goals developed in alignment with assumptions in the President's Budget. These estimates are 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 Bioproducts processes.

[b] Mid-term program benefits were estimated utilizing the GPRA05-NEMS model, based on the Energy Information Administration's (EIA) National Energy Modeling System (NEMS) and utilizing the EIA's Annual Energy Outlook (AEO) 2003 Reference Case. The cellulosic ethanol production estimates were derived from the Ethanol Long Range Systems Analysis Spreadsheet (ELSAS) model. "ns" stands for "not significant."

[c] Long-term benefits were estimated utilizing the GPRA05 - 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.

Feedstock Infrastructure

Funding Schedule by Activity

(dollars in thousands)

	FY 2003	FY 2004	FY 2005	$ Change	% Change
Feedstock Infrastructure					
Feedstock Infrastructure	1,924	982	2,000	+1,018	+103.7%
Congressionally Directed Activities, Feedstock Infrastructure	481	1,230	0	-1,230	-100.0%
Total, Feedstock Infrastructure ..	2,405	2,212	2,000	-212	-9.6%

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 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.

Detailed Justification

(dollars in thousands)

	FY 2003	FY 2004	FY 2005
Feedstock Infrastructure	**1,924**	**982**	**2,000**

In FY 2005, the program will continue work based on the harvesting and logistics roadmap, the sustainability roadmap, policy considerations and other relevant factors. This is expected to include work on one-pass harvesting systems for wheat straw and corn stover, innovative densification and

	FY 2003	FY 2004	FY 2005

storage systems, continued development of models for total infrastructure systems optimization, development of sustainability guidelines, and regional modeling that integrates economic and environmental considerations.

(dollars in thousands)	FY 2003	FY 2004	FY 2005
Congressionally Directed Activities, Feedstock Infrastructure	**481**	**1,230**	**0**

The following projects were directed by Congress to be included: Hybrid Poplar Tree Research (FY 2003 $481,000, FY 2004 $0); Switchgrass Demonstration Project (FY 2004 $981,072); Biomass Restoration by Eastern Nevada Landscape Coalition[a] (FY 2004 $248,525).

	FY 2003	FY 2004	FY 2005
Total, Feedstock Infrastructure	**2,405**	**2,212**	**2,000**

Explanation of Funding Changes

	FY 2005 vs. FY 2004 ($000)
Feedstock Infrastructure	
Increase efforts related to conceptual design of biomass harvesting and storage subsystems.	+1,018
Congressionally Directed Activities, Feedstock Infrastructure	
No funds are requested because funds are being allocated to other activities more closely aligned with the Program's goal.	-1,230
Total Funding Change, Feedstock Infrastructure	**-212**

[a] Included in the Omnibus Appropriation Bill.

Platforms Research and Development

Funding Schedule by Activity

(dollars in thousands)

	FY 2003	FY 2004	FY 2005	$ Change	% Change
Platforms Research and Development					
Thermochemical Platform R&D					
Thermochemical Platform R&D	9,921	16,835	24,000	+7,165	+42.6%
Congressionally Directed Activities, Thermochemical Platform R&D	13,080	5,017	0	-5,017	-100.0%
Total, Thermochemical Platform R&D	23,001	21,852	24,000	+2,148	+9.8%
Bioconversion Platform R&D for Sugars					
Bioconversion Platform R&D for Sugars	17,986	14,440	19,000	+4,560	+31.6%
Congressionally Directed Activities, Bioconversion R&D	3,854	5,199	0	-5,199	-100.0%
Total, Bioconversion Platform R&D for Sugars.......	21,840	19,639	19,000	-639	-3.3%
Total, Platforms Research and Development..............................	44,841	41,491	43,000	+1,509	+3.6%

Description

The program has defined two basic processes for the conversion of biomass into intermediates that can be used for the production of a number of liquid fuels, power, or chemical and materials. The process intermediates are synthesis gas (syngas), pyrolysis oils, and sugars. One of the key thermochemical R&D goals of the Platform R&D subprogram 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 liquid fuels or hydrogen. The subprogram will also 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.

Benefits

Integration and optimization of these processes will be necessary in order to:

- Reduce the cost of cleaned and reformed biomass-derived synthesis gas produced, from a mature gasification plant, from $9.80 per million Btu in 2003 to $7.58 per million Btu by 2010. Indicators of progress toward that goal include successful bench-scale studies by 2007 and pilot-scale studies by 2010.
- Reduce the cost of a mixed, dilute sugar stream suitable for fermentation to ethanol, in a mature biochemical plant, from $0.15 per lb. in 2003 to $0.10 per lb. by 2010. Indicators of progress toward that goal include successful bench-scale studies by 2007 and pilot-scale studies by 2010.

Progress toward these goals are:

	FY 2003	FY 2005	FY 2010	FY 2015
Syngas cost ($/MM Btu)	9.80	9.80	7.58	6.02
Sugars cost ($/lb.)	0.15	0.15	0.10	0.082

Detailed Justification

(dollars in thousands)

	FY 2003	FY 2004	FY 2005
Thermochemical Platform R&D	**23,001**	**21,852**	**24,000**
▪ **Thermochemical Platform R&D**	**9,921**	**16,835**	**24,000**

The Thermochemical Platform R&D Activity includes the former Advanced Biomass Technology R&D-Thermochemical Conversion R&D activity and the Systems Integration and Production-Thermochemical Production Integration activity from FY 2004.

The program 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.

In FY 2005, in collaboration with industrial partners, the program will demonstrate the continuous production, cleanup and conditioning of biomass syngas and pyrolysis oils suitable for conversion to fuels, chemicals or hydrogen. 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

	(dollars in thousands)		
	FY 2003	FY 2004	FY 2005

tars, improving syngas yields, and on shift reactions to adjust hydrogen ratios. These efforts will develop technologies compatible with the scale of biomass facilities. The program will examine the production of hydrogen from biomass via the synthesis gas pathway. The program will continue analysis and evaluation of the potential for biorefineries, at varying scale, to incorporate syngas systems.

In FY 2003 this activity was reduced by $158,000 for SBIR/STTR that was transferred to the Science Appropriation.

	FY 2003	FY 2004	FY 2005
▪ **Congressionally Directed Activities, Thermochemical Platform R&D**	**13,080**	**5,017**	**0**

The following projects were directed by Congress to be included in this program: Vermont Biomass Energy Center (FY 2003 $481,000, FY 2004 $392,429); Biomass Gasification Research Center - AL (FY 2003 $1,927,000, FY 2004 $0); Iowa Switchgrass Project[a] (FY 2003 $2,582,337, FY 2004 $1,962,143); Winona, MS Biomass Project (FY 2003 $2,889,000, FY 2004 $0); Gasification of Switchgrass – IA (FY 2003 $481,000, FY 2004 $735,804); Agricultural Mixed Waste Biorefinery - CO (FY2003 $2,408,000, FY2004 $0); University of North Dakota (FY2003 $385,000; FY 2004 $490,536); Combined Heat and Power Green Institution – MN (FY 2003 $1,927,000, FY 2004 $0); Biomass Cogeneration Project at North Country Hospital (FY 2004 $245,268); Biomass Gasification at Mount Wachusett Community College (FY 2004 $941,829); and Biomass Conversion in White Pine County, NV[b] (FY 2004 $245,268).

	FY 2003	FY 2004	FY 2005
Bioconversion Platform R&D for Sugars	**21,840**	**19,639**	**19,000**
▪ **Bioconversion Platform R&D for Sugars**	**17,986**	**14,440**	**19,000**

In the FY 2004 budget request, this activity was called Bioconversion R&D within Advanced Biomass Technology R&D.

This work is comprised of four major elements: improved enzymes, advanced pretreatment, enhanced process integration capabilities, and development of enabling analytical tools.

The costs of enzymes and capital costs of pretreatment systems are high, and the nature of the pretreatment process impacts all downstream operations. For these reasons, evaluations of novel pretreatment systems and advanced enzymes will continue to identify improved, lower cost processes.

In FY 2005, the program will continue to work with industry on pretreatment and analytical technologies, and improved process integration capabilities that will enable industrial biorefineries. Through collaboration with universities and industry, efforts will focus on developing and

[a] FY 2004 amount shown is still under negotiation as of February 2004.
[b] Included in the Omnibus Appropriation bill.

	(dollars in thousands)		
	FY 2003	FY 2004	FY 2005

understanding the fundamental principles of biomass depolymerization to aid in developing novel pretreatment.

Integration of improved fermentation micro-organisms with pretreatment will allow the testing of the micro-organisms using biomass hydrolysates that come out of the pretreatment process with varying levels of inhibitory compounds, acidity, etc. The program will continue to fund existing partnerships to develop more productive and lower-cost cellulase enzyme systems, and will form additional partnerships to accelerate the use of commercially available cellulase systems. These additional cost reductions will come from increasing enzyme activity and tolerance to inhibition by biomass sugars, and production process innovations.

The program will continue to improve analytical tools and approaches, including methods for monitoring the mass and component balances across pretreatment processes, increasing the understanding of the fine structure of the biomass (native or pretreated), identifying the reactions and mass transfer processes that occur during biomass pretreatment, and characterizing the interactions between pretreated biomass and enzymes.

	FY 2003	FY 2004	FY 2005
▪ **Congressionally Directed Activities, Bioconversion R&D**	**3,854**	**5,199**	**0**

The following projects were directed by Congress to be included in this program: Michigan Biotechnology Initiative (FY 2003 $1,927,000, FY 2004 $1,962,413); Consortium for Plant Biotechnology Research (FY 2003 1,927,000, FY 2004 $2,943,215); and Ethanol Production at University of Louisville (FY 2004 $294,321).

	FY 2003	FY 2004	FY 2005
Total, Platforms Research and Development	**44,841**	**41,491**	**43,000**

Explanation of Funding Changes

	FY 2005 vs. FY 2004 ($000)
Thermochemical Platform R&D	
▪ **Thermochemical Platform R&D**	
Increase research and development in the areas of gasification fundamentals and cleanup and conditioning of syngas to make it suitable for conversion to fuels, chemicals or hydrogen	+7,165

	FY 2005 vs. FY 2004 ($000)
▪ **Congressionally Directed Activities, Thermochemical Platform R&D**	
No funds are requested because funds are being allocated to other activities more closely aligned with the Program's goal	-5,017
Total, Thermochemical Platform R&D	+2,148
Bioconversion Platform R&D for Sugars	
▪ **Bioconversion Platform R&D for Sugars**	
Increase collaboration with industrial and university partners on sugar production technology including feedstock pretreatment, enzymes and micro-organisms for sugar fermentation	+4,560
▪ **Congressionally Directed Activities, Bioconversion Platform R&D for Sugars**	
No funds are requested because funds are being allocated to other activities more closely aligned with the Program's goal	-5,199
Total, Bioconversion Platform R&D for Sugars	-639
Total Funding Change, Platforms Research and Development	+1,509

Utilization of Platform Outputs

Funding Schedule by Activity

(dollars in thousands)

	FY 2003	FY 2004	FY 2005	$ Change	% Change
Utilization of Platform Outputs					
Integration of Biorefinery Technologies					
Integration of Biorefinery Technologies	21,107	13,312	20,000	+6,688	+50.2%
Congressionally Directed Activities, Integration of Biorefinery Technologies..	4,852	6,328	0	-6,328	-100.0%
Total, Integration of Biorefinery Technologies.......	25,959	19,640	20,000	+360	+1.8%
Products Development					
Products Development.....	7,745	206	7,596	+7,390	+3,587.4%
Congressionally Directed Activities, Products Development	4,333	22,922	0	-22,922	-100.0%
Total, Products Development	12,078	23,128	7,596	-15,532	-67.2%
Total, Utilization of Platform Outputs	38,037	42,768	27,596	-15,172	-35.5%

Description

The Utilization of Platform Outputs R&D subprogram consists of two components: Integration of Biorefinery Technologies and Products Development. Projects within the first component 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 cellulosic conversion processes into existing starch-based ethanol plants. The Products Development component's focus is on the integration of programs and partnerships with colleges, universities, national laboratories, and Federal and State research agencies that fund R&D in bio-based products.

Benefits

This subprogram will provide essential benefits in the following areas:

- Accelerating the use of cellulosic feedstock in existing corn ethanol plants to expand domestic ethanol production while reducing the industry's overall carbon emission intensity. Indicators of progress toward that goal include the completion of a pilot plant project in partnership with a corn ethanol producer by 2008 and another by 2012.
- Increasing partnering activities with states, industry, universities, other Federal agencies, etc, will expand the necessary support structure needed for accelerated market transition. Indicators of progress toward that goal include annual collaborative activities.

Detailed Justification

(dollars in thousands)

	FY 2003	FY 2004	FY 2005
Integration of Biorefinery Technologies	**25,959**	**19,640**	**20,000**
▪ **Integration of Biorefinery Technologies**	**21,107**	**13,312**	**20,000**

In the FY 2004, budget request, this activity was called Bioconversion Production Integration within the Systems Integration and Production activity.

In FY 2005, 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 corn fiber or corn stover to fuels and co-products. Industry partners will conduct developmental work at the bench-scale and/or pilot-scale, refine engineering and economic evaluations, and develop commercialization plans. National Laboratory personnel will assist with process simulation analysis using the latest energy and material balance information, development of advanced analytical tools for characterization of biomass and intermediates, and conceptual equipment cost estimates.

	FY 2003	FY 2004	FY 2005
▪ **Congressionally Directed Activities, Integration of Biorefinery Technologies R&D**	**4,852**	**6,328**	**0**

The following projects were directed by Congress to be included in this program: On-Farm Small Scale Waste Energy Demonstration Project (FY 2004 $735,808); Iroquois Bioenergy Cooperative (FY 2003 $2,889,000, FY 2004 $0); Corn Bioproduct Research with the National Corn Growers Association (FY 2003 $1,000,000, FY 2004 $0); Oxygenated Diesel Emissions Testing in CA and NV (FY 2003 $963,000, FY 2004 $981,072); New Uses Info & Entrepreneur Development Center (FY 2004 $981,072); Gridley Rice Straw Project (FY 2004 $2,943,215); and Biorefinery at Louisiana State University (FY 2004 $490,536).

	(dollars in thousands)		
	FY 2003	FY 2004	FY 2005
Products Development	**12,078**	**23,128**	**7,596**
▪ **Products Development**	**7,745**	**206**	**7,596**

In the FY 2004 budget request, this activity was called Crosscutting Biomass R&D within the Systems Integration and Production activity. The focus is on the integration of programs and partnerships with colleges, universities, national laboratories, and Federal and State research agencies that fund R&D in biobased products. In prior years, the Small Modular Biopower activity was also part of Products Development.

In FY 2005, the Program will continue to work with other Federal agencies to identify opportunities for expanding the biomass R&D portfolio, and will conduct analyses of the potential for biobased processes not contained in the current portfolio. The program will investigate the use of platform outputs for the production of value-added products that will enable the development of commercial biorefineries. The State/Regional Partnerships activity ($4.0 M) will involve collaboration with States on technology transfer, research, development, field testing, and other needed efforts to overcome market barriers in order to achieve common goals of increasing domestic, clean energy supplies and reducing oil imports. States and the Federal government can benefit from collaboration and leveraging of funds aimed at accelerating and expanding biomass utilization. In FY 2003 this activity was reduced by $1,263,337 for SBIR/STTR that was transferred to the Science Appropriation.

▪ **Congressionally Directed Activities, Products Development**	**4,333**	**22,922**	**0**

The following projects were directed by Congress to be included in this program: Regional Biomass Energy Program (FY 2003 $2,889,000, FY 2004 $1,962,143); Fibrowatt Biomass Project – MS (FY 2003 $481,000, FY 2004 $0); Ag-Based Industrial Lubricants at the University of Northern Iowa (FY 2003 $963,000, FY 2004 $981,072); Biodiesel Demonstration with Missouri Soybean Association (FY 2004 $294,321); Mississippi State Biodiesel Production Project (FY 2004 $981,072); Improved Soybean Oil for Biodiesel in Nebraska (FY 2004 $490,536); McMinnville Biodiesel Project (FY 2004 $981,072); Bio-Based Products and Energy with Midwest Consortium (FY 2004 $1,962,143); Maine Forest Bio-Products R&D (FY 2004 $981,072); Center for Catalysis at Iowa State University (FY 2004 $981,072); E-Diesel Research with National Corngrowers Association (FY 2004 $981,072); and Fuels from Agricultural/Animal Wastes[a] (FY 2004 $12,326,840).

Total, Utilization of Platform Outputs	**38,037**	**42,768**	**27,596**

[a] Included in the Omnibus Appropriation bill.

Explanation of Funding Changes

	FY 2005 vs. FY 2004 ($000)
Integration of Biorefinery Technologies	
▪ **Integration of Biorefinery Technologies**	
Increase collaboration with ethanol producers on corn residue and corn fiber conversion technology, including bench-scale investigations and pilot plant development for scale-up testing	+6,688
▪ **Congressionally Directed Activities, Integration of Biorefinery Technologies**	
No funds are requested because funds are being allocated to other activities more closely aligned with the Program's goal	-6,328
Total, Integration of Biorefinery Technologies	+360
Products Development	
▪ **Products Development**	
Increase research and development on sugar-based and syngas-based products, including catalyst development, reactor testing and products characterization. Expand collaboration with States to overcome market barriers	+7,390
▪ **Congressionally Directed Activities, Products Development**	
No funds are requested because funds are being allocated to other activities more closely aligned with the Program's goal	-22,922
Total, Products Development	-15,532
Total Funding Change, Utilization of Platform Outputs	**-15,172**

Intergovernmental Activities

Funding Profile by Subprogram

(dollars in thousands)

	FY 2003 Comparable Appropriation	FY 2004 Original Appropriation	FY 2004 Adjustments[a,b]	FY 2004 Comparable Appropriation	FY 2005 Request
Intergovernmental Activities					
International Renewable Energy Program....................	3,853	6,000	-112	5,888	6,500
Tribal Energy Activities	5,780	5,000	-94	4,906	5,500
Renewable Energy Production Incentive	4,816	4,000	-74	3,926	4,000
Total, Intergovernmental Activities.....................................	14,449	15,000	-280	14,720	16,000

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) which addresses complementary subprograms included in the Energy Conservation Budget, all of which support the program's and Department's mission to develop, promote, and accelerate the adoption of energy efficiency, renewable energy, and oil displacement technologies and practices by providing customers with choices for improved energy utilization. Intergovernmental Activities promote the market transfer of clean energy innovations for sustainable development, trade, security, environment and climate.

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 Program and the

[a] Programs in the Energy Supply appropriation were reduced by .59 percent as required by the Omnibus Appropriation Bill.

[b] Programs in the Energy Supply appropriation were proportionally reduced based upon the allocated General Reduction of $4,684,000.

Tribal Energy Program helps 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 National Energy Policy recommendation.

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 Intergovernmental program supports the following goals:

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 Goals 4 in the "goal cascade":

Program Goal 04.11.01.00: 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 04.11.02.00 (Intergovernmental Activities)

The Weatherization and Intergovernmental Program contributes to General Goal 4 by providing appropriate technical assistance in targeted intergovernmental communities that provide high leverage and public policy responsive to acceleration of the adoption of cost-effective EERE technologies.

Annual Performance Results and Targets

FY 2000 Results	FY 2001 Results	FY 2002 Results	FY 2003 Results	FY 2004 Targets	FY 2005 Targets
Program Goal 04.11.01.00 (Intergovernmental Activities)					
International Renewable Energy					
		Implemented energy efficiency and renewable energy provisions of DOE's bi-lateral and multi-lateral agreements with Mexico, China, the EU, and other priority countries including work with APEC and NAEWG.	Expanded support for DOE's priority agreements, including the harmonization of standards and labels in North America and the implementation of the U.S. Energy Efficiency for Sustainable Development and Global Village Energy Partnership initiatives. Continued to work with APEC and NAEWG.	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. Tribal Energy will conduct 6 technical and policy development workshops.	Provide technical analysis and reviews, data access, training and project support for 11 international clean energy projects which includes: developing 4 components for GIS tools to analyze U.S. EERE technology export markets; provide phase 1 and 2 technical assistance to secure access for EERE technologies to build 1000 MW of generation globally over 10 years. Tribal Energy will provide direct technical assistance to tribal nations including: 5 development workshops, 5 economic development projects, 15 "first steps" efforts, and 15 feasibility studies, working toward goal of 100 MW of generation in Indian country by 2010.
Tribal Energy					
		Tribal Energy funded technical assistance in the form of 4 feasibility studies and 14 economic development projects.	Tribal Energy funded technical assistance in the form of 5 workshops, 20 economic development projects and 4 feasibility studies.		
Renewable Energy Production Incentive (REPI)					
Processed applications for more than 508 million kWh total of qualified renewable energy produced during the prior fiscal year	Processed applications for more than 685 million kWh total of qualified renewable energy produced during the prior fiscal year	Processed applications for more than 701 million kWh total of qualified renewable energy produced during the prior fiscal year	Processed applications for more than 730 million kWh total of qualified renewable energy produced during the prior fiscal year		
Processed payments for $1.5M worth of qualified energy.	Processed payments for $3.991M worth of qualified energy.	Processed payments for $3.787M worth of qualified energy.	Processed payments for $4.815M worth of qualified energy.		

Management of Funds		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 uncosteds to a range of 20-25 percent by reducing program annual uncosteds by 10 percent in 2005 relative to the program uncosted baseline (2004) until the target range is met.

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:

- In countries where the electricity infrastructure is underdeveloped or non-existent, distributed energy systems such as photovoltaic arrays, small wind turbines, biomass power systems, or other renewable systems have an advantage by avoiding the cost of construction of transmission and distribution facilities. U.S. equipment manufacturers rely on these markets abroad to sustain their business operations while domestic markets for these devices develop. The program will focus its efforts to promote these technologies.
- While tax credits exist to encourage private utilities to own and operate renewable energy systems, they offer no benefit to non-profit organizations. The Renewable Energy Production Incentive was created by Congress to provide a corresponding stimulus for the Nation's non-tax paying electricity producers (mostly the 3,000 publicly owned and electric cooperative electric utilities) to own and operate renewable energy systems. Within the limits of the enabling legislation, the Department's program fairly and equitably seeks to provide an incentive payment of 1.76 cents/kWh (FY 2003) for adoption of the renewable technologies most needing Federal assistance. Importantly, all qualifying projects are planned, bid, purchased, built, and operated following normal commercial practices.
- 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 following external factor could effect the Intergovernmental Activities achievement of its strategic goal:

President Bush, on June 11, 2001 and February 14, 2002, set America on a path to slow the growth of our greenhouse gas emissions and, as science justifies, to stop and then reverse the growth of emissions. He reaffirmed America's commitment to the United Nations Framework Convention on Climate

Change and its central goal "to stabilize atmospheric greenhouse gas concentrations at a level that will prevent dangerous human interference with the climate." U.S. climate-change policy is based upon voluntary action and incentives, rather than intrusive government regulation. 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.

In carrying out the program mission, Intergovernmental Activities collaborates with Tribal governments and with international agencies and governments in several important activities including:

- The International Renewable Energy Program works with the multi-agency Climate Change Technology Program (CCTP), which organizationally is located within and led by DOE aims to evaluate the current state of U.S. climate change technology R&D and make recommendations for improvement and to enhance coordination across Federal agencies, and among the Federal Government, universities, and the private sector.
- Tribal Energy Subprogram maintains a close collaboration with the Bureau of Indian Affairs, with HUD and the Native American Housing Assistance and Self-Determination Act (NAHASDA) on building codes for Native American tribes. The sub-program coordinates closely with all other agencies that deal with tribes such as DOI, DOJ, HHS, and EPA.

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 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:	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. Information collected directly from WIP performers and partners.
Baselines:	The baseline for non-hydro, non-pulp and paper renewable electricity is 7.0 gigawatts (1999); the baseline for distributed energy resources is 14.7 gigawatts (1997).
Frequency:	Annual.
Data Storage:	The EIA and other data sources store the data on their computers. WIP program output information is contained in various reports and memoranda.
Verification:	A trade association working group reviews REPIS renewable and DER data. The EIA uses and verifies the REPIS database. The November 2001 Distributed Energy Resources Peer Review verified the distributed generation data.

Funding by General and Program Goal

(dollars in thousands)

	FY 2003	FY 2004	FY 2005	$ Change	% Change
General Goal 4, Energy Security					
Program Goal 04.11.01.00, Intergovernmental Activities					
International Renewable Energy Program	3,853	5,152	6,500	+1,348	+26.2%
Tribal Energy Activities	4,817	3,925	5,500	+1,575	+40.1%
Renewable Energy Production Initiative	4,816	3,926	4,000	+74	+1.9%
Total, Program Goal 04.11.01.00, Intergovernmental Activities	13,486	13,003	16,000	+2,997	+23.0%
All Other					
Congressionally Directed Activity, International Renewable Energy Program/Renewable Energy Policy Project	0	736	0	-736	-100.0%
Congressionally Directed Activity, Tribal Energy/Council of Renewable Energy Resource Tribes (CERT)	963	981	0	-981	-100.0%
Total, All Other	963	1,717	0	-1,717	-100.0%
Total, General Goal 4 (Intergovernmental Activities)	14,449	14,720	16,000	+1,280	+8.7%

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.

Estimates of annual non-renewable energy savings, energy expenditure savings, carbon emission reductions, oil savings, natural gas savings, and displaced need for electricity capacity additions that result from the realization of the Intergovernmental Program goals are shown in the table below through 2025. 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.

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. 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 estimated to be completed and posted by March 15, 2004.

GPRA Benefits Estimates for the Weatherization and Intergovernmental Activities[a]

Mid-Term Benefits

	2010	2015	2020	2025
Primary Non-Renewable Energy Savings (Quads)	0.4	0.7	0.9	1.1
Energy Expenditure Savings (Billion 2001$)	5	8	11	17
Carbon Emission Reductions (MMTCE)	8	13	19	24
Oil Savings (MBPD)	0.0	0.0	0.1	0.1
Natural Gas Savings (Quads)	0.19	0.29	0.29	0.23
Total Displaced Need for New Electric Capacity (GW)	6	11	11	13

[a] Benefits reported are annual, not cumulative, for the year given. Estimates reflect the benefits associated with program activities from FY 2005 to the benefit year or to program completion (whichever is nearer), and are based on program goals developed in alignment with assumptions in the President's Budget. Mid-term program benefits were estimated utilizing the GPRA05-NEMS model, based on the Energy Information Administration's (EIA) National Energy Modeling System (NEMS) and utilizing the EIA's Annual Energy Outlook (AEO) 2003 Reference Case.

International Renewable Energy Program

Funding Schedule by Activity

(dollars in thousands)

	FY 2003	FY 2004	FY 2005	$ Change	% Change
International Renewable Energy Program					
International Renewable Energy Program	2,649	3,190	6,500	+3,310	+103.8%
Congressionally Directed Activities, International Renewable Energy Program.	1,204	2,698	0	-2,968	-100.0%
Total, International Renewable Energy Program	3,853	5,888	6,500	+612	+10.4%

Description

The International Renewable Energy Program (IREP) activities are focused in three broad areas: market and trade development; U.S. energy security; and global environmental and energy issues. To address these needs, IREP provides technical assistance, disseminates information, conducts trade missions and reverse trade missions. The IREP promotes the use of U.S. renewable energy technologies; assists sector project development; and helps reduce non-technical barriers (e.g., financing, resources, tariffs, and local prohibitions).

Benefits

The IREP supports the program mission through technical assistance with National Laboratories and outside experts, helping meet DOE international goals and specific commitments contained in bilateral and multilateral agreements, which further WIP goals. 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 based upon voluntary action and incentives, rather than intrusive government regulation. 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."

Detailed Justification

	(dollars in thousands)		
	FY 2003	FY 2004	FY 2005
International Renewable Energy Program..................	**2,649**	**3,190**	**6,500**

International Renewable Energy supports bilateral and multilateral agreements and builds partnerships with international energy organizations and governments to foster information exchange on renewable energy and energy technology choices for consumers and businesses. These activities include technical and financial assistance projects. They are intended to promote better understanding and acceptance of energy efficiency and renewable energy technologies in other countries' to foster stronger public-private partnerships and to expand domestic and overseas markets for U.S. manufacturers of these technologies. These efforts include cost-shared field validation projects, whose primary purpose is to educate foreign energy decision makers about the merits of U.S. energy efficiency and renewable energy technologies and programs. Also important are the efforts to assist international educational institutions with the creation of renewable energy curricula, workshop development, and multi-year activity planning. This enables participating countries to understand the potential benefits of energy efficiency and renewable energy technologies, and to develop plans for their appropriate application.

International Renewable Energy includes the following efforts: 1) Continued support for Energy Efficiency and Sustainable Development Centers in countries with transitional economies to gain access to U.S. technologies; 2) Support for establishment of Regional Centers in Africa and Latin America in countries with good governance to promote energy innovations in support of sustainable economic development and regional stability; 3) The Hemispheric Energy Initiative, which works with the energy ministers of member countries of the Organization of American States to support their renewable energy programs; 4) The US-China Renewable Energy Cooperation, which supports business development for U.S. renewable and energy efficiency enterprises in China; 5) Russian and other Eastern Europe programs, which cooperate with multilateral agencies on energy efficiency and renewable energy projects and policy development; 6) The Africa Project, which holds workshops and supports the Conference of Energy Ministers in Africa; 7) World Summit on Sustainable Development activities in selected countries; and 8) Clean Energy Initiative. These efforts provide technical assistance to support sustainable development and emerging market economies.

	(dollars in thousands)		
	FY 2003	FY 2004	FY 2005
Congressionally Directed Activities, International Renewable Energy Program	**1,204**	**2,698**	**0**

International Utility Energy Partnership, Inc. - The 2004 grant to IUEP will finalize projects sponsored under prior RFPs conducted by IUEP, open a new RFP for the IUEP and Power Partners' member companies interested in developing international GHG reduction projects, create new partnerships under the IPP initiative to incubate future development opportunities, and provide a program-mechanism for the U.S.-investor owned electric industry to partner with the developing world to take a leadership role in voluntary GHG reduction effort. FY 2003 ($1,204,000), FY 2004 ($1,962,143); Renewable Energy Policy Project - The grant to the Renewable Energy Policy Project (REPP) will fund the survey of all commercially viable domestic renewable energy technologies to determine the job and skill requirements relating to the manufacturing, installation, and operation and maintenance for each technology. FY 2004 ($735,804)

	FY 2003	FY 2004	FY 2005
Total, International Renewable Energy Program	**3,853**	**5,888**	**6,500**

Explanation of Funding Changes

	FY 2005 vs. FY 2004 ($000)
International Renewable Energy Program	
The International Renewable Energy Program is being increased in order to improve the tools, technical services, and capacity to promote energy innovations that support climate change objectives, sustainable development, global security, trade and exports for the Clean Energy Initiatives follow-up to the World Summit on Sustainable Development, the U.N. Framework Convention on Climate Change, the Clean Energy Technology Exports Initiative, and other international agreements for renewable energy and efficiency, including membership and supporting activities in the Asian Pacific Economic Cooperation (APEC) organization. Tools include improved Geographical Information System support for analysis and mapping of clean energy resources in U.S. technology export markets	**+3,310**
Congressionally Directed Activities, International Renewable Energy Program	
International Utility Energy Partnership, Inc.: This activity is expected to be completed under the one-time grant issued in FY 2004. The results of the survey will need to be reviewed and assessed against programmatic priorities to determine the appropriateness of any separate follow on activities. Renewable Energy Policy Project: DOE is developing a public-private partnership to achieve	**-2,698**

	FY 2005 vs. FY 2004 ($000)
broader market transfer of clean energy innovations through collaborative work with industry	
Total Funding Change, International Renewable Energy Program.	**+612**

Tribal Energy Activities

Funding Schedule by Activity

(dollars in thousands)

	FY 2003	FY 2004	FY 2005	$ Change	% Change
Tribal Energy Activities					
Tribal Energy Activities.......	4,817	1,669	5,500	+3,831	+229.5%
Congressionally Directed Activities, Tribal Energy Activities	963	3,237	0	-3,237	-100.0%
Total, Tribal Energy Activities	5,780	4,906	5,500	+594	+12.1%

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 and for the electrification of 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 2003	FY 2004	FY 2005
Tribal Energy Activities	**4,817**	**1,669**	**5,500**

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 productive uses; provides, where appropriate, new power supplies for export to areas facing energy challenges; and advances the Department's technology performance and integration efforts. Through resource assessments, workshops, training and energy plan development assistance, Tribal leaders develop the capacity to make knowledgeable decisions regarding their Tribes' energy future. Through competitively selected cost-shared projects, Tribes will begin implementing comprehensive energy plans to assist Tribal members in using renewable energy technologies and resources.

The Tribal Energy activities develop, implement, and manage 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. Working with Native American communities on Tribal lands and at Tribal Colleges, projects include resource assessments and development plans for energy efficient and renewable energy technologies on Tribal lands. Technical assistance helps Native American Tribes, communities on Tribal lands, 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.

Economic development is an ongoing challenge facing America's Native American populations. Tribal governments work in partnership with the Federal Government and others to foster rural development and the elimination of poverty. Access to energy is a particular problem in this regard. Because of their remote locations and distance from transmission and distribution systems, many tribes have inadequate energy services, which interferes with economic development efforts and programs to promote rural education, public health, and safety. In many ways, the energy problems faced by these tribes resemble the energy problems faced by developing nations and remote populations around the world.

The Tribal Energy activity will continue efforts to assist Tribes in developing Tribal Utility Authorities, where appropriate, to aid in obtaining private sector and other Federal funding. Capacity building and cost-shared deployment projects will continue.

	FY 2003	FY 2004	FY 2005
	(dollars in thousands)		
Congressionally Directed Activities, Tribal Energy Activities	**963**	**3,237**	**0**

Intertribal Council on Utility Policy - Will provide support and funding for wind projects. FY 2004 ($1,275,393); Pyramid Lake Paiute Tribe Renewable Energy Park - Will provide support and funding for projects. FY 2004 ($981,072); Tribal Energy/Council of Renewable Energy Resource Tribes (CERT) - The 2004 grant to the CERT will provide technical expertise and training of Native Americans in renewable energy resources development and electric generation facilities management. FY 2003 ($963,000), FY 2004 ($981,072)

	FY 2003	FY 2004	FY 2005
Total, Tribal Energy Activities	**5,780**	**4,906**	**5,500**

Explanation of Funding Changes

	FY 2005 vs. FY 2004 ($000)
Tribal Energy Activities	
Tribal Energy will focus resources on technical support and funding to Tribal energy projects selected from competitive solicitations.	**+3,831**
Congressionally Directed Activities, Tribal Energy Activities	
Intertribal Council on Utility Policy: Funds provided for in FY 2004 will complete contemplated activities and any additional technical assistance needed will be provided from within the planned Tribal Energy Activities efforts. Pyramid Lake Paiute Tribe Renewable Energy Park: Funds provided for in FY 2004 will complete contemplated activities and any additional technical assistance needed will be provided from within the planned Tribal Energy Activities efforts. Congressionally Directed Activity, Tribal Energy/Council of Renewable Energy Resource Tribes (CERT): Funds provided for in FY 2004 will complete contemplated activities and any additional technical assistance needed will be provided from within the planned Tribal Energy Activities efforts	**-3,237**
Total Funding Change, Tribal Energy Activities	**+594**

Renewable Energy Production Incentive (REPI)

Funding Schedule by Activity

(dollars in thousands)

	FY 2003	FY 2004	FY 2005	$ Change	% Change
Renewable Energy Production Incentive (REPI)					
Renewable Energy Production Incentive (REPI)	4,816	3,926	4,000	+74	+1.9%
Total, Renewable Energy Production Incentive (REPI).......	4,816	3,926	4,000	+74	+1.9%

Description

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 from appropriations.

Benefits

REPI supports the WIP program goal of deploying renewable energy technologies by providing Federal tax credits to encourage adoption of renewable energy systems for the Nation's non-tax paying electricity producers (mostly the 3,000 publicly owned and electric cooperative electric utilities) to own and operate renewable energy systems.

Detailed Justification

(dollars in thousands)

	FY 2003	FY 2004	FY 2005
Renewable Energy Production Initiative (REPI).........	**4,816**	**3,926**	**4,000**

REPI will continue to review applications for renewable energy incentive payments and pay qualified energy as allowed under Section 1212 of the Energy Policy Act of 1992 for electricity from renewable energy generated by states, political subdivisions of states, or rural electric cooperatives.

	FY 2003	FY 2004	FY 2005
Total, Renewable Energy Production Initiative (REPI)	**4,816**	**3,926**	**4,000**

Explanation of Funding Changes

	FY 2005 vs. FY 2004 ($000)
Renewable Energy Production Incentive (REPI)	
The increase supports activities at an ongoing level	+74
Total Funding Change, Renewable Energy Production Incentive (REPI)	**+74**

Renewable Program Support

Funding Profile by Subprogram

(dollars in thousands)

	FY 2003 Comparable Appropriation	FY 2004 Original Appropriation	FY 2004 Adjustments[a,b]	FY 2004 Comparable Appropriation	FY 2005 Request
Renewable Program Support					
Renewable Program Support................................	0	4,000	+ 919[c]	4,919	0
Total, Renewable Program Support	0	4,000	+ 919	4,919	0

Public Law Authorizations:

P.L. 95-91, "Department of Energy Organization Act" (1977)

Mission

This provides for the 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 provides 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.

Benefits

These congressionally-directed, crosscutting activities do not measurably contribute to the goals of individual renewable energy programs or integrated renewable energy portfolio results.

[a] Programs in the Energy Supply appropriation were reduced by .59 percent as required by the Omnibus Appropriation Bill.

[b] Programs in the Energy Supply appropriation were proportionally reduced based upon the allocated General Reduction of $4,684,000.

[c] Renewable Program Support was provided increases by the Omnibus Appropriation Bill of $1,000,000. This amount was subject to the .59 percent reduction required by the Omnibus Appropriation Bill.

Funding Schedule by Activity

	(dollars in thousands)				
	FY 2003	FY 2004	FY 2005	$ Change	% Change
Renewable Program Support					
Southwestern Multi-Programs Virtual Site in Nevada	0	3,925	0	-3,925	-100.0%
Energy Center of Wisconsin Renewable Fuels Project	0	746	0	-746	-100.0%
Lead Animal Shelter Animal Campus Renewable Energy Demonstration Project	0	248	0	-248	-100.0%
Total, Renewable Program Support	0	4,919	0	-4,919	-100.0%

Description

Continues 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 provides 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.

Benefits

Activities do not measurably contribute to goals of individual renewable energy programs or integrated renewable energy portfolio results.

Detailed Justification

	(dollars in thousands)		
	FY 2003	FY 2004	FY 2005
Renewable Program Support			
▪ **Southwestern Multi-Programs Virtual Site in Nevada**	**0**	**3,925**	**0**

Supports 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 (FY 2004: $3,924,286). In FY 2003, $3,155,806 was provided by Congress and is displayed with the Office of Electricity Transmission and Distribution's Budget.

	FY 2003	FY 2004	FY 2005
	(dollars in thousands)		
▪ **Energy Center of Wisconsin Renewable Fuels Project**	**0**	**746**	**0**

Congressionally-directed funding for the Energy Center of Wisconsin Renewable Fuels Project. This activity is provided for with in the Consolidated Appropriations Act of 2004 (FY 2004: $745,475).

	FY 2003	FY 2004	FY 2005
▪ **Lead Animal Shelter Animal Campus Renewable Energy Demonstration Project**	**0**	**248**	**0**

Congressionally-directed funding to remain available until expended for the Lead Animal Shelter Animal Campus Renewable Energy Demonstration Project. This activity is provided for with in the Consolidated Appropriations Act of 2004 (FY 2004: $248,425).

	FY 2003	FY 2004	FY 2005
Total, Renewable Program Support	**0**	**4,919**	**0**

Explanation of Funding Changes

	FY 2005 vs. FY 2004 ($000)
Southwestern Multi-programs virtual site in Nevada	
Within the FY 2005 budget request, DOE has reallocated the funding for this directed activity to higher-priority, mission-supporting activities within the Renewable Energy Program portfolio in the Energy Efficiency and Renewable Energy	-3,925
Energy Center of Wisconsin Renewable Fuels Project	
Within the FY 2005 budget request, DOE has reallocated the funding for this directed activity to higher-priority, mission-supporting activities within the Renewable Energy Program portfolio in the Energy Efficiency and Renewable Energy	-746
Lead Animal Shelter Animal Campus Renewable Energy Demonstration Project	
Within the FY 2005 budget request, DOE has reallocated the funding for this directed activity to higher-priority, mission-supporting activities within the Renewable Energy Program portfolio in the Energy Efficiency and Renewable Energy	-248
Total, Funding Change, Renewable Program Support	-4,919

Departmental Energy Management Program

Funding Profile by Subprogram

(dollars in thousands)

	FY 2003 Comparable Appropriation	FY 2004 Original Appropriation	FY 2004 Adjustments[a,b]	FY 2004 Comparable Appropriation	FY 2005 Request
Departmental Energy Management Program					
Energy Management Project Support	1,084	1,500	-28	1,472	1,467
Energy Management Model Program Development..........	361	500	-9	491	500
Total, Departmental Energy Management Program	1,445	2,000	-37	1,963	1,967

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 Programs (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 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

[a] Programs in the Energy Supply appropriation were reduced by .59 percent as required by the Omnibus Appropriation Bill.

[b] Programs in the Energy Supply appropriation were proportionally reduced based upon the allocated General Reduction of $4,684,000.

promoting a diverse supply and delivery of reliable, affordable, 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 change inertia. The President's National Energy Policy calls for America to modernize conservation efforts, increase energy supplies, and "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. The DEMP 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 DEMP program contributes to the FEMP program goal which contributes to General Goal 4 in the "goal cascade":

Program Goal 04.13.01.00: DEMP. The Federal Energy Management Program's goal is to provide the efficiency and renewable energy-related technical assistance Federal agencies need to lead the Nation by example through government's own actions, expressly increasing Federal renewable energy use by 2.5 percent by 2005 and reducing energy intensity in Federal buildings by 35 percent by 2010 (using 1985 as a baseline).

Contribution to Program Goal 04.13.01.00 (DEMP)

To lead other federal agencies by its example, DEMP has a higher goal than the overall FEMP goal. The Departmental Energy Management Program's goal is to provide direct funding and energy efficiency related technical assistance to Departmental facilities such that the energy intensity in standard buildings is reduced by 45% by 2010 (using 1985 as a baseline). [DOE Order 430.2A].

Because of its success, DEMP has already achieved the 2010 goal in 2003 (which is the year with the latest data available). The baseline (1985) energy intensity in standard buildings was 473,126 Btu per square foot, whereas the energy intensity in 2003 was 245,469 Btu per square foot, showing a 48 % reduction in energy intensity in that time period. Even though DEMP has already achieved its 2010 goal, it is setting even higher goals. Each year, DEMP has set a goal of reducing the energy intensity each year by 1 percent (using the previous year as the benchmark for comparison).

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 manage its energy loads during emergencies to the benefit of local authorities in the event of local energy supply constraints or emergencies.

Annual Performance Results and Targets:

FY 2000 Results	FY 2001 Results	FY 2002 Results	FY 2003 Target	FY 2004 Targets	FY 2005 Targets
Program Goal 04.13.01.00 (DEMP)					
Departmental Energy Management Program					
No funding in FY 2000	Decreased energy consumption intensity in DOE facilities by 36 percent from the 1985 baseline. Achieved 42 percent rate of Return on Investment (ROI) for energy projects.	Decreased energy consumption intensity in DOE facilities by 37 percent from the 1985 baseline. Achieved 29 percent ROI for energy projects.	Decreased energy consumption intensity in DOE facilities by 38 percent from the 1985 baseline. Achieved 25 percent ROI for energy projects.	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 4 to13 energy efficiency projects through a competitive selection process that chooses those projects with the greatest return on investment.
Management of Funds					
				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 uncosteds to a range of 20-25 percent by reducing program annual uncosteds by 10 percent in 2005 relative to the program uncosted baseline (2004) until the target range is met.

Means and Strategies

The DEMP 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.

DEMP will implement the following means and strategies:

- Conduct an annual call among DOE sites and fund projects that support achievement of the goal.
- Provide funds or use private sector investments in energy efficiency and renewable energy technologies.
- Analyze opportunities for energy management improvements and conservation measures at selected DOE facilities.

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 funded retrofit projects.

The following external factors could affect DEMP’s ability to achieve its strategic goal:

- Cost of energy purchased at DOE sites.
- 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.

Validation and Verification

To validate and verify program performance, the DEMP Program will conduct internal and external reviews and audits. These programmatic activities are subject to continuing review by the Department’s Inspector General. 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:	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.
Frequency:	Annual.
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 2003	FY 2004	FY 2005	$ Change	% Change
General Goal 4, Energy Security					
Program Goal 04.03.01.00, DEMP					
Energy Management Project Support....................	1,084	1,472	1,467	-5	-0.3%
Energy Management Model Program Development..	361	491	500	+9	+1.8%
Total, Program Goal 04.03.01.00, DEMP	1,445	1,963	1,967	+4	+0.2%
Total, General Goal 4 (DEMP)...................................	1,445	1,963	1,967	+4	+0.2%

Expected Program Outputs

FEMP pursues its mission through integrated activities designed to improve the energy efficiency of, and renewable energy usage by, the Federal government. We expect these improvements to reduce susceptibility of federal agencies 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. In addition to these "EERE business-as-usual" benefits, realizing the FEMP goals would provide the technical potential to reduce conventional energy use by the federal government even further if warranted by future energy needs.

The assumptions and methods underlying the modeling efforts affect the estimated benefits, and results could vary if external factors, such as future energy prices, differ from the baseline case assumed for this analysis. 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 estimated to be completed and posted by March 15, 2004.

[a] Benefits reported are annual, not cumulative, for the year given. Estimates reflect the benefits associated with program activities from FY 2005 to the benefit year or to program completion (whichever is nearer), and are based on program goals developed in alignment with assumptions in the President's Budget. Mid-term program benefits were estimated utilizing the GPRA05-NEMS model, based on the Energy Information Administration's (EIA) National Energy Modeling System (NEMS) and utilizing the EIA's Annual Energy Outlook (AEO) 2003 Reference Case.

FY 2005 GPRA Benefits Estimates for FEMP [a]

Mid-term benefits

	2010	2015	2020	2025
Primary Non-Renewable Energy Savings (Quads)	0.03	0.04	0.05	0.07
Energy Expenditure Savings (Billion 2001$)	0.2	0.3	0.5	0.6
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.

Energy Management Project Support

Funding Schedule by Activity

(dollars in thousands)

	FY 2003	FY 2004	FY 2005	$ Change	% Change
Energy Management Project Support					
Energy Management Project Support	1,084	1,472	1,467	-5	-0.3%
Total, Energy Management Project Support	1,084	1,472	1,467	-5	-0.3%

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 at various DOE facilities for energy projects to increase the energy efficiency of our 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 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 of reliable, affordable, and environmentally sound energy to DOE facilities. It is expected that these activities will have returns on investment of greater than 20 percent based on the performance of DEMP projects previously funded.

Detailed Justification

	(dollars in thousands)		
	FY 2003	FY 2004	FY 2005
Energy Management Project Support	**1,084**	**1,472**	**1,467**

DEMP will provide support through direct funding and leveraged cost sharing at various DOE facilities for energy projects to increase the energy efficiency of our facilities and reduce future utility and maintenance costs. 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: providing a rate of return of at least 20 percent per dollar invested; and achieving annual savings of 20 billion Btus.

DEMP will fund approximately 4-13 energy projects including two to three renewable energy or other emerging technologies; projects provide a rate of return of at least 20 percent per dollar invested; and achieve annual savings of 20 billion Btus by 2006.

Total, Energy Management Project Support	**1,084**	**1,472**	**1,467**

Explanation of Funding Changes

	FY 2005 vs. FY 2004 ($000)
Energy Management Project Support..	-5
Total Funding Change, Energy Management Project Support	**-5**

Energy Management Model Program Development

Funding Schedule by Activity

	(dollars in thousands)				
	FY 2003	FY 2004	FY 2005	$ Change	% Change
Energy Management Model Program Development					
Energy Management Model Program Development	361	491	500	+9	+1.8%
Total, Energy Management Model Program Development	361	491	500	+9	+1.8%

Description

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 initiatives as sustainable building design, the acquisition of Energy Star Labels for buildings, building re-commissioning, and energy consumption reductions in excess buildings.

Benefits

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 2003	FY 2004	FY 2005
Energy Management Model Program Development			
Analyze opportunities for energy management and conservation at selected DOE facilities. Expand the use of private sector financing by identifying candidate sites to replace chillers using ozone depleting substances and reduce energy consumption in surplus facilities. Meter the energy consumption at DOE office buildings for ENERGY STAR labels, and assist in the design of energy-efficient 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.			
Total, Energy Management Model Program Development	**361**	**491**	**500**

Explanation of Funding Changes

	FY 2005 vs. FY 2004 ($000)
Energy Management Model Program Development	+9
Total Funding Change, Energy Management Model Program Development	**+9**

National Climate Change Technology Initiative Competitive Solicitation

Funding Profile by Subprogram

(dollars in thousands)

	FY 2003 Comparable Appropriation	FY 2004 Original Appropriation	FY 2004 Adjustments	FY 2004 Comparable Appropriation	FY 2005 Request
National Climate Change Technology Initiative Competitive Solicitation					
National Climate Change Technology Initiative Competitive Solicitation	0	0	0	0	3,000
Total, National Climate Change Technology Initiative Competitive Solicitation	0	0	0	0	3,000

Public Law Authorizations:

P.L. 93-275, "Federal Energy Administration Act of 1974"
P.L. 93-577, "Federal Non-nuclear Energy Research and Development Act of 1974"
P.L. 94-163, "Energy Policy and Conservation Act" (EPCA) (1975)
P.L. 95-91, "Department of Energy Organization Act" (1977)
P.L. 102-486, "Energy Policy Act of 1992"

Mission

The mission of the President's National Climate Change Technology Initiative (NCCTI) is to strengthen the Federal portfolio of climate change related research and technology development, demonstration and deployment (RDD&D) investments, make recommendations for realignments and priorities, as appropriate, and accelerate the development of technologies that can significantly reduce greenhouse gas emissions. The Competitive Solicitation Program (CSP) is a key component of the President's NCCTI. The mission of the CSP is to ensure that innovative, novel, high-impact potential climate change technology options in this area are explored. The CSP will focus on achieving specific climate change goals. The CSP will do so without designating *a priori* any one particular technology solution or another.

Benefits

The Competitive Solicitation Program is intended to complement and enrich the existing portfolio of climate change-related research and applied technology R&D exploring novel and potentially important research concepts not elsewhere funded. By stimulating and strengthening Federal research in this area, the President's NCCTI hopes to inspire private sector interest and international cooperation in a sustained collaborative program of research investment aimed at accelerating technology development and advancing the Administration's climate change goals.

Funding Schedule by Activity

(dollars in thousands)

	FY 2003	FY 2004	FY 2005	$ Change	% Change
National Climate Change Technology Initiative Competitive Solicitation					
National Climate Change Technology Initiative Competitive Solicitation	0	0	3,000	+3,000	
Total, National Climate Change Technology Initiative Competitive Solicitation	0	0	3,000	+3,000	

Description

Through competitive solicitations of research grant proposals, the CSP will explore novel concepts, technologies or technical approaches, not elsewhere covered, that could, if successful, contribute in significant ways to the reduction, avoidance or permanent sequestration of greenhouse gas (GHG) emissions. The CSP will focus on: (1) reducing GHG emissions from energy-use and infrastructure; (2) reducing emissions from energy supply; (3) capturing and sequestering carbon dioxide (CO2) gas; (4) reducing emissions of other GHGs; (5) enhancing capabilities to measure and monitor GHG emissions; and (6) strengthening supporting or contributing research aimed at overcoming related technical barriers. A technical review committee, consisting of agency program officials for whom the research results might benefit, will oversee the CSP. Results will be reported annually.

Detailed Justification

(dollars in thousands)

	FY 2003	FY 2004	FY 2005
National Climate Change Technology Initiative Competitive Solicitation	**0**	**0**	**3,000**

In order to complement existing R&D programs, address structural issues that tend to discourage some meritorious concepts from being explored, and ensure that important technology options are considered, the CSP will solicit research proposals for grants on innovative climate technologies. Proposals may focus on any concept, technology, or technical approach that can be shown to be relevant to the stated research goals and meet other criteria outlined below; and must not duplicate already completed or ongoing R&D. Areas for funding would include: strategic research; advanced concepts; integrative concepts; novel concepts; greenhouse gases other than CO2; measuring and monitoring systems; novel

	FY 2003	FY 2004	FY 2005
	(dollars in thousands)		

process feedstocks, materials and materials substitutes; and enabling technologies. The solicitation would be open to all proposers and subject to merit review with peer evaluation. In keeping with the nature of the solicitation, which is focused on novel concepts and exploratory research, each award would be relatively small.

Awards would be evaluated on the basis of the following four criteria: (a) potential contributions to the research goal; (b) novelty; (c) technical merit; and (d) quality of the research team and institutional support. A technical review committee (TRC), composed of Federal members from the DOE R&D programs, other Federal R&D agencies, and experts in climate change technology and related research, would provide overall guidance for each year's solicitation and periodically review the activities of the program to ensure coordination, non-duplication, and efficacy of administrative procedure. The competitive solicitation would be administered by the DOE-led, U.S. Climate Change Technology Program (CCTP).

	FY 2003	FY 2004	FY 2005
Total, National Climate Change Technology Initiative ...	**0**	**0**	**3,000**

Explanation of Funding Changes

	FY 2005 vs. FY 2004 ($000)
NCCTI Solicitations	
In FY 2005, the NCCTI Competitive Solicitation Program represents a new activity.......	+3,000
Total, Funding Change, National Climate Change Technology Initiative	+3,000

Facilities and Infrastructure

Funding Profile by Subprogram

(dollars in thousands)

	FY 2003 Comparable Appropriation	FY 2004 Original Appropriation	FY 2004 Adjustments[a,b]	FY 2004 Comparable Appropriation	FY 2005 Request
Facilities and Infrastructure					
National Renewable Energy Laboratory	5,297	13,200	-250	12,950	11,480
Total, Facilities and Infrastructure	5,297	13,200	-250	12,950	11,480

Public Law Authorizations:

P.L. 95-91, Department of Energy Organization Act (1977)

Mission

This Facilities and Infrastructure budget addresses capital investments that are essential to support a vibrant world-class research and development program at major participant DOE laboratory sites. Included are funding requirements 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 EERE's programs. It provides in-house research, user facilities, analysis, and management of R&D contracts for the Solar, Wind, Geothermal, Biomass, and Hydrogen programs within the Energy Supply budget, and does the same for the Vehicles, Fuel Cells, Buildings, and Distributed Energy programs in the Energy Conservation budget. It also supports superconductivity research in the Office of Electricity Transmission and Distribution. It is home to 1,100 researchers, engineers, analysts, and administrative staff, plus visiting professionals, graduate students, and interns on a 300-acre campus in Golden, CO, occupying 5 large research buildings (with another about to begin construction), a dozen or so smaller facilities, and over 200,000 square feet of research and administrative space in a neighboring office park.

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

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[a] Programs in the Energy Supply appropriation were reduced by .59 percent as required by the Omnibus Appropriation Bill.

[b] Programs in the Energy Supply appropriation were proportionally reduced based upon the allocated General Reduction of $4,684,000.

that underpin the advancements made by our R&D programs. The concentration of expertise also makes NREL a central player in EERE's deployment programs.

National Renewable Energy Laboratory

Funding Schedule by Activity

(dollars in thousands)

	FY 2003	FY 2004	FY 2005	$ Change	% Change
National Renewable Energy Laboratory					
Operation and Maintenance					
General Plant Projects....	2,504	2,060	2,400	+340	+16.5%
General Purpose Equipment......................	2,023	2,060	2,400	+340	+16.5%
Congressionally Directed Activity, National Center on Energy Management and Building Technologies	0	4,905	0	-4,905	-100.0%
Total, Operation and Maintenance.........................	4,527	9,025	4,800	-4,225	-46.8%
Construction (02-NREL-001)	770	3,925	6,680	+2,755	+70.2%
Total, National Renewable Energy Laboratory	5,297	12,950	11,480	-1,470	-11.4%

Description

Within Operations and Maintenance, general plant projects (GPP) serve to address rising maintenance expenses and to address a backlog of maintenance needs that has built up, while general purpose equipment (GPE) acquisitions promote better operational efficiencies and maintain first-rate lab and user-facility capabilities. Funding to begin construction of the 71,000 square foot Science and Technology Facility was provided in the FY 2004 appropriation, and funds to continue the work are included for FY 2005.

Detailed Program Justification

	(dollars in thousands)		
	FY 2003	FY 2004	FY 2005
Operations and Maintenance	**4,527**	**9,025**	**4,800**

These funds provide for general infrastructure upgrades and maintenance that address NREL's general capital needs (general purpose projects, general purpose equipment). This does not include technology-specific capital equipment funded by individual program budgets. The funding includes: Projects to correct environmental, safety and health deficiencies including fire safety and roadway improvements; Projects that renovate or replace inefficient and unreliable facilities including utility systems, roads, general purpose research and support facilities, general purpose research, and support equipment; and Projects that improve or enhance general purpose facilities or capabilities including utility systems, energy efficiency, renewable energy use, roads, site improvements, general purpose research and support facilities, general purpose research and support equipment.

	FY 2003	FY 2004	FY 2005
▪ **General Plant Projects**	**2,504**	**2,060**	**2,400**

This investment serves 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. Specific projects are initially identified at the time of budget submission, then are reevaluated as funding becomes available in the requested execution year. These projects include: Safety and security improvements within buildings; Upgrades to utilities, heating ventilation and air conditioning systems, and related systems within buildings; Energy efficiency improvements within buildings; Small expansions of existing buildings or small additional buildings to accommodate changes or growth in R&D programs or research support needs; Expansions and upgrades of site-wide utility systems, such as electrical, water, sewer/septic, natural gas, telecommunications and computer networks; Addition of onsite electricity generating capacity; Road, parking, and traffic infrastructure improvements; and Walkway, landscaping, water management, water treatment, and other site improvements to enhance the sustainability, cohesiveness, and pedestrian nature of the site.

	FY 2003	FY 2004	FY 2005
▪ **General Purpose Equipment**......................................	**2,023**	**2,060**	**2,400**

This investment replaces and upgrades NREL's general capital equipment at a regular annual rate of approximately 4 percent. Specific equipment needs are initially identified for annual spring DOE budget submission, then reevaluated as funding becomes available in the requested execution year. This equipment includes: Upgrades to NREL's information technology systems necessary to keep them near state-of-the-art; and Upgrades and additions to NREL's scientific instrumentation shared by several programs or projects, 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.

	(dollars in thousands)		
	FY 2003	FY 2004	FY 2005
▪ **Congressionally Directed Activity, National Center on Energy Management and Building Technologies**	**0**	**4,905**	**0**

In FY 2003, funding for this activity was included by Congress in the Zero-Energy Buildings program.

Construction: NREL Science and Technology Facility	**770**	**3,925**	**6,680**

FY 2005 continues construction of the Science and Technology Facility (S&TF) at NREL, which is beginning 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.

Total, Facilities and Infrastructure	**5,297**	**12,950**	**11,480**

Explanation of Funding Changes

	FY 2005 vs. FY 2004 ($000)
Operations and Maintenance	
▪ **General Plant Projects**	
The FY 2005 budget includes a modest increase in GPP funding to address an existing backlog of maintenance and upgrade projects	+ 340
▪ **General Purpose Equipment**	
The FY 2005 budget includes a modest increase in GPE funding to keep up with expanded program activities at the lab. The funds provide for a 3-4 year replacement cycle for IT equipment and upgraded scientific equipment to address	+ 340

the lab's advancing technical programs and the needs of user facilities	
▪ **Congressionally Directed Activity, National Center on Energy Management and Building Technologies**	
No funds are requested because funds are being allocated to other activities more closely aligned with the Program's goal.	- 4,905
Total, Operations and Maintenance	**- 4,225**
Construction (02-NREL-001)	
Continues with second-year construction of the Science and Technology Facility (S&TF). This facility will be crucial to the commercialization of next-generation thin-film and nanostructure photovoltaics systems and related energy technologies	+ 2,755
Total Funding Change, National Renewable Energy Laboratory	**- 1,470**

02-NREL-001, Science and Technology Facility, National Renewable Energy Laboratory, Golden, Colorado

Significant Changes

This is the initial inclusion of the capital construction budget request for the DOE National Renewable Energy Laboratory's (NREL) Science and Technology Facility in Golden, CO. $6,680,000 is requested to fund the second year of construction.

Critical Decision 1 ("Approve Preliminary Baseline Range") was received on June 6, 2002. This project was baselined and received Critical Decision 2 ("Approve Performance Baseline"), approval on September 16, 2003, following an External Independent Review (EIR) and completion of corrective actions for 10 essential findings. One additional corrective action was completed for the last of the essential findings (total of 11) by September 30, 2003, and corrective actions were completed for the remaining nine lesser findings by October 31, 2003. This project received Critical Decision 3 ("Approve Start of Construction"), on December 12, 2003.

1. Construction Schedule History

	Fiscal Quarter					
	A-E Work Initiated	A-E Work Completed	Physical Construction Start	Physical Construction Complete	Total Estimated Cost ($000)	Total Project Cost ($000)
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 *(Acquisition performance baseline)*	No Construction Data Sheet was included in the FY 2004 Budget.					
FY 05 Budget Request *(Acquisition performance baseline)*	1Q 2002	4Q 2003	4Q 2004	4Q 2006	21,190	28,386

2. Financial Schedule

(dollars in thousands)

	Appropriations	Obligations	Costs
Design and Construction			
FY 2002	800	800	272
FY 2003	770	770	1,259
FY 2004[a]	3,925 [b]	3,925	1,114
FY 2005[a]	6,680	6,680	9,193
FY 2006[a]	9,015	9,015	9,352
Total, Design and Construction	21,190	21,190	21,190

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 second inclusion of the capital construction budget request for this project, the Science and Technology Facility (S&TF). The TEC is based on the final design cost estimate as verified through an Independent Cost Review and Constructability Analysis.

The purpose of the S&TF is to provide a facility to expand the research capabilities to enable DOE to achieve its strategic goals, as outlined in the National Energy Policy (NEP). 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 that can only be accomplished in the S&TF will fill a critical knowledge gap that will 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

[a] The financial schedule for FY 2004, FY 2005, and FY 2006 has been modified to reflect the unanticipated and unbudgeted appropriation of $3,925,000 to start construction of this project in FY 2004 instead of FY 2005. Out-year financial data have been adjusted to maintain the TEC.

[b] The FY 2004 appropriation shown here includes a reduction of $23K in anticipation of the 0.59 percent across-the-board reduction contained in the FY 2004 Omnibus appropriations bill.

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 US 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.
- The S&TF design will demonstrate dramatic energy savings for National Laboratory facilities.
- The S&TF is designed to provide the research and development capability for improving the environment by reducing pollutants from today's electric power generators.

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% to 65%) 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 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 lower floors with a ceiling height of 18 ft. The office block is 165 ft. long and 72 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 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 69 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 proposed funding for BY2005 of $6,680,000 for this project will provide for the continued build-out of the building shell, and site-work/ and utility work and the start of interior construction and finishes. Additional funding in BY2006 of $9,015,000 will be required to complete the construction effort for this project.

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
	Construction Line Item	Construction Line Item
Design Phase		
Preliminary and Final Design costs	1,332	1,332
Design Management costs (0.2% of TEC)	48	48
Project Management costs (0.1% of TEC)	12	12
Total, Design Costs (6.6% of TEC)	1,392	1,392
Execution (Construction) Phase		
Improvements to Land	1,152	1,152
Buildings	13,959	13,959
Utilities	674	674
Standard Equipment	692	692
Inspection, Design and Project Liaison, Testing, Checkout and Acceptance	589	589
Construction Management (2.3% of TEC)	478	478
Project Management (1.5% of TEC)	328	328
Total, Execution Costs	17,872	17,872
Contingencies		
Design Phase (0.7 % of TEC)	139	139
Execution Phase (8.4 % of TEC)	1,787	1,787
Total, Contingencies (9.1% of TEC)	1,926	1,926
Total, Estimated Costs	21,190	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	FY 2008
Facility Costs								
Design (PED)[a]	0	272	1,259	39	0	0	0	1,570
Execution (Construction)	0	0	0	1,075	9,193	9,352	0	19,620
Total, Line item TEC	0	272	1,259	1,114	9,193	9,352	0	21,190
Total Facility Costs (Federal and Non-Federal)	0	272	1,259	1,114	9,193	9,352	0	21,190
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	380	287	1,331	1,124	12,402	12,059	2,543	28,386

[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 the second quarter of FY 2002 to support the CD-1 Authorization.

[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 July 1, 2003.

[d] ES&H costs represent the cost of preparing the Hazard Analysis Report 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

(dollars in thousands)

Annual Operating Costs[a] (Operating from FY 2007 through FY 2057)	Current Estimate	Previous Estimate
Maintenance and Repair costs	341	N/A
Utility costs	250	N/A
Other costs	66	N/A
Total, Annual Operating Costs	657	N/A

8. Design and Construction of Federal Facilities

- All DOE facilities 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.

- The project will be located in an area not subject to flooding determined in accordance with Executive Order 11988.

- DOE has reviewed the GSA inventory of Federal Scientific laboratories and found insufficient space available, as reported by the GSA inventory.

[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. No costs are included for future facility upgrades, general-purpose equipment (GPE), or costs associated with possible changes in current mission.

Capital Operating Expenses and Construction Summary

Capital Operating Expenses

(dollars in thousands)

	FY 2003	FY 2004	FY 2005	$ Change	% Change
Capital Operating Expenses					
General Plant Projects	2,504	2,060	2,400	+ 340	+ 16.5%
Capital Equipment					
General-Purpose Equipment, NREL	2,023	2,060	2,400	+ 340	+ 16.5%
Solar Energy Program/NREL STF	0	0	3,100	+ 3,100	
Wind Energy Program	450	400	450	+50	+12.5%
Subtotal, Capital Equipment	2,473	2,460	5,950	+ 3,490	+ 141.9%
Total, Capital Operating Expenses	4,977	4,520	8,350	+ 3,830	+ 84.7%

Construction Projects

(dollars in thousands)

	Total Estimated Cost (TEC)	Prior-Year Appropriations	FY 2003	FY 2004	FY 2005	Unappropriated Balance
NREL Science & Tech Facility	21,190	800	770[a]	3,925	6,680	9,015
Total, Construction	21,190	800	770	3,925	6,680	9,015

[a] Net after required use of $19,000 in prior-year balances.

Program Direction

Funding Profile by Category

(dollars in thousands/whole FTEs)

	FY 2003[a]	FY 2004[b,c]	FY 2005	$ Change	% Change
Golden Field Office					
Salaries and Benefits	1,631	1,642	3,601	+1,959	+119.3%
Travel	64	79	124	+45	+57.0%
Support Services	100	300	401	+101	+33.7%
Other Related Expenses	82	281	581	+300	+106.8%
Total, Golden Field Office	1,877	2,302	4,707	+2,405	+104.5%
Full Time Equivalents	15	15	31	+16	+106.7%
Idaho Operations Office					
Salaries and Benefits	109	0	0	0	0.0%
Travel	4	0	0	0	0.0%
Total, Idaho Operations Office	113	0	0	0	0.0%
Full Time Equivalents	1	0	0	0	0.0%
Headquarters					
Salaries and Benefits	8,079	7,663	9,013	+1,350	+17.6%
Travel	190	180	276	+96	+53.3%
Support Services	1,138	1,146	4,980	+3,834	+334.6%
Other Related Expenses	1,218	1,073	1,735	+662	+61.7%
Total, Headquarters	10,625	10,062	16,004	+5,942	+59.1%

[a] FY 2003 figures reflect a comparability adjustment as a result of the splitting-off of the Office of Electricity Transmission and Distribution (OETD). The adjustment includes a total reduction of $2.799 million, from $15,785 million to $12.615 million, and a reduction of 17 FTE, from 109 to 92.

[b] Programs in the Energy Supply appropriation were reduced by .59 percent as required by the Omnibus Appropriation Bill.

[c] Programs in the Energy Supply appropriation were proportionally reduced based upon the allocated General Reduction of $4,684,000.

Full Time Equivalents	76	69	75	+6	+8.7%
Total Program Direction					
Salaries and Benefits	9,819	9,305	12,614	+3,309	+35.6%
Travel	258	259	400	+141	+54.4%
Support Services	1,238	1,446	5,381	+3,935	+272.1%
Other Related Expenses	1,300	1,354	2,316	+962	+71.0%
Total Program Direction	12,615	12,364	20,711	+8,347	+67.5%
Total, Full Time Equivalents	92	84	106	+22	+26.2%

Mission

This Program Direction budget component provides the Federal staffing resources and associated costs for supporting the responsive management and oversight of the Office of Energy Efficiency and Renewable Energy (EERE) programs funded by the Energy Supply appropriation. Activities also include necessary funds for support service contractors, equipment, travel, and crosscutting analysis and activities.

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. EERE business operation model is aimed at 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.

As stated in the Departmental Strategic Plan, DOE’s Strategic and General Goals will be accomplished not only through the efforts of the major programs in the Department but with additional effort from offices which support the programs in carrying out the mission. Through its Program Direction activities, 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, 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 2003	FY 2004	FY 2005
Salaries and Benefits	**9,819**	**9,305**	**12,614**

Salaries and Benefits funds a total of 106 full time equivalent employees in FY 2005, 22 more than the FY 2004 planned level. 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 76 FTEs in FY 2005, is responsible for the development of policies, strategic plans and related guidance to program offices; the evaluation of program performance; the formulation, defense and execution of renewable energy 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 30 FTEs. This represents an increase of 10 from the FY 2004 planned level, and continues the development of 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. One of the 10 FTE will be stationed at the NNSA Service Center in Albuquerque, NM, to provide dedicated financial services to the Golden Field Office and EERE.

The funding request includes a technical adjustment to account for true personnel costs that have been higher than embodied in past budgets, as well as for expected FY 2005 pay raises.

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; and further integration of program metrics into resource allocation processes.

Travel	**258**	**259**	**400**

The increased staff and project management responsibilities at the Golden Field Office will require increased travel for contractor oversight. Similarly, the increased emphasis on program management at headquarters will require increased travel by headquarters personnel. The FY 2005 request raises the per-capita travel budget to a level that will allow proper management of the programs.

Support Services	**1,238**	**1,446**	**5,381**

Includes funding for support service contractors, including IT (LAN and PC) support and e-mail service; crosscutting planning, analysis, and evaluation; and general Assistant Secretary initiatives that support all renewable energy resources programs. The requested increase reflects more comprehensive budgeting under Program Direction for the full "costs of doing business" of the renewable energy programs, as well as support for the Hydrogen initiative, and increased efforts to

	(dollars in thousands)		
	FY 2003	FY 2004	FY 2005

implement the President's Management Agenda. The increase also will allow EWD-funded staff to receive computer and e-mail support and more reliable servers.

By Congressional direction, not only are management support services funded within this line-item, but also technical program support for planning, road-mapping, market studies, etc. The proposed increase provides support services needed for advice on critical science, engineering, environmental, economic, and legal issues; as well as business management systems development; safety and health support; facility safeguards and security; and computer hardware and software installation, configuration, and maintenance activities. The increase proposed for FY 2005 provides full funding for the renewable energy programs' share of landlord services at the Golden Field Office and for their share of IT services and local-area network operations, and would permit some program and project management activities to be directly funded and managed through the Golden Field Office and DOE headquarters, rather than having management delegated to national laboratories.

Three million dollars of the proposed increase in EERE Program Direction will be used to provide analytical and technical support for the U.S. Climate Change Technology Program (CCTP). The U.S. CCTP is a multi-agency research planning and coordination activity, chartered by President Bush and led by DOE, aimed at accelerating the development of technologies that can significantly reduce greenhouse gas emissions. It also serves as the administrative and implementing arm of the President's National Climate Change Technology Initiative (NCCTI). Specific CCTP activities will include strategic R&D planning; developing planning scenarios with supporting technology analyses and long-term modeling; and identifying, documenting and helping to prioritize related R&D investments across participating Federal agencies.

Other Related Expenses	**1,300**	**1,354**	**2,316**

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, and contractual services associated with landlord support of the Golden Field Office (GO). Rent is the largest component of the WCF, but it also includes telephones, copying, network operations, payroll and other employee services, printing, etc. The requested increase includes the Energy Supply programs' full share of rent and utilities at the Golden Field Office, which have previously been paid by the Subcommittee on Interior and Related Agencies. The FY 2005 figure also includes an increase of $211,000 to adjust for the fact that $211,000 in balances will be used to supplement the amount shown above for FY 2004 (balances will be used in the WCF).

Total, Program Direction	**12,615**	**12,364**	**20,711**

Explanation of Funding Changes

	FY 2005 vs. FY 2004 ($000)
Salaries and Benefits	
The increase supports 22 additional FTEs who will support the Hydrogen and other R&D programs or will provide project management at the Golden Field Office for some activities now managed by national laboratories. It also reflects the full effect of the FY 2004 pay raise and the partial effect of the FY 2005 pay raise	+3,309
Travel	
Increase reflects additional travel by existing and new FTEs in support of more diligent project management.	+141
Support Services	
Three million dollars of this increase will support analysis of technology impacts on climate change and management support for an integrated R&D response to climate change. The remainder of the increase provides support for increased staff at the Project Management Office in Golden, and to pay the Energy Supply programs' staffing of existing support activities at the Golden Field Office. Also will allow the transition of some supporting functions from national laboratories to lower-cost contractors, for activities such as multi-year plans, technology roadmaps, development of deployment and outreach materials, and market studies........................	+3,935
Other Related Expenses	
Reflects latest estimates of Other Related Expenses at Golden and the Headquarters Working Capital Fund, Energy Supply share of GO landlord expenses, and training expenses. Also reflects the use of $211K in balances in FY04, which reduces the FY04 base amount in this line..	+962
Total Funding Change, Program Direction..	+8,347

Support Services by Category

	(dollars in thousands)				
	FY 2003	FY 2004	FY 2005	$ Change	% Change
Technical Support					
Economic and Environmental Analyses	300	300	1,800	+1,500	+500.0%
Management Support					
IT Support	638	846	1,000	+154	+18.2%
Administrative Support Services	300	300	2,581	+2,281	+760.3%
Total, Management Support	938	1,146	3,581	+2,435	+212.5%
Subtotal, Support Services	1,238	1,446	5,381	+3,935	+272.1%
Total, Support Services	1,238	1,446	5,381	+3,935	+272.1%

Other Related Expenses by Category

	(dollars in thousands)				
	FY 2003	FY 2003	FY 2005	$ Change	% Change
Other Related Expenses					
Rent to GSA	0	0	381	+381	
Communications, Utilities, Misc.	37	160	225	+65	+40.6%
Printing and Reproduction	0	15	25	+10	+66.7%
Other Services	0	35	56	+21	+60.0%
Operation and Maint. of Equip.	29	101	265	+164	+162.4%
Supplies and Materials	16	20	29	+9	+45.0%
Equipment	0	50	100	+50	+100.0%
Working Capital Fund	1,218	973 [a]	1,235	+262	+26.9%
Total, Other Related Expenses	1,300	1,354	2,316	+962	+71.0%

[a] In FY 2004, $211K of prior-year balances will applied to the Working Capital Fund, in addition to the appropriation shown here.

Electric Transmission and Distribution

Electric Transmission and Distribution

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Energy Supply
Office of Electric Transmission and Distribution

Overview

Appropriation Summary by Program

(dollars in thousands)

	FY 2003 Comparable Appropriation	FY 2004 Original Appropriation	FY 2004 Adjustments	FY 2004 Comparable Appropriation	FY 2005 Request
Energy Supply (OETD)					
Electric Transmission and Distribution	88,384[ab]	82,377	-1,559[cd]	80,818	90,880
Subtotal, Energy Supply (OETD)	88,384	82,377	-1,559	80,818	90,880
General Reduction	0	-1,080	+1,080	0	0
Total, Energy Supply (OETD)	88,384	81,297	-479	80,818	90,880

Preface

As the Nation moves forward seeking new energy technologies and methodologies, and transferring those technologies and methodologies to the private sector, the Department of Energy leads this critical endeavor which breaks the Nation's reliance on imported energy sources. Within the Energy Supply appropriation, the Office of Electric Transmission and Distribution (OETD) is at the forefront of this effort to modernize and expand the Nation's electricity delivery system. These endeavors 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 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.

[a] Reflects the spread of $2,082,000 reduction in prior year balances.
[b] Reflects the spread of $1,447,000 for SBIR/STTR
[c] Reflects the distribution of the 0.59% rescission ($479,000) from the Consolidated (Omnibus) Appropriations Bill for FY 2004
[d] Reflects OETD's share of the $10,000,000 Energy Supply general reduction ($1,080,000)

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 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).

Mission

The mission of the newly created Office of Electric Transmission and Distribution (OETD) is 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. 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.

Benefits

The Office's research and development (R&D) in high temperature superconductivity, transmission reliability, distributive technologies, energy storage, GridWise and GridWorks fosters a diverse supply of affordable and environmentally sound energy, provides for reliable delivery of energy, helps guard against energy emergencies, and improves energy efficiency. This leads to primary energy savings and environmental emissions reduction, as well as energy reliability and cost savings. The Office's electricity restructuring and analysis work supports States and regions in developing 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.

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[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.

Strategic 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 promoting a diverse supply and delivery 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 Subprograms funded within the Energy Supply Appropriation have one Program Goal that contributes to the General Goals in the "goal cascade." This 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

Within the Office of Electric Transmission and Distribution, the Research and Development Program and the Electricity Restructuring Program contribute to General Goal 4 as follows:

The High Temperature Superconductivity (HTS) R&D Program Activity contributes to this goal by improving the reliability and security of the Nation's electric power 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 Program Activity goal — are detailed in the chart which follows, entitled "Targets for High Temperature Superconducting Electric Power Equipment Prototypes."

The Transmission Reliability R&D Program Activity contributes to this goal by developing real-time information and control technologies and systems that increase transmission capability, economic and efficient electricity markets, and grid reliability. This Program Activity tracks its progress by measuring the amount of cumulative savings.

The Electric Distribution Transformation R&D Program Activity contributes to this goal by developing distributed sensing, intelligence and control technologies that improve the electric infrastructure's security, reliability, and resiliency. This Program Activity tracks its progress by measuring peak load reduction.

The Energy Storage R&D Program Activity contributes to this 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 Program Activity tracks its progress by measuring reductions in cost per kilowatt and per kilowatt-hour for three storage technologies.

The GridWise Program Activity contributes to this goal by continuing development of communication and control systems to support adaptive intelligent grid operations, integrating distributed energy devices and enhancing customer electric service, thereby allowing the use of real-time information to improve reliability and system efficiency and allowing the electric system to be more resilient.

The GridWorks Program Activity contributes to this goal by providing seed support to accelerate development and demonstration of an integrated portfolio of advanced technologies that bridge the gap between laboratory prototypes of the base Program Activities and the application needs of the electric industry. 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 afford a decrease of 25 percent in regional blackouts by 2015 as compared to 2003. Reliability events consist of roughly 80 percent distribution (localized) events and 20 percent transmission (multi-region) events.

The Electricity Restructuring Program 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 Program tracks its progress by measuring the increase in impact upon regional transmission organizations.

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. IEA's activities help deregulate energy markets and reduce international trade barriers, as well as create an integrated North American energy market. IEA encourages greater exchange of technical and regulatory information among our trading partners. Through its publications, IEA increases public awareness of energy issues and the advantages of competition in the marketplace.

The High Temperature Superconductivity R&D targets below assume a continuation of recent funding patterns and that the Program Activity managers will pursue these targets as opposed to pursuing more basic R&D. These targets also represent the lowest performance values (in terms of voltage and power) that must be demonstrated to establish the technical capability to develop future commercial versions that address all, or a majority, of possible usage on the grid.

Targets for High Temperature Superconducting Electric Power Equipment Prototypes

	HTS Wire	HTS Motors		HTS Generators		HTS Transformers		HTS Power Cables		
Metric	Cost	Voltage	Power	Voltage	Power	Voltage	Power	Voltage	Power	Length
Current Status	$200/ kA-M	4kV	1.2 MW (2001)	4.16 kV	1.8 MW testing	13.8 kV	1.7 MW (2001)	12.5kV	25 MW	0.02 mile (2000)
2004						24.9 kV	10 MW			
2005	$150/ kA-M			13.8 kV	100 MW			13.8 kV	40 MW	0.2 mile
2006	$100/ kA-M							34.5 kV	30 MW	0.2 mile
2007	$75/ kA-M	4 kV	5 MW					138 kV	600 MW	0.5 mile
2008	$50/ kA-M			13.8 kV	340 MW	138 kV	50 MW			
2009	$30/ kA-M									
2010	$25/ kA-M							138 kV	600 MW	2 miles
2012	$20/ kA-M	6kV	5 MW	13.8kV	850 MW	345kV	340 MW			
2017	$10/ kA-M									

Funding by General Goal

(dollars in thousands)

	FY 2003	FY 2004	FY 2005	$ Change	% Change
General Goal 4, Energy Security	88,384	80,818	90,880	+10,062	+12.5%
Program Goal 04.12.00.00, Electric Transmission and Distribution	88,384	80,818	90,880	+10,062	+12.5%
Total, General Goal 4 (Energy Supply (OETD)	88,834	80,818	90,880	+10,062	+12.5%

Annual Performance Results and Targets

FY 2000 Results	FY 2001 Results	FY 2002 Results	FY 2003 Results	FY 2004 Targets	FY 2005 Targets
Electric Transmission and Distribution					
Installed first industrial HTS electrical transmission cables at Southwire Plant in Carrollton, Georgia and began testing system reliability. (MET GOAL)	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)		Complete testing of 10 MVA superconducting transformer in operation on the Wisconsin Electric Power Company grid.	Complete testing of a 13.8 kV, 100MW HTS generator.
	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)		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.	Install and operate a prototype wide area measurement system in the Nation's Eastern Interconnect with 12 time-synchronized and monitoring instruments that feed data into two data archiving and analysis locations	Install and operate a prototype wide area measurement system in the Nation's Eastern Interconnect that includes 50 time-synchronized monitoring instruments that feed data into six data archiving and analysis locations.
			Support the field test of a 100kW lithium battery system for 700 hrs at a utility site.	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 testing and report on a sodium sulfur battery system in both peak shaving and power quality modes at American Electric Power.
					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.

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.

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

- Congressionally-directed projects that do not contribute to the program's goals;
- Funding that is below the requested levels;
- Partners, including industry and governmental, who discontinue key transmission and distribution technology R&D and cost sharing with OETD;
- The low level of investment in transmission-and-distribution deployable hardware;
- Policies that fail to adequately address underlying transmission and distribution infrastructure and systemic problems.

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 Office of Energy Assurance, 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 (TVA) 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 (FERC) 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 (NERC) and the Electric Power Research Institute (EPRI) 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 (NARUC) 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. Program Activity managers also maintain monthly accounts of project status to ensure that all projects are on-track and within budget. 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.

R&D Investment Criteria

The President's Management Agenda identified the need to tie R&D investment to performance and well-defined practical outcomes. One criterion by which the Department's performance is measured involves using a framework in the R&D funding decision process and then referencing the use and outcome of the framework in budget justification material.

The goal is to develop highly analytical justifications for applied research portfolios in future budgets. This will require the development and application of a uniform cost and benefit evaluation methodology across programs to allow meaningful program comparisons.

The Scoring Criteria for Applied R&D Investments, along with Program Assessment Rating Tool (PART), has helped OETD focus on developing long-term program/subprogram goals, performance indicators, annual targets, and benefits analysis that more clearly identify OETD's direction and help redefine strategies for meeting long-term goals.

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 2005 Budget Request, and the Department will take the necessary steps to continue to improve performance.

The refocusing of the High Temperature Superconductivity R&D (HTS) Program Activity was supported by the results of the PART review. In arriving at a summary score of 70, OMB gave the OETD 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.

Scores on Program Purpose and Design (80), Strategic Planning (70) and Program Results (59), primarily reflected OMB's 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. A cost-effectiveness measure is included in the budget as well, and the HTS Program Activity plans to devote more of its resources to its long-term performance goal. The HTS Program Activity has developed "bubble charts" showing risk, years to commercialization, public benefits and Federal costs, which will be used in the future to make decisions on R&D investments, including prioritization of work.

Significant Program Shifts

DOE established the Office of Electric Transmission and Distribution (OETD) during FY 2003 to satisfy the National Energy Policy (NEP) and the National Transmission Grid Study (NTGS) recommendations. The funding was shifted in its entirety from the Electricity Reliability Program of the Office of Energy Efficiency and Renewable Energy to the new office. OETD will have four Subprogram line items: 1) Research and Development, 2) Electricity Restructuring 3) Program Direction, and 4) Energy Reliability and Efficiency Laboratory (EREL). Research and Development has six Program Activities: 1) High Temperature Superconductivity R&D, 2) Transmission Reliability R&D, 3) Electric Distribution Transformation R&D, 4) Energy Storage R&D, 5) GridWise, and 6) GridWorks.

Beginning in FY2005, the Import/Export Authorization function will be transferred from Fossil Energy in the Interior and Related Agencies Appropriation to OETD in the Energy Supply Appropriation because this function matches the mission of OETD.

Energy Supply
Office of Electric Transmission and Distribution

Funding by Site by Program

(dollars in thousands)

	FY 2003	FY 2004	FY 2005	$ Change	% Change
NNSA Service Center					
Lawrence Berkeley National Laboratory	2,743	5,853	7,010	+1,157	+ 19.8%
Total, NNSA Service Center	2,743	5,853	7,010	+1,157	+ 19.8%
Chicago Operations Office					
Argonne National Laboratory	3,198	1,165	3,031	+1,866	+ 160.2%
Brookhaven National Laboratory	480	424	505	+81	+ 19.1%
Chicago Operations Office					
Research and Development	4,557	13,928	3,509	-10,419	- 74.8%
Program Direction	369	0	0	0	0.0%
Total, Chicago Operations Office	4,926	13,928	3,509	-10,419	- 74.8%
National Renewable Energy Laboratory	15,551	8,977	4,847	-4,130	- 46.0%
Total, Chicago Operations Office	24,155	24,494	11,892	-12,602	- 51.4%
Golden Field Office					
Golden Field Office	15,166	14,165	16,169	+2,004	+ 14.1%
Idaho Operations Office					
Idaho Operations Office					
Research and Development	12,061	583	2,021	+1,438	+ 246.7%
Program Direction	189	0	0	0	0.0%
Total, Idaho Operations Office	12,250	583	2,021	+1,438	+ 246.7%
Idaho National Engineering and Environmental Laboratory	72	0	0	0	0.0%
Total, Idaho Operations Office	12,322	583	2,021	+1,438	+ 246.7%
Los Alamos Site Office					
Los Alamos National Laboratory	7,202	6,091	8,084	+1,993	+ 32.7%

(dollars in thousands)

	FY 2003	FY 2004	FY 2005	$ Change	% Change
Oak Ridge Operations Office					
Oak Ridge Operations Office	454	0	1,010	+1,010	+ 100.0%
Oak Ridge National Laboratory					
Research and Development	12,320	13,507	18,187	+4,680	+ 34.6%
EREL	0	736	0	-736	- 100.0%
Total, Oak Ridge National Laboratory	12,320	14,243	18,187	+3,944	+ 27.7%
Total, Oak Ridge Operations Office........	12,774	14,243	19,197	+4,954	+ 34.8%
Richland Operations Office					
Pacific Northwest National Laboratory	1,042	2,326	7,865	+5,539	+ 238.1%
Sandia Site Office					
Sandia National Laboratories	5,338	7,298	5,638	-1,660	- 22.7%
National Energy Technology Laboratory	0	257	208	-49	- 19.1%
Washington Headquarters					
Office of Scientific and Technical Information.....................................	26	0	33	+33	+ 100.0%
Research and Development	4,487	1,818	2,562	+744	+ 40.9%
Program Direction..........................	3,129	3,690	10,201	+6,511	+ 176.4%
Total, Washington Headquarters	7,642	5,508	12,796	+7,288	+ 132.3%
Total, Energy Supply (OETD)	88,384	80,818	90,880	+10,062	+12.5%

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 Program Activity. In support of the Electricity Restructuring Program Activity, 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 as well as transmission policy analysis support. In conjunction with SNL, the National Science Foundation and the California Energy Commission, LBNL is involved in the design, demonstration, and analysis of the Microgrid concept. As currently envisioned, a microgrid includes a cluster of loads and microsources connected at one controllable point within the distribution system. In FY 2004, LBNL is providing support on the 2003 Summer Blackout Investigation.

Chicago Operations Office

Argonne National Laboratory (ANL)

Argonne National Laboratory performs research and development for the High Temperature Superconductivity R&D (HTS) Program Activity. Argonne utilizes unique expertise in ceramics and materials science to improve conductor performance and to investigate deposition processes, such as metal-organic chemical vapor deposition (MOCVD), which are potentially scalable by industry for a second generation of HTS conductors. 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 performs research on superconducting electric motors, transmission cables, and flywheel electricity systems.

Brookhaven National Laboratory (BNL)

BNL supports the High Temperature Superconductivity R&D Program Activity by working with national laboratory/industry teams and universities to undertake research on fundamental wire processing and application 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. Beginning in FY 2004, 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.

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. NREL also supports the High Temperature Superconductivity R&D

Program Activity by working with national laboratory/industry teams and universities to undertake research on fundamental wire processing and application issues.

Golden Field Office

Golden Field Office (GFO)

GFO administers the Superconductivity Partnership with Industry (SPI) for the High Temperature Superconductivity R&D Program Activity. The SPI is 50 percent cost-shared with industry and consists of 11 projects to develop first-of-a-kind designs for more efficient power cables, transformers, industrial motors and flywheel energy systems.

Idaho Operations Office

Idaho Operations Office (IDO)

The Idaho Operations Office administers all financial assistance agreements for Congressionally directed funds for Alaska transmission construction projects. IDO also administers the University Cooperative Projects for the High Temperature Superconductivity R&D Program 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)

INEEL assists NREL in developing a uniform national standard for interconnection of distributed resources with the electric grid.

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 be able 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).

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.

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 transformers and transmission cables. ORNL also participates in strategic planning for the next generation control architecture for the distribution system. In FY 2004, ORNL is providing support on the 2003 Summer Blackout Investigation.

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. In FY 2004, PNNL is providing support on the 2003 Summer Blackout Investigation.

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.

National Energy Technology Laboratory (NETL)

NETL will provide strategic planning and technical support to the Electric Distribution Transformation Program Activity as well as intra- and inter-departmental coordination support with other Federal Programs.

Washington Headquarters

Office of Scientific and Technology Information (OSTI)

The OSTI publishes and maintains on-line, full-text electronic current awareness publications and produces CD-ROM disks containing the High Temperature Superconductivity R&D Program Activity annual Peer Reviews.

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 is also 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. Other activities include SBIR/STTR, I-Manage and communications.

Electric Transmission and Distribution

Funding Profile by Subprogram

(dollars in thousands)

	FY 2003 Comparable Appropriation	FY 2004 Original Appropriation	FY 2004 Adjustments	FY 2004 Comparable Appropriation	FY 2005 Request
Electric Transmission and Distribution					
Research and Development .	80,439	70,807	-1,340	69,467	75,679
Electricity Restructuring	4,816	7,059	-134	6,925	5,000
Energy Reliability and Efficiency Laboratory............	0	750	-14	736	0
Program Direction	3,129	3,761	-71	3,690	10,201
Subtotal, Electric Transmission and Distribution	88,384	82,377	-1,559	80,818	90,880
General Reduction	0	-1,080	+1,080	0	0
Total, Electric Transmission and Distribution	88,384[ab]	81,297	-479[cd]	80,818	90,880

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 newly created Office of Electric Transmission and Distribution (OETD) is 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. 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.

[a] Reflects the spread of $2,082,000 reduction in prior year balances
[b] Reflects the spread of $1,447,000 for SBIR/STTR
[c] Reflects the distribution of the 0.59% rescission ($479,000) from the Consolidated (Omnibus) Appropriations Bill for FY 2004
[d] Reflects OETD's share of the $10,000,000 Energy Supply general reduction ($1,080,000)

Benefits

The President's National Energy Policy (NEP) contains more than 20 recommendations pertaining to the development of electricity reliability and distributed energy technologies and programs. Among these recommendations, DOE should expand research and development on transmission reliability and superconductivity, as well as conduct a study to examine the benefits of establishing a national electricity transmission grid and to identify transmission bottlenecks and measures to address them.

To satisfy these recommendations, DOE: (1) conducted an independent analysis of U.S. electricity markets and identifying transmission system bottlenecks; (2) led an extensive, open, public input process; and (3) commissioned a series of six issue papers from teams of nationally recognized experts to provide a comprehensive survey of the Nation's electric infrastructure.

These six issue papers combined to form the National Transmission Grid Study, which contains 51 recommendations for improving the reliability of the Nation's electric transmission system. Among the recommendations, DOE should create an Office of Electric Transmission and Distribution in order to adequately address the Nation's vital electricity needs. The study further recommended accelerated development and demonstration of high-temperature superconductivity, advanced conductors, energy storage, real-time system monitoring and control, voluntary load reduction technologies and program, and interconnection and integration of distributed energy resources.

In Secretary of Energy Spencer Abraham's May 2002 letter to the President as a response to the NEP recommendation, he wrote, "This report makes clear that our Nation's transmission system over the next decade will fall short of the reliability standards our economy requires and will result in additional bottlenecks and higher cost to consumers." It is essential that we begin immediately to implement the improvements that are needed to ensure continued growth and prosperity.

On August 14, 2003, a multi-regional electric power blackout affected an area with an estimated 50 million people and 61,800 megawatts of electric load in the States of Ohio, Michigan, Pennsylvania, New York, Vermont, Massachusetts, Connecticut and New Jersey, and the Canadian Province of Ontario. In the aftermath of the blackout, OETD is co-founding, with their Canadian counterparts, the U.S.-Canada Power System Outage Task Force, which is investigating the causes of the major event and developing recommendations to reduce the possibilities of future outages and limiting the scope of any that occur. This event underscores the urgency of advancing OETD's research and development and electricity restructuring activities.

The Office of Electric Transmission and Distribution supports the Energy Supply Appropriation and DOE's Mission by 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.

Research and Development

Funding Schedule by Activity

(dollars in thousands)

	FY 2003	FY 2004	FY 2005	$ Change	% Change
Research and Development					
High Temperature Superconductivity R&D	38,801	34,129	45,000	+ 10,871	+ 31.9%
Transmission Reliability R&D	21,576	11,760	10,720	- 1,040	- 8.8%
Electric Distribution Transformation R&D	11,072	14,563	5,459	- 9,104	- 62.5%
Energy Storage R&D	8,990	9,015	4,000	- 5,015	- 55.6%
GridWise	0	0	5,000	+ 5,000	+ 100.0%
GridWorks	0	0	5,500	+ 5,500	+ 100.0%
Total, Research and Development	80,439	69,467	75,679	+ 6,212	+ 8.9%

Mission

The mission of the Research and Development program 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 support 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 program provides for the research and development that will advance high temperature superconducting, transmission reliability, electric distribution and storage technologies. Together, these technologies provide a backbone for modernizing and expanding the Nation's grid.

Activity Focus

The program works through six main Program Activities. The High Temperature Superconductivity R&D Program Activity works to bring the unique efficiency and capacity advantages of superconductivity to electric power applications. The Transmission Reliability R&D Program 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 Program Activity transforms today's electric distribution infrastructure for increased affordability, security, resiliency, and reliability. The Energy Storage R&D Program Activity includes research in advanced energy storage systems for applications ranging from power quality for digital facilities to voltage support for transmission lines. The GridWise Program

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 Program 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.

High Temperature Superconductivity R&D

Funding Schedule by Subactivity

(dollars in thousands)

	FY 2003	FY 2004	FY 2005	$ Change	% Change
High Temperature Superconductivity R&D					
Superconductivity Partnerships	15,776	13,580	17,838	+ 4,258	+ 31.4%
Second Generation Wire Development	17,839	12,819	17,162	+ 4,343	+ 33.9%
Strategic Research	5,186	6,749	10,000	+ 3,251	+ 48.2%
Congressionally Directed Activities	0	981	0	- 981	- 100.0%
Total, High Temperature Superconductivity R&D	38,801	34,129	45,000	+ 10,871	+ 31.9%

Description

The High Temperature Superconductivity (HTS) R&D Program Activity will support OETD's mission by bringing the unique efficiency and capacity advantages of superconductivity to electric power applications.

Benefits

The High Temperature Superconductivity (HTS) R&D Program Activity provides 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, incorporating HTS wires, are being developed to have only half the energy losses and to be half the size of conventional power units. This Program Activity is 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.

Activity Focus

This Program Activity seeks to develop fully operational, pre-commercial prototypes of energy intensive power equipment that, by incorporating HTS wires, will have only half the energy losses and are half the size of conventional units. The mission will be supported by developing HTS distribution and transmission cables that have three to five times the capacity of conventional copper cables and higher efficiency for use in congested urban areas.

The High Temperature Superconductivity (HTS) R&D Program 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.

Statutory mandates for this Program 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 equipment using HTS wires.

Detailed Justification

	(dollars in thousands)		
	FY 2003	FY 2004	FY 2005
High Temperature Superconductivity R&D			

Complete initial performance testing of a prototype, high-efficiency HTS generator being developed with General Electric to increase stability and decrease losses. Test the open-geometry, low power, Magnetic Resonance Imaging (MRI) system being developed with Oxford Superconducting Technologies; this will be smaller and more affordable than currently available.

▪ **Superconductivity Partnerships**	**15,776**	**13,580**	**17,838**

Complete initial performance testing of a prototype, high-efficiency HTS generator being developed with General Electric to increase stability and decrease losses. Test the open-geometry, low power, Magnetic Resonance Imaging (MRI) system being developed with Oxford Superconducting Technologies, which will be smaller and more affordable than currently available.

▪ **Second Generation Wire Development**	**17,839**	**12,819**	**17,162**

The coordinated industry-national laboratory-university effort to establish manufacturing capability at one or more private companies will conduct research that will result in the availability of long (100 meter to 1 kilometer) lengths of high performance "second generation" 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.

▪ **Strategic Research**	**5,186**	**6,749**	**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, 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 mechanical properties (flexibility and strength) of second generation wires.

Congressionally Directed Activities	**0**	**981**	**0**

A joint research program between Wright State University and the University of Albany, in collaboration with Wright Patterson Air Force Base, to enhance the performance of second generation, high-temperature coated superconductors.

Total, High Temperature Superconductivity R&D	**38,801**	**34,129**	**45,000**

Explanation of Funding Changes

	FY 2005 vs. FY 2004 ($000)
High Temperature Superconductivity R&D	
▪ **Superconductivity Partnerships**	
Funding is increased to restore the more rapid development and testing of prototype superconducting power cables in three different electric grid applications and a superconducting 100 MW generator as the projects move from the design phase to the construction phase	+4,258
▪ **Second Generation Wire Development**	
Funding is increased to restore the experimental fabrication of greater length and more uniform Second Generation Wire. Industry and national laboratory researchers are moving from fabrication of 10 meter lengths to 100 meter lengths of wire and higher current capacity through greater wire uniformity	+4,343
▪ **Strategic Research**	
Funding is increased for cooperative Strategic Research between national laboratories and industry to restore development and testing of designs for a new generation of more efficient cryogenic refrigeration systems to cool future superconducting equipment	+3,251
Congressionally Directed Activities	
Reflects research on second generation high temperature coated superconductor research	-981
Total Funding Change, High Temperature Superconductivity R&D	**+10,871**

Transmission Reliability R&D

Funding Schedule by Subactivity

(dollars in thousands)

	FY 2003	FY 2004	FY 2005	$ Change	% Change
Transmission Reliability R&D					
Real Time Grid Reliability Management	2,946	3,034	6,000	+ 2,966	+ 97.8%
Reliability and Markets	2,164	1,467	4,720	+ 3,253	+ 221.7%
Congressionally Directed Activities	16,466	7,259	0	- 7,259	- 100.0%
Total, Transmission Reliability R&D	21,576	11,760	10,720	- 1,040	- 8.8%

Description

The Transmission Reliability R&D Program 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 monitor, track, predict and react to grid, market, and security operational trends to provide grid operators with the means 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.

Benefits

The Transmission Reliability R&D Program Activity supports 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 Program 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.

Activity Focus

The Transmission Reliability R&D Program Activity is 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 Program Activity collaborates with transmission system operators and other electricity industry stakeholders through peer reviews to identify electric transmission technology research needs. Transmission Reliability R&D supports the integration of advanced transmission monitoring and control systems, in addition to composite conductors, into the national grid through industry partnerships. It also provides technical and analytical support to allow customers to control their own loads and participate in competitive electricity markets, performs market monitoring and design analysis to identify market participant behavior and impacts, and conducts unbiased, third-party analysis on technically-based policy options for efficient, fair competitive markets.

Detailed Justification

(dollars in thousands)

	FY 2003	FY 2004	FY 2005
Transmission Reliability R&D			

The Transmission Reliability R&D Program Activity supports modernization of the Nation's transmission infrastructure through information technologies that provide enhanced grid reliability and efficient electricity markets under competition.

	FY 2003	FY 2004	FY 2005
▪ **Real Time Grid Reliability Management**	**2,946**	**3,034**	**6,000**

Supports recommendations in the National Energy Policy (NEP) and the National Transmission Grid Study (NTGS). 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 specifically recommends accelerating development and demonstration of real time system monitoring and control technologies. Increase support development of real time grid monitoring sensors, software and system deployment.

	FY 2003	FY 2004	FY 2005
▪ **Reliability and Markets**	**2,164**	**1,467**	**4,720**

Supports recommendations in the National Energy Policy (NEP) and the National Transmission Grid Study (NTGS). 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.

	FY 2003	FY 2004	FY 2005
Congressionally Directed Activities	**16,466**	**7,259**	**0**
▪ Field testing of aluminum ceramic fiber composite conductors	2,838	3,924	0
▪ Swan Lake – Lake Tyree electrical intertie pursuant to the Southeast Alaska	4,732	0	0
▪ Upper Lynn Canal Power Supply Project	4,732	0	0
▪ Tok-to-Christochina Transmission Project	1,893	0	0
▪ Power Grid Project, New Jersey and Pennsylvania, Drexel University	1,893	1,962	0
▪ Indian Point Energy Center Study in New York	0	981	0
▪ Dine' Power Authority in New Mexico to continue development of the Navajo Transmission Project	378	392	0
Total, Transmission Reliability R&D	**21,576**	**11,760**	**10,720**

Explanation of Funding Changes

	FY 2005 vs. FY 2004 ($000)
Transmission Reliability R&D	
▪ **Real Time Grid Reliability Management**	
Increase to accelerate development and deployment of real time grid monitoring systems in the Eastern United States to avoid reoccurrence of the August 14, 2003 blackout	+2,966
▪ **Reliability and Markets**	
Increase accelerates research and development in market design and evaluation, and in demonstration of demand responsive load as spinning reserve capacity	+3,253
Congressionally Directed Activities	
Includes research on aluminum matrix composite conductors, PowerGrid simulator at Drexel University and the New Jersey Institute of Technology, Dine Power Authority project, and Indian Point Energy Center Study in New York	-7,259
Total Funding Changes, Transmission Reliability R&D	**-1,040**

Electric Distribution Transformation R&D

Funding Schedule by Subactivity

(dollars in thousands)

	FY 2003	FY 2004	FY 2005	$ Change	% Change
Electric Distribution Transformation R&D					
Peak Load Reduction	3,615	3,208	5,459	+2,251	+ 70.2%
GridWise	1,212	711	0	-711	- 100.0%
Congressionally Directed Activities	6,245	10,644	0	-10,644	- 100.0%
Total, Electric Distribution Transformation R&D	11,072	14,563	5,459	-9,104	- 62.5%

Description

The Electric Distribution Transformation R&D (EDT) Program Activity transforms today's electric distribution infrastructure for increased affordability, security, resiliency, and reliability. The existing grid system, primarily employing a design from the 1950's, has low asset utilization and does not engage distributed resources to collaboratively manage peak loads. It is deficient in its ability to tailor the level of power quality and reliability to specific customer needs, and in offering customer choice in power generation and use. Through integration of advanced communications, information, sensor and control infrastructure, and distributed energy resources, EDT will transform this aging distribution system into an information rich, intelligent power network that will address current deficiencies and lay the foundation for the next-generation distribution infrastructure. The new infrastructure will be secure from, and resilient to natural and man-made incidents, as well as reliable and responsive to customer needs.

Benefits

The Electric Distribution Transformation R&D Program Activity supports R&D that will enable "plug-and-play" of distributed resources, including load, through the development and testing of advanced interconnection technologies and standards. This "plug-and-play" technology will allow the full integration of distributed resources into distribution operations. This integration will lead to increased asset utilization and enhanced system reliability for the entire national electric system. The R&D conducted within EDT supports the mission of OETD by ensuring greater system reliability and by increasing technology choices for expanding America's electricity delivery system.

Detailed Justification

	(dollars in thousands)		
	FY 2003	FY 2004	FY 2005

Electric Distribution Transformation R&D

The Electric Distribution Transformation (EDT) R&D Program Activity conducts research and development to advance efficient, reliable and secure electric power distribution systems of the future, from the substation through the interconnection system of distributed energy resources (DER) to demand/load management at end-use facilities.

	FY 2003	FY 2004	FY 2005
▪ **Peak Load Reduction**...	**3,615**	**3,208**	**5,459**

Continue level of effort to support completion of demonstrating distributed energy resources aggregation, at >1 MW, for integration with grid operations – in support of a major research and development/demonstration/deployment priority identified through industry-led, Federal-facilitated technology roadmap workshops. Continue and/or complete projects supporting interconnection technology development and standards development as recommended by the National Transmission Grid Study.

In the area of interconnection standards and activities, OETD will develop IEEE P1547 "Draft Standard for Interconnecting Distributed Resources with the Electric Power System" series of standards and advanced modular plug-and-play technologies for seamlessly integrating DER with electric power system and local needs.

In the area of test-bed and field demonstration, OETD will conduct a phased demonstration of DER system integration, progressing from the packaged system to facility, utility and smart utility levels.

In the area of distribution system simulation and analysis, OETD will develop advanced simulation and analysis tools to provide high-fidelity predictions for technology applications, system reliability, and economic decision-making, as well as model verification data from field tests and demonstrations.

In the area of stakeholder and institutional adoption, OETD will promote acceptance of new distribution infrastructure, standards, and practices and support removal of institutional/regulatory barriers and constraints.

	FY 2003	FY 2004	FY 2005
▪ **GridWise**...	**1,212**	**711**	**0**

Activity moved to GridWise Program Activity.

	(dollars in thousands)		
	FY 2003	FY 2004	FY 2005
Congressionally Directed Activities	**6,245**	**10,644**	**0**
▪ Automated energy distribution and reliability systems in Indiana	2,838	981	0
▪ Micro-distributed generation prototype in Vermont	331	245	0
▪ Natural Energy Laboratory in Hawaii to continue development and deployment of distributed energy systems	473	491	0
▪ Distributed energy systems integration, demonstration, and technology transition program in Pennsylvania	1,893	0	0
▪ Electric Infrastructure Technology, Training and Assessment Program in Pennsylvania	0	2,943	0
▪ Center for Distributed Generation and Thermal Distribution at Washington State University	0	491	0
▪ Navajo electrification demonstration project	0	2,943	0
▪ Research on advanced ceramic engines and materials for energy applications	0	294	0
▪ Research at the Georgia Institute of Technology on the use of recycled carpet as fuel for kilns	0	294	0
▪ The Connecticut Power Technologies Project	0	1,962	0
▪ Co-OP Plus, in Western Massachusetts, for installing and servicing fuel cells and distributing green electricity	710	0	0
Total, Electric Distribution Transformation R&D	**11,072**	**14,563**	**5,459**

Explanation of Funding Changes

	FY 2005 vs. FY 2004 ($000)
Electric Distribution Transformation R&D	
▪ **Peak Load Reduction**	
Increase supports the initiation of new projects to evaluate the impact of DER and interconnections with the grid; new demonstration projects in DER system integration; provide increased support for State and local reforms to remove barriers to distributed energy resources; solicit new projects in distributed sensing, intelligence and control technologies.	+2,251
▪ **GridWise**	
Activity moved to GridWise Program Activity for FY 2005	-711
Congressionally Directed Activities	
Reflects research on automated energy distribution and reliability systems, a micro distribution generation prototype, the development and deployment of distributed energy systems in Hawaii, a distributed energy systems integration, demonstration, and technology transition program, the Electric Infrastructure Technology, Training and Assessment Program, the Center for Distributed Generation and Thermal Distribution, Navajo electrification demonstration project, research on advanced ceramic engines and materials, and the use of recycled carpet as fuel for kilns, and the Connecticut Power Technologies project.	-10,644
Total Funding Change, Electric Distribution Transformation R&D	**-9,104**

Energy Storage R&D

Funding Schedule by Subactivity

(dollars in thousands)

	FY 2003	FY 2004	FY 2005	$ Change	% Change
Energy Storage R&D					
Energy Storage R&D	5,678	2,148	4,000	+1,852	+ 86.2%
Congressionally Directed Activities	3,312	6,867	0	- 6,867	- 100.0%
Total, Energy Storage R&D	8,990	9,015	4,000	- 5,015	- 55.6%

Description

Energy Storage R&D Program Activity includes research in advanced energy storage systems for applications ranging from power quality for digital facilities to voltage support for transmission lines. 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 respond in a coordinated, planned manner.

Benefits

The Energy Storage R&D Program Activity develops advanced electricity storage technologies, which supports OETD's goal of modernizing America's electric delivery system to provide a reliable and robust electricity supply. This is done with industry partnership, which plays a significant role in modernizing and expanding the electric delivery system. Energy storage technologies will improve the quality, reliability, flexibility and cost effectiveness of the existing system during normal operation. 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 sources and energy storage closer 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.

Detailed Justification

	(dollars in thousands)		
	FY 2003	FY 2004	FY 2005
Energy Storage R&D			
▪ **Energy Storage R&D**	**5,678**	**2,148**	**4,000**

Energy Storage R&D

Energy Storage R&D Program Activity include research in advanced energy storage systems for applications ranging from power quality for digital facilities to voltage support for transmission lines.

- **Energy Storage R&D** **5,678** **2,148** **4,000**

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 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. These activities also support Chapter 7 of the National Energy Policy recommendations to develop a comprehensive energy delivery system.

Together with distributed energy resource technologies, energy storage technologies provide the high reliability required by the digital economy, telecommunication, and high technology manufacturing. While today's grid can at best give three "nines" of reliability (i.e., 99.9 percent reliability), energy storage provides seamless power during micro outages, voltage sags, and frequency disturbances yielding the equivalent of seven to nine "nines" of reliability (i.e. 99.99999 percent to 99.9999999 percent). Industry estimates that disturbances cost U.S. industry up to $25 billion per year. Energy storage systems, backed up by distributed generation, are the cost effective way to provide required reliability for the consumer.

The Program Activity funds the design of systems with integrated power electronics and controls, contributes to research on advanced storage components, and performs strategic research analysis by developing economic and performance models to effectively guide future research. Technologies involved in the Energy Storage R&D Program Activity include advanced battery systems, flywheels, supercapacitors, and thermal storage.

In FY 2005**,** collaborative demonstration projects with the California Energy Commission will be operational. Data collection, both economic and technical, will begin with periodic reports on the systems performance. Testing of the sodium sulfur battery system in both peak shaving and power quality modes at American Electric Power (AEP) will be completed and the final report issued. 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 sensing being developed under a SBIR contract.

(dollars in thousands)

	FY 2003	FY 2004	FY 2005
Congressionally Directed Activities	**3,312**	**6,867**	**0**
▪ Electricity transmission research at the University of Missouri-Rolla	0	981	0
▪ Research into lead carbon acid asymmetric supercapacitors	0	2,943	0
▪ Continue development of bipolar nickel metal hydride battery storage system	946	981	0
▪ Research, development and demonstration of advanced thermal energy storage technology integrated with renewable thermal energy technology	2,366	1,962	0
Total, Energy Storage R&D	**8,990**	**9,015**	**4,000**

Explanation of Funding Changes

	FY 2005 vs. FY 2004 ($000)
Energy Storage R&D	
▪ **Energy Storage R&D**	
Increase will accelerate development of advanced storage technologies to mitigate grid congestion and increase grid stability to avoid reoccurrence of the 2003 blackouts	+1,852
Congressionally Directed Activities	
Reflects research into electric transmission, lead carbon acid asymmetric supercapacitors, development of a bipolar nickel metal hydride battery storage system, and advanced thermal energy storage technology integrated with renewable thermal energy technology	-6,867
Total Funding Change, Energy Storage R&D	**-5,015**

GridWise

Funding Schedule by Subactivity

(dollars in thousands)

	FY 2003	FY 2004	FY 2005	$ Change	% Change
GridWise					
GridWise R&D	0	0	5,000	+ 5,000	+ 100.0%
Total, GridWise	0	0	5,000	+ 5,000	+ 100.0%

Description

GridWise denotes a modernized electric infrastructure framework where open, but secure, communication and information technologies, and associated standards, are used throughout the electric grid to enhance reliability and robustness, promote economic efficiencies, and provide value and choices to electricity consumers. In contrast to the GridWorks Program Activity, which focuses on advanced equipment applications, the GridWise Program Activity (software-centric) comprises the intelligence — or brains — behind a modern electric grid that incorporates GridWorks (hardware-centric) technology. Leading the electric system into the high-tech information age with GridWise will allow the Nation to realize the benefits achieved by cutting-edge industries that use essential real-time information to maximize reliability and system efficiency. GridWise also creates a more resilient electric system by incorporating autonomic system reconfiguration ("self-healing") in response to disruptions.

Benefits

GridWise will enable a higher level of end-to-end productivity, security and reliability within the energy system. Utilizing new and existing technologies, GridWise will deliver real-time information via an integrated network that functions much like a nervous system in a living organism. Access to this continuous information stream enables instant detection and reaction to pressures on the energy system, allows for a more informed decision-making process and empowers customers — all of which leads to increased electricity security and reliability for individuals, organizations and the country as a whole, in accordance with the mission of OETD.

Detailed Justification

	(dollars in thousands)		
	FY 2003	FY 2004	FY 2005
GridWise R&D	**0**	**0**	**5,000**

GridWise

GridWise denotes a modernized electric infrastructure framework where open, but secure, communication and information technologies, and associated standards, are used throughout the electric grid to enhance reliability and robustness, promote economic efficiencies, and provide value and choices to electricity consumers.

- **GridWise R&D.. 0 0 5,000**

  Gridwise R&D 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. This hierarchy will enable isolation and mitigation of faults before they cascade through the system. The work will also help users and electric power system operators achieve optimized control of a large, complex network of DER systems, and will provide remote detection, protection, control, and contingency measures for the electric system.

  Funding will allow continued development of communication and control systems to support adaptive intelligent grid operations, integrate distributed energy devices and enhance customer electric service.

  This work will initiate the integration of information technologies into transmission and distribution networks that eventually will help develop autonomous control and protection at the local level, and thereby reduce the risk of cascading power outages and improve reliability of the electric system. The impact of not funding this work is a higher vulnerability to faults cascading into larger regions of the country, which may result in multi-region blackouts.

  The system architecture and standards work will guide development of the electric system from transmission to end-use. At present, there is no common architectural construct or standards for integrating information and control technologies into the electric delivery system. Their existence would enable cooperative, real-time optimization of the system across all levels. This work begins the necessary coordination to develop a system architecture and associated standards for the electric system.

  The Program Activity's education and training work aims at assisting grid operators to perform their jobs more effectively in the face of growing electric system complexity. Eventually, there may be intelligent agents to take action before disturbances propagate through the system. However, grid reliability will depend on an operator's ability to analyze the data and respond appropriately. This will require training (including electric grid simulators).

	(dollars in thousands)		
	FY 2003	FY 2004	FY 2005
This work launches an education and training development program for operators, including university centers of excellence. Graduates of these programs will have the skills needed to properly analyze and manage electric grid operations, and more effectively prevent disturbances, including blackouts.			
Total, GridWise	**0**	**0**	**5,000**

Explanation of Funding Changes

	FY 2005 vs. FY 2004 ($000)
GridWise	
▪ **GridWise R&D**	
Increases sensing, intelligence & control technologies; systems architecture and standards; and education and training activities and allows for electric system integration of communication and control technologies for adaptive grid operations (not just on the distribution system). Activity was moved from Electric Distribution Transformation (formerly Distribution and Interconnection R&D) in order to focus more on the integration across the entire electric system, not just the distribution system	+5,000
Total Funding Change, GridWise	**+5,000**

GridWorks

Funding Schedule by Subactivity

(dollars in thousands)

	FY 2003	FY 2004	FY 2005	$ Change	% Change
GridWorks					
GridWorks R&D	0	0	5,500	+ 5,500	+ 100.0%
Total, GridWorks	0	0	5,500	+ 5,500	+ 100.0%

Description

GridWorks 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. GridWorks bridges the gap between the laboratory prototypes of the base programs and the application needs of the electric industry. It is focused on achieving the commercial viability of these technologies — taking an integrated perspective of the entire electric system — by: 1) working with industry to identify needs; 2) mobilizing manufacturers to respond with product; and, 3) utilizing demonstrations to ensure functionality (e.g. durability). GridWorks is organized to encourage increased collaboration among the base programs, and to create a cohesive, comprehensive portfolio of systems and equipment that will be introduced into the electric system in a manner that will ensure safe, reliable, and efficient operation.

Benefits

The increasing demand for electricity to drive our economy and meet our modern way of life has placed strains on our antiquated infrastructure. By accelerating the development of a robust portfolio of technologies for modernizing and expanding the electric grid, GridWorks reduces the likelihood and impact of reliability events, including blackouts. GridWorks uses the facilities at our National Laboratories to accelerate development and testing of advanced conductors, increasing much-needed transmission line capacity. GridWorks complements the architectural software development of GridWise by developing and demonstrating associated hardware. For example, GridWorks significantly expands the deployment of sensors needed for a real-time monitoring system that provides the electric system operator with the ability to quickly see and respond to system disturbances and failures. In addition, GridWorks provides faster protection by pursuing technological breakthroughs in the development of advanced power electronics so that unintentional problems can be curtailed before they can propagate through the electric system.

Detailed Justification

	(dollars in thousands)		
	FY 2003	FY 2004	FY 2005
GridWorks			
GridWorks 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.			
▪ **GridWorks R&D**...............................	**0**	**0**	**5,500**

GridWorks crosscuts the electric system, funding effort in four major areas: cables and conductors; operator-based control and monitoring; substation and auxiliary equipment; and power electronics.

For cables and conductors, the transmission of electricity over long distances and at higher voltages has become an important component of a future modernized electric system. There is a national need to increase transmission and distribution capacity, not only to relieve congestion costs, but also to ensure the reliable and efficient operation of the electric grid. However, siting new transmission lines is time-consuming and costly, and often meets with public resistance. An alternative is to expand transmission capacity by increasing the utilization of existing rights-of-way. In FY 2005, this Program Activity will accelerate the development and testing of advanced composite conductors. This 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.

A modernized electric infrastructure will need a control and monitoring system to ensure reliable and secure operation of the grid. GridWorks complements the architectural development of GridWise by developing and demonstrating associated hardware. For example, a real-time monitoring system requires widespread deployment of sensors to provide appropriate information to the operators and/or distributed intelligent agents. In FY 2005, this Program Activity will accelerate the development and deployment of low-cost, reliable and robust sensors that can monitor current flow, voltage, and phase angle throughout the electric system. These sensors are a core component of the real-time monitoring system that provides the operator with the ability to see in real-time what is happening on the electric grid and also provides a method of archiving time-synchronized grid information for further analysis. The goal is to significantly expand deployment of these technologies in the Eastern Interconnection (where the 2003 blackout occurred) and ultimately throughout the Nation.

Substations are located at both ends of the transmission line. 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. 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). In addition,

	(dollars in thousands)	
FY 2003	FY 2004	FY 2005

a distribution substation has circuit breakers, switches, and other protective devices so that distribution lines can be disconnected when necessary. There is a need to develop smaller, lighter, more efficient, lower cost transformers and fault protection equipment.

Presently, faults and instability in an electrical grid are detected by protective relaying, and cleared by operation of circuit breakers or fuses. It is desirable in the future for stability protection to act much faster and for fault currents to be cleared quicker. The response rate of static interruption devices (i.e. power electronics) shows potential for reducing system faults. The problem is that most commercial power electronics devices are silicon-based, and their performance in power applications is limited by the material properties of silicon. There is a need for further development of advanced high voltage, high current, high frequency power switches and for technical analysis and research in the area of Diamond and SiC (silicon carbon)-based power electronics, to improve the mechanical robustness and increase the service lifetime of power electronic devices for electric system applications, including protective, switching control for two-way power flow.

	FY 2003	FY 2004	FY 2005
Total, GridWorks	**0**	**0**	**5,500**

Explanation of Funding Changes

	FY 2005 vs. FY 2004 ($000)
GridWorks	
▪ **GridWorks R&D**	
Funding will provide for conducting research on advanced composite conductors, control and monitoring, substation and auxiliary equipment, and power electronics.	+5,500
Total Funding Change, GridWorks	**+5,500**

Electricity Restructuring

Funding Schedule by Activity

(dollars in thousands)

	FY 2003	FY 2004	FY 2005	$ Change	% Change
Electricity Restructuring					
Electricity Restructuring............	4,816	6,925	5,000	-1,925	-27.8%
Total, Electricity Restructuring........	4,816	6,925	5,000	-1,925	- 27.8%

Mission

The mission of the Electricity Restructuring Program Activity 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, as well as to conduct investigations into reliability events — including the use of modeling and analysis — to understand the causes and to develop recommendations for avoiding such future events.

Benefits

The Electricity Restructuring Program Activity 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 Subprogram helps to prevent future reliability events by conducting investigations of previous regional blackouts and more local outages, analyzing these events, and making recommendations to avoid future occurrences.

The Subprogram supports the Energy Supply Appropriation and DOE's mission by providing for a more 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.

Electricity Restructuring

Funding Schedule by Subactivity

(dollars in thousands)

	FY 2003	FY 2004	FY 2005	$ Change	% Change
Electricity Restructuring					
Electric Markets Technical Assistance	871	2,020	5,000	+ 2,980	+ 147.5%
Blackout Investigation	0	4,905	0	- 4,905	- 100.0%
Congressionally Directed Activities	3,945	0	0	0	0%
Total, Electricity Restructuring	4,816	6,925	5,000	- 1,925	- 27.8%

Description

The mission of the Electricity Restructuring Program Activity 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.

Benefits

Using education and outreach, the Electricity Restructuring Program Activity 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.

Detailed Justification

	(dollars in thousands)		
	FY 2003	FY 2004	FY 2005

Electricity Restructuring

Provides technical assistance and analytical support to states/regions on policies, market mechanisms and programs that facilitate competitive, reliable, environmentally sensitive, customer-friendly electricity markets and conducts investigations and analysis of reliability events.

▪ **Electric Markets Technical Assistance**	**871**	**2,020**	**5,000**

Expert technical assistance is given 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 (e.g. renewable portfolio standards, public benefit funds). Improvements in transmission policy, such as better state-based practices for siting of transmission lines, and improved coordination among states in the review of siting proposals, are also supported. Electric Markets Technical Assistance provides technical assistance in these same subjects to existing and emerging regional electricity organizations that are responsible for wholesale power system operations or coordination among state regulators.

A substantial effort is placed on quickly and efficiently disseminating 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 does not advocate, but serves as a clearinghouse to assist and inform State- and regionally-based policymakers on electricity market policies and programs. This Program Activity respects State and regional differences and avoids instructing about or directing their actions.

Also to be undertaken is analysis and implementation of policy-related recommendations that would improve reliability and enhance the electric transmission system contained in the National Transmission Grid Study, the August 2003 Blackout Investigation Final Report, or Congressionally-directed in pending energy legislation.

	(dollars in thousands)		
	FY 2003	FY 2004	FY 2005

Electric Markets Technical Assistance will implement the National Transmission Grid Study recommendation to identify transmission bottlenecks (chokepoints) that are especially significant as threats to system reliability or barriers to economic efficiency. These bottlenecks, called "National Interest Transmission Bottlenecks," will be identified through a two-year open and public process using input from industry, States, independent experts, and other stakeholders. Public identification by DOE of these National Interest Transmission Bottlenecks is needed every two years to focus appropriate actions by the Federal Energy Regulatory Commission (FERC), electric grid regional organizations, States, and private sector firms to ease such bottlenecks by means of timely investments drawing on the full range of appropriate technologies. After identifying bottlenecks, DOE will work pragmatically with affected parties to identify appropriate investments and remove obstacles to their realization.

Additional areas of possible transmission and reliability policy analyses include: 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; investigation of benefits from bulk power "superhighways" and other alternative electric grid architectures; and analytical support for improvements to grid reliability standards and regulation.

▪ **Blackout Investigation**	**0**	**4,905**	**0**

These funds shall be used to conduct an extensive investigation, to include modeling and analysis, of the various electrical and System Control and Data Analysis (SCADA) systems, the reliability rules, systems operations and other factors, such as cyber situations and disturbances that might have caused or contributed to the August 14, 2003 blackout. This activity should be completed by the end of FY 2004.

Congressionally Directed Activities	**3,945**	**0**	**0**
▪ National Alliance of Clean Energy Incubators	789	0	0
▪ National Renewable Energy Laboratory virtual site office in Nevada to develop renewable energy resources	3,156	0	0
Total, Electricity Restructuring	**4,816**	**6,925**	**5,000**

Explanation of Funding Changes

	FY 2005 vs. FY 2004 ($000)
Electricity Restructuring	
▪ **Electric Markets Technical Assistance**	
Implements National Transmission Grid Study recommendation to identify National Interest Transmission Bottlenecks using a biannual public process; take appropriate actions to mitigate these bottlenecks. Assesses economics of major technological alternatives for increasing grid carrying capacity	+2,980
▪ **Blackout Investigation**	
The reduction in funding is due to the termination of the investigation into the causes of the August 14, 2003, blackout. These activities should be completed by the end of FY 2004.	-4,905
Total Funding Change, Electricity Restructuring	**-1,925**

Energy Reliability and Efficiency Laboratory

Funding Schedule by Activity

(dollars in thousands)

	FY 2003	FY 2004	FY 2005	$ Change	% Change
Energy Reliability and Efficiency Laboratory					
Energy Reliability and Efficiency Laboratory...............	0	736	0	- 736	- 100.0%
Total, Energy Reliability and Efficiency Laboratory	0	736	0	- 736	- 100.0%

Mission

The mission of the Energy Reliability and Efficiency Laboratory (EREL) is to research and develop electricity transmission and distribution technologies, distributed energy resources and demand-responsive building systems in order to create an electric grid that is secure, flexible, reliable, efficient, expandable, and affordable.

Benefits

EREL will help the Office of Electric Transmission and Distribution develop an electric grid that is secure from physical and cyber terrorism, has the flexibility to incorporate both central and distributed generation, has the embedded intelligence to manage power flows under normal and emergency circumstances, and that meets the nation's growing needs for increased transmission capacity and power quality, at an affordable cost.

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.

Energy Reliability and Efficiency Laboratory

Funding Schedule by Subactivity

(dollars in thousands)

	FY 2003	FY 2004	FY 2005	$ Change	% Change
Energy Reliability and Efficiency Laboratory					
Project Engineering & Design ...	0	736	0	- 736	- 100.0%
Construction	0	0	0	0	0%
Total, Energy Reliability and Efficiency Laboratory	0	736	0	- 736	- 100.0%

Description

The mission of the Energy Reliability and Efficiency Laboratory (EREL) is to research and develop electricity transmission and distribution technologies, distributed energy resources and demand-responsive building systems in order to create an electric grid that is secure, flexible, reliable, efficient, expandable, and affordable.

Benefits

EREL will help the Office of Electric Transmission and Distribution develop an electric grid that is secure from physical and cyber terrorism, has the flexibility to incorporate both central and distributed generation, has the embedded intelligence to manage power flows under normal and emergency circumstances, and that meets the nation's growing needs for increased transmission capacity and power quality, at an affordable cost.

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 2003	FY 2004	FY 2005
Energy Reliability and Efficiency Laboratory			

EREL will help the Office of Electric Transmission and Distribution develop an electric grid that is secure from physical and cyber terrorism, has the flexibility to incorporate both central and distributed generation, has the embedded intelligence to manage power flows under normal and emergency circumstances, and that meets the nation's growing needs for increased transmission capacity and power quality, at an affordable cost.

▪ **Project Engineering & Design................................**	0	736	0

In FY 2004, Oak Ridge National Laboratory (ORNL) will provide 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 during FY 2004.

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 upgrade 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 includes modifying the space 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.

▪ **Construction**	0	0	0

(dollars in thousands)		
FY 2003	FY 2004	FY 2005

Physical construction will begin late in the second quarter of FY 2006 and should be completed in FY 2009.

Approximately 80 percent of the 52,000 square foot multistory building will be laboratory space, including a large high bay area serviced by two 2-ton cranes for handling large equipment and integrated energy systems. These laboratories are critical to achieving DOE/OETD program goals such as improving the cost-performance ratio of HTS wires by at least a factor of four by 2012 and enabling T&D systems to flexibly respond in real time to local power reliability conditions. The facility's unique capabilities will include:

- A full spectrum of equipment for continuous processing and characterization of 2nd generation HTS tape;
- An isolated power line for electricity T&D research including impulse testing to 500KV to determine breakdown properties; and
- Facilities for optimizing the integration of distributed generation and thermally-activated equipment, along with advanced power electronics, communications, sensors, and controls.

The remainder of the space will contain offices for approximately 40 occupants, and conference and meeting rooms. Some of the office space will be for visiting scientists from energy companies, technology manufacturers, energy-intensive industries, universities, and other national laboratories to collaborate with ORNL staff on cost-shared R&D. Through designation as a National User Center, and with the support of advanced information technologies, researchers from across the nation will have access to EREL's unique collection of research equipment without having to travel to East Tennessee. Strong R&D partnerships are essential to achieving OETD's goals. Such R&D alliances leverage public and private resources and foster innovation. By providing university scientists access to unique facilities and equipment and by arranging technical personnel exchanges, the EREL will generate advances in fundamental science. By developing new technologies and the equipment needed to characterize and test them, the EREL will allow industry to address scale-up and user requirements.

The EREL will be located at the north entrance of ORNL, where it will be a highly visible showcase for sustainable energy technologies and design practices. The building structure will be steel and will be clad with an aesthetic low-maintenance exterior. An advanced heating, ventilating, and air-conditioning (HVAC) system will provide cost-effective, energy-conserving space conditioning utilizing the waste heat from on-site power generation. Land improvements will include service drives, walkways, drainage, and landscaping. Utilities will be extended from the existing distribution systems adjacent to the site and upgraded as required. The EREL will be designed and engineered to achieve a silver rating based on the Leadership in Energy & Environmental Design (LEED™) rating system developed by the U.S. Green Building Council. Energy Star certification will be sought for applicable portions of the building.

Total, Energy Reliability and Efficiency Laboratory...	**0**	**736**	**0**

Explanation of Funding Changes

	FY 2005 vs. FY 2004 ($000)
Energy Efficiency and Reliability Laboratory	
▪ **Project Engineering & Design (PED)**	
Project engineering and design is delayed in FY 2005 to allow OETD to focus on higher level priority activities. PED will resume in FY 2006.	- 736
Total Funding Change, Energy Efficiency and Reliability Laboratory	**-736**

Capital Operating Expenses and Construction Summary

Construction Projects

(dollars in thousands)

	Total Estimated Cost (TEC)	Prior-Year Appropriations	FY 2003	FY 2004	FY 2005	Unappro-priated Balance
EREL........................	19,500	0	0	736	0	18,764
Total, Construction....	19,500	0	0	736	0	18,764

Program Direction

Funding Profile by Category

(dollars in thousands/whole FTEs)

	FY 2003	FY 2004	FY 2005	$ Change	% Change
Chicago Operations Office					
Argonne National Laboratory					
Salaries and Benefits..............	0	0	0	0	0
Travel......................................	0	0	0	0	0
Support Services	0	0	200	+200	+ 100.0%
Other Related Expenses	0	0	0	0	0
Total, Argonne National Lab…	0	0	200	+200	+ 100.0%
Full Time Equivalents..............	0	0	0	0	0
Chicago Field Office					
Salaries and Benefits..............	300	300	430	+ 130	+ 43.3%
Travel......................................	36	25	60	+ 35	+ 140.0%
Support Services	36	17	40	+ 23	+ 135.3%
Other Related Expenses	45	25	80	+ 55	+ 220.0%
Total, Chicago Field Office	417	367	610	+ 243	+ 66.2%
Full Time Equivalents	2	2	3	+1	+ 50.0%
Total, Chicago Operations Office..	417	367	810	+443	+ 120.7%
Idaho Operations Office					
Salaries and Benefits..............	140	96	0	-96	- 100.0%
Travel......................................	15	2	0	- 2	- 100.0%
Support Services	0	0	0	0	0%
Other Related Expenses	27	2	0	- 2	- 100.0%
Total, Idaho Operations Office.....	182	100	0	- 100	- 100.0%
Full Time Equivalents	1	1	0	-1	- 100.0%

Headquarters					
Salaries and Benefits	2,080	2,314	4,778	+ 2,464	+ 106.5%
Travel	90	73	330	+ 257	+ 352.1%
Support Services	90	331	1,820	+ 1,489	+ 449.8%
Other Related Expenses	270	505	2,463	+ 1,958	+ 387.8%
Total, Headquarters	2,530	3,223	9,391	+ 6,168	+ 191.4%
Full Time Equivalents	16	16	34	+18	+ 112.5%
Total Program Direction					
Salaries and Benefits	2,520	2,710	5,208	+ 2,498	+ 92.2%
Travel	141	100	390	+ 290	+ 290.0%
Support Services	126	348	2,060	+ 1,712	+ 492.0%
Other Related Expenses	342	532	2,543	+ 2,011	+ 378.0%
Total, Program Direction	3,129	3,690	10,201	+ 6,511	+ 176.4%
Total, Full Time Equivalents	19	19	37	+18	+94.7%

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) activity was transferred from Fossil Energy under the Interior and Related Agencies Appropriation to OETD under the Energy Supply Appropriation because its activities meet the mission of OETD.

Detailed Justification

(dollars in thousands)

	FY 2003	FY 2004	FY 2005
Salaries and Benefits	**2,520**	**2,710**	**5,208**

Funds a total of 37 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 28 FTEs in FY 2005 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.

With a Congressionally approved transfer from the Interior Budget, headquarters salaries and benefits also includes $726K for 6 FTEs that are responsible for performing the congressionally mandated 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. IEA's activities help deregulate energy markets and reduce international trade barriers, and create an integrated North American energy market. IEA encourages greater exchange of technical and regulatory information among our trading partners. Through its publications, IEA increases public awareness of energy issues and the advantages of competition in the marketplace.

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.

	FY 2003	FY 2004	FY 2005
Travel	**141**	**100**	**390**

Travel will allow OETD to effectively manage R&D programs and provide technical outreach to regional, State and local organizations. Of the amount requested in 2005, $16K would be used by staff performing IEA activities.

	(dollars in thousands)		
	FY 2003	FY 2004	FY 2005
Support Services..	**126**	**348**	**2,060**

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 2005, $335K will be used to provide for contractor support to execute IEA activities.

Other Related Expenses..	**342**	**532**	**2,543**

This includes working capital fund expenses such as rent, supplies, copying, graphics, mail services, printing and telephones. Also, $124K will be used in FY 2005 to provide training, supplies and working capital fund costs for the six IEA program staff.

Total, Program Direction	**3,129**	**3,690**	**10,201**

Explanation of Funding Changes

	FY 2005 vs. FY 2004 ($000)
Salaries and Benefits	
▪ Reflects 18 additional full time equivalent employees (FTEs) that will support the expanding roles of the Office of Electric Transmission and Distribution. The additional FTEs will allow the OETD to effectively manage its R&D programs. The increase also reflects general pay increases, promotions, and other within-grade increases	+2,498
Travel	
▪ Additional travel to support the increase in FTEs. Travel will allow OETD to effectively manage R&D programs and provide technical outreach to regional, state and local organizations.	+290
Support Services	
▪ Reflects market analysis, scenario planning, operations planning, technical reviews, workforce analysis, and general support	+1,712
Other Related Expenses	
▪ Includes development of information technology infrastructure (including eXCITE support), systems (including websites and intranet), program management and capital planning, as well as telecommunications	+2,011
Total Funding Change, Program Direction	**+6,511**

Support Services by Category

	(dollars in thousands)				
	FY 2003	FY 2004	FY 2005	$ Change	% Change
Technical Support					
Energy Technology Advisement on Critical Issues	82	263	460	+ 197	+ 74.9%
Total, Technical Support	82	263	460	+ 197	+ 74.9%
Management Support					
Computer Systems Development, Installation, Configuration and Maintenance	0	37	1,470	+ 1,433	+ 3,873.0%
Preparation of Program Plans	24	28	56	+ 28	+ 100.0%
Training and Education	20	20	74	+ 54	+ 270.0%
Total, Management Support	44	85	1,600	+1,515	+ 1,782.4%
Subtotal, Support Services	126	348	2,060	+1,712	+ 492.0%
Use of Prior-Year Balances	0	0	0	0	0
Total, Management Support	126	348	2,060	+1,712	+ 492.0%

Other Related Expenses by Category

(dollars in thousands)

	FY 2003	FY 2004	FY 2005	$ Change	% Change
Other Related Expenses					
Equipment	163	50	240	+ 190	+ 380.0%
Working Capital Fund	179	482	2,303	+ 1,821	+ 377.8%
Subtotal, Other Related Expenses	342	532	2,543	+ 2,011	+ 378.0%
Use of Prior-Year Balances	0	0	0	0	0
Total, Other Related Expenses	342	532	2,543	+ 2,011	+ 378.0%

Nuclear Energy

Nuclear Energy

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Energy Supply and Other Defense Activities

Office of Nuclear Energy, Science and Technology

Overview

Appropriation Summary by Program

(reflects the FY 2005 Stat table)

(dollars in thousands)

	FY 2003 Comparable Appropriation	FY 2004 Original Appropriation	FY 2004 Adjustments	FY 2004 Comparable Appropriation	FY 2005 Request
Energy Supply					
University Reactor Infrastructure and Education Assistance	18,034	23,500	-645	22,855	21,000
Research and Development					
Nuclear Energy Plant Optimization	4,806	3,000	-56	2,944	0
Nuclear Energy Research Initiative	17,413	11,000	-4,408	6,592	0
Nuclear Energy Technologies	31,579	20,000	-378	19,622	10,246
Generation IV Nuclear Energy Systems Initiative	16,940	24,000	+3,744	27,744	30,546
Nuclear Hydrogen Initiative	2,000	6,500	-123	6,377	9,000
Advanced Fuel Cycle Initiative	57,292	68,000	-1,287	66,713	46,254
Infrastructure					
Radiological Facilities Mgmt	62,928	64,655	-1,224	63,431	69,110
Idaho Facilities Mgmt	42,341	76,560	-1,026	75,534	87,164
Idaho Sitewide Safeguards and Security	0	56,654	0	56,654	0
Program Direction	23,974	59,200	+779	59,979	26,427
Use of Prior Year	-6,000	0	0	0	0
Less Security Charge for Reimbursable Work	0	-3,003	0	-3,003	0
Funding from Other Defense Activities	0	-112,306	0	-112,306	0
Subtotal, Energy Supply	271,307	297,760	-4,624	293,136	299,747

	(dollars in thousands)				
	FY 2003 Comparable Appropriation	FY 2004 Original Appropriation	FY 2004 Adjustments	FY 2004 Comparable Appropriation	FY 2005 Request
Other Defense Activities					
Infrastructure:					
Idaho Facilities Mgmt	20,642	21,415	-119	21,296	20,886
Idaho Sitewide Safeguards and Security	52,560	56,654	-311	56,343	58,103
Program Direction	33,935	34,237	-192	34,045	33,858
Less Security Charge for Reimbursable Work	-3,003	0	0	0	-3,003
Subtotal, Other Defense	104,134	112,306	-622	111,684	109,844
Total, NE	375,441	410,066	-5,246	404,820	409,591

Appropriation Summary by Program
(reflects funding adjustments between Energy Supply and Other Defense Activities in FY 2004)

(dollars in thousands)

	FY 2003 Comparable Appropriation	FY 2004 Original Appropriation	FY 2004 Adjustments	FY 2004 Comparable Appropriation	FY 2005 Request
Energy Supply					
University Reactor Infrastructure and Education Assistance	18,034	23,500	-645[ac]	22,855	21,000
Research and Development					
Nuclear Energy Plant Optimization	4,806	3,000	-56[a]	2,944	0
Nuclear Energy Research Initiative	17,413	11,000	-4,408[ad]	6,592	0
Nuclear Energy Technologies	31,579[b]	20,000	-378[a]	19,622	10,246
Generation IV Nuclear Energy Systems Initiative	16,940	24,000	+3,744[ae]	27,744	30,546
Nuclear Hydrogen Initiative	2,000	6,500	-123[a]	6,377	9,000
Advanced Fuel Cycle Initiative	57,292	68,000	-1,287[a]	66,713	46,254
Infrastructure					
Radiological Facilities Mgmt	62,928	64,655	-1,224[a]	63,431	69,110
Idaho Facilities Mgmt	42,341	55,145	-1,026[a]	54,119	87,164
Program Direction	23,974	24,963	+779[af]	25,742	26,427
Use of Prior Year	-6,000	0	0[a]	0	0
Less Security Charge for Reimbursable Work	0	-3,003	0[a]	-3,003	0
Subtotal, Energy Supply	271,307	297,760	-4,624	293,136	299,747
Other Defense Activities					
Infrastructure:					
Idaho Facilities Mgmt	20,642	21,415	-119[a]	21,296	20,886
Idaho Sitewide Safeguards and Security	52,560	56,654	-311[a]	56,343	58,103
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	(dollars in thousands)				
	FY 2003 Comparable Appropriation	FY 2004 Original Appropriation	FY 2004 Adjustments	FY 2004 Comparable Appropriation	FY 2005 Request
Less Security Charge for Reimbursable Work	-3,003	0	0	0	-3,003
Subtotal, Other Defense	104,134	112,306	-622	111,684	109,844
Total, NE	375,441	410,066	-5,246	404,820[g]	409,591

[a] Government Performance and Results Act of 1993

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 infrastructure. NE serves the present and future energy needs of the country by managing the safe operation and maintenance of our 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 Energy Technologies, 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.

This Overview will describe Strategic Context, Mission, Benefits, Strategic Goals and Funding by General Goal. These items together put the appropriation in perspective. This Overview will also 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 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 [a].

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).

Mission

A key mission of the Department's nuclear energy research and development program is to enhance that basic technology, and through some of the most advanced civilian technology research conducted today, chart the way toward the next leap in technology. From these efforts, and those of industry and our overseas partners, nuclear energy will fulfill its promise as a safe, advanced, inexpensive and environmentally benign approach to providing reliable energy to all the world's people.

Benefits

The benefits of nuclear power as a clean, reliable, and affordable source of energy are a key to economic and environmental underpinnings of the U.S. Nuclear power has become the second most important source of electric energy in the U.S. and also the most operationally economic. 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 significant improvements in environmental quality. It builds on important work started over the last two years to deploy new nuclear plants in the U.S. by 2010, 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 and advanced energy products—including high efficiency electricity and hydrogen—that provide significant improvements in sustainability, economics, safety and reliability, and proliferation and terrorism resistance. 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 fuel volume and the recovery of spent nuclear fuel's valuable energy. Over the last four 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. The U.S. has found considerable merit in this area of advanced research.

NE plans to maintain and enhance the national nuclear infrastructure currently in place to 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. Among these is oversight of the Department's Paducah Gaseous Diffusion Plant uranium enrichment facilities and select surplus uranium inventories.

Strategic 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 goal:

Energy Strategic Goal: To protect our national and economic security by promoting a diverse supply and delivery 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 and advanced energy products—including high efficiency electricity and hydrogen—that provide significant improvements in sustainability, economics, safety and reliability, and proliferation and terrorism resistance.

Program Goal 04.15.00.00: Develop advanced, proliferation-resistant nuclear fuel technologies that maximize energy output, minimize wastes, and operate in a safe and environmentally sound manner.

Program Goal 04.17.00.00: Maintain and enhance the national nuclear infrastructure to support the requirements of the Department's energy security technology development/demonstration programs, and to meet the Nation's energy, environmental, health care, and national security needs.

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 *National Energy Policy* and the President's goal of reducing greenhouse gas intensity by 18 percent by 2012, the Nuclear Power 2010 program will enable an industry decision by 2005 to deploy at least one new advanced nuclear power plant in the U.S.

For the longer-term future, the Department believes that new, next-generation technologies should be considered. This is a key role of the Department of Energy: developing and enabling the deployment of revolutionary energy technologies. While these efforts are long-term and high-risk by nature, the results can provide tremendous benefits to the American people.

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. Hydrogen will 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. 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 (current fossil-fuel-based methods emit greenhouse gases and are roughly four times more costly than the market will support).

Developing the next-generation nuclear systems to make hydrogen possible will be a key 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 based on the results of the U.S. led, multi-national *Generation IV Technology Roadmap.* 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, NERAC, working with the *Generation IV International Forum*, has identified six systems around which the international activity to develop next-generation nuclear energy systems will revolve. Of these, the Department, with the advice of NERAC, has selected the Next Generation Nuclear Plant (NGNP) as the center of its Generation IV research and development effort. This advanced technology has the potential to provide a very efficient generation of electricity while simultaneously producing inexpensive, commercial quantities of clean, emissions-free hydrogen. With this technology, the Nation can realize the President's vision of a future with plentiful energy and no environmentally harmful emissions far earlier than would be possible otherwise.

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) program will develop 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.

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 vital resources and capabilities efficiently and effectively to ensure that major research/critical facilities will continue to be operational and available for fulfillment of long-term 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 at 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 Idaho National Laboratory (INL) which, beginning in FY 2005, combines the physical and intellectual resources of the Idaho National Engineering and Environmental Laboratory and Argonne National Laboratory-West (ANL-W) under a single, more efficient management structure. In addition, Radiological Facilities Management funds the oversight and contingency planning to ensure the Department's Paducah Gaseous Diffusion Plant (Paducah GDP) uranium enrichment facilities and select surplus uranium inventories are available to support future national energy security priorities and satisfy the Department's statutory liabilities.

The **Idaho Facilities Management** program maintains the Department's facilities at Idaho in a safe, secure and environmentally compliant condition to support nuclear energy R&D programs, as announced by the Secretary in July 2002. 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. As the lead Federal program overseeing the INL, program direction also funds expenses associated with the infrastructure operations and safeguards and security activities at the Idaho site, particularly through NE's field component, the Idaho Operations Office. 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.

In FY 2005, the Government intends to continue operating the shipping and transfer facility to remove technicium-99 from contaminated uranium, contingent upon reaching a barter arrangement with USEC. The arrangement will utilize assets managed by NE. The Department is evaluating the need for authorization to pursue such a barter arrangement to carry out this work.

Funding by General Goal

	(dollars in thousands)				
	FY 2003	FY 2004	FY 2005	$ Change	% Change
General Goal 4, Energy Security					
Program Goal 04.14.00.00, Develop new nuclear generation technologies......................	67,932	60,335	49,792	-10,543	-17.5%
Program Goal 04.15.00.00, Develop advanced, proliferation-resistant nuclear fuel technologies	57,292	66,713	46,254	-20,459	-30.7%
Program Goal 04.17.00.00, Maintain and enhance the national nuclear infrastructure	196,505	218,044	256,263	+38,219	+17.5%
All Other..	62,715	62,731	60,285	-2,446	-3.9%
Use of Prior Year balances.............................	-6,000	0	0	+0	+0%
Less Security Charge for Reimbursable Work	-3,003	-3,003	-3,003	+0	+0%
Total, General Goal 4, Energy Security	375,441	404,820	409,591	+4,771	+1.2%

R&D Investment Criteria

The *President's Management Agenda* identified the need to tie R&D investment to performance and well-defined practical outcomes. One criterion by which the Department's performance is measured involves using a framework in the R&D funding decision process and then referencing the use and outcome of the framework in budget justification material.

The goal is to develop highly analytical justifications for applied research portfolios in future budgets. This will require the development and applications of a uniform cost and benefit evaluation methodology across programs to allow meaningful program comparisons.

All NE applied research programs completed an R&D Criteria scorecard and have used the scoring and results as a guide to improve program management. In areas scored that are under program management control, programs have taken steps wherever needed and possible to improve their performance and scores. The drivers behind the Applied R&D Investment Criteria questions are integral to NE planning, performance and management, and are incorporated in the NE planning processes.

Program Assessment Rating Tool (PART)

In addition to the use of R&D investment criteria, 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 2005 Budget Request, and the Department will take the necessary steps to continue to improve performance.

The results of the review are reflect in the FY 2005 Budget Request as follows:

Nuclear Power 2010 (NP 2010) received an overall score of 69 (adequate), Advanced Fuel Cycle Initiative (AFCI) received an overall score of 76 (moderately effective), and Generation IV Nuclear Energy Systems Initiative received an overall score of 79 (moderately effective). All three 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 three. To address these findings, significantly 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.

In FY 2004, the Nuclear Energy Research Advisory Committee (NERAC) is establishing 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 would engage appropriate experts to monitor, on a continuing 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 is expected and intended to provide the arm's length, independent assessments that are key to OMB's evaluation of NE programs.

Significant Program Shifts

Beginning in FY 2005, the Department will integrate 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 will seek universities to conduct research that is focused specifically on programmatic issues for Generation IV Nuclear Energy Systems Initiative, Advanced Fuel Cycle Initiative, Nuclear Hydrogen Initiative, and Nuclear Energy Technologies. Funding for these research projects will come 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 NERI research will retain the independent peer review critical to ensuring the pursuit of leading-edge technologies, and integrate the Nation's universities into the Department's mainline nuclear R&D programs. The Department plans to use the bilateral International Nuclear Energy Research Initiative (I-NERI) agreements it has implemented with other nations to continue international cost-shared R&D in the Generation IV Nuclear Energy Systems Initiative, Advanced Fuel Cycle Initiative, and Nuclear Hydrogen Initiative. The new approach to executing international, cost-shared research will allow 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.

On May 19, 2003, oversight of and Landlord responsibilities for the Idaho National Engineering and Environmental Laboratory (INEEL) transferred from the Office of Environmental Management (EM) to the Office of Nuclear Energy, Science and Technology (NE). Beginning in the second quarter of FY 2005, the laboratory will be merged with Argonne National Laboratory - West (ANL-W) to create the Idaho National Laboratory (INL). INL will become the center for NE's strategic nuclear energy research and development enterprise. INL will play a lead role in Generation IV nuclear energy systems development, advanced fuel cycle development, vital nuclear reactor testing, irradiation testing of Naval reactor fuels and components, and space nuclear power and propulsion applications.

NE's expanding responsibilities are reflected in the transfer of staff from other organizations to assist in a range of vital missions. NE has also assumed oversight responsibility for the Department's interaction with the Organization for Economic Cooperation and Development's (OECD), reflecting its expanding role in guiding U.S. policy related the OECD Nuclear Energy Agency. With that responsibility, beginning in FY 2005, NE will assume full responsibility for one FTE transferred from NNSA. Finally, several staff at the Oak Ridge Operations Office (OR) are supporting EM and NE headquarters in managing a range of activities associated with the management of uranium resources and related functions, overseeing the Department's lease agreement with USEC Inc, and assisting in various management activities associated with the DOE enrichment sites. With a recent decision to release the Office of Science from its LPSO responsibilities for the Portsmouth and Paducah sites, seven staff at the Oak Ridge Operations Office will be transferred from Office of Science oversight to NE beginning in FY 2005.

Also beginning in FY 2005, the Radiological Facilities Management program will fund the oversight and planning activities needed to ensure the Department's Paducah Gaseous Diffusion Plant (Paducah GDP) uranium enrichment facilities and select surplus uranium inventories are available to support future national energy security priorities and satisfy the Department's statutory liabilities.

Office of Nuclear Energy, Science and Technology
Funding by Site by Program

(dollars in thousands)

	FY 2003	FY 2004	FY 2005	$ Change	% Change
Chicago Operations Office					
Chicago Operations Office					
Nuclear Hydrogen Initiative	58	0	0	0	0.0%
Nuclear Energy Technologies	58	0	0	0	0.0%
Idaho Facilities Management	335	500	500	0	0.0%
Program Direction	1,234	1,296	0	-1,296	-100.0%
Total, Chicago Operations Office	1,685	1,796	500	-1,296	-72.2%
Ames Laboratory					
Nuclear Energy Research Initiative	325	0	0	0	0.0%
Total, Ames Laboratory	325	0	0	0	0.0%
Argonne National Laboratory [a]					
University Reactor Infrastructure and Education Assistance	110	110	110	0	0.0%
Nuclear Energy Plant Optimization	382	0	0	0	0.0%
Generation IV Nuclear Energy Systems Initiative	3,683	1,686	1,630	-56	-3.3%
Nuclear Hydrogen Initiative	170	300	600	300	+100.0%
Nuclear Energy Research Initiative	2,588	0	0	0	0.0%
Nuclear Energy Technologies	500	0	0	0	0.0%
Advanced Fuel Cycle Initiative	2,337	7,980	5,089	-2,891	-36.2%
Total, Argonne National Laboratory	9,770	10,076	7,429	-2,647	-26.3%
Brookhaven National Laboratory					
Nuclear Energy Plant Optimization	330	0	0	0	0.0%
Generation IV Nuclear Energy Systems Initiative	50	290	200	-90	-31.0%
Advanced Fuel Cycle Initiative	390	700	0	-700	-100.0%

[a] For comparability purposes funding in FY 2003 and FY 2004 for ANL-W is included in the Idaho National Laboratory amounts.

(dollars in thousands)

	FY 2003	FY 2004	FY 2005	$ Change	% Change
Radiological Facilities Management.	1,700	2,373	2,673	+300	+12.6%
Total, Brookhaven National Laboratory	2,470	3,363	2,873	-490	-14.6%
Total, Chicago Operations Office............	14,250	15,235	10,802	-4,433	-29.1%
Idaho Operations Office					
Idaho Operations Office					
University Reactor Infrastructure and Education Assistance....................	13,939	17,353	17,498	+145	+0.8%
Generation IV Nuclear Energy Systems Initiative..........................	1,470	9,103	12,040	+2,937	+32.3%
Nuclear Energy Research Initiative	6,746	2,874	0	-2,874	-100.0%
Nuclear Energy Plant Optimization.	3,051	1,862	0	-1,862	-100.0%
Nuclear Hydrogen Initiative............	0	1,488	3,448	+1,960	+131.7%
Nuclear Energy Technologies	8,531	17,144	9,000	-8,144	-47.5%
Advanced Fuel Cycle Initiative	0	1,700	1,000	-700	-41.2%
Program Direction	32,308	32,011	32,574	+563	+1.8%
Total, Idaho Operations Office	66,045	83,535	75,560	-7,975	-9.5%
Idaho National Laboratory					
University Reactor Infrastructure and Education Assistance	3,126	5,032	3,032	-2,000	-39.7%
Generation IV Nuclear Energy Systems Initiative..........................	4,370	8,121	8,451	+330	+4.1%
Nuclear Hydrogen Initiative............	50	1,160	2,000	+840	+72.4%
Nuclear Energy Technologies	2,140	289	0	-289	-100.0%
Nuclear Energy Research Initiative	1,842	36	0	-36	-100.0%
Advanced Fuel Cycle Initiative	31,046	27,601	26,755	-846	-3.1%
Radiological Facilities Management	10,512	18,244	14,000	-4,244	-23.3%
Idaho Facilities Management	62,150	74,915	107,550	+32,635	+43.6%
Idaho Sitewide Safeguards and Security.......................................	52,560	56,343	58,103	+1,760	+3.1%
Total, Idaho National Laboratory	167,796	191,741	219,891	+28,150	+14.7%
Total, Idaho Operations Office	233,841	275,276	295,451	+20,175	+7.3%

	FY 2003	FY 2004	FY 2005	$ Change	% Change
	(dollars in thousands)				
Golden Site Office					
Nuclear Hydrogen Initiative	100	0	0	0	0.0%
Total, Golden Site Office	100	0	0	0	0.0%
Livermore Site Office					
Livermore Site Office					
Nuclear Energy Plant Optimization	119	0	0	0	0.0%
Nuclear Energy Technologies	245	70	0	-70	-100.0%
Program Direction	127	134	0	-134	-100.0%
Total, Livermore Site Office	491	204	0	-204	-100.0%
Lawrence Livermore National Laboratory					
Generation IV Nuclear Energy Systems Initiative	700	346	300	-46	-13.3%
Nuclear Energy Research Initiative	795	0	0	0	0.0%
Advanced Fuel Cycle Initiative	175	150	100	-50	-33.3%
Total, Lawrence Livermore National Laboratory	1,670	496	400	-96	-19.4%
Total, Livermore Site Office	2,161	700	400	-300	-42.9%
Sandia Site Office					
Sandia Site Office					
Generation IV Nuclear Energy Systems Initiative	390	200	0	-200	-100.0%
Advanced Fuel Cycle Initiative	2,648	3,810	1,000	-2,810	-73.8%
Total, Sandia Site Office	3,038	4,010	1,000	-3,010	-75.1%
Los Alamos National Laboratory					
Generation IV Nuclear Energy Systems Initiative	550	327	400	+73	+22.3%
Nuclear Energy Research Initiative	422	295	0	-295	-100.0%
Advanced Fuel Cycle Initiative	12,040	12,000	7,825	-4,175	-34.8%
Radiological Facilities Management	14,748	15,212	16,960	+1,748	+11.5%
Total, Los Alamos National Laboratory	27,760	27,834	25,185	-2,649	-9.5%

	(dollars in thousands)				
	FY 2003	FY 2004	FY 2005	$ Change	% Change
Sandia National Laboratories					
Nuclear Energy Plant Optimization.	452	0	0	0	0.0%
Generation IV Nuclear Energy Systems Initiative.........................	825	1,330	670	-660	-49.6%
Nuclear Hydrogen Initiative...........	650	600	1,400	+800	+133.3%
Nuclear Energy Research Initiative	1,442	906	0	-906	-100.0%
Advanced Fuel Cycle Initiative.......	824	1,800	1,210	-590	-32.8%
Radiological Facilities Management	1,800	1,750	1,900	+150	+8.6%
Total, Sandia National Laboratories...	5,993	6,386	5,180	-1,206	-18.9%
University of Nevada, Las Vegas					
Nuclear Hydrogen Initiative...........	750	1,900	0	-1,900	-100.0%
Advanced Fuel Cycle Initiative.......	3,860	3,500	0	-3,500	-100.0%
Total, University of Nevada, Las Vegas	4,610	5,400	0	-5,400	-100.0%
Total, Sandia Site Office........................	41,401	43,630	31,365	-12,265	-28.1%
Savannah River Site Office					
University Reactor Infrastructure and Education Assistance	300	300	300	0	0.0%
Nuclear Energy Research Initiative ...	460	367	0	-367	-100.0%
Advanced Fuel Cycle Initiative	696	800	0	-800	-100.0%
Total, Savannah River Site Office	1,456	1,467	300	-1,167	-79.6%
Oak Ridge Operations Office					
Oak Ridge Operations Office					
Radiological Facilities Management	0	0	500	+500	+100.0%
Program Direction	1,806	1,896	1,957	+61	+3.2%
Total, Oak Ridge Operations Office...	1,806	1,896	2,457	+561	+29.6%
Oak Ridge National Laboratory					
University Reactor Infrastructure and Education Assistance	25	25	25	0	0.0%
Nuclear Energy Plant Optimization	175	150	0	-150	-100.0%

	(dollars in thousands)				
	FY 2003	FY 2004	FY 2005	$ Change	% Change
Generation IV Nuclear Energy Systems Initiative......................	1,329	5,055	6,000	+945	+18.7%
Nuclear Hydrogen Initiative.........	0	250	600	+350	+140.0%
Nuclear Energy Research Initiative	1,446	697	0	-697	-100.0%
Nuclear Energy Technologies	3,413	2,000	0	-2,000	-100.0%
Advanced Fuel Cycle Initiative	1,803	3,370	2,775	-595	-17.7%
Radiological Facilities Management	33,272	25,400	32,625	+7,225	+28.4%
Total, Oak Ridge National Laboratory	41,463	36,947	42,025	+5,078	+13.7%
Total, Oak Ridge Operations Office.........	43,269	38,843	44,482	+5,639	+14.5%
Richland Operations Office					
Pacific Northwest National Laboratory					
Generation IV Nuclear Energy Systems Initiative......................	110	166	0	-166	-100.0%
Nuclear Energy Research Initiative	1,314	1,121	0	-1,121	-100.0%
Advanced Fuel Cycle Initiative	106	200	0	-200	-100.0%
Total, Pacific Northwest National Laboratory	1,530	1,487	0	-1,487	-100.0%
Richland Operations Office					
Generation IV Nuclear Energy Systems Initiative......................	890	0	0	0	0.0%
Total, Richland Operations Office......	890	0	0	0	0.0%
Total, Richland Operations Office...........	2,420	1,487	0	-1,487	-100.0%
Washington Headquarters					
University Reactor Infrastructure and Education Assistance......................	534	35	35	0	0.0%
Nuclear Energy Plant Optimization....	297	932	0	-932	-100.0%
Nuclear Energy Research Initiative ...	33	296	0	-296	-100.0%
Nuclear Energy Technologies	16,692[a]	119	1,246	+1,127	+947.1%
Generation IV Nuclear Energy Systems Initiative	2,573	1,120	855	-265	-23.7%

[a] Includes $15M identified as use of prior year balances to fund the Environmental Management liability for OVEC in FY 04.

	(dollars in thousands)				
	FY 2003	FY 2004	FY 2005	$ Change	% Change
Nuclear Hydrogen Initiative	222	679	952	+273	+40.2%
Advanced Fuel Cycle Initiative	1,367	3,102	500	-2,602	-83.9%
Radiological Facilities Mgmt	896	452	452	0	0.0%
Idaho Facilities Mgmt	498	0	0	0	0.0%
Program Direction	22,434	24,450	25,754	+1,304	+5.3%
Total, Washington Headquarters	45,546[a]	31,185[a]	29,794	-1,391	-4.5%
Subtotal, Nuclear Energy	384,444	407,823	412,594	+4,771	+1.2%
Use of prior year balances	-6,000	0	0	0	+0.0%
Less security charge for reimbursable work	-3,003	-3,003	-3,003	0	+0.0%
Total, Nuclear Energy	375,441	404,820	409,591	+4,771	+1.2%

Site Description

Ames Laboratory

Introduction

The Ames Laboratory is a single-purpose laboratory operated by Iowa State University in Iowa for the U.S. Department of Energy. Ames Laboratory conducts research in materials science, analytical chemistry, and nondestructive evaluation programs.

Nuclear Energy Research Initiative

Ames is the lead organization for a project conducting research for advanced reactor instrumentation.

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 is located at two sites. The Illinois site, ANL-East, is the main laboratory and occupies 1500 acres, surrounded by a forest preserve about 25 miles southwest of the Chicago Loop. The Idaho site, ANL-West, comprises the bulk of Argonne's nuclear energy program. It is located within the boundary of the Idaho National Laboratory (INL) in Southeastern Idaho, about 35 miles west of Idaho Falls. Beginning in FY 2005, ANL-West will become part of the INL.

[a] Includes funding identified to fund the Environmental Management liability for OVEC in FY 2004.

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.

Nuclear Energy Plant Optimization
ANL is conducting two NEPO research tasks. The research tasks include: assessing the effectiveness of non-destructive examination techniques for the detection and characterization of service-induced cracks in steam generator tubes; and providing on-going support of signal validation technologies and quantification of benefits of on-line monitoring.

Generation IV Nuclear Energy Systems Initiative
ANL and INL coordinated the preparation of the Generation IV Technology Roadmap, and continue to play a leading role in conducting the R&D as integrators of the U.S. participation in the international collaborations and by conducting, for one or more concepts, R&D in accordance with the Generation IV Roadmap. ANL is the lead for two I-NERI projects with France and the lead and collaborator for four I-NERI projects with Korea in reactor safety, advanced conventional methods, gas cooled reactor technology, and advanced fuels and materials. ANL also is the lead on a project on melt/concrete interaction, which is sponsored by the U.S. DOE and NRC and the Organization for Economic Cooperation and Development's Nuclear Energy Agency.

Nuclear Hydrogen Initiative
ANL will support the program by conducting laboratory analyses of thermochemical hydrogen production methods, specifically the calcium-bromine (Ca-Br) cycle.

Nuclear Energy Research Initiative
ANL is the lead organization or collaborator for nine Nuclear Energy Research Initiative (NERI) projects in the areas of reactor systems, fundamental chemistry, material science for Generation IV systems, integrated nuclear and hydrogen production, and advanced nuclear fuels/fuel cycles.

Nuclear Energy Technologies
ANL is conducting a macroeconomic policy assessment relating to the deployment of new nuclear power plants.

Advanced Fuel Cycle Initiative
ANL 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 is also responsible for the development of laboratory-scale pyroprocessing and advanced aqueous separations technologies.

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.

Nuclear Energy Plant Optimization

BNL is performing a task to provide guidance for definition, design, implementation, operation, and maintenance of hybrid control rooms.

Generation IV Nuclear Energy Systems Initiative

BNL is providing support to INL on the Gas-Cooled Fast Reactor (GFR) and associated fuel cycle concept.

Advanced Fuel Cycle Initiative

BNL supports the AFCI program in the conduct of 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, cooper-67, and others that are used in medical diagnostic applications are produced at BLIP.

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 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 the 27 university research reactors; and part of the university programs summer internship program.

Generation IV Nuclear Energy Systems Initiative
INL developed improvements to coated particle fuel performance computer models, and design an advanced irradiation test fixture in support of the gas-cooled reactor fuel development and qualification program. INL and ANL will continue to play a leading role in conducting the R&D as integrators of the U.S. participation in the international collaborations and by conducting, for one of more concepts, R&D in accordance with the Generation IV Roadmap. INL was awarded an U.S.-Korean I-NERI project focused on modeling of coated particle fuel for gas reactors. INL will also lead the development of the next generation nuclear plant for the Department.

Nuclear Hydrogen Initiative
INL will provide leadership in executing the Nuclear Hydrogen Initiative. INL supported the development of the Nuclear Hydrogen Research and Development Plan in FY 2004. INL will cooperate with the 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 Technologies
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.

Nuclear Energy Research Initiative
INL is the lead organization or collaborator for seven R&D projects in the areas of plasma technology for producing hydrogen, pebble bed reactor neutronics, advanced nuclear energy systems and advanced nuclear fuels/duel systems.

Advanced Fuel Cycle Initiative
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 also provides leadership in separations technology development and Generation IV systems analysis as the National Technical Director.

INL is also responsible for pyroprocessing research and qualification of resulting waste forms. The capabilities include nuclear fuel development, 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
Activities include upgrading the Zero Power Physics Reactor Mock Up Building (Building 792) for the radioisotope power systems heat source and test and assembly operations being transferred from the Mound Site.

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 formerly at ANL-W, 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.

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.

Nuclear Energy Research Initiative

LLNL was the lead organization and a collaborator on two R&D projects initiated in FY 2001 in the areas of computational science associated with intergrannular stress-corrosion cracking and irradiation creep in next generation reactors. These two NERI projects will be completed in FY 2004.

Advanced Fuel Cycle Initiative

LLNL provides expertise in 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.

Nuclear Energy Research Initiative

LANL is the lead organization or collaborator for two R&D projects.

Advanced Fuel Cycle Initiative

LANL supports the AFCI and Generation IV programs through advanced fuels, materials and science research. LANL staffs the AFCI National Technical Directors positions for Fuels and Transmutation Technology. 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 processing. This capability is the only existing Pu-238 processing 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) is used to produce three 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 sodium-22, a positron-emitter used in neurological research.

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.

Nuclear Energy Plant Optimization
SNL will complete the investigation of nuclear magnetic resonance relaxation modulus profiling and destiny measurements for cable polymer aging assessment, and the preparation of a cable aging database.

Generator IV Nuclear Energy Systems Initiative
SNL manages Generation IV crosscutting R&D in its role as Generation IV National Technical Director for Energy Conversion Systems.

Nuclear Hydrogen Initiative
As part of the Nuclear Hydrogen Initiative, SNL will expand the scope of its research and development on the sulfur-iodine thermochemical process to complete an integrated demonstration in FY 2006.

Nuclear Energy Research Initiative
SNL is the lead organization or the collaborator for four R&D projects. SNL also is the lead on a project with France focused on development of the sulfur-iodine thermochemical process for production of hydrogen from nuclear power.

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.

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.

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 will fabricate gas reactor fuel in a laboratory-scale facility to supply demonstration fuel for irradiation testing and fuel performance modeling in support of the Generation IV Next Generation Nuclear Plant. ORNL staffs the Generation IV National Technical Director for Materials. ORNL will publish an Integrated Plan for Generation IV Materials R&D, and begin materials testing in FY 2005.

Nuclear Hydrogen Initiative
ORNL will support the program by conducting research on the potential for thermochemical process improvements using membranes, specifically those previously developed for gaseous diffusion.

Nuclear Energy Research Initiative
ORNL is the lead organization or collaborator for eight R&D projects in the areas of advanced reactor and control concepts, reactor materials research, and advanced fuel components.

Nuclear Energy Technologies
ORNL is the co-lead laboratory for the development of advanced gas reactor fuels.

Advanced Fuel Cycle Initiative
ORNL conducts research in basic and applied science in support of the AFCI program. ORNL also provides materials expertise to develop spallation targets and specific reactor components, conducts research and development on 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. ORNL is also the Department's site for the assembly and the processing of targets associated with the domestic production of Pu-238. Targets will be irradiated at the High Flux Isotope Reactor (HFIR) located at ORNL or the Advanced Test Reactor in Idaho. ORNL is preparing to receive and store the Np-237 inventory currently stored at Savannah River.

Currently, the electromagnetic calutrons at Y-12, ORNL have been placed in a standby but operable condition. Within the calutron building, ORNL operates two laboratories used for processing and forming enriched stable isotopes: 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. These laboratories and the stable isotope inventories will be transferred to site area X-10 at Oak Ridge by the end of September 2003.

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 2007.

Pacific Northwest National Laboratory

Introduction

Pacific Northwest National Laboratory (PNNL) is a multi-program laboratory is approximately 640 acres located on the Department's Hanford site plus a marine science lab at Sequim in Washington State.

Generation IV Nuclear Energy Systems Initiative

PNNL serves as the Executive Agent for the I-NERI program. In this role PNNL provides technical assistance to DOE in development and conduct of procurements, peer-review of proposals, and project monitoring and reporting in support of the bilateral research and development conducted under the I-NERI program.

Nuclear Energy Research Initiative

PNNL is the lead organization or collaborator for three R&D projects in the areas of instrumentation and control systems and materials science.

Advanced Fuel Cycle Initiative

PNNL provides the technical support in the AFCI advanced separation and fuel development work.

Washington Headquarters

Washington Headquarters includes funding to support the FY 2003 use of prior year balances reduction, FY 2004 reduction to fund OVEC, Small Business and Innovative Research (SBIR), and other small business initiatives.

Nuclear Energy Technologies

Provides for the regulatory demonstration projects, including the Early Site Permit (ESP) scoping study and the ESP demonstration project, other reactor development and licensing activities for which decisions on the performing organizations have not been made.

Nuclear Energy Plant Optimization

Includes cost-shared research and development projects with industry in the areas of advanced power generating technologies, nuclear power security, and advanced in-service inspection technologies.

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 2003 Comparable Appropriation	FY 2004 Appropriation	FY 2004 Adjustments	FY 2004 Comparable Appropriation	FY 2005 Request
University Reactor Infrastructure and Education Assistance	18,034	23,500	-645	22,855	21,000

Mission

The mission of the University Reactor Infrastructure and Education Assistance program is to produce highly-trained nuclear scientists and engineers to meet the Nation's energy, environment, health care, and national security needs.

Benefits

The United States has led the world in the development and application of nuclear technology for many decades. This leadership, which spans national security, energy, environmental, medical and other applications, has been possible only because the United States Government fostered advanced nuclear technology education at many universities and colleges across the Nation. The government's role has not diminished over the years and is now more essential to the preservation of 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 university nuclear engineering programs and research reactors in the United States declined precipitously causing a corresponding decline in nuclear engineering graduates. As a result of the decline in nuclear engineering graduates coupled with the increasing number of retirements in the nuclear field, demand for nuclear engineers now exceeds supply. The Nation's critical need for nuclear engineers and nuclear-trained personnel is now on the rise. The University Reactor Infrastructure and Education Assistance program ensures and addresses these issues by providing essential support to university nuclear engineering programs and the university research reactor community.

This 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 will be needed as the United States continues its reliance on advanced nuclear technologies into the future. This program is essential to the continued operation of the Nation's university research and training reactors, which play a vital 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, medicine, environmental restoration, and national security, as well as 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 Grant program permits universities to strengthen their nuclear engineering course of study in a way that best fits each institution and the private sector match in this program leverages DOE funding. 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. Academic assistance is provided to outstanding students and faculty through the Fellowships and Scholarships program with an added dimension of supporting students at minority institutions in achieving nuclear engineering degrees at universities with a nuclear engineering department. The key component to nuclear engineering infrastructure continues to be the quality of students produced by the universities. DOE's fellowships and scholarship programs not only help assure that sufficient students are attracted to nuclear engineering but that the best and brightest students pursue this discipline.

One educational area that has not been addressed adequately in the past has been that of Health Physics (HP). While a few of the fellowships awarded each year were allocated to HP under the NEER program, funds for HP fellowships and scholarships were not specifically designated in our budget. Beginning in FY 2005, funds are specifically requested to provide fellowships and scholarships to help increase enrollments in HP and to begin to address the shortage of trained personnel who can perform the needed research to support advanced reactors. These funds will help heighten the visibility of HP as a viable career opportunity and strengthen the HP pipeline to replace retiring professionals.

The most exciting development in University Reactor Infrastructure and Education Assistance is 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. Under the INIE program, the universities are encouraged to make new investments in their research reactor and nuclear engineering programs while establishing strategic partnerships with national laboratories and industry. Subsequently, an independent peer review panel of experts evaluated 13 proposals and recommended seven meritorious ones. Based on this expert review, the Department was able to fund four consortia in FY 2002 encompassing 14 universities at geographically diverse locations throughout the United States. In FY 2003, two additional university consortia were awarded, bringing the total to six INIE grants, providing support to 24 universities in 19 states across the Nation. The consortia have demonstrated remarkable collaborative efforts and strong formation of 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 fresh fuel to and return of spent fuel from university research reactors allowing universities to continue their important research and education activities. Beginning in FY 2005, funding and program responsibility for transportation of domestic spent nuclear fuel shipments from university research reactors will be transferred from NE to the Office of Civilian Radioactive Waste Management (RW), allowing a single program office to be responsible for transportation of all spent fuel in the DOE complex. The Reactor Upgrade program provides funding for equipment and instrumentation upgrades at the universities' research reactors, increasing their value as research tools, while the radiochemistry program supports students and faculty in the discipline of radiochemical science, which supports the nuclear energy infrastructure of the Nation. 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, including internships for students at DOE national laboratories. This program was initiated to address the knowledge gap of incoming college freshmen in the area of nuclear science and engineering.

Several studies have been completed in an attempt 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, Nuclear Energy Department Heads Organization surveyed U.S. industry and universities concerning manpower requirements (see ***www.engin.umich.edu/~nuclear/NEDHO/***). The conclusion of both of these 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 recommended significant increases in funding to maintain the nuclear engineering infrastructure in the United States. (This and related studies can be found at ***www.nuclear.gov***.) This led to the formation of the INIE program.

Recent surveys conducted by NEDHO and the DOE have found that the increased support of DOE university activities has significantly helped increase undergraduate nuclear engineering enrollments and this turn has led to increased support by universities to their nuclear engineering programs and research reactors. Therefore, while DOE funding has been a catalyst for this dramatic improvement in nuclear engineering education and infrastructure, it has enabled other interested parties to increase their efforts as well.

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 that contributes to General Goal 4 in the goal "cascade":

Program Goal 04.17.00.00: Maintain and enhance the national nuclear infrastructure to support the requirements of the Department's energy security technology development/demonstration programs, and to meet the Nation's energy, environmental, health care, and national security needs.

Contribution to Program Goal 04.17.00.00: Maintain and enhance the national nuclear infrastructure

The University Reactor Infrastructure and Education Assistance program contributes to the program goal by identifying 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 will also provide funding to improve existing infrastructure and 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 effectiveness of the program goal in producing highly-trained nuclear scientists and engineers to fulfill critical national requirements.

Annual Performance Results and Targets

FY 2000 Results	FY 2001 Results	FY 2002 Results	FY 2003 Results	FY 2004 Targets	FY 2005 Targets
Program Goal 04.17.00.00 (Energy Security)					
University Reactor Infrastructure and Education Assistance					
Support U.S. universities' nuclear energy research and education capabilities by: - Providing fresh fuel to all university reactors requiring this service; - Providing funding for reactor upgrades and improvements at 23 universities; - Partnering with 17 or more private companies to fund DOE/Industry Matching Grants Programs for universities; and -Increasing the funding for Reactor Sharing by 20 percent over FY 1998, enabling each of the 29 schools eligible for the program to improve the use of their reactors for teaching, training, and education within the surrounding community. (MET GOAL)	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.	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 35 fellowships and 80 scholarships.

FY 2000 Results	FY 2001 Results	FY 2002 Results	FY 2003 Results	FY 2004 Targets	FY 2005 Targets
Attract outstanding U.S. students to pursue nuclear engineering degrees by: - Providing 18-20 fellowships; - Increasing the number of Nuclear Engineering Education Grants to 45 existing and new grants; and - Providing scholarships and summer on-the-job training to approximately 50 sophomore, junior and senior nuclear engineering and science scholarship recipients. (MET GOAL)	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, providing nuclear science and engineering concepts to thousands of teachers and students so that informed career choices can be made.
- 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.
- Coordinate the Department's university reactor support and educational assistance activities with the universities Nuclear Energy Department Heads Organization and ANS.

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-ID database and reviewed by the NE-ID Program Manager for compliance. Nuclear Engineering Education Research (NEER) annual and final reports are posted to the NEER web page. 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.
- INIE grant reviews have been held twice a year in conjunction with ANS meetings. In addition, comprehensive reviews were held with each INIE consortia to go over performance and cost. Each consortia member had an opportunity to provide progress information and input into upcoming performance. In addition, INIE awardees are required to submit annual progress reports to NE-ID.

They are logged in the NE-ID database and reviewed by the NE-ID Program Manager for compliance with program goals.

- NE conducts annual reviews of fellowship and scholarship recipients prior to receiving renewal of their award.

- 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 2003	FY 2004	FY 2005	$ Change	% Change
General Goal 4, Energy Security					
Program Goal 4.17.00.00, Maintain and enhance the national nuclear infrastructure	18,034	22,855	21,000	-1,855	-8.1%
Total, General Goal 4, Energy Security	18,034	22,855	21,000	-1,855	-8.1%

Detailed Program Justification

	(dollars in thousands)		
	FY 2003	FY 2004	FY 2005
University Reactor Infrastructure and Education Assistance	**18,034**	**22,855**	**21,000**
▪ **University Nuclear Infrastructure (UNI)**	**10,615**	**15,155**	**12,200**

The UNI program provides new fuel for the universities; instrumentation, electronics, hardware, and software upgrades for the research reactors; and reactor sharing and research cooperation among 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. The UNI program will continue to supply fresh fuel to university reactors requiring these services in FY 2005. In FY 2004, the program provided fuel elements for the reactors at the Massachusetts Institute of Technology, Kansas State University, and the Universities of Missouri, California, and Utah. Beginning in FY 2005, funding and program responsibility for transportation of these domestic spent nuclear fuel shipments from university research reactors will be transferred from NE to the Office of Civilian Radioactive Waste Management (RW) to allow for a single program office to be responsible for transportation of spent fuel in the DOE complex.

In FY 2005, the program will continue to provide grants permitting universities without research reactors to have access to university reactors for training, education, and research purposes. The Department awarded 19 grants in FY 2003. In FY 2004 and FY 2005 the number of reactor sharing grants is expected to remain relatively constant.

The UNI program will continue to assist in addressing the maintenance and upgrades to equipment required at university research reactors; providing for replacement of outdated equipment; maintenance of reactor systems; and upgrading of experimental capabilities at 23 university reactors in FY 2003 and approximately 20 reactors in FY 2004 and FY 2005.

The UNI program, in FY 2005, will support the Innovations in Nuclear Infrastructure and Education (INIE) grant initiative. The INIE grants will 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 will expand the use of university facilities for research, education, and training of nuclear engineers and scientists through the establishment of regional research and training centers and strategic partnerships. INIE began in FY 2002 with awards to four partnerships in geographically diverse areas of the United States. In FY 2003, two additional university consortiums were awarded, bringing the total to six INIE grants, providing support for 23 universities with nuclear engineering programs and/or nuclear research and training reactors. INIE now supports university programs in Ohio, Pennsylvania, Wisconsin, Illinois, Indiana, Massachusetts, Rhode Island, Maryland, South Carolina, North Carolina, Georgia, Tennessee, Texas, New Mexico, Missouri, California, Oregon, Washington and Idaho. In FY 2005, the program will continue to support the six grants previously awarded. The grants are for one year, renewable annually, for up to five years.

	FY 2003	FY 2004	FY 2005
(dollars in thousands)			
▪ **DOE/Industry Matching Grants Program**..........................	**800**	**800**	**1,000**

In FY 2005, the DOE/Industry Matching grants program supports education, training, and innovative research at participating universities. This program provides grants of up to $60,000, which are matched by industry. In FY 2003, 25 universities received awards and an expected 20-25 will receive awards in FY 2004 and FY 2005.

▪ **Fellowships/Scholarships to Nuclear Science and Engineering Programs at Universities**................................	**1,200**	**1,200**	**2,000**

In FY 2005, fellowships and scholarships will be provided to students enrolled in nuclear science and engineering at U.S. universities. Fellowships will be 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, discouraging some students from continuing in the field of nuclear engineering. In FY 2003, stipends for these fellowships were increased to keep them competitive with non-nuclear engineering fellowships. A total of 18 fellowships and more than 40 scholarships were awarded in FY 2003 with 18 fellowships and 47 scholarships expected in FY 2004 and 30 fellowships and 70 scholarships FY 2005.

The University Partnership program was initiated in FY 2000 to encourage students enrolled in minority-serving institutions to pursue a nuclear engineering degree in cooperation with universities that grant those degrees. In FY 2003, the Department funded five university partnerships and expects to continue to fund five in FY 2004 and six in FY 2005.

▪ **Health Physics Fellowships & Scholarships**	**0**	**0**	**200**

In FY 2005, 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. It is likely that areas requiring health physicists could be impacted in the near future due to the lack of educated graduates needed to replace personnel reaching retirement age.

▪ **Nuclear Engineering Education Research (NEER) Grants**	**4,734**	**5,000**	**4,900**

In FY 2003, existing and new NEER grants totaled approximately 37. A total of 50 new and existing NEER grants are planned for FY 2004 and FY 2005. The NEER program provides grants allowing nuclear engineering faculty and students to conduct innovative research in nuclear engineering and related areas.

	(dollars in thousands)		
	FY 2003	FY 2004	FY 2005
▪ **Nuclear Engineering Education Opportunities**....................	**385**	**400**	**400**

The Nuclear Engineering Education Opportunities program began in FY 2000 to support nuclear engineering education recruitment activities to ensure a highly informed group of students are available to enter university nuclear engineering and related scientific courses of study. The funding enables teacher workshops in nuclear science and engineering to be conducted at high schools and middle schools across the United States; the production and distribution of educational materials; and permits universities to address equipment, faculty, and material needs for their nuclear engineering curriculum that do not fall within the scope of other university program activities. The teacher workshops program is conducted in conjunction with the American Nuclear Society (ANS) which provides the training. ANS uses qualified volunteers from its membership to train teachers and students, keeping costs down. Since this program began in FY 2000, more than 100 workshops have been held throughout the country. The workshops planned for FY 2005 will reach thousands of teachers enabling them to explain nuclear science and engineering principles to their students.

▪ **Radiochemistry Awards**	**300**	**300**	**300**

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 2005, the program will continue to fund the existing three grants at three universities offering curriculum, faculty and graduate student support.

Total, University Reactor Infrastructure and Education Assistance..	**18,034**	**22,855**	**21,000**

Explanation of Funding Changes from FY 2004 to FY 2005

	FY 2005 vs. FY 2004 ($000)
University Reactor Infrastructure and Education Assistance	
▪ The decrease of $2,955,000 occurs primarily due to a one-time increase for spent nuclear fuel shipments in FY 2004 and a small decrease in INIE efforts.	-2,955
▪ The increase of $200,000 will permit DOE to better match the cost sharing amounts contributed by industry for the DOE/Industry Matching Grant program.	+200
▪ The increase of $800,000 will allow for additional fellowships/scholarships to nuclear engineering students assisting in the replenishment of highly trained nuclear scientists and engineers to meet the Nation's energy, environment, national security and healthcare needs.	+800
▪ The increase of $200,000 will allow for 5 fellowships and 10 scholarships to health physics students.	+200
▪ The decrease of $100,000 is for a reduction in research efforts in the NEER program.	-100
Total Funding Change, University Reactor Infrastructure and Education Assistance	**-1,855**

Research and Development

Funding Profile by Subprogram

(dollars in thousands)

	FY 2003 Comparable Appropriation	FY 2004 Original Appropriation	FY 2004 Adjustments	FY 2004 Comparable Appropriation	FY 2005 Request
Research and Development					
Nuclear Energy Plant Optimization	4,806	3,000	-56	2,944	0
Nuclear Energy Research Initiative	17,413[a]	11,000	-4,408[a]	6,592	0
Nuclear Energy Technologies	31,579[b]	20,000	-378	19,622	10,246
Generation IV Nuclear Energy Systems Initiative	16,940[ac]	24,000	3,744[a]	27,744	30,546
Nuclear Hydrogen Initiative	2,000[c]	6,500	-123	6,377	9,000
Advanced Fuel Cycle Initiative	57,292	68,000	-1,287	66,713	46,254
Total, R&D	130,030	132,500	-2,508	129,992[d]	96,046

Mission

The mission of the Research and Development program is to continue to expand the benefits of nuclear science and technology by investing in innovative research.

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—some through

[a]For comparability purposes, the I-NERI funding has been included in the Generation IV Nuclear Energy Systems Initiative program. In FY 2003, the I-NERI funding is $6.258M. In FY 2004, the I-NERI funding is $4.2M of which $0.118M is SBIR/STTR.

[b]Includes $15M identified as use of prior year balances to fund the Environmental Management liability for OVEC in FY 2004.

[c] For comparability purposes in FY 2003, the $2.0M that was directed by Congress to be used from within Nuclear Energy Technologies/Generation IV Nuclear Energy Systems Initiative for a hydrogen study is shown in the Nuclear Hydrogen Initiative program.

[d] Includes $1.83M identified as use of prior year balances to fund the Environmental Management liability for OVEC in FY 2004.

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.

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 very 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*. NERAC is also providing expert advice to help guide government-industry cooperative research to improve the operation, reliability, and security of the Nation's 103 operating nuclear power plants, and development of new technology approaches to the civilian nuclear fuel cycles.

The *Long-Term Nuclear Technology Research and Development Plan*, developed by NERAC with significant input from the wider research community, recommends that R&D budget levels be increased to enable the Nation to realize further value from our currently operating nuclear plants; provide for economic technologies and approaches to build advanced nuclear power plants in the United States; complete a design for a Generation IV nuclear energy system; and support a range of nuclear energy related missions within the Department.

The *Nuclear Science and Technology Infrastructure Roadmap* evaluates the Department's ability to support the most likely R&D needs for the next 20 years. The roadmap is focused on reactors, hot cells and accelerators used to produce isotopes, irradiate materials, and to conduct experiments and examinations required to support our national missions in space exploration, national security, nuclear energy, medical isotopes, and general nuclear science. The roadmap matches the capabilities of each facility to one or more R&D requirements. The Roadmap concludes that although we are meeting most of our current needs with existing facilities, the Department must add significant new generation capacity if it is to meet expected infrastructure demands over the next decade.

A Roadmap to Deploy New Nuclear Power Plants in the United States by 2010, issued on October 31, 2001, provides a detailed assessment of the technical and institutional actions which must be taken by industry and government to enable the deployment of new, advanced nuclear power plants in the United States by 2010. This near-term deployment roadmap recommends the cost-shared demonstration of the federal regulatory processes for designing, siting, and operating new nuclear power plants.

A Technology Roadmap for Generation IV Nuclear Energy Systems, prepared under the auspices of the Nuclear Energy Research Advisory Committee (NERAC) and the Generation IV International Forum (GIF), outlines the benefits, the technical and institutional barriers, and the research needs for the most promising nuclear energy system concepts. The GIF is a formal, chartered organization of governments with representatives from Argentina, Brazil, Canada, the European Union, France, Japan, the Republic of

Korea, the Republic of South Africa, Switzerland, the United Kingdom, and the United States. The *Roadmap,* prepared by nearly one hundred experts from GIF countries and international organizations, was submitted to Congress in March 2003. The *Roadmap* serves as the organizing basis for national, bilateral, and multilateral research and development activities for the development of Generation IV systems. Following the issuance of the *Roadmap,* the Department formulated its national nuclear energy R&D priorities in *The U.S. Generation IV Implementation Strategy,* which was submitted to Congress in September 2003.

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. While historically modest, this growth, which powers the United States economy, would require the United States to build between 1,000 and 1,200 new power plants by 2025. This equates to building and commissioning 50 to 60 power plants each year over the next two decades. 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 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 enable an industry decision by 2005 to deploy at least one new advanced nuclear power plant in the U.S.

The research conducted under the Nuclear Energy Research Initiative (NERI) program addresses the principal obstacles to the expanded use of nuclear energy (*i.e.* cost, safety, waste and non-proliferation), advances the state of nuclear technology for a competitive marketplace, and helps maintain a nuclear science and technology infrastructure to meet future challenges. NERI has helped return the United States to a key leadership role in the international exploration of nuclear technology, prompting the interest and support of many other nations and leading to expanded research and development collaboration. The Department initiated an International NERI (I-NERI) effort in FY 2001 with bilateral, cost-shared research collaborations with other nations. I-NERI is focused on scientific research and advanced technology development to improve the cost and enhance the safety, proliferation resistance, and waste management of advanced nuclear energy systems.

Beginning in FY 2005, the Department will integrate 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 will seek universities to conduct research that is focused specifically on programmatic issues for Generation IV Nuclear Energy Systems Initiative, Advanced Fuel Cycle Initiative, Nuclear Hydrogen Initiative, and Nuclear Energy Technologies. Funding for these research projects will come 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 NERI research will retain the independent peer review critical to ensuring the pursuit of leading-edge technologies, and integrate the Nation's universities into the Department's mainline nuclear R&D programs. The Department plans to use the bilateral I-NERI agreements it has implemented with other nations to continue international cost-shared R&D in the Generation IV Nuclear Energy Systems Initiative, Advanced Fuel Cycle Initiative, and Nuclear Hydrogen Initiative. The new approach to executing international, cost-shared research will allow 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.

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 oil 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 mission is focused on the development and demonstration of a commercially viable, reactor-driven process for the large-scale production of hydrogen. To address these issues, the Nuclear Hydrogen Initiative will:

- demonstrate the economic feasibility of thermochemical water splitting techniques for hydrogen production; and
- achieve operation of a commercial-scale hydrogen production system prototype in about the middle of 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 a prototype thermal-spectrum Generation IV nuclear energy system in the Next Generation Nuclear Plant (NGNP) that provides significant improvements in proliferation and terrorism resistance, safety and reliability, and economics, and demonstrates 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, provides significant improvements in proliferation and terrorism resistance, safety and reliability, economics, and long-term sustainability.

The Department will conduct research on an international cost-shared basis with the other GIF member countries to develop the thermal-spectrum and fast-spectrum Generation IV reactor concepts. These next-generation concepts include: the Next Generation Nuclear Plant, which is capable of generating very high temperatures that enable the highly efficient production of electricity and/or hydrogen, the Supercritical Water-Cooled Reactor, which has potential for significantly improved economics; and the Lead-Cooled and Gas-Cooled Fast Reactors, both capable of burning waste products from spent nuclear fuel while generating economic energy products. The Department also intends to support the efforts of our overseas colleagues who are pursing sodium-cooled reactor and molten salt reactor technologies. The Department maintains considerable expertise in this area and our resources may be valuable to countries pursuing these sodium reactor technologies.

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 is sufficient to store all commercial spent fuel waste generated by existing nuclear power plants, the current "once-through" approach to spent fuel 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 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 new research effort with both an intermediate-term and a long-term component. This program, the Advanced Fuel Cycle Initiative, aims 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 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 is also being conducted under the Advanced Fuel Cycle Initiative.

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 R&D 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 two program goals that contribute to General Goal 4 in the goal "cascade":

Program Goal 04.14.00.00: Develop new nuclear generation technologies and advanced energy products–including high efficiency electricity and hydrogen–that provide significant improvements in sustainability, economics, safety and reliability, and proliferation and terrorism resistance.

Program Goal 04.15.00.00: Develop advanced, proliferation-resistant nuclear fuel technologies that maximize energy output, minimize wastes, and operate in a safe and environmentally sound manner.

Contribution to Program Goal 04.14.00.00: Develop new nuclear generation technologies
The Nuclear Power 2010 program supports this goal by identifying sites for new nuclear power plants, developing advanced nuclear plant technologies, evaluating the business case for building new nuclear power plants, and demonstrating untested regulatory processes leading to an industry decision by 2005 to order a new nuclear power plant for deployment in the 2010 timeframe.

The Nuclear Hydrogen Initiative contributes to this program goal by demonstrating hydrogen production technologies using nuclear energy. The initiative will develop hydrogen production technologies that are compatible with nuclear energy systems through scaled demonstrations.

The Generation IV Nuclear Energy Systems Initiative supports this goal through the development of innovative, next-generation reactor and fuel cycle technologies. Within the Generation IV program, the Next Generation Nuclear Plant project will develop and demonstrate advanced high temperature reactor technology and the capability of this technology to power the economic production of hydrogen and electricity. 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.

Contribution to Program Goal 04.15.00.00: Develop advanced, proliferation-resistant nuclear fuel technologies
The Advanced Fuel Cycle Initiative program contributes to this program 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 2000 Results	FY 2001 Results	FY 2002 Results	FY 2003 Results	FY 2004 Targets	FY 2005 Targets
Program Goal 04.14.00.00 (Energy Security)					
Nuclear Energy Research Initiative					
Continue Nuclear Energy Research Initiative (NERI) research to improve the understanding of new reactor and fuel cycle concepts and nuclear waste management technologies, and begin to develop a preliminary feasibility assessment of the concepts and technologies. (MET GOAL)	Complete funding for the first 3-year phase of Nuclear Energy Research Initiative (NERI) research and development; select feasible and important reactor and fuel cycle concepts for continued development; and, issue approximately 15 new awards. (MET GOAL)	Complete the first 3-year phase of NERI research and development. (MET GOAL) Complete funding for the 10 NERI projects initiated in FY 2000; provide funding for the second year of the 13 NERI projects initiated in FY 2001; and, award at least 16 new NERI projects. (MET GOAL)	Complete 29 NERI projects initiated in FY 1999 and FY 2000 in the areas of advanced reactor technology, advanced reactor fuel, fundamental nuclear science technology, and/or nuclear waste management. (MET GOAL)	No Measure. Completion of NERI projects is not considered significant enough for inclusion in the Department's high-level set of measures. However, they will be tracked at the program level.	No Measure. Beginning in FY 2005, the Department is integrating its NERI and I-NERI activities within its mainline R&D programs.
Advance the state of scientific knowledge and technology to enable incorporation of improved proliferation resistance, safety, and economics in the potential future design, and development of advanced reactor and nuclear fuel systems. (MET GOAL)	Establish bilateral research programs with other countries to improve the cost, and enhance the safety, non-proliferation, and waste management capabilities of future nuclear energy systems. (MET GOAL)		Award five new I-NERI projects in the areas of next generation reactor and fuel cycle technology, innovative nuclear plant design and advanced nuclear fuels and materials with the Republic of Korea. (MET GOAL)	No Measure. Completion of I-NERI projects is not considered significant enough for inclusion in the Department's high-level set of measures. However, they will be tracked at the program level.	

FY 2000 Results	FY 2001 Results	FY 2002 Results	FY 2003 Results	FY 2004 Targets	FY 2005 Targets
Nuclear Energy Technologies					
		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.	Increase the amount of industry cost share funding for Nuclear Power 2010 program activities from 44 percent in FY 2003 to a minimum of 80 percent of available program budget funding by FY 2005.
		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)		
Generation IV Nuclear Energy Systems Initiative					
	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)		

FY 2000 Results	FY 2001 Results	FY 2002 Results	FY 2003 Results	FY 2004 Targets	FY 2005 Targets
			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.	Complete the pre-conceptual design of the Next Generation Nuclear Plant, prepare the specifications for the conceptual design, and award a contract for the conceptual design.
					Achieve variance of less than 10% from cost and schedule baselines for Generation IV activities.
Nuclear Hydrogen Initiative					
				Complete final designs for the baseline thermochemical and high-temperature electrolysis laboratory-scale experiments.	Complete conceptual design and begin preliminary design of the thermochemical and high-temperature electrolysis pilot scale experiments.

Annual Performance Results and Targets

FY 2000 Results	FY 2001 Results	FY 2002 Results	FY 2003 Results	FY 2004 Targets	FY 2005 Targets
Program Goal 04.15.00.00 (Energy Security)					
Advanced Fuel Cycle Initiative					
The following additional results are included to provide historical context for the FY 2002 and FY 2003 targets, and do not correspond to prior year APP target. Established a science and engineering based research program into Accelerator Transmutation of Waste (ATW) technology development. Commenced systems studies to establish and evaluate technology options and narrow choices. Issue a Program Plan for the conduct and management of the ATW research program.	Establish new international agreement on advanced 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)			Achieve variance of less than 10 percent from cost and schedule baselines for Advanced Fuel Cycle Initiative (AFCI) activities.	Achieve variance of less than 10 percent from cost and schedule baselines for Advanced Fuel Cycle Initiative (AFCI) activities.
		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.	Issue the report 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.
		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.	Issue the report on the laboratory-scale "hot" testing of the UREX+ process that is designed to separate plutonium/neptunium to a purity of 99.9 percent or higher.

FY 2000 Results	FY 2001 Results	FY 2002 Results	FY 2003 Results	FY 2004 Targets	FY 2005 Targets
	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 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:

- A joint government/industry cost-shared effort to identify sites for new nuclear power plants, develop advanced nuclear plant technologies, evaluate the business case for building new nuclear power plants, and demonstrate untested regulatory processes leading to an industry decision by 2005 to order a new nuclear power plant for deployment in the 2010 timeframe will be developed by the Nuclear Power 2010 program.

- Hydrogen production technologies compatible with nuclear energy systems will be developed by the Nuclear Hydrogen Initiative. The hydrogen program will include participation by the Nation's laboratories, industry, and university research communities as well as our 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 commercial-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 will be developed by the Generation IV Nuclear Energy Systems Initiative. The program will include 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 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 will be developed by the Advanced Fuel Cycle Initiative. In addition, these fuels and fuel cycle technologies will 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 will include 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 will implement the following strategies:

- Partner with private sector, national laboratories, universities, and international partners to develop advanced nuclear technologies.

- Develop new technologies to increase the use of nuclear energy in the United States.

- Lead the international community in pursuit of advanced nuclear technology that will benefit the U.S. with enhanced safety, improved economics, and reduced production of wastes.

- Integrate 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, Nuclear Hydrogen Initiative, and Nuclear Energy Technologies.

- Conduct 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, whether the technology is competitive, considering relevant policies (*e.g.* tax incentives for new nuclear plants), and power company resource commitment to build new nuclear plants.

- Deployment of advanced fuel technologies will depend upon policy changes permitting fuel reprocessing.

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.

Validation and Verification

To validate and verify program performance, the Office of Nuclear Energy, Science and Technology (NE) will conduct various internal and external reviews and audits. NE's programmatic activities are subject to continuing review by the Congress, the General Accounting 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 Nuclear Energy Research Initiative (NERI), the International-Nuclear Energy Research Initiative (I-NERI), 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, are held to ensure technical progress, cost and schedule adherence, and responsiveness to program requirements. In addition, NE conducts semiannual Operational Program Reviews of the performance of national laboratories on NE programs.

Special reviews, including peer reviews, are held by NE as appropriate, *e.g.*, in FY 2003, a comprehensive NERI project review was 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. This peer review provided an evaluation of each NERI project's continued technical merit, its progress in accomplishing stated objectives, and its programmatic contribution.

Nuclear Energy Research Advisory Committee (NERAC) subcommittees evaluate progress of NE's research and development programs. NERAC similarly reviews specific program plans, *e.g*., the Nuclear Hydrogen R&D Plan, as they are being formulated.

In FY 2004, the Nuclear Energy Research Advisory Committee (NERAC) is establishing 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 would engage appropriate experts to monitor, on a continuing 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 is expected and intended to provide the arm's length, independent assessments that are key 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 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 into the FY 2005 Budget Request and has taken or will take the necessary steps to continue to improve performance.

The results of the review are reflected in the FY 2005 Budget Request as follows:

For the Nuclear Power 2010 (NP 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 last year's performance goals. The need for improvements in the conduct of independent evaluations was identified. This area will be strengthened in 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 has revised its near and long-term goals. In addition, the program will work 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 2003	FY 2004	FY 2005	$ Change	% Change
General Goal, Energy Security Program Goal 04.14.00.00: Develop new nuclear generation technologies	67,932	60,335	49,792	-10,543	-17.5%
Program Goal 04.15.00.00: Develop advanced, proliferation-resistant nuclear fuel technologies	57,292	66,713	46,254	-20,459	-30.7%
All Other (Nuclear Energy Plant Optimization)	4,806	2,944	0	-2,944	-100.0%
Total, Research and Development	130,030	129,992	96,046	-33,946	-26.1%

Nuclear Energy Plant Optimization

Funding Schedule by Activity

(dollars in thousands)

	FY 2003	FY 2004	FY 2005	$ Change	% Change
Nuclear Energy Plant Optimization					
Nuclear Energy Plant Optimization	4,806	2,862	0	-2,862	-100.0%
Small Business Innovative Research/Small Technology Transfer Program	0	82	0	-82	-100.0%
Total, Nuclear Energy Plant Optimization	4,806	2,944	0	-2,944	-100.0%

Description

The President's Committee of Advisors on Science and Technology (PCAST) Panel on Federal Energy Research and Development identified the critical role of nuclear power in its November 1997 report. The Nuclear Energy Plant Optimization (NEPO) program was implemented by the Department in FY 2000 in response to the recommendation in the Panel's 1997 report that the Department work with its laboratories and industry to develop a cost-shared program to address the technical issues that may prevent the continued operation of existing nuclear power plants.

Benefits

The NEPO program was developed as part of a comprehensive approach to assure that the United States has the technological capability to assure adequate supplies of baseload electricity while minimizing harmful impacts on the environment.

The NEPO program has supported the *National Energy Policy* objectives regarding the use of nuclear energy in the United States by conducting research and development to ensure current nuclear plants can continue to deliver reliable, safe, and affordable electricity up to and beyond their initial license period. The NEPO program has also supported the Secretary of Energy's priority to ensure U.S. energy security by protecting critical infrastructure that supports the production and delivery of electricity in the United States and focusing on programs that help increase the supply of domestically produced energy.

The Department and the electric utility industry's Electric Power Research Institute (EPRI) developed the *Joint DOE-EPRI Strategic Research and Development Plan to Optimize U.S. Nuclear Power Plants* to help the Federal Government and private sector jointly identify, prioritize, and execute R&D. The plan, first issued in March 1998 and later updated in October 2000, is based upon input from utilities, DOE national laboratories, the Nuclear Regulatory Commission (NRC), and other key stakeholders. Research funded under the NEPO program is consistent with this joint strategic plan.

The Department established the NEPO program in FY 2000 as a cost-shared program with industry. The R&D projects initiated in FY 2000, FY 2001, and FY 2002 address plant aging and development of new technologies to improve plant reliability, availability, and productivity while maintaining a high level of safety. In FY 2003, the NEPO R&D program was implemented using a more competitive project selection process in order to attract the most promising research, development and demonstration project proposals to meet the program's science and technology goals. This project selection process will be continued in FY 2004, and the program activities will include some or all of the following R&D areas: advanced power generating technologies, nuclear power security, and advanced in-service inspection technologies. In addition, approximately $1,000,000 will be used to expand the transfer of Mechanical Stress Improvement Process technology to countries in the former Soviet Union as directed by Congress.

The Nuclear Energy Research Advisory Committee (NERAC) provides the Department independent, expert advice on the planning and execution of the NEPO program. Representatives from a variety of stakeholder groups including NRC, utilities, national laboratories, and universities are involved in the peer review and recommended prioritization of the R&D projects. NEPO R&D projects are awarded on a competitive basis, unless there is a unique capability that justifies the work being performed at a specific location or by a specific contractor. Non-competitive awards are made only when the R&D require a unique facility or unique knowledge of and experience with the R&D being conducted. NEPO research is performed at U.S. national laboratories, commercial contractors, and universities.

The NEPO program has made significant progress toward addressing many of the aging material and generation optimization issues which have been identified as the key long-term issues facing current operating plants. Examples of recent accomplishments from the NEPO program include improved understanding of material cracking mechanisms to further refine corrosion modeling of reactor vessel materials, development of a new fracture toughness analysis approach that is expected to extend the predicted operating life of many reactor vessels, the completion of a study that identified technical approaches to the on-site storage and transportation of high burn-up spent nuclear fuel, and the completion of a *Roadmap for Research, Development and Demonstration* of Security Technologies for the Nuclear Energy Industry. Further information about current projects and recent results of the NEPO program can be obtained at the NEPO web site (***http://nuclear.gov/nepo2/default-nepo.asp***).

While the Department continues to support the objectives of the NEPO program, no funding is requested for this activity in FY 2005.

Detailed Justification

	(dollars in thousands)		
	FY 2003	FY 2004	FY 2005
Nuclear Energy Plant Optimization..................................	**4,806**	**2,944**	**0**
▪ **Nuclear Energy Plant Optimization**............................	**4,806**	**2,862**	**0**

In FY 2004, complete R&D activities on 14 projects initiated in FY 2003 related to advanced generation, capacity factor improvements and long-term plant aging utilizing prior year funds. Approximately 8 new one-year projects will be initiated in FY 2004 focusing on the development and application of technologies to increase electrical power generation, to advance security and/or to provide advanced in-service inspection methods based on availability of funding. In addition, approximately $1,000,000 will be used to expand the transfer of Mechanical Stress Improvement Process technology to other countries in the former Soviet Union as directed by Congress.

No funds are requested for FY 2005.

	FY 2003	FY 2004	FY 2005
▪ **Small Business Innovative Research and Small Business Technology Transfer Programs**	**0**	**82**	**0**
Total, Nuclear Energy Plant Optimization.......................	**4,806**	**2,944**	**0**

Explanation of Funding Changes from FY 2004 to FY 2005

	FY 2005 vs. FY 2004 ($000)
Nuclear Energy Plant Optimization	
▪ The funding decrease of $2,862,000 reflects no funds being requested in FY 2005 ...	-2,862
Small Business Innovative Research and Small Business Technology Transfer Programs	
▪ SBIR/STTR..	-82
Total Funding Change, Nuclear Energy Plant Optimization	**-2,944**

Nuclear Energy Research Initiative

Funding Schedule by Activity

(dollars in thousands)

	FY 2003	FY 2004	FY 2005	$ Change	% Change
Nuclear Energy Research Initiative					
Nuclear Energy Research Initiative	17,413	6,407	0	-6,407	-100.0%
Small Business Innovative Research/Small Business Technology Transfer Program..................................	0	185	0	-185	-100.0%
Total, Nuclear Energy Research Initiative	17,413[a]	6,592[a]	0	-6,592	-100.0%

Description

The Nuclear Energy Research Initiative (NERI) supports the *National Energy Policy* by conducting research to advance the state of nuclear science and technology in the United States by addressing the key technical issues impacting the expanded use of nuclear energy. 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. The advances in these areas will be incorporated in potential future advanced reactor designs and nuclear fuel systems.

Benefits

The President's Committee of Advisors on Science and Technology (PCAST) determined that for the United States to maintain a viable, long-term option to use nuclear energy to meet the important energy and environmental challenges facing the future of the Nation, key issues affecting the future viability of nuclear energy must be addressed. The Department and its independent Nuclear Energy Research Advisory Committee (NERAC) endorsed PCAST's recommendations and established, with the support and advice of the Congress, both a base NERI program and an International Nuclear Energy Research Initiative (I-NERI) component.

NERI features 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 own Office of Science, the NERI program solicits proposals from the U.S. scientific and engineering community for research at universities, national laboratories, and industry. NERI encourages collaborative research and development activities among these different research organizations, as well as participation of research organizations funded by other

[a] For comparability purposes, the I-NERI funding has been included in the Generation IV Nuclear Energy Systems Initiative program. In FY 2003, the I-NERI funding is $6.258M. In FY 2004, the I-NERI funding is $4.2M of which $0.118M is SBIR/STTR.

nations. NERAC also provides ongoing oversight and advice on the planning and implementation of the NERI program.

The NERI program is realizing its goals to develop advanced nuclear energy systems and technology to help assure that the United States maintains a viable option to use nuclear energy to meet its energy and environmental needs. The 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 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 2002 Annual Report (see* ***http://neri.ne.doe.gov/****).*

Beginning in FY 2005, the Department will integrate 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 will seek universities to conduct research that is focused specifically on programmatic issues for Generation IV Nuclear Energy Systems Initiative, Advanced Fuel Cycle Initiative, Nuclear Hydrogen Initiative, and Nuclear Energy Technologies. Funding for these research projects will come 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 NERI research will retain the independent peer review critical to ensuring the pursuit of leading-edge technologies, and integrate the Nation's universities into the Department's mainline nuclear R&D programs. As the NERI activities will be integrated into the Department's mainline nuclear R&D programs in FY 2005, no funding for the stand-along NERI program is requested.

The Department plans to use the bilateral I-NERI agreements it has implemented with other nations to continue international cost-shared R&D in the Generation IV Nuclear Energy Systems Initiative, Advanced Fuel Cycle Initiative, and Nuclear Hydrogen Initiative. The new approach to executing international, cost-shared research will allow 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. Base funding for existing I-NERI projects is included in the Department's Generation IV Nuclear Energy Systems Initiative program.

Detailed Justification

	(dollars in thousands)		
	FY 2003	FY 2004	FY 2005
▪ **Nuclear Energy Research Initiative**	**17,413**	**6,407**	**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. The advances in these areas will be incorporated in potential future advanced reactor designs and nuclear fuel systems.

Since NERI began in 1999, it has sponsored 93 investigator-initiated, peer reviewed and merit selected research projects in nuclear science and technology. These projects have energized the nuclear research community, collectively involving 28 universities, 11 national laboratories, and over 28 private sector companies.

In FY 2003, 29 of the NERI projects initiated in FY 1999 and FY 2000 were completed. The program completed funding for projects initiated in FY 2001 and provided funding for projects initiated in FY 2002. No new awards were made in FY 2003.

In FY 2004, 17 of the NERI projects initiated in FY 2000 and FY 2001 are planned to be completed. The program will complete funding for the 24 projects initiated in FY 2002; these projects will be completed in FY 2005. No new projects will be awarded in FY 2004.

Beginning in FY 2005, the Department will integrate the NERI activity directly into its mainline nuclear R&D programs: Advanced Fuel Cycle Initiative, Generation IV Nuclear Energy Systems Initiative, Nuclear Hydrogen Initiative, and Nuclear Energy Technologies. As such, no stand-alone NERI program funding is requested.

▪ **Small Business Innovative Research and Small Business Technology Transfer Programs (SBIR/STTR)**	**0**	**185**	**0**
Total, Nuclear Energy Research Initiative	**17,413**	**6,592**	**0**

Explanation of Funding Changes

	FY 2005 vs. FY 2004 ($000)
Nuclear Energy Research Initiative	
▪ The funding decrease from FY 2004 to FY 2005 reflects the Department's objective to integrate the NERI activity directly into its mainline nuclear R&D programs. The competitive solicitations for NERI research will request work that is focused specifically on programmatic issues for Generation IV Nuclear Energy Systems Initiative, Advanced Fuel Cycle Initiative, Nuclear Hydrogen Initiative and Nuclear Energy Technologies. Funding for these research projects will come directly from the budgets of these programs.	-6,407
Small Business Innovative Research and Small Business Technology Transfer Programs	
▪ SBIR/STTR	-185
Total Funding Change, Nuclear Energy Research Initiative	**-6,592**

Nuclear Energy Technologies

Funding Schedule by Activity

	(dollars in thousands)				
	FY 2003	FY 2004	FY 2005	$ Change	% Change
Nuclear Energy Technologies					
Nuclear Power 2010	31,579[a]	19,359	10,246	-9,113	-47.1%
Small Business Innovative Research/Small Business Technology Transfer Program	0	263	0	-263	-100.0%
Total, Nuclear Energy Technologies	31,579[a]	19,622	10,246	-9,376	-47.8%

Description

The Nuclear Power 2010 program is a joint government/industry cost-shared effort identify sites for new nuclear power plants, develop advanced nuclear plant technologies, 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 by the end of 2005 to order a new nuclear power plant which will be built and begin commercial operation early in the next decade.

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 1,400 and 1,650 new power plants over the next two decades. This averages to building and commissioning 70 to 85 new power plants per year.

To help meet our growing demand for new baseload capacity, the *National Energy Policy* (NEP) has recommended preserving our current generating share of nuclear energy as a major component of our Nation's energy picture. The NEP specifically recommends government support for licensing new nuclear power plants and the development of next generation nuclear energy technologies for our extended future demand.

Fully 20 percent of our Nation's current electricity production is generated by nuclear power plants. In order to maintain nuclear power's electricity share to meet future electricity demand, the technical,

[a] Includes $15M identified as use of prior year balances to fund the Environmental Management liability for OVEC in FY 04.

regulatory, and institutional barriers, which currently exist, must be successfully addressed by government and industry. The Department recognizes that there are near-term and long-term elements to this challenge. The Nuclear Energy Technologies program is structured to address the challenges ahead, partnering with industry to achieve near-term expansion of nuclear energy. For this near-term expansion, the technology focus is on the Generation III+ designs which offer incremental advancements over the Generation III advanced light water reactor designs certified in the 1990's by the Nuclear Regulatory Commission. The Department is working with the international community to develop technologies under the Generation IV Nuclear Energy Systems Initiative to continue this expansion in the long-term. Generation IV systems represent a new generation of nuclear energy and fuel cycle technologies that can be made available in the 2015-2030 timeframe, and offer significant advances in the areas of sustainability, proliferation resistance and physical protection, safety, and economics. Funding for this initiative was previously requested under Nuclear Energy Technologies. In the FY 2005 budget request, the Generation IV Nuclear Energy Systems Initiative is a stand-alone line item in the Nuclear Energy Research and Development Budget.

To enable the deployment of new, Generation III+ nuclear power plants in the United States in the relatively near-term, it is essential to demonstrate the untested Federal regulatory and licensing processes for the siting, construction, and operation of new nuclear plants. In addition, independent expert analysis commissioned by the Department and carried out by the Nuclear Energy Research Advisory Committee (NERAC) has shown 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 Department believes it is important to deploy new baseload nuclear generating capacity within a decade to support the *National Energy Policy* objectives of energy supply diversity and energy security. Major obstacles to building new nuclear plants include the uncertainties associated with the Federal regulatory processes, the initial high capital costs of the first few plants and the business risks resulting from these uncertainties. The Nuclear Power 2010 initiative was developed to address these obstacles.

A Near-Term Deployment Working Group, operating under the auspices of the Department's independent Nuclear Energy Research Advisory Committee, 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 actions to be taken by industry and the Department to support deployment of new advanced nuclear power plants in the United States by 2010 (see ***www.nuclear.gov***). 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 Nuclear Power 2010 program seeks to achieve near-term deployment of new power plants in the United States through cost-shared demonstration of untested regulatory processes affecting the siting, construction and operation of new nuclear power plants, cost-shared development of advanced reactor technologies, and implementation of appropriate strategies to enhance the business case for building new nuclear power plants. The regulatory tasks include the demonstration of the Early Site Permit (ESP) and combined Construction and Operating License (COL) processes to reduce licensing uncertainties and minimize the attendant financial risks to the licensee. The technology development activities support research and development to finalize and license a standardized advanced reactor design which U. S. power generation companies are willing to build. The safety and economic performance of these Generation III+ light water reactor nuclear plants will be superior to existing nuclear plants, allowing new nuclear plants to be more competitive in the deregulated electricity market. 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 published a draft report, *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 ***www.nuclear.gov***). 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. In FY 2003, the Department also initiated a study on economic policy benefits and impacts resulting from the deployment of new nuclear power plants in the United States. 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 technology development activities and requires a minimum of 50 percent industry cost share for these program activities. Through the competitive procurement process, it is expected that innovative business arrangements will be formed among power generating companies and reactor vendors with strong and common incentives to successfully build and operate new nuclear plants in the United States.

As an initial step in the demonstration of the untested regulatory processes, the Department has established competitively selected, cost-shared cooperative agreements with nuclear power generating companies for the preparation and submittal of Early Site Permit (ESP) applications to the Nuclear Regulatory Commission (NRC). In FY 2002, ESP scoping studies were completed by two power generation companies that evaluated the site suitability and, developed schedule and resource estimates for licensing both federal and commercial sites for new nuclear power plants. In FY 2003, the Department initiated a third site scoping study with a third power company to evaluate the environmental, seismic and geo-technical suitability of a commercial nuclear plant site for locating an advanced Generation III+ design. ESP demonstration projects, with three U.S. power generation companies, were initiated in FY 2002 to demonstrate the untested Federal licensing process for approving sites to build new nuclear power plants. Under these projects, each of the three power generation companies prepared and submitted, in the fall of 2003, an ESP application to the NRC for approval. ESP project tasks in FY 2004 and 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 issuance of Early Site Permits is expected in FY 2006. The ESP process results in resolution of the site safety, environmental and emergency planning issues ahead of the technology selection and a decision to build a new nuclear power plant by a power generation company.

In FY 2003, the Department initiated a cost-shared project with industry to develop generic guidance for the combined Construction and Operating License (COL) application preparation and to resolve generic COL regulatory issues. The COL process is a "one-step licensing" process which results in resolution of all public health and safety issues associated with construction and operation of a new nuclear power plant before a power generation company begins construction of the plant. Included in the COL are the Inspection, Testing, Analyses, and Acceptance Criteria (ITAAC) that are to be used to demonstrate that the facility has been constructed and will operate in conformity with NRC regulations. The successful demonstration of the ESP and COL regulatory processes will lead to the licensing of multiple sites for locating new nuclear power plants, and the issuance of a license to construct and operate at least one advanced nuclear power plant.

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. Under these cost-shared projects, power companies will conduct studies, analyses, and other activities necessary to select an advanced reactor technology and prepare a site-specific, technology-specific COL application. These projects will provide for NRC design certification and other activities to license a standardized nuclear power plant design. The Department expects to award at least one project in FY 2004. The focus of activities in FY 2005 for these projects will be on development of the COL application.

The Department has initiated a nuclear power plant construction technology assessment in cooperation with power generation companies to assess the schedule and construction methods for the most likely Generation III+ nuclear power plant designs to be built in the near-term. Reduction in the construction durations for nuclear plants improves the economic competitiveness of this important electricity generation technology. The study will also identify promising improvements to the construction methods, techniques and sequences needed to support new nuclear power plant deployment in the 2010 timeframe.

The Department has requested only minimal funding for FY 2005 to enable the continuation of ongoing licensing demonstration and related analysis projects. Future requirements for the program will be reviewed as Congress completes work on comprehensive energy legislation and the Department assess the responses and requirements associated with its recent solicitation related to New Plant Licensing Demonstration Projects.

Detailed Justification

	(dollars in thousands)		
	FY 2003	FY 2004	FY 2005
▪ **Nuclear Power 2010**	**31,579**	**19,359**	**10,246**

In FY 2003, the Department:

- Continued the three cost-shared ESP demonstration projects initiated with industry in FY 2002. Completed ESP applications were submitted by two power generating companies to NRC for review and approval in the last quarter of FY 2003. A new project was initiated in cooperation with an additional power company to conduct site suitability studies at another existing commercial power plant site.
- Initiated a nuclear power plant construction technology assessment to independently evaluate the schedule and construction methods of advanced nuclear plant designs and identify promising improvements to the construction methods and techniques to support new nuclear power plant deployment in the 2010 timeframe.
- Continued the advanced gas-cooled reactor fuel development and qualification activities initiated in FY 2001 and initiated fuel fabrication process development in laboratory-scale equipment as well as manufacture and characterization of the demonstration fuel which will undergo irradiation testing. Beginning in FY 2004, these activities will be integrated with the Generation IV Nuclear Energy Systems Initiative.
- Initiated an industry cost-shared project to develop generic guidance for the combined Construction and Operating License (COL) application preparation and to resolve generic COL regulatory issues.
- Initiated a macroeconomic policy study to identify the economic benefits or consequences of alternative policies through evaluation of tangible benefits of a balanced energy portfolio in the United States, which would include the expansion of nuclear energy development.

In FY 2004, the Department will:

- Continue the ESP demonstration projects with resolution of site-specific issues arising from the NRC review of the ESP applications. Two of these applications were submitted for NRC approval 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. Continue the third nuclear plant site suitability study.
- Complete the nuclear construction technology assessment initiated in FY 2003.
- 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.

	(dollars in thousands)		
	FY 2003	FY 2004	FY 2005

- Complete the macroeconomic policy study initiated in FY 2003 on the economic consequences of alternative policies through evaluation of tangible benefits of a balanced energy portfolio in the United States, which would include the expansion of nuclear energy development.
- Award New Nuclear Plant Licensing Demonstration Projects to teams led by power generation companies. The Department issued a solicitation in FY 2004 to invite proposals for these projects. Under these cost-shared projects, power companies will conduct studies, analyses, and other activities necessary to select an advanced reactor technology and prepare a site-specific, technology-specific COL application. Activities in FY 2004 will focus on NRC design certification of at least one standardized nuclear power plant design.

In FY 2005, the Department will:

- Continue the ESP demonstration projects and support NRC review of the ESP applications for commercial sites. Complete the third commercial nuclear plant site suitability study.
- Complete 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.
- Continue the New Nuclear Plant Licensing Demonstration Projects. Activities for power company selection of the advanced reactor technology will be completed paving the way for a power company decision to proceed with a new plant order by the end of 2005. Activities associated with preparation of a COL application will continue on a limited basis awaiting the outcome of pending energy legislation.

	FY 2003	FY 2004	FY 2005
▪ **Small Business Innovative Research and Small Business Technology Transfer Programs**	**0**	**263**	**0**
Total, Nuclear Energy Technologies................................	**31,579**	**19,622**	**10,246**

Explanation of Funding Changes

	FY 2005 vs. FY 2004 ($000)
Nuclear Power 2010	
▪ The decrease of $9,113,000 for FY 2005 reflects the need to await resolution of the comprehensive energy legislation and responses to the Department's recent solicitation related to New Plant Licensing Demonstration Projects..........................	-9,113
Small Business Innovative Research and Small Business Technology Transfer Programs	
▪ The decrease of $263,000 reflects requested funding decrease for reactor technology development activities in the Nuclear Power 2010 Program......................................	-263
Total Funding Change, Nuclear Energy Technologies..	**-9,376**

Generation IV Nuclear Energy Systems Initiative

Funding Schedule by Activity

	(dollars in thousands)				
	FY 2003	FY 2004	FY 2005	$ Change	% Change
Generation IV Nuclear Energy Systems Initiative					
Next Generation Nuclear Plant	2,970	14,394	19,300	+4,906	+34.1%
Generation IV R&D	7,712	8,491	7,557	-934	-11.0%
International Nuclear Energy Research Initiative	6,258[a]	4,082	2,834	-1,248	-30.6%
Small Business Innovative Research and Small Business Technology Transfer Programs	0	777	855	+78	-10.0%
Total, Generation IV Nuclear Energy Systems	16,940[b]	27,744	30,546	+2,802	+10.1%

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. By successfully addressing the fundamental research and development issues of system concepts that excel in safety, sustainability, cost-effectiveness and proliferation resistance, the systems are highly likely to attract future private-sector sponsorship and ultimate commercialization by the private sector.

Benefits

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, then the United States would need between 1,000 and 1,200 new power plants over the next two decades - about 50 to 60 new power plants per year.

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. The NEP specifically recommends government support for licensing new nuclear power plants and development of next generation nuclear energy technologies for the future. Moreover, as new

[a] For comparability purposes, the I-NERI funding has been included in the Generation IV Nuclear Energy Systems Initiative program. In FY 2003, the I-NERI funding is $6.258M. In FY 2004, the I-NERI funding is $4.2M of which $0.118M is SBIR/STTR.

[b] For comparability purposes in FY 2003, the $2.0M that was directed by Congress to be used from within Nuclear Energy Technologies/ Generation IV Nuclear Energy Systems Initiative for a hydrogen study is shown in the Nuclear Hydrogen Initiative program.

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.

While current nuclear power plant technology has proven to be the most efficient means to produce baseload quantities of emissions-free energy, new technologies will be needed to enable a major 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 and fuel cycle technologies that can be made available in the 2015-2030 timeframe, and offer significant advances in the areas of sustainability, proliferation resistance and physical protection, safety, and economics.

Next-generation nuclear energy systems 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* was prepared under the auspices of the Department's independent Nuclear Energy Research Advisory Committee (NERAC) and the Generation IV International Forum (GIF). The 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, United Kingdom, 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.

The Department describes its detailed research and development priorities for the Generation IV program in the *U.S. Generation IV Implementation Plan.* This plan, issued in October 2003, serves to guide the strategic development of the Generation IV research and development program. As identified in the plan, the United States expects its primary focus to be the development of the Next Generation Nuclear Plant (NGNP), a system that combines the VHTR with advanced hydrogen and electricity generation. 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.

In FY 2004, the Department continues to emphasize research and development on the Next Generation Nuclear Plant and continues collaborative research on the Lead-Cooled Fast Reactor, the Gas-Cooled Fast Reactor, and the Supercritical Water-Cooled Reactor. These systems were chosen as the best match for the future needs of the United States. The role of each system in meeting our long-term energy requirements is quite different. The NGNP is capable of very high temperature operation that enables the emission-free co-production of high efficiency electricity and hydrogen in a thermochemical system. In addition to emission-free energy products, both the Lead-Cooled Fast Reactor and the Gas-Cooled Fast Reactor have potential for acting in concert with the Advanced Fuel Cycle Initiative (AFCI) to transmute the actinide components of spent nuclear fuel into far shorter-lived, less toxic species. The Supercritical Water-Cooled Reactor features high power densities, large economies of scale, and improved electrical conversion efficiencies to economically generate electricity in large central stations. Finally, the Department continues to monitor overseas efforts to develop sodium-cooled reactor technologies for near-term application.

Beginning in FY 2005, the Department puts special emphasis on the NGNP, working towards the potential early deployment of the NGNP as a demonstration of a promising Generation IV reactor technology. While the Department has not at this time made a decision to proceed with such a demonstration plant, such a project would be required to validate the potential of this technology to meet the need highlighted by the President in his call for a *National Hydrogen Fuel Initiative.* If successful, this technology could produce hydrogen at a cost that is competitive with gasoline and electricity at a cost competitive with advanced natural gas-fired systems.

If a decision is made to build such a pilot facility, the Department believes the Idaho National Laboratory would be the appropriate location for the demonstration. The Department believes that such a project would enhance its effort to build a strong, work-class nuclear energy research center in Idaho and would benefit from the unique concentration of nuclear technology expertise available at the INL.

The NGNP concept utilizes an advanced high temperature reactor system for the highly efficient production of electricity and hydrogen. The NGNP would also provide a regulatory basis for licensing the technology in the United States. The Department anticipates considerable collaboration with the international community and the private sector in pursuing this technology.

In FY 2005, the Department also continues its advanced gas-cooled reactor fuel development and qualification program in cooperation with the Nuclear Regulatory Commission (NRC) under the Generation IV program. This important fuel program supports future deployment of the NGNP. The Department is also coordinating these research activities with the Nuclear Regulatory Commission (NRC) to leverage planned fuel irradiation tests to meet NRC research needs.

The Department plans to use the bilateral I-NERI agreements it has implemented with other nations to continue international cost-shared R&D in the Generation IV Nuclear Energy Systems Initiative, Advanced Fuel Cycle Initiative, and Nuclear Hydrogen Initiative. The new approach to executing international, cost-shared research will allow 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. Base funding for ongoing projects initiated under the existing I-NERI agreements and support for International Near Term Deployment (INTD) work identified by the GIF 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 Nuclear Energy Agency, the European Union, Canada, and Brazil. Discussions on collaboration are ongoing with Japan, the Republic of South Africa, and the United Kingdom with agreements being completed in FY 2004.

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 evaluate common areas of research to develop advanced materials for use in Generation IV nuclear energy systems, as well as nuclear hydrogen 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 2003	FY 2004	FY 2005
Next Generation Nuclear Plant	**2,970**	**14,394**	**19,300**

In FY 2003, preliminary functional requirements were established for the NGNP. Based on these requirements, program staff formulated initial material data requirements for this technology.

In FY 2004, the Department is focusing on developing a high-burnup NGNP particle fuel that can withstand postulated accident conditions while maintaining the integrity of the fuel and retaining the fission products within the kernel. Beginning in FY 2004, the NGNP fuel development activities are funded in collaboration with the AFCI program. Work is proceeding in developing design information sufficient to support pre-conceptual specifications for such key components as the reactor vessel and Brayton cycle turbine-generator. The Department is optimistic about the potential for a future collaboration with countries such as Japan, France, and South Korea to demonstrate this technology. The following activities are supported:

- Complete the reference point design for NGNP to support the competitive selection of pre-conceptual design(s) and the development of detailed trade studies. 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.
- Complete work to coat TRISO fuel (particle fuel with three layers of coatings) in small coaters to facilitate a larger number of coater runs with parametric variations at a low cost. The experimental work will allow a better understanding and optimization of the TRISO coating process.
- Establish inspection capability for quality control of TRISO coated particles and fuel compacts.
- Develop compacting process to agglomerate fuel particles into a suitable shape for loading into a reactor core. This effort would allow for development of improved compact processing at a lower cost, and demonstrate the improved TRISO fuel/compact performance at higher temperatures for the NGNP.

In FY 2005, the Department will be focused on fuel fabrication and qualification testing, systems design, materials development and testing, and program planning. Fuel development in FY 2005 will continue to be done in collaboration with the AFCI program. Pre-conceptual design of the NGNP will be completed as required to define future research and development requirements. The following activities will be supported:

- Complete pre-conceptual design including the reactor core, primary heat-transport system, the intermediate heat exchanger, high-efficiency gas turbine, and supercritical CO_2 power generation systems. Analyze candidate materials meeting the requirements for ultra long life power conversion components in high temperature helium and salt environments. Establish design parameters for a high temperature helium Brayton cycle in the helium turbine and a supercritical CO_2 cycle for high-efficiency electricity generation.

	(dollars in thousands)		
	FY 2003	FY 2004	FY 2005

- Develop TRISO fuel to be used in the NGNP. The following major tasks will be conducted:

  - Complete fabrication of irradiation test fuel specimens and 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 baseline reference TRISO fuel and provide required information for the NGNP fuel design activities.

  - Initiate development of advanced TRISO characterization techniques.

  - 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. TRISO fuel will be coated using laboratory scale coaters for the initial shakedown tests in FY 2005. Using intermediate size coaters will provide essential process information for modeling and resolving engineering production scale issues for potential vendors of NGNP TRISO fuel.

	FY 2003	FY 2004	FY 2005
Generation IV Research and Development	**7,712**	**8,491**	**7,557**

The reference Lead-Cooled Fast Reactor (LFR) concept is a 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 relatively high core outlet temperatures, which will allow realization of relatively 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 scheme 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 with the United States. In addition, Russia's Ministry of the Russian Federation for Atomic Energy (MINATOM) is interested in the potential of lead-cooled systems and may be a future partner.

In FY 2004, research and development is being conducted on the following activities:

- Completing reference point designs; evaluate and select a preferred concept. This activity supports core physics and thermal-hydraulic design of proposed design concepts. Emphasis is placed on meeting design objectives, such as long-lifetime cores for enhanced proliferation resistance, passive safety, and autonomous load following. Conduct limited materials screening tests for compatibility with lead alloy coolant.

- Developing analysis tools and a refueling approach. Incorporate 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. Conduct 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 will focus on the following activities:

- Design experiments to test materials compatibility for LFR energy conversion devices. The use of lead alloy coolant allows the potential innovation in plant design that could reduce capital cost and improve energy conversion efficiency. However, there is little knowledge regarding the compatibility of structural and component materials with lead alloy coolant, proposed secondary heat transfer fluids, and proposed working fluids.

- Design a steam generator and intermediate heat exchanger experiment. A particular concern for operability and safety of the LFR is the potential for chemical or pressure-induced interactions at the interface between coolant and working fluid, such as would be present with a rupture in a steam generator or heat exchanger. This experiment will evaluate ruptures using prototypic geometry and environmental conditions.
- Develop a proliferation resistant refueling strategy. The proliferation resistance of small modular LFR concepts will be greatly enhanced if the fuel is inaccessible in locations where the reactors would be deployed. Such a vision can be realized with the proposed "cartridge core" designs. Because the proliferation resistance of the LFR is an important attribute, a report describing a strategy for cartridge refueling, transport to the reactor site, and cartridge unloading and loading into the reactor plant will be developed. This report will document the results of the design concept and evaluations performed to date.

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 high efficiency electricity production at high temperatures. An alternate system which uses supercritical carbon dioxide as the coolant may offer similar high efficiency while maintaining lower coolant temperatures. The GFR's fast 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 minor-actinide management from spent fuel. Interest is high in GIF member countries, Japan and France, for the GFR. Most U.S. participation is leveraged from similar work required for the NGNP.

(dollars in thousands)

FY 2003	FY 2004	FY 2005

In FY 2004, research and development is being conducted as follows:

- Analyze accident scenarios for both the reference and alternate designs to verify the reactor's ability to shutdown passively through negative reactivity coefficients. This activity includes 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 will need to be identified and analyzed for all operational modes and accident scenarios.
- Design and fabricate candidate high temperature, in-core materials. Perform screening and testing of candidate high temperature materials. These materials include refractory ceramics and refractory or special metals. Test leading in-core and out-of-core candidates appropriately.
- Continue supercritical carbon dioxide corrosion studies of candidate materials, including baseline coolant chemistry. Screening of candidate materials for in-core and ex-core service will be continued, where high pressure (20-25 megapascals) and medium temperatures (550-650°C) will be used during the tests. In addition, radiolysis experiments will be performed to identify the chemical species that are formed in the carbon dioxide coolant during irradiation for corrosion testing.

In FY 2005, research and development activities for the GFR will focus on the following:

- Performing pre-conceptual safety systems design, and conduct further accident analyses. Current studies show that passive decay heat removal may be possible through heavy gas injection but may be further enhanced by coupling to an active system. The studies will also include containment building design and performance, as natural convection cooling will require a pressurized containment. Analysis of accident scenarios and initiators will also continue, and be coupled to the safety system design.

- Continuing material characterization and fabrication, and prepare for candidate material irradiation. Leading candidates from the screening studies will be fabricated for further thermal-mechanical testing to obtain property data. An irradiation test plan and material preparation for in-reactor testing will also be initiated.

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. Strong international interest in the SCWR comes from Japan, Korea, and Canada.

In FY 2004, research and development is being conducted as follows:

Prepare a plan for all SCWR-related research activities including design and materials. The plan will detail the project organization including performers, tasks and budgets.

- Define a coolant chemistry-control strategy. Analyze existing light water reactor and supercritical fossil plant coolant chemistry control strategies and evaluate their applicability to the SCWR system. This task also includes consideration of supercritical water radiolysis and the means to suppress it, *e.g.*, by hydrogen injection.

In FY 2005, SCWR research and development will focus on the following activities:

- Establish superior 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. These experiments are likely to be suitable for research sponsored under DOE-University collaborations.

- Fabricate laboratory-scale multi-sample stress corrosion cracking super critical water loop experiments for investigating candidate materials. These experiments are required to understand the susceptibility of candidate materials to stress corrosion cracking. These experiments are likely to be suitable for research sponsored under DOE-University collaborations.

- Fabricate a high-pressure facility for critical flow experiments at critical conditions. Data on basic critical flow and heat transfer is lacking for prototypical super critical water conditions. These data are needed to evaluate the safety and performance characteristics of candidate materials. These experiments are likely to be suitable for research sponsored under DOE-University collaborations.

In addition to the above, there are several crosscutting research activities that apply to all of the concepts. In FY 2003, initiated, in cooperation with the NRC, the development of a risk-informed regulatory framework to support the future certification and licensing of advanced reactor designs.

In FY 2004, the following crosscutting research activities that support Generation IV reactor system concepts are being conducted:

- Design and Evaluations crosscutting activities include: 1) establishing methodology for measuring proliferation resistance and physical protection of Generation IV reactor and fuel cycle systems, and 2) develop economic methodology upon which to evaluate Generation IV systems.
- Materials crosscutting activities include preparation of an integrated program plan for the qualification and development of advanced materials for use in Generation IV reactors.
- Energy Conversion crosscutting activities include preparing 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.

	(dollars in thousands)	
FY 2003	FY 2004	FY 2005

In FY 2005, crosscutting research activities will be continued:

- Design and Evaluations crosscutting activities will include: 1) validating computer models for use in design and safety analysis applications; 2) the development of the methodology for evaluating the economics of hydrogen production with Generation IV systems; 3) the development of methods for evaluating proliferation resistance and physical protection metrics, and 4) ongoing U.S. participation in Generation IV International Forum activities.
- Materials crosscutting activities will include initiating mechanical tests and irradiation tests on commercially available and advanced materials; coordination and integration of specific materials needs of each reactor type to develop and implement the required materials R&D; coordination and integration of specific materials needs of power conversion systems to develop and implement required materials R&D; initial development of a comprehensive irradiation-effects materials database for materials needed for radiation service; and initial development of a comprehensive high-temperature materials properties database to support the design, use, and codification of materials needed.
- Energy Conversion crosscutting activities will include completion of a conceptual system and turbo machinery design for a 300 megawatts electric supercritical carbon dioxide commercial cycle; and development of a preliminary design for a scaled supercritical carbon dioxide demonstration experiment.

	FY 2003	FY 2004	FY 2005
International Nuclear Energy Research Initiative (I-NERI) .	**6,258**	**4,082**	**2,834**

In FY 2003, bilateral research projects initiated in FY 2001 and FY 2002 were continued. A bilateral agreement between the United States and the European Commission was signed in March 2003. I-NERI agreements with Canada and Brazil were signed in June 2003. Five new projects with the Republic of Korea were awarded in early FY 2003.

In FY 2004, the program is funding the I-NERI projects with France, the Republic of Korea, and the Nuclear Energy Agency initiated in FY 2001 and FY 2002. Three I-NERI projects initiated with France in FY 2001, in the areas of advanced reactor technology, advanced nuclear fuels and materials, will be completed. The I-NERI projects initiated with the Republic of Korea in early FY 2003 are continued. The Department expects to complete bilateral I-NERI agreements with the Republic of South Africa, Japan and the United Kingdom. No new projects will be initiated in FY 2004.

Beginning in FY 2005, the Department will use its bilateral International Nuclear Energy Research Initiative agreements to conduct international cost-shared R&D in 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 will allow 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. The Generation IV Nuclear Energy Systems Initiative program request includes base funding for existing I-NERI projects and support for INTD work identified by the GIF that is relevant to U.S. technology needs.

	(dollars in thousands)		
	FY 2003	FY 2004	FY 2005
Small Business Innovative Research and Small Business Technology Transfer Programs	**0**	**777**	**855**
Total, Generation IV Nuclear Energy Systems Initiative ...	**16,940**	**27,744**	**30,546**

Explanation of Funding Changes

	FY 2005 vs. FY 2004 ($000)
Next Generation Nuclear Plant (NGNP)	
▪ An increase of $4,906,000 will allow for the completion of pre-conceptual designs required to support technology development and development of advanced fuels and materials	+4,906
Generation IV Research and Development	
▪ A decrease of $934,000 results from the further prioritization of the NGNP within the overall Generation IV budget. Essential work will continue to further the research and development of the SCWR, LFR, and GFR concepts	-934
International Nuclear Energy Research Initiative (I-NERI)	
▪ The decrease of $1,248,000 is a result of funding only the base program to continue research projects underway with international partners under Generation IV Nuclear Energy Systems Initiative	-1,248
Small Business Innovative Research and Small Business Technology Transfer Programs	
▪ The increase of $78,000 is due to the increased funding for research and development activities	+78
Total Generation IV Nuclear Energy Systems Initiative	**+2,802**

Nuclear Hydrogen Initiative

Funding Schedule by Activity

(dollars in thousands)

	FY 2003	FY 2004	FY 2005	$ Change	% Change
Nuclear Hydrogen Initiative					
Nuclear Hydrogen Initiative	2,000[a]	6,198	8,748	+2,550	+41.1%
Small Business Innovative Research/Small Business Technology Transfer Program	0	179	252	+73	+40.8%
Total, Nuclear Hydrogen Initiative	2,000	6,377	9,000	+2,623	+41.1%

Description

The Nuclear Hydrogen Initiative will conduct research and development on enabling technologies, demonstrate nuclear-based hydrogen producing technologies, study potential hydrogen production schemes, and develop deployment alternatives to meet future needs for increased hydrogen consumption. The objective of the Nuclear Hydrogen Initiative is to demonstrate commercial-scale hydrogen production using nuclear energy by the middle of the next decade.

Benefits

With increased concerns about global climate change and greenhouse gases, there is an ongoing global effort to reduce carbon dioxide emissions and to develop non-carbon-based 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, methane, or sugar. 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, and issues associated with the environmental impacts of this new hydrogen infrastructure must be addressed.

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 the primary advantage of using hydrogen—its environmental benefits. Another existing method, electrolysis, converts water into hydrogen using

[a] For comparability purposes in FY 2003, the $2.0M that was directed by Congress to be used from within Nuclear Energy Technologies/Generation IV Nuclear Energy Systems Initiative for a hydrogen study is shown in the Nuclear Hydrogen Initiative program.

electricity. Electrolysis is typically used for small production quantities but is inherently inefficient 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 energy, is used to produce the electricity.

Research conducted under the Department's Nuclear Energy Research Initiative (NERI) indicates strong potential for using a thermochemical water splitting process to produce hydrogen economically on a commercial scale without the release of greenhouse gases. One of the characteristics of these thermochemical processes is the requirement for very high temperatures—around 1000°C. The Department believes that advanced, high temperature nuclear energy systems can provide the heat necessary for these processes. Preliminary estimates conducted under the NERI program and by the Electric Power Research Institute (EPRI) indicate that hydrogen produced using nuclear-driven thermochemical or high-temperature electrolysis processes would be only slightly more expensive than gasoline *without* considering emissions-avoidance incentives. Such systems are projected to be the most cost-effective methods of producing hydrogen yet identified.

The Department's Offices of Nuclear Energy, Science and Technology (NE), Energy Efficiency and Renewable Energy (EE), Fossil Energy (FE), and Science (SC) jointly created the integrated *Hydrogen Posture Plan*. The plan highlights program planning for R&D on potential production sources of hydrogen, the infrastructure required to support the distribution of hydrogen, and end-use applications, such as those being explored through the FreedomCAR Initiative. NE has built upon this plan and the *National Hydrogen Energy Roadmap*, released by Secretary Abraham in November 2002 (***http://www.eere.energy.gov/hydrogenandfuelcells/pdfs/national_h2_roadmap.pdf),*** by developing the *Nuclear Hydrogen R&D Plan*, which was completed in FY 2003. This 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 identifies specific technology gaps (such as high-temperature materials, high-temperature membranes, and separation technologies), and knowledge gaps (such as kinetic, thermodynamic, and heat transfer data) and the R&D necessary to bridge the gaps. *The Nuclear Hydrogen R&D Plan* was coordinated with other departmental elements and draws upon expertise from industry, universities, and national laboratories. Investigating and demonstrating these nuclear-based systems will require advances in materials and systems technology to produce hydrogen using thermochemical cycles and high-temperature electrolysis.

Research and development will be conducted that focuses on the development of the high-temperature water splitting technologies that can be driven by nuclear systems and the underlying sciences supporting these advanced technologies. Two such areas are high-temperature and corrosive-resistant materials development and advanced chemical systems analysis. NE is working in close cooperation with the Department's Office of Science, through the *Materials for Advanced Energy Systems* initiative working group, to evaluate common areas of research to develop advanced materials for use in nuclear hydrogen systems as well as Generation IV nuclear energy systems. 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.

The Nuclear Energy Research Advisory Committee (NERAC), an independent federal advisory committee, will provide oversight for the Nuclear Hydrogen Initiative.

Detailed Justification

	(dollars in thousands)		
	FY 2003	FY 2004	FY 2005
Nuclear Hydrogen Initiative	**2,000**	**6,198**	**8,748**

The program will demonstrate the feasibility of using nuclear energy for the large-scale, emission-free production of hydrogen. The Department plans to develop the sulfur-iodine (S-I) thermochemical cycle and high-temperature electrolysis as baseline technologies.

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 is at a low level of maturity. The second baseline technology, high-temperature electrolysis, produces hydrogen from steam using electricity. This method promises far higher efficiencies than standard electrolysis. The new high-temperature design involves many technical challenges, including the development of high-temperature materials and membranes.

In FY 2003, the Department developed the *Nuclear Hydrogen R&D Plan*. The Department initiated research and development at the University of Nevada, Las Vegas, on heat exchanger design and materials required for the coupling of a hydrogen production facility with a high-temperature reactor. In addition, the Department began identifying opportunities for significant collaboration with countries of the Generation IV International Forum that are involved in applying high-temperature nuclear systems to the production of hydrogen. Currently, work with international partners is under way to demonstrate the S-I hydrogen production process on a laboratory scale.

In FY 2004, the Department is:

- Initiating laboratory-scale research, experimental design, and fabrication on the baseline hydrogen production technologies - the S-I thermochemical cycle and high-temperature electrolysis (HTE).
- Initiating screening and testing of component materials to determine compatibility with process working fluids.
- Initiating 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.
- Continuing research to determine candidate high-temperature process heat exchanger concepts and materials.
- Initiating conceptual design of a 200 kilowatt HTE experiment and a 500 kilowatt S-I thermochemical process experiment.

	(dollars in thousands)		
	FY 2003	FY 2004	FY 2005

In FY 2005, the Department will:

- Continue laboratory-scale research, experimental design, and fabrication on baseline hydrogen production technologies.
- Begin targeted laboratory-scale research, engineering assessments, experimental design, and component fabrication on alternative hydrogen production methods, such as the calcium-bromine thermochemical cycle.
- Begin assessment of membranes for thermochemical cycles to determine where process improvements can be made. These membranes have the potential to greatly improve the performance of the baseline and alternative technologies.
- 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 design and construction of selected heat exchanger designs to be tested before pilot and engineering-scale technology experiment operations. Conduct thermal, thermal hydraulic and structural analysis of heat exchanger concepts for use with alternative hydrogen production technologies.
- Complete conceptual design and begin preliminary design of the 200 kilowatt HTE experiment and the 500 kilowatt S-I thermochemical process experiment.

	FY 2003	FY 2004	FY 2005
Small Business Innovative Research and Small Business Technology Transfer Programs	**0**	**179**	**252**
Total, Nuclear Hydrogen Initiative....................................	**2,000**	**6,377**	**9,000**

Explanation of Funding Changes

	FY 2005 vs. FY 2004 ($000)
Nuclear Hydrogen Initiative	
▪ The increase of $2,550,000 will support the development of the S-I thermochemical and high-temperature electrolysis hydrogen production methods to determine the efficiencies and costs of the processes. In addition, the increase will enable the initiation of targeted research, assessment, and design for alternative hydrogen production methods to determine process viability and support the assessment of membranes for potential thermochemical process improvements. Additionally, the increase will provide for initiation of preliminary design of a 200 kilowatt HTE experiment and a 500 kilowatt S-I thermochemical process experiment.	+2,550
Small Business Innovative Research and Small Business Technology Transfer Programs	
▪ The increase of $73,000 is due to the increased funding for research and development activities.	+73
Total Funding Change, Nuclear Hydrogen Initiative	**+2,623**

Advanced Fuel Cycle Initiative

Funding Schedule by Activity

(dollars in thousands)

	FY 2003	FY 2004	FY 2005	$ Change	% Change
Advanced Fuel Cycle Initiative					
Separations Technology Development	32,188	32,103	25,754	-6,349	-19.8%
Advanced Fuels Development	10,894	14,805	14,000	-805	-5.4%
Transmutation Engineering	4,910	5,425	2,500	-2,925	-53.9%
Systems Analysis	2,500	4,330	2,500	-1,830	-42.3%
Transmutation Education	6,800	9,050	1,000	-8,050	-89.0%
Small Business Innovative Research and Small Business Technology Transfer Programs	0	1,000	500	-500	-50.0%
Total, Advanced Fuel Cycle Initiative	57,292	66,713	46,254	-20,459	-30.7%

Description

The mission of the Advanced Fuel Cycle Initiative (AFCI) is to develop advanced fuel cycle technologies, which include spent fuel treatment, advanced fuels, and transmutation technologies, for application to current operating commercial reactors and next-generation reactors and to inform a recommendation by the Secretary of Energy in the 2007-2010 timeframe on the need for a second geologic repository. Current legislation requires the Secretary to make a recommendation on the need for a second repository after January 1, 2007, but before January 1, 2010.

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 use of 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 inventories of commercially-generated plutonium (which is contained in all commercial spent fuel, and can, over succeeding decades, become easier to extract) 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.

The AFCI program will develop technologies to address intermediate and long-term issues associated with spent nuclear fuel. The intermediate-term issues are the reduction of the volume and heat generation (short-term) of material requiring geologic disposal. The program will develop proliferation-resistant processes and fuels for application to current light water reactor systems and advanced 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 reduce the technical need for an additional repository.

The longer-term issues to be addressed by the AFCI program is the development of fuel cycle technologies to destroy minor actinides, greatly reducing the long-term radiotoxicity and 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 the next-generation reactor 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 its hazard level to equal 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 gas-cooled reactors that may be available in the future. In addition, develop ultra-high burn-up fuels for use in LWRs and gas-cooled reactors in order to extract more energy from that fuel during its initial cycle and improve spent fuel management and storage. Very high burn-ups are possible in high-temperature reactors (such as the Next Generation Nuclear Plant (NGNP)), to the degree 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 recycling research, design, development, and demonstration. 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 and the Republic of Korea in separations, fuels, and test facilities. Other potential international partners include Italy, Spain, the European Commission, and Japan.

The AFCI program is comprised of five main research elements: Separations Technology Development; Advanced Fuels Development; Transmutation Engineering; Systems Analysis, and Transmutation Education.

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 best suited to address the needs of Generation IV fast reactor fuels.

Completed experiments 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 potential exists to reduce significantly the volume of high-level waste requiring disposal in a geologic repository.

Uranium Extraction Plus (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 fuels. Long-lived fission products, iodine-129 and technicium-99, which are major contributors to the long-term radiotoxicity from spent fuel, could be separated for long-term storage or incorporated into advanced fuels for next-generation reactors.

Pyroprocessing is the electrometallurgical treatment of spent nuclear fuel to separate the actinides from fission products for either storage or long-term geologic disposal at a high degree of proliferation resistance. Advanced pyroprocessing technologies are long-term alternatives to aqueous-based treatments. The AFCI pyroprocessing activities support the ultimate 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, aqueous-based separation technologies, *e.g.* Actinide Crystallization Process (ACP), to remove the uranium from the spent fuel. In addition, novel 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:

- *Hollow Fiber Modules:* The hollow fiber modules system is based on liquid-liquid extraction where the aqueous phase and the organic phase are separated by tubes with micron-sized apertures. The benefits of this system are a highly efficient transport mechanism with minimal phase. These systems are best used with separations that have smaller throughput requirements, *e.g.*, americium/curium separations;

- *Ionic Liquids:* Ionic liquids are molten salts and that have little to no vapor pressure. Over the past decade, ionic liquids have been produced that are fluid at room temperature and have viscosities similar to water or ethylene glycol. Current formulations of room temperature ionic liquids (RTIL) have organic-based cations and/or anions. If successful, these liquids could be used in either liquid-liquid extraction or electrochemical applications;

- *Supercritical Solvent Systems:* Many new separation processes outside the nuclear area are using supercritical solvents, *e.g.*, carbon dioxide and water. For supercritical carbon dioxide, the solvent has the benefit of returning to a gaseous state, dramatically reducing the solvent waste-treatment costs. Organic and inorganic reactants can be used within these systems and could be amenable to unique chemical transformations;

- *Advanced Sorption Technologies:* The selective binding or gating of materials using solid-state membranes have received a significant amount of attention for highly efficient separation methods. The scalability and selectivity of these technologies are the primary issues that keep these techniques from traditional consideration for large-scale treatment. However, it is possible with a dedicated research program that significant progress towards a viable deployment could be achieved;

- *Volatility:* Fluoride and chloride volatility flowsheets have been discussed for many years. There are many benefits to these technologies that if developed could be used as front-end processes that would make the size of the traditional spent nuclear fuel treatment facilities smaller.

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.

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.

AFCI will also manage the development of advanced fuels for Generation IV nuclear systems, including the Advanced Gas Reactor Fuel Development and Qualification (AGR) program, consistent with the objective of AFCI support to the fuel cycle development for Generation IV nuclear systems.

Transmutation Engineering

Transmutation is a process by which certain long-lived radioactive species are converted to short-lived and lower radiotoxicity species. The use of transmutation to convert the most significant long-lived species in spent nuclear fuel changes the decay timescale in the geologic repository from millenia to centuries.

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.

Through international cooperation, the AFCI program remains involved in accelerator-driven systems (ADS) research and development activities performed overseas. AFCI is cooperating with France, Switzerland, and the European Union on accelerator-driven system spallation target (MEGAPIE) tests and a reactor-accelerator coupling experiment (TRADE), 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 on operations research and computer modeling of various separations and transmutation options. The activity will develop 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 their radiotoxicity from 300,000 years to less than 1,000 years. Cost-benefit analyses will be performed for each promising option. The systems analysis activity, by determining the optimum mix of facilities and systems, enables the Department to effectively prioritize program research and development.

Systems analyses will include broad system studies, integrated nuclear fuel cycle system studies, transmutation system studies, technology and facility assessments, and transmutation system studies.

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 energy systems. It also includes directed university research to supplement the national laboratories in their R&D activities.

Detailed Justification

	(dollars in thousands)		
	FY 2003	FY 2004	FY 2005
Separations Technology Development	**32,188**	**32,103**	**25,754**

The primary goal of the separations activities is to develop and demonstrate advanced separations technologies – aqueous-based and pyrochemical and to inform a recommendation by the Secretary of Energy in the 2007-2010 timeframe on the technical need for a second repository.

▪ **UREX+ Experiment**	**6,963**	**7,050**	**8,754**

In FY 2003, the Department demonstrated on a laboratory-scale, two of the UREX+ separations processes: plutonium-neptunium extraction and cesium-strontium extraction - using actual spent nuclear fuel. This work was performed at Argonne National Laboratory and Oak Ridge National Laboratory. The Department also completed the pre-conceptual design of a UREX+ engineering scale experiment (ESE).

In FY 2004, laboratory-scale "hot" testing of the UREX+ processes is being continued. In addition, an architecture and engineering firm was selected and a scoping study of a future commercial processing plant is being conducted.

In FY 2005, the Department will:

- Continue laboratory-scale "hot" testing of advanced aqueous processes at INL and ORNL (including plutonium/uranium, cesium/strontium, and americium/curium extraction) that will provide the baseline data required for selection of the optimum UREX+ flowsheet and aid in the verification of the AMUSE modeling program (the AMUSE computer code models various chemical processes and computes the most effective concentrations of various reagents);
- Continue the development and determine the product storage form for uranium, neptunium and plutonium and support additional research and development for the storage of other elements including cesium, strontium, and heavier transuranics.

▪ **Generation IV Fuel Treatment Process Development**..	**25,225**	**25,053**	**17,000**

In FY 2003, the Department supported the continuing demonstration of pyroprocessing technologies for the treatment of metallic spent nuclear fuel. Electrorefiner operations were continued to treat spent fuel to provide feed material for additional research. The design of a production metal waste furnace was initiated. An electrometallurgical oxide-reduction process was demonstrated at laboratory-scale. Research into the Actinide Crystallization Process (ACP) separations technology was initiated.

In FY 2004, the Department is continuing electrorefiner operations in support of pyroprocessing development. Waste qualification experiments and data analysis are being continued. The Department is also supporting 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* (June 2003), the program is focusing on treating highly-enriched, sodium-bonded driver fuel while investigating alternatives to more cost-effective technologies for processing sodium-bonded blanket fuel.

In FY 2004, advanced alternative separations experiments applying the Actinide Crystallization Process (ACP) technology continue to be investigated. The Department is:

- Continuing development and demonstration of separation methods for lanthanides from trivalent actinides, and americium/curium;
- Demonstrating the feasibility of the ACP by performing research and development on the isolation of uranium with a purity of 99.9% from a cold spent fuel surrogate dissolved in nitric acid;
- Determining the versatility of the process to separate the neptunium and plutonium along with uranium; and
- Completing research on a flowsheet for a carbonate-based crystallization process that may have additional benefits compared to the acidic nitrate system.

In FY 2005, the Department will:

- Develop state-of-the-art safety and security systems for the control of nuclear material within pyroprocessing facilities, including on-line monitoring systems, materials control and accountability, supply of feed chemicals, analytical chemistry, and environment, safety and health;
- Continue development and demonstration of proliferation-resistant pyroprocessing and advanced alternative separations technologies; and
- Continue electrorefiner operations in support of pyroprocessing development, including the treatment of highly-enriched, sodium-bonded driver fuel.

Advanced Fuels Development	**10,894**	**14,805**	**14,000**

The AFCI fuels development effort will develop proliferation-resistant transmutation fuels for use in advanced fuel cycles for current LWRs and gas-cooled reactors. It will develop ultra-high burn-up fuels for use in existing LWRs and also develop and demonstrate prototypic fuels for Generation IV Nuclear Energy Systems.

	(dollars in thousands)		
	FY 2003	FY 2004	FY 2005
▪ **LWR Oxide Fuel Development and Testing**	**3,351**	**3,439**	**3,500**

In FY 2003, the Department developed the first series of LWR mixed-oxide fuel pellets containing plutonium and neptunium for insertion into a test article for irradiation in the Advanced Test Reactor (ATR) in FY 2004.

In FY 2004, the Department is initiating ATR irradiations of LWR mixed-oxide test fuels.

In FY 2005, the Department will complete ATR irradiations of LWR mixed-oxide test fuels and initiate post-irradiation examinations. 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.

▪ **Generation IV Reactor Fuel Development and Testing**	**7,543**	**11,366**	**10,500**

In FY 2003, the Department developed high actinide-bearing nitride and metal fuels and began irradiation testing in ATR to qualify these fuels for future irradiation in the French PHENIX fast spectrum test reactor in FY 2007.

In FY 2004, the Department is screening fuel options for next-generation reactor concepts and completing plans for irradiation testing and post-irradiation examination of possible Generation IV fuel forms. In support of the PHENIX tests, irradiation testing of metal fuels in the ATR is being continued and irradiation testing of nitride fuels is being initiated.

In FY 2005, the Department will complete ATR irradiation experiments and commence post-irradiation examination on approximately 20 fuel samples of actinide-bearing metal and nitride fuel forms in support of PHENIX test scheduled to begin in FY 2007.

In support of the AGR program, the Department in FY 2005 will:

- Complete the fabrication of a multi-cell capsule for ATR irradiation tests, produce the fuel test specimens for the first ATR irradiation test (AGR-1) and start the AGR-1 shakedown capsule tests;
- Complete compacting process development for the TRISO fuel; and
- Complete the consolidation of existing phenomenological models into an integrated fuel performance model.

	FY 2003	FY 2004	FY 2005
	(dollars in thousands)		
Transmutation Engineering	**4,910**	**5,425**	**2,500**

Transmutation engineering provides critical research and development in the areas of physics, materials, and accelerator-driven systems.

In FY 2003, key transmutation-related neptunium and americium cross section measurements were performed to reduce uncertainties in transmutation reactor computations. The Department also engaged in international collaboration to leverage transmutation program funds in the areas of transmutation science (TRADE) and materials (MEGAPIE). This collaboration continues in FY 2004.

In FY 2004, the Department is continuing analytical work on physics cross section measurements of selected minor actinides (americium-241 and -242) required for advanced transmutation reactor design.

In FY 2005, the Department will continue transmutation physics measurement and analysis work to reduce uncertainties in minor actinide cross sections required for advanced transmutation reactor designs. This will include the completion of the americium measurements.

Systems Analysis	**2,500**	**4,330**	**2,500**

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 2003, the Department:

- Established a baseline deployment scenario, as well as upper- and lower-bound deployment scenarios;
- Undertook activities that develop and benchmark an integrated fuel cycle model;
- Conducted a preliminary scoping study to estimate cost and schedule requirements for a spent fuel treatment facility;
- Initiated studies on the performance expectations of individual transmutation systems; and
- Evaluated the requirements for an engineering scale experiment of the UREX+ aqueous separations technology.

In FY 2004, the Department is identifying the nuclear fuel cycle technologies that offer the greatest promise for future use, developing the information necessary to conduct cost-benefit analyses for each of these technologies, and by determining the optimum mix of facilities and systems, prioritizing program research and development. This effort includes the conduct of broad system studies, integrated nuclear fuel cycle system studies, transmutation system studies and technology and facility assessments.

(dollars in thousands)			
	FY 2003	FY 2004	FY 2005

In FY 2005, the Department will continue the development of cost-benefit analyses of each promising nuclear fuel cycle technology, updating existing analyses with information developed from the previous year's R&D activities. This may result in different conclusions regarding the optimum mix of facilities and systems which, in turn, may result in readjusted R&D priorities. This effort will continue to comprise broad system studies, integrated nuclear fuel system studies, transmutation system studies and technology and facility assessments. Because this will build on work created in FY 2004, the requested level of funding will also allow for development of an analytic model to compare cost estimates for a deployed nuclear system using fast reactors for waste transmutation versus using a combination of fast reactors and accelerator-driven systems.

	FY 2003	FY 2004	FY 2005
Transmutation Education	**6,800**	**9,050**	**1,000**

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 2003, Masters of Science (M.S.) fellowships were suspended for one year. The Department funded university research programs at the University of Nevada at Las Vegas (UNLV) and the Idaho Accelerator Center (IAC) to integrate other universities and institutions into the larger AFCI research and development effort.

In FY 2004, the Department is:

- Awarding seven M.S. fellowships to assure that new engineers will enter the field of transmutation science;
- Continuing and expanding directed university research to support advanced fuel cycles, and
- Continuing the university research programs at UNLV and IAC.

In FY 2005, the Department will continue directed university research to support advanced fuel cycles. It will not provide for new fellowships and research grants due to a change in focus to emphasize other research and development activities.

	FY 2003	FY 2004	FY 2005
Small Business Innovative Research and Small Business Technology Transfer Programs	**0**	**1,000**	**500**
Total, Advanced Fuel Cycle Initiative	**57,292**	**66,713**	**46,254**

Explanation of Funding Changes

	FY 2005 vs. FY 2004 ($000)
Separations Technology Development	
▪ **UREX+ Experiment**	
The increase of $1,704,000 is due to an increased level of effort to complete laboratory-scale "hot" testing of advanced aqueous processes to optimize the UREX+ flowsheet	+1,704
▪ **Generation IV Fuel Treatment Process Development**	
The decrease of $8,053,000 is due to a reduced level of effort on treatment of sodium-bonded fuel and advanced treatment processes	- 8,053
Total, Separations Technology Development	-6,349
Advanced Fuels Development	
▪ **LWR Oxide Fuel Development and Testing**	
The increase of $61,000 is due to an increased level of effort to complete LWR oxide fuel irradiations and post-irradiation examination	+61
▪ **Generation IV Reactor Fuel Development and Testing**	
The decrease of $866,000 is due to delaying experiments required to test Generation IV fuel forms	-866
Total, Advanced Fuels Development	-805
Transmutation Engineering	
The decrease of $2,925,000 is due to postponement of AFCI specific materials development	-2,925
Systems Analysis	
The decrease of $1,830,000 is due to a reduced level of effort on broad system studies, integrated fuel cycle system studies, and facility assessments, focusing principal activities on developing the information required for the FY 2005 Annual AFCI Comparison Report to Congress that in turn will inform the 2007-2010 Secretarial recommendation on a second repository	-1,830

Transmutation Education

The decrease of $8,050,000 is due to no new fellowships and research grants being awarded in FY 2005	-8,050

Small Business Innovative Research and Small Business Technology Transfer Programs

The decrease of $500,000 is due to the decreased funding for research and development activities	-500
Total Advanced Fuel Cycle Initiative	**-20,459**

Infrastructure

Funding Profile by Subprogram

(dollars in thousands)

	FY 2003 Comparable Appropriation	FY 2004 Original Appropriation	FY 2004 Adjustments	FY 2004 Comparable Appropriation	FY 2005 Request
Infrastructure					
Radiological Facilities Management	62,928	64,655	-1,224	63,431	69,110
Idaho Facilities Management	62,983	76,560	-1,145	75,415	108,050
Idaho Sitewide Safeguards and Security	52,560	56,654	-311	56,343	58,103
Total, Infrastructure.................	178,471	197,869	-2,680	195,189[a]	235,263

Funding Profile – Energy Supply

	FY 2003 Comparable Appropriation	FY 2004 Original Appropriation	FY 2004 Adjustments	FY 2004 Comparable Appropriation	FY 2005 Request
Infrastructure					
Radiological Facilities Management	62,928	64,655	-1,224	63,431	69,110
Idaho Facilities Management	42,341	55,145	-1,026	54,119	87,164
Total, Infrastructure	105,269	119,800	-2,250	117,550	156,274

Funding Profile – Other Defense Activities

	FY 2003 Comparable Appropriation	FY 2004 Original Appropriation	FY 2004 Adjustments	FY 2004 Comparable Appropriation	FY 2005 Request
Infrastructure					
Idaho Facilities Management	20,642	21,415	-119	21,296	20,886
Idaho Sitewide Safeguards and Security	52,560	56,654	-311	56,343	58,103
Total, Infrastructure	73,202	78,069	-430	77,639	78,989

[a] Includes $3.17M identified as use of prior year balances to fund the Environmental Management liability for OVEC in FY 2004.

Mission

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.

On May 19, 2003, oversight of and landlord responsibilities for the INEEL transferred from the Office of Environmental Management (EM) to NE. Beginning in the second quarter of FY 2005, the 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 Generations IV reactor, the Advanced Fuel Cycle Initiative, and the Space Nuclear Propulsion development program. 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 Idaho Facilities Management 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 assuring 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 assessment 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 is creating a Subcommittee on Nuclear Laboratory Requirements to identify what characteristics, capabilities and attributes a world-class nuclear laboratory would possess. This Subcommittee will become familiar with the practices, culture and facilities of other world-class laboratories and will use this knowledge to recommend by the end of FY 2004 what needs to be implemented at Idaho. The objective of this activity is to help make Idaho National Laboratory the leading nuclear energy research laboratory in the world within ten years of its inception.

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 support the requirements of the Department's energy security technology development/demonstration programs, and to meet the Nation's energy, environmental, health care, and national security needs.

Contribution to Program Goal 04.17.00.00 (Energy Security) (Maintain and enhance the national nuclear infrastructure)

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 assuring 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 2000 Results	FY 2001 Results	FY 2002 Results	FY 2003 Results	FY 2004 Targets	FY 2005 Targets
Program Goal 04.17.00.00 (Energy Security)					
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.	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.
			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.	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.
		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.	Maintain and operate radioisotope power systems facilities with less than 10 percent unscheduled downtime from approved baseline.

FY 2000 Results	FY 2001 Results	FY 2002 Results	FY 2003 Results	FY 2004 Targets	FY 2005 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)			
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.	Approve corrective action plans, which indicate an analysis of causal factors, list steps to resolve the findings, and provide a completion schedule with milestones for all cited findings for Category I and II facilities within 60 calendar days of issuance of final reports that resulted from Safeguards and Security inspections performed by the Office of Independent Oversight and Performance Assurance pursuant to DOE Orders 470.1 chg 1 and 470.2B.

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:

- For Idaho Facilities Management, lack of Congressional and Administration support to accomplish the goals of the *INL Ten Year Site Plan* would impact Idaho's ability to achieve the strategic goals for the site.

- Changing mission requirements from agencies that use radioisotope power systems and the risk associated with technological developments could affect the Department's ability to deliver these systems to customers in a timely manner.

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 and grantee 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 Accounting 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 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. In addition, NE conducts semiannual Operational Program Reviews of the performance of national laboratories on NE programs.

Funding by General and Program Goal

(dollars in thousands)

	FY 2003	FY 2004	FY 2005	$ Change	% Change
General Goal 4, Energy Security					
Program Goal 04.17.00.00: Maintain and enhance the national nuclear infrastructure	178,471	195,189	235,263	+40,074	+20.5%
Total, General Goal 4, Energy Security	178,471	195,189	235,263	+40,074	+20.5%

Radiological Facilities Management

Funding Schedule by Activity

	(dollars in thousands)				
	FY 2003	FY 2004	FY 2005	$ Change	% Change
Radiological Facilities Management					
Space and Defense Infrastructure	28,608	35,544	33,800	-1,744	-4.9%
Medical Isotopes Infrastructure............	34,320	27,887	34,810	+6,923	+24.8%
Enrichment Facility Infrastructure	0	0	500	+500	+100.0%
Total, Radiological Facilities Management .	62,928	63,431	69,110	+5,679	+9.0%

Description

The mission of the Radiological Facilities Management program is to maintain critical user facilities in a safe, secure, 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 NE-managed facilities at Oak Ridge National Laboratory (ORNL), Los Alamos National Laboratory (LANL), Sandia National Laboratory (SNL), Brookhaven National Laboratory (BNL), and Argonne National Laboratory-West (ANL-W). Beginning in the second quarter of FY 2005, ANL-W will become part of the Idaho National Laboratory (INL). In addition, Radiological Facilities Management funds the oversight and contingency planning to ensure the Department's Paducah Gaseous Diffusion Plant (Paducah GDP) uranium enrichment facilities and select surplus uranium inventories are available to support future national energy security priorities and satisfy the Department's statutory liabilities.

Benefits

These funds assure that NE facilities meet essential safety and environmental requirements, as well as assuring that various NE-managed facilities are maintained at user-ready levels. Actual operations, production, research, or other additional activities are funded either by DOE, by industrial organizations, or by other Federal agency users.

As part of the Radiological Facilities Management program, the Department has operated its radioisotope heat source and power system assembly and testing program at the Mound, Ohio Plant for several decades. 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 of a range of alternative actions, the Department decided to permanently locate the operations at INL. The transfer of applicable equipment was completed in FY 2003 and some capabilities will be operational by mid-FY 2004 with the full capability in place early in FY 2005.

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. In addition, ORNL is preparing to receive and store the Neptunium-237 (Np-237) inventory currently stored at Savannah River. The Np-237 is the required target material to establish a domestic capability to produce Pu-238.

At ORNL, the 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 ORNL is storing 1.5 metric tons of uranium, containing 450 kilograms of U-233, in Building 3019. Storage of this material presents several safety issues due in part to the fact that Building 3019 was built during the days of the Manhattan Project and the storage containers, while robust, would need inspection over the next several years. The Uranium-233 Disposition, Medical Isotope Production, and Building 3019 Complex Shutdown Preliminary Project (U-233 Project) will resolve these safety issues while increasing the availability of medically valuable isotopes that will be extracted from the U-233 during processing. The down-blending of U-233 will also reduce the global nuclear danger by making this material unsuitable for use in weapons.

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 so that it can be safely transported and used in radioisotope power systems.

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. Also, a preliminary report has been developed for a dedicated isotope production 70 MeV cyclotron at BNL. The FY 2005 budget request continues pre-conceptual design activities for the cyclotron.

The Department-owned Paducah GDP is the only operating domestic enriched uranium production facility. Its continued operational capacity is essential to assure an adequate supply of nuclear fuel for the Nation's electric utilities. The Paducah GDP lessee, USEC Inc. (USEC), committed, in a DOE-USEC Memorandum of Agreement on June 17, 2002, to operate and maintain the integrity of the Department-owned Paducah GDP until USEC deploys new enrichment technology at the end of this decade. The Department will inspect 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 the protection of the Government's rights under the DOE-USEC Agreement.

The FY 2005 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 2003	FY 2004	FY 2005
Space and Defense Infrastructure	**28,608**	**35,544**	**33,800**
▪ **Idaho National Laboratory (INL)**	**10,580**	**18,244**	**14,000**
• **Radioisotope Power Systems Assembly Operations**	5,100	9,044	9,900

The Department had maintained and operated facilities at the Mound Plant in Ohio that enabled the Department to conduct heat source and power system assembly and testing operations for radioisotope power systems. In late FY 2002, the decision was made and efforts were initiated to transfer these operations from Mound to INL. During FY 2003, the transfer of critical equipment from Mound was completed and detailed plans and schedules for equipment installation and training of personnel proceeded. During FY 2004, efforts will focus on installing the transferred equipment 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 operational planning and readiness reviews will be completed. The funding also supports design studies and analysis that are related to the efforts at INL.

• **Capital Equipment for Radioisotope Power System Assembly Operations**	550	800	800

Though significant amounts of equipment are being transferred from Mound, additional new equipment must be procured to support the heat source test and assembly operations at INL. These equipment purchases will continue through FY 2005 at the same funding level as FY 2004.

• **General Plant Project (GPP) for Modifying Building 792 and for related site infrastructure upgrades**	1,630	5,100	0

The GPP budget line includes two major GPP projects. The first would involve modifications to Building 792 to support the radioisotope power system operations being transferred from the Mound Plant in Ohio. The building modifications include building extensions, electrical modifications, inert gas capabilities, and general modifications to fire and exhaust systems. The other site infrastructure project involves general site upgrades that will support the operations in Building 792 and other facilities and operations.

	(dollars in thousands)		
	FY 2003	FY 2004	FY 2005
• **Safety Analysis and Testing Infrastructure**	3,300	3,300	3,300

The Department maintains an analytical and testing infrastructure enabling the Department to assure the safety of the radioisotope power systems it builds. 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.

	FY 2003	FY 2004	FY 2005
▪ **Los Alamos National Laboratory (LANL)**	**10,928**	**12,200**	**13,800**
• **Pu-238 Encapsulation and Scrap Recovery Facilities**	9,928	10,200	11,800

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. The full-scale scrap recovery line will be in full operation in late FY 2004. In FY 2005, the Pu-238 processing and encapsulation facilities to produce encapsulated pellets will also continue to be in full operation.

	FY 2003	FY 2004	FY 2005
• **Capital Equipment for the Pu-238 Facilities**......	1,000	2,000	2,000

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 2003 and 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. In FY 2005, installation of new gloveboxes will continue and consolidation of the isotopic analysis within TA-55 will proceed.

	FY 2003	FY 2004	FY 2005
▪ **Oak Ridge National Laboratory (ORNL)**................	**7,100**	**5,100**	**6,000**
• **Iridium Fabrication Facilities for Radioisotope Power Systems**	3,900	3,900	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 sophisticated heat source components are necessary for the safe operation of the radioisotope power systems. Funding will continue to assure the operational capability of this facility.

	(dollars in thousands)		
	FY 2003	FY 2004	FY 2005
• **Capital Equipment for Iridium Fabrication Facilities**	0	200	500

Upgrade and replace aging welding equipment to support iridium processing and fabrication at ORNL.

• **Domestic Pu-238 Production/Np-237 Transfer/Storage**	3,200	1,000	1,000

The Department issued a Record of Decision in January 2001 that called for the reestablishment of a domestic Pu-238 production capability using facilities at ORNL and INEEL. The need for this capability has been highlighted in a letter from the Deputy Secretary of Defense to the Secretary of Energy. During FY 2003 and FY 2004, ORNL developed plans, conducted design studies, and prepared for the transfer and storage of the Np-237 that will be used as the irradiation target material in Pu-238 production. This Np-237 material is currently stored at the Savannah River Site as part 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, ORNL will begin to receive shipments of Np-237 in FY 2005 and begin repackaging this material for longer-term storage at Y-12.

Medical Isotopes Infrastructure	**34,320**	**27,887**	**34,810**
▪ **Oak Ridge National Laboratory (ORNL)**	**26,172**	**20,300**	**26,625**
• **Building 3047 Hot Cells**	2,549	2,650	2,750

Maintain facility in a safe and environmentally compliant condition for the continued production, 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 this facility.

• **Building 9204-3 – Chemical and Material Laboratories**	2,422	2,500	2,675

Maintain facility in a safe and environmentally compliant condition and state of readiness 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.

	(dollars in thousands)		
	FY 2003	FY 2004	FY 2005
• **Other ORNL Facilities**...	6,839	1,900	0

FY 2003 funding provided for 15 maintenance and repair projects at the Bethel Valley Hot Cell complex. In FY 2004, funding provides for infrastructure upgrades and maintenance at the following hot cells and support buildings: Radioactive Materials Analytical Laboratory, 2026; Irradiated Materials Examination and Testing Facility, 3025E; Radioisotope Development Laboratory, 3047; Irradiated Fuels Examination Laboratory, 3525; High Level Radiochemical Laboratory, 4501; Special Nuclear Materials Vault, 3027; Interim Manipulator Repair Facility, 3074; Resource Craft Maintenance Facility, 3104; Specialized Boot and Rubber Shop, 3502; Transuranium Element Processing Building, 7920; and Californium Building, 7930.

• **Isotope Production**..	450	450	600

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.

• **Uranium-233 (U-233) Program**	13,912	12,800	6,984

Continue baseline operation and maintenance of Building 3019 and surveillance of U-233 material through the contract awarded in October 2003 consistent with the business case approved by OMB in FY 2002.

• **Facility Modification for ^{233}U Disposition**...........	0	0	13,616

Start the construction phase of the U-233 project through the contract awarded in October 2003 consistent with the business case approved in FY 2002. This will include procuring and installing uranium processing equipment in Building 3019, facility modifications and removal of legacy equipment. (TEC $40,134M).

	(dollars in thousands)		
	FY 2003	FY 2004	FY 2005
▪ **Los Alamos National Laboratory (LANL)**	**4,248**	**3,012**	**3,160**
• **Isotope Production Facility/TA-48 Hot Cell, Building RC-1**	1,696	1,750	2,850

Maintain facilities in a safe and environmentally compliant condition for the producing, processing, packaging, and shipment 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 these facilities.

• **Isotope Production Facility**	1,702	0	0

Isotope Production Facility – Line Item Construction Project: In FY 2003, the Department completed the construction of the Los Alamos Isotope Production Facility for the production of accelerator isotopes needed for medical and scientific research.

• **Isotope Production Facility – Other Project and Start-up and Maintenance Costs**	850	1,262	0

Start-up expenses associated with the Isotope Production Facility (IPF) target station and beam line will be completed in FY 2004.

• **Capital Equipment**	0	0	310

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)**	**1,800**	**1,750**	**1,900**
• **TA-5 ACRR & Hot Cells**	1,800	1,750	1,900

Support operations of the Annular Core Research Reactor (ACRR) in a safe, environmentally compliant condition and state of readiness, and maintain the associated hot cells in a non-nuclear stand-by status. Activities include maintenance, radiological monitoring, and facility inspections.

	FY 2003	FY 2004	FY 2005
▪ **Brookhaven National Laboratory (BNL)**	**1,700**	**2,373**	**2,673**
• **Brookhaven Linear Isotope Producer (BLIP) Building 931 and Hot Cell Building 801**	1,700	2,075	2,558

(dollars in thousands)

Maintain the BLIP Building 931 and Hot Cell Building 801 facilities in a safe and 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**	0	298	115

In FY 2005, funds will provide for a pyrogen-free Super Q water system, a spare hot cell manipulator, and an upgrade to the fume hood ventilation system to avoid processing inefficiencies and potential safety issues.

▪ **Other Activities**	**400**	**452**	**452**
• **Associated Nuclear Support**	400	452	452

This funding provides for requirements applicable to isotope producing sites. Such items include annual NRC certification for isotope shipping casks, independent financial audits of the revolving fund, and other related expenses.

Enrichment Facility Infrastructure	**0**	**0**	**500**

Funding provides for oversight and contingency planning at the Department-owned Paducah GDP. Under the DOE-USEC Memorandum of 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 the Government's rights and options under the Agreement. The funding also provides for the management of commercial-grade uranium inventories to minimize storage and disposition costs.

Total, Radiological Facilities Management....................	**62,928**	**63,431**	**69,110**

Explanation of Funding Changes

	FY 2005 vs. FY 2004 ($000)
Space and Defense Infrastructure	
▪ **Idaho National Laboratory (INL)**	
• **Radioisotope Power Systems Assembly Operations**	
The increase of $856,000 in operating funds reflects completing the installation by early FY 2005 of the equipment being transferred from Mound to INL and the startup of regulator assembly operations.	+856
• **General Plant Project (GPP) for Modifying Building 792 and for related site infrastructure upgrades**	
The decrease of $5,100,000 in GPP funding reflects the completion by early FY 2005 of Building 792 modifications and related site infrastructure upgrades	-5,100
▪ **Total, INL**	-4,244
▪ **Los Alamos National Laboratory (LANL)**	
• **Pu-238 Encapsulation and Scrap Recovery Facilities**	
The increase of $1,600,000 is associated with operating the full-scale scrap recovery line for the entire fiscal year along with the increased analytical chemistry costs associated with operation of the line	+1,600
▪ **Oak Ridge National Laboratory (ORNL)**	
• **Iridium Fabrication Facilities for Radioisotope Power Systems**	
The increase of $600,000 will be needed to refine additional iridium scrap and to process the scrap into ingots so that the iridium material can be reused	+600
• **Capital Equipment for Iridium Fabrication Facilities**	
The increase of $300,000 will be used to upgrade and replace aging welding equipment to support iridium processing and fabrication	+300
▪ **Total, ORNL**	+900
Total, Space and Defense Infrastructure	**-1,744**

	FY 2005 vs. FY 2004 ($000)
Medical Isotopes Infrastructure	
▪ **Oak Ridge National Laboratory (ORNL)**	
• **Building 3047 Hot Cells**	
The increase of $100,000 will permit needed minor repairs and keep the maintenance schedule current ...	+100
• **Building 9204-3 – Chemical and Material Laboratories**	
The increase of $175,000 will permit needed minor repairs and keep the maintenance schedule current ...	+175
• **Other ORNL Facilities**	
The decrease of $1,900,000 reflects the completion of hot cells and support building upgrades and maintenance ...	-1,900
• **Isotope Production**	
The increase of $150,000 will permit modification to the current system to accommodate electronic ordering, payments, and transfer of funds to the production sites and inventory control. ...	+150
• **Uranium-233 Program**	
The decrease of $5,816,000 will be used for the Facility Modification for U-233 Disposition Project ...	-5,816
• **Facility Modification for ^{233}U Disposition**	
The increase of $13,616,000 reflects costs for capital improvements to the Building 3019 Complex necessary to carryout the contract awarded in October 2003...	+13,616
▪ **Total, ORNL** ...	+6,325
▪ **Los Alamos National Laboratory (LANL)**	
• **Isotope Production Facility/TA-48 Hot Cell, Building RC-1**	
The $1,100,000 increase provides funds to maintain the facility in a safe and environmentally compliant condition ...	+1,100
• **Isotope Production Facility– Other Project and Start-up and Maintenance Costs**	
The decrease of $1,262,000 is due to the completion of the IPF project...	-1,262

	FY 2005 vs. FY 2004 ($000)
• **Capital Equipment**	
The increase of $310,000 will be used to purchase shipping containers needed for transportation of isotopes between facilities and customers	+310
▪ **Total, LANL**	+148
▪ **Sandia National Laboraties (SNL)**	
• **TA-5 ACRR & Hot Cells**	
The increase of $150,000 will support additional maintenance activities	+150
▪ **Brookhaven National Laboratory (BNL)**	
• **Brookhaven Linear Isotope Producer Building 931 and Hot Cell Building 801**	
The increase of $483,000 is to address additional maintenance requirements	+483
• **Capital Equipment**	
The decrease of $183,000 results from completing purchases and installation of equipment requested in FY 2004	-183
▪ **Total, BNL**	+300
Total, Medical Isotopes Infrastructure	**+6,923**
Enrichment Facility Infrastructure	
The increase of $500,000 will fund the inspection, analysis, validation of operating and maintenance data, and observation of industrial activities at the Department-owned Paducah GDP, and to plan for commercial end-use of select surplus uranium inventories to minimize storage and disposition costs	+500
Total, Enrichment Facility Infrastructure	**+500**
Total Funding Change, Radiological Facilities Management	**+5,679**

Capital Operating Expenses and Construction Summary

Capital Operating Expenses

	(dollars in thousands)				
	FY 2003	FY 2004	FY 2005	$ Change	% Change
Capital Equipment	1,550	3,298	3,725	+427	+12.9%
General Plant Projects/General Purpose Equipment	1,630	5,100	0	-5,100	-100.0%
Total, Capital Operating Expenses	3,180	8,398	3,725	-4,673	-55.6%

Construction Projects

	(dollars in thousands)					
	Total Estimated Cost (TEC)	Prior-Year Approp.	FY 2003	FY 2004	FY 2005	Unapprop. Balance
99-E-201, Isotope Production Facility, LANL	19,980	18,278	1,702	0	0	0
05-E-233, Facility Modification for ^{233}U Disposition	40,134	0	0	0	13,616	26,518
Total, Construction	60,114	18,278	1,702	0	13,616	26,518

05-E-203 - Facility Modifications for ^{233}U Disposition, Oak Ridge National Laboratory, Oak Ridge, Tennessee

Note: Total estimated cost and total project cost estimates are preliminary and should not be construed as a project baseline. Estimates will be updated during Phase I of the project by the selected contractor.

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

2. Financial Schedule [c]

(dollars in thousands)

Fiscal Year	Appropriations	Obligations	Costs
2005	13,616	13,616	9,627
2006	19,077	19,077	14,071
2007	7,441	7,441	16,436

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[a] Design will be performed during Phase I from budgeted amounts for Building 3019 Complex operations as noted in the Preliminary Project Execution Plan (PEP) provided to Congress in May 2002. Phase I will be conducted on a cost-plus-fixed-fee basis with an estimated duration of 13 months based on the contract awarded in October 2003.

[b] Total estimated cost and total project cost data reflect estimates of cost for capital improvements to the Building 3019 Complex that will be performed during Phase II and are based preliminary estimates developed as a part of the contractor's proposal. These numbers will be updated during Phase I of the contract. All other costs identified in the Preliminary PEP (including baseline security cost of approximately $6 million per year funded by the Office of Science) are addressed in Section 7.

[c] Financial schedule data reflects requirements for capital improvements that will be performed during Phase II. Approval of Phase II will be optional for the Department of Energy based on Phase I deliverables, contractor performance, and analysis of final cost estimates prepared during Phase I.

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 and safety issues associated with the inventory and its storage facility; specifically, the safety issues that were identified by the Defense Nuclear Facilities Safety Board (DNFSB) in *Recommendation 97-1, Safe Storage of Uranium-233*. Furthermore, blending down this material will support National non-proliferation goals by making the material unsuitable for use in weapons.

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).
- Meet the requirements of *DNFSB Recommendation 97-1*, which addresses the storage, inspection, and repackaging of the ^{233}U maintained at ORNL.

The Department has developed a three-phased approach to allow for systematic decision-making and to increase the Department's flexibility. The base contract award will consist only of Phase I /Planning and Design. Phase II/ Project Implementation, and Phase III/Building 3019 Complex Shutdown, are contract options that may be unilaterally exercised by the Department.

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.

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 and will be updated during the course of Phase I activities.

<u>Phase I - Planning and Design</u>:

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 with an estimated duration of 13 months. 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. Building 3019 Complex operations and Phase I will be funded within the FY 2004 appropriation level.

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.
- 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" to determine if it makes good business sense for DOE to proceed to Phase II. 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) estimated at $40.134 million. Total estimated cost and total project cost data reflect estimates of cost for capital improvements to the Building 3019 Complex that will be performed during Phase II and are based preliminary estimates developed as a part of the contractor's proposal. These numbers will be updated during Phase I of the contract. Following the completion of the capital construction improvements, the contractor would begin the program activities of ^{229}Th extraction while isotopically 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. Isotek estimates the duration of Phase II to be 84 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 Environmental Management (EM) program for decommissioning. Isotek estimates the duration of Phase III to be 15 months.

4. Details of Cost Estimate

(dollars in thousands)

	Current Estimate	Previous Estimate
Design Phase[a]		
Preliminary and Final Design costs	n/a	n/a
Design management costs	n/a	n/a
Total, Design Phase	n/a	n/a
Construction Phase		
Facility Modifications/Process Equipment	32,924	n/a
Project Management (4.9% of TEC)	1,975	n/a
Subtotal	34,899	n/a
Contingency (13% of TEC)	5,235	n/a
Total Line Item Cost	40,134	n/a
Less: Non-Agency Contribution	0	n/a
Total, Line Item Costs (TEC)	40,134	n/a

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] Design will be performed during Phase I from appropriated amounts for Building 3019 Complex operations as noted in the Preliminary PEP provided to Congress in May 2002.

6. Schedule of Project Funding

(dollars in thousands)

	Prior Year Costs	FY 2005	FY 2006	FY 2007	Outyears	Total
Project Cost[a]						
Facility Cost						
Construction	0	9,627	14,071	16,436	0	40,134
Total, Line Item TEC	0	9,627	14,071	16,436	0	40,134
Total Project Cost (TPC)	0	9,627	14,071	16,436	0	40,134

[a] Construction line item costs consist of facility modifications to the Building 3019 Complex and process equipment procurement and installation.

7. Related Annual Funding Requirements

	Current Estimate	Previous Estimate
Facility operating costs	*	*

*Narrative Explanation of Related Annual Funding Requirements

The total estimated cost and total project cost 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 operations and baseline security costs which will be required from award of Phase I to shutdown of the Building 3019 Complex during Phase III. A description of related annual funding requirements occurring during this period and a preliminary estimate of cost are provided below:

Baseline security costs of approximately $6 million per year will be funded by the Office of Science safeguards and security budget. The preliminary IGE cost estimate was $49,500,000.

Incremental security cost will be funded by the operating program and will cover access and handling of ^{233}U during processing activities. The preliminary IGE cost estimate was $28,100,000.

Other project-related costs include DOE project support and storage of down-blended material. The preliminary IGE cost estimate was $22,200,000.

The total related annual funding estimate for all phases including these related annual funding requirements was $254,272,000 based on the Preliminary PEP provided to Congress in May 2002.

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. It is estimated that over 16 million nuclear medicine procedures are performed each year 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.

Idaho Facilities Management

Funding Schedule by Activity

(dollars in thousands)

	FY 2003	FY 2004	FY 2005	$ Change	% Change
Idaho Facilities Management					
INL Operations	60,691	73,120	106,527	+33,407	+45.7%
INL Construction	2,292	2,295	1,523	-772	-33.6%
Total, Idaho Facilities Management	62,983	75,415	108,050	+32,635	+43.3%

Funding Schedule by Activity – Energy Supply

(dollars in thousands)

	FY 2003	FY 2004	FY 2005	$ Change	% Change
Idaho Facilities Management – Energy Supply[a]					
INL Operations	40,049	51,824	85,641	+33,817	+65.3%
INL Construction	2,292	2,295	1,523	-772	-33.6%
Total, Idaho Facilities Management – Energy Supply[a]	42,341	54,119	87,164	+33,045	+61.1%

Funding Schedule by Activity – Other Defense Activities

(dollars in thousands)

	FY 2003	FY 2004	FY 2005	$ Change	% Change
Idaho Facilities Management – Other Defense Activities[b]					
INL Operations	20,642	21,296	20,886	-410	-1.9%
Total, Idaho Facilities Management – Other Defense Activities[b]	20,642	21,296	20,886	-410	-1.9%

[a] Funding for Test Reactor Area (TRA) Landlord and Argonne National Laboratory - West (ANL-W) activities.
[b] Funding for Idaho Landlord activities less TRA and ANL-W (previously funded under Defense EM).

Description

On May 19, 2003, oversight of and Landlord responsibilities for the Idaho National Engineering and Environmental Laboratory (INEEL) transferred from the Office of Environmental Management (EM) to the Office of Nuclear Energy, Science and Technology (NE). Beginning in the second quarter of FY 2005, the laboratory will be merged with Argonne National Laboratory - West (ANL-W) to create the Idaho National Laboratory (INL).

The purpose of the Idaho Facilities Management program is to provide the Idaho National Laboratory (INL) with the site-wide Landlord infrastructure required to support technical efforts such as development of Generation IV nuclear energy systems, the Advanced Fuel Cycle Initiative, the Space Nuclear Propulsion program, and the Navy's nuclear propulsion research and development program. 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.

Benefits

The Idaho Facilities Management program supports *National Energy Policy* goals by maintaining and operating important Landlord infrastructure required to support 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 assuring 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.

To address the new mission, an *INL Ten-Year Site Plan* has been developed. The plan presents a mission needs analysis of existing facilities and infrastructure and of new facilities needed. It provides recommendations for short- and long-term recapitalization of existing mission essential facilities and infrastructure. It also presents a plan for revitalization of laboratory facilities to support the Generation IV Nuclear Energy Systems Initiative, the Advanced Fuel Cycle Initiative, national security technology programs, and multi-program advanced technology services and support. The plan identifies and prioritizes the projects, activities, and mission resource requirements for real property assets that covers a ten-year planning horizon. It 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 2005 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 2003	**FY 2004**	**FY 2005**
INL Operations	**60,691**	**73,120**	**106,527**
▪ **Laboratory Transition and Restructuring**	**0**	**0**	**43,800**

The current plan for the INEEL is to divide the contract into two new contracts both of which will be in place February 2005, through a competitive selection process. NE will manage the new nuclear power research laboratory contract, which is referred to as the Idaho National Laboratory (INL) contract. EM will manage the Idaho Closure Project contract. The new INL contractor will be responsible for continuity of services and restructuring the site to meet the needs of the new and enduring program missions. These one-time costs do not include the transition costs generally paid to new contractors or any worker severance costs.

▪ **Infrastructure Operations**	**46,046**	**52,264**	**53,011**

Provide landlord facility operations for operating and maintaining common use and user facilities, including nuclear and radiological facilities, and ensuring environmental compliance; infrastructure program management and support for planning, managing, and administering the Idaho Facilities Management Program. This includes: 890 square miles of land use; maintenance of 800 miles of roads; site railroad and 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 project funding. It 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.

▪ **General Plant Projects**	**8,092**	**4,800**	**6,863**

In FY 2005, funding will provide for projects such as:

- Minimum Safe/Caretaker Operations – GPPs will be used to reduce or eliminate emerging emergency infrastructure-related Environment, Safety, and Health problems.
- Upgrade the high voltage protective relays for the INL main electrical power distribution system.
- Complete construction of a new potable water well and water system for the Test Reactor Area (TRA) to meet new State and Federal drinking water standards.
- Test Reactor Area Retention Basin Isolation to prevent uncontrolled release of contaminated water.

	(dollars in thousands)		
	FY 2003	FY 2004	FY 2005
▪ **General Purpose Capital Equipment**	**6,553**	**5,395**	**2,853**

Purchase equipment in accordance with the *INL Ten Year Site Plan*. This funding primarily provides upgraded replacements for aged, deteriorated equipment and new equipment to meet emerging requirements. This includes such things as: shop and miscellaneous maintenance equipment; vehicles; and heavy equipment.

▪ **Advanced Test Reactor Research and Development Upgrade Initiative**	**0**	**4,824**	**0**

Initiate upgrades in FY 2004, to the Advanced Test Reactor to support planned advanced nuclear energy research projects.

▪ **ANL-W General Site Upgrades**	**0**	**5,837**	**0**

Provide for infrastructure projects and upgrades in FY 2004 such as the Industrial Waste Pond Remediation, and various urgent General Plant Projects needed to restore the site's aging infrastructure.

INL Construction	**2,292**	**2,295**	**1,523**
▪ **TRA Fire & Life Safety Improvements**	**481**	**490**	**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.

▪ **TRA Electrical Utility Upgrade**	**1,811**	**1,805**	**1,523**

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.

Total, Idaho Facilities Management	**62,983**	**75,415**	**108,050**

Explanation of Funding Changes

	FY 2005 vs. FY 2004 ($000)
INL Operations	
▪ **Laboratory Transition and Restructuring**	
The increase of $43,800,000 reflects one-time costs associated with restructuring the Idaho laboratory complex and supporting site infrastructure services until the new contractors are in place	+43,800
▪ **Infrastructure Operations**	
The increase of $747,000 reflects the goal of baselining routine maintenance and repair in FY 2005 and increasing funding to achieve and maintain an expenditure rate of 2-4 percent of Replacement Plant Value, a level recommended by the National Academy of Science and generally applied in industry	+747
▪ **General Plant Projects**	
The increase of $2,063,000 will be used to support necessary maintenance projects at INL	+2,063
▪ **General Purpose Capital Equipment**	
The decrease of $2,542,000 reflects deferring equipment purchases to future years due to higher priority activities	-2,542
▪ **Advanced Test Reactor Research and Development Upgrade Initiative**	
The decrease of $4,824,000 reflects the FY 2004 Appropriation language to initiate upgrades to the Advanced Test Reactor to support advanced nuclear energy research projects	-4,824
▪ **ANL-W General Site Upgrades**	
The decrease of $5,837,000 reflects the final FY 2004 Appropriation to provide funding for necessary infrastructure projects and upgrades that could no longer be deferred.	-5,837
Total, INL Operations	**+33,407**
INL Construction	
▪ **TRA Fire & Life Safety Improvements Project**	
The decrease of $490,000 reflects completion of the project in FY 2004	-490
▪ **TRA Electrical Utility Upgrade**	
The decrease of $282,000 reflects completion of the project in FY 2005 in accordance with the project plan.	-282

	FY 2005 vs. FY 2004 ($000)
Total, INL Construction	**-772**
Total Funding Change, Idaho Facilities Management	**+32,635**

Capital Operating Expenses

(dollars in thousands)

	FY 2003	FY 2004	FY 2005	$ Change	% Change
Capital Equipment	6,553	5,395	2,853	-2,542	-47.1%
General Plant Projects	8,092	10,637	6,863	-3,774	-35.5%
Total, Capital Operating Expenses	14,645	16,032	9,716	-6,316	-39.4%

Construction Projects

(dollars in thousands)

	Total Estimated Cost (TEC)	Prior-Year Approp.	FY 2003	FY 2004	FY 2005	Unapprop. Balance
95-E-201, TRA Fire & Life Safety Improvements Project (LICP)	14,768	13,797	481	490	0	0
99-E-200, TRA Electrical Utility Upgrade (LICP)	7,732	2,593	1,811	1,805	1,523	0
Total, Construction	22,500	16,390	2,292	2,295	1,523	0

99-E-200, Test Reactor Area Electrical Utility Upgrade, Idaho National Laboratory, Idaho

(Changes from FY 2004 Congressional Budget Request are denoted with a vertical line [|] in the left margin.)

Significant Changes

The A-E Work Completed date in Table 1 below for FY 2003 and FY 2004 has been changed from 4Q 2001 to 4Q 2003 to correct an error in last year's FY 2004 project data sheet.

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 1999 Budget Request *(Preliminary Estimate)*....................	2Q 1999	3Q 2000	3Q 2000	3Q 2002	6,700	7,320
FY 2000 Budget Request	2Q 1999	3Q 2000	4Q 2000	1Q 2004	6,700	7,560
FY 2001 Budget Request.............	2Q 1999	3Q 2001	4Q 2001	4Q 2004	6,995	7,937
FY 2002 Budget Request.............	2Q 1999	3Q 2001	2Q 2002	4Q 2005	7,709	8,856
FY 2003 Budget Request.............	2Q 1999	4Q 2003	2Q 2002	4Q 2005	7,709	8,856
FY 2004 Budget Request.............	2Q 1999	4Q 2003	4Q 2002	4Q 2005	7,709	8,856
FY 2005 Budget Request (Current Baseline Estimate).........	2Q 1999	4Q 2003	2Q 2002	4Q 2005	7,767	8,914
FY 2005 Budget Request (Congressional Budget Req).........	2Q 1999	4Q 2003	2Q 2002	4Q 2005	7,7324	8,87981

2. Financial Schedule

(dollars in thousands)

Fiscal Year	Appropriations	Obligations	Costs
Design/Construction			
1999	341	341	315
2000	425[a]	425	343
2001	877[b]	877	131
2002	950	950	1,804
2003	1,811[c]	1,811	1,698
2004	1,805[d]	1,805	1,840
2005	1,523	1,523	1,601

3. Project Description, Justification and Scope

The Test Reactor Area (TRA) was established in the early 1950's with the development of the Materials Test Reactor. Two other major test reactors as well as other facilities followed. The electrical distribution system supplying power to these programs was installed in accordance with the applicable codes and standards of the day but has not been upgraded to remain compliant with current safety and construction codes. The equipment is deteriorated and obsolete, and now is becoming unreliable. Repair parts are difficult to acquire or completely unavailable.

Over the past 40 years, numerous modifications to the configuration of the system have been accomplished. These modifications, while providing immediate solutions to specific problems, did not always address optimum overall system operation. These changing requirements have resulted in two main transformers being operated above manufacturer's recommended sustained loading. Even though this is safe, it will shorten transformer life. Plans and drawings of the system have not kept up with all the modifications and are unreliable, which poses a clear safety hazard to personnel operating and maintaining the system.

This project addresses: (1) the need to bring the system into compliance with current codes and standards, (2) the inadequate configuration that has developed over time, and (3) the need to replace obsolete, deteriorated system equipment that can no longer be maintained. Failure to correct these deficiencies will result in unreliable systems and significant personnel safety hazards.

[a] Excludes $908K reprogrammed to other DOE activities in FY 2000.
[b] Includes $48K reduction for FY 2001 rescission.
[c] Includes $29K reduction for FY 2003 rescission.
[d] Includes reductions of $24K for a FY 2004 general reduction and $11K for a rescission.

An external, independent review of this project conducted in June 1999, in response to a Congressional mandate for such reviews, strongly endorsed the need for this project, found the project well planned, and recommended that the Department accelerate funding.

The TRA Electrical Utility Upgrade Project provides for the design, procurement, and construction activities to correct the above described general system deficiencies in the 13.8kV and 5kV class equipment at the TRA. The work scope of this project provides:

1. Increased reliability by replacement of 30 to 40 year old switch gear, transformers and panels. The old equipment is subject to failure, spare parts unavailability, and unreliable operation increasing the risk of interruptions to down stream equipment.
2. An upgrade of the standby power system. The standby power system is used to supply emergency power to the breakers during power failures so that breaker operation can be maintained. The standby power system is 45 years old and subject to frequent failure and unavailability of spare parts.
3. Consolidation and reconfiguration of the electrical distribution system to make the system more efficient and provide for future possible expansion. This will reduce the amount of switchgear required and provide for standardization, both of which will result in (1) an overall savings to the government by significantly reducing maintenance and training costs in future years and (2) will significantly lower safety risk for operators and maintenance personnel.
4. Reconfiguration to remove parts of the electrical distribution system currently housed in otherwise shutdown facilities. This will allow for demolition of these unneeded facilities by the Office of Environmental Management which will result in a significant overall savings to the government by eliminating maintenance costs.
5. A significant reduction in fire hazards. Obsolete, deteriorated switchgear will be replaced with modern equipment designed to current fire safety code requirements.

The project scope includes, but is not limited to, replacement of selected switchgear and facility transformers, modifications to electrical services and panels, construction of underground ductbanks, replacement of power cables and control wiring, and modifications to instrumentation and control equipment.

4. Details of Cost Estimate

	(dollars in thousands)	
	Current Estimate	Previous Estimate
Design Phase		
Preliminary and Final Design Costs (Design Drawings and Specifications)	662	662
Design Management Costs (0.3% of TEC)	24	24
Project Management Costs (1.3% of TEC)	101	101
Total, Design and Management Costs (10.2% of TEC)	787	787
Construction Phase		
Utilities	3,996	3,996
Inspection, Design and Project Liaison, Testing, Checkout and Acceptance	315	315
Construction management (9.4% of TEC)	727	731
Project management (8.8% of TEC)	681	685
Total, Construction Costs	5,719	5,727
Contingencies (15.9~~8~~% of TEC)	1,226~~8~~	1,253
Total, Line Item costs (TEC)	7,7324	7,767

5. Method of Performance

The Department of Energy Idaho Operations Office (DOE-ID) will be responsible for project validation, implementation of the project (including selection of principal contractors) and approval of specified procurement actions. DOE-ID project management oversight will be performed by the Construction Management Group in the Office of Program Execution. Safety, environmental, and other project support will be furnished to the project on an as-needed basis by the DOE-ID matrix organization.

The design, project management, and construction management will be performed under a negotiated contract with the operating contractor. Construction and procurement will be accomplished by fixed price contracts awarded on the basis of competitive bidding. Inspection may be performed by another agent. Check-out of systems and maintenance of the completed project will be performed by the operating contractor.

The IN~~EE~~L operating contractor Project Manager will be responsible for the entire project.

6. Schedule of Project Funding

(dollars in thousands)

	Prior Years	FY 2003	FY 2004	FY 2005	Outyears	Total
Project Cost						
Facility Cost						
Design	789	114	0	0	0	903
Construction	1,804	1,584	1,840	1,601~~3~~	0	6,829~~31~~
Total, Line item TEC	2,593	1,698	1,840	1,601~~3~~	0	7,7324
Other project costs						
Conceptual design costs	138	0	0	0	0	138
NEPA documentation costs	4	0	0	0	0	4
Other project-related costs	311	184	184	326	0	1,005
Total other project costs	453	184	184	326	0	1,147
Total, Project Cost (TPC)	3,046	1,882	2,024	1,929	0	8,879~~81~~

7. Related Annual Funding Requirements

	(FY 2005 dollars in thousands)	
	Current Estimate	Previous Estimate
Total related annual funding	*	*

*Narrative Explanation of Related Annual Funding Requirements

This project replaces existing equipment and cabling built to outdated standards and currently at the end of useful life. The replacement system will be built using current standards for design and materials and will correct numerous inefficiencies with the existing system. Routine maintenance and repairs for all TRA common use facilities and utilities, including this system, are funded through the annual TRA Facilities Maintenance and Repair budget. Annual maintenance and operating costs for the design life expectancy of the new system are expected to be significantly less than the current costs of operating the existing system for reasons noted in Section 3 above.

Program Direction

Funding Schedule

(dollars in thousands/whole FTEs)

	FY 2003	FY 2004	FY 2005	$ Change	% Change
Program Direction					
Salaries and Benefits	44,997	47,151	47,356	+205	+0.4%
Travel	1,511	1,732	1,732	+0	+0.0%
Support Services	3,460	2,430	2,430	+0	+0.0%
Other Related Expenses	7,941	8,474	8,767	+293	+3.5%
Total Program Direction	57,909	59,787	60,285	+498	+0.8%
Headquarters FTEs	137	142	144	+2	+1.4%
Field FTEs	259	259	251	-8	-3.1%

Funding Schedule- Energy Supply

(dollars in thousands/whole FTEs)

	FY 2003	FY 2004	FY 2005	$ Change	% Change
Program Direction – Energy Supply					
Salaries and Benefits	17,474	19,741	20,140	+399	+2.0%
Travel	757	951	951	+0	+0.0%
Support Services	2,710	1,627	1,627	+0	+0.0%
Other Related Expenses	3,033	3,423	3,709	+286	+8.4%
Total Program Direction – Energy Supply	23,974	25,742	26,427	+685	+2.7%
Headquarters FTEs	128	133	141	+8	+6.0%
Field FTEs	23	23	14	-9	-39.1%

Funding Schedule- Other Defense

(dollars in thousands/whole FTEs)

	FY 2003	FY 2004	FY 2005	$ Change	% Change
Program Direction – Other Defense					
Salaries and Benefits	27,523	27,410	27,216	-194	-0.7%
Travel	754	781	781	+0	+0.0%
Support Services	750	803	803	+0	+0.0%
Other Related Expenses	4,908	5,051	5,058	+7	+0.1%
Total Program Direction – Other Defense	33,935	34,045	33,858	-187	-0.5%
Headquarters FTEs	9	9	3	-6	-66.7%
Field FTEs	236	236	237	+1	+0.4%

Program Direction
Funding Profile by Category

(dollars in thousands/whole FTEs)

	FY 2003	FY 2004	FY 2005	$ Change	% Change
Chicago					
Salaries and Benefits	1,044	1,063	0	-1,063	-100.0%
Travel	71	80	0	-80	-100.0%
Support Services	52	78	0	-78	-100.0%
Other Related Expenses	67	75	0	-75	-100.0%
Total, Chicago	1,234	1,296	0	-1,296	-100.0%
Full Time Equivalents	8	8	0	-8	-100.0%
Idaho					
Salaries and Benefits	26,279	25,778	26,108	+330	+1.3%
Travel	695	714	794	+80	+11.2%
Support Services	712	764	842	+78	+10.2%
Other Related Expenses	4,622	4,755	4,830	+75	+1.6%
Total, Idaho	32,308	32,011	32,574	+563	+1.8%
Full Time Equivalents	236	236	237	+1	+0.4%
Oak Ridge					
Salaries and Benefits	1,705	1,759	1,819	+60	+3.4%
Travel	37	39	39	+0	+0.0%
Support Services	22	23	23	+0	+0.0%
Other Related Expenses	42	75	76	+1	+1.3%
Total, Oak Ridge	1,806	1,896	1,957	+61	+3.2%
Full Time Equivalents	14	14	14	+0	+0.0%
Livermore Site Office					
Salaries and Benefits	110	116	0	-116	-100.0%
Travel	5	6	0	-6	-100.0%
Support Services	0	0	0	+0	-100.0%
Other Related Expenses	12	12	0	-12	-100.0%
Total, Livermore Site Office	127	134	0	-134	-100.0%
Full Time Equivalents	1	1	0	-1	-100.0%

(dollars in thousands/whole FTEs)

	FY 2003	FY 2004	FY 2005	$ Change	% Change
Headquarters					
Salaries and Benefits	15,859	18,435	19,429	+994	+5.4%
Travel	703	893	899	+6	+0.7%
Support Services	2,674	1,565	1,565	+0	+0.0%
Other Related Expenses	3,198	3,557	3,861	+304	+8.5%
Total, Headquarters	22,434	24,450	25,754	+1,304	+5.3%
Full Time Equivalents	137	142	144	+2	+1.4%
Total Program Direction					
Salaries and Benefits	44,997	47,151	47,356	+205	+0.4%
Travel	1,511	1,732	1,732	+0	+0.0%
Support Services	3,460	2,430	2,430	+0	+0.0%
Other Related Expenses	7,941	8,474	8,767	+293	+3.5%
Total, Program Direction	57,909	59,787	60,285	+498	+0.8%
Full Time Equivalents	396	401	395	-6	-1.5%

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.

On May 19, 2003, oversight of and Landlord responsibilities for the Idaho National Engineering and Environmental Laboratory (INEEL) transferred from the Office of Environmental Management (EM) to the Office of Nuclear Energy, Science and Technology (NE). Beginning in the second quarter of FY 2005, the 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.

The Office of Nuclear Energy, Science and Technology and the DOE Idaho Operations Office (NE-ID) are being integrated into a single functional organization to optimize the efficiency and effectiveness of the Department's oversight of the INL. NE is committed to eliminating the barriers associated with the traditional headquarters/field relationship. This new structure will carry out all of the programmatic, project, and landlord responsibilities assigned to NE now and in the future, both as Lead Program Secretarial Officer (PSO) and Contracting Officer for DOE's operations in Idaho, and as responsible PSO for programs, projects, facilities and operations at other DOE sites.

NE is one of the most programmatically diverse organizations in the Department 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.

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 2003 to reflect the transfer of Lead Program Secretarial Office (LPSO) responsibilities to NE from the Office of Environmental Management and other mission changes. 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 49.5 years, just slightly higher than the 47.5 year average age of the Federal workforce overall. Out of the current workforce, thirty six percent will be eligible to retire within 5 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 *Plan* indicates that, especially in the area of project management, 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 *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 *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; to retain special skills through special incentive programs; succession planning; to train/retrain; and participate in special employment programs.

NE's expanding responsibilities are reflected in the transfer of staff from other organizations to assist in a range of vital missions. In FY 2004, NE will complete its absorption of twenty experienced staff from the Office of Environmental Management to assist in the oversight of the Idaho Laboratory Complex and guide its reformation into a world-class nuclear energy research center. NE has also assumed oversight responsibility for the Department's interaction with the Organization for Economic Cooperation and Development's (OECD), reflecting its expanding role in guiding U.S. policy related the OECD Nuclear Energy Agency. With that responsibility, beginning in FY 2005, NE will assume full responsibility for one FTE transferred from NNSA, including all associated expenses and International Cooperative Administrative Support Services (ICASS). Finally, several staff at the Oak Ridge Operations Office (OR) are supporting EM and NE headquarters in managing a range of activities associated with the management of uranium resources and related functions, overseeing the Department's lease agreement with USEC Inc, and assisting in various management activities associated with the DOE enrichment sites. With a recent decision to release the Office of Science from its LPSO responsibilities for the Portsmouth and Paducah sites, seven staff at the Oak Ridge Operations Office will be transferred from Office of Science oversight to NE beginning in FY 2005.

As stated in the Departmental Strategic Plan, DOE's Strategic and General Goals will be accomplished not only through 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 Nuclear Energy, Science and Technology performs critical functions which directly support the mission of the Department.

Detailed Justification

	(dollars in thousands)		
	FY 2003	FY 2004	FY 2005
Salaries and Benefits	**44,997**	**47,151**	**47,356**

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 132. As nearly forty percent of the staff will be eligible to retire within 5 years, it is essential that program direction resources are available to compete for needed skills. In addition to the Headquarters staff, NE also funds one oversees FTE located in Paris to support international collaboration activities. In FY 2005, NE field employees include: Idaho Operations Office (237), and Oak Ridge Operations Office (14).

Travel	**1,511**	**1,732**	**1,732**

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	**3,460**	**2,430**	**2,430**

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.

Other Related Expenses	**7,941**	**8,474**	**8,767**

The major expenditure in the other related expenses category ($2,334,000 million in FY 2005, up from $2,068,000 million in FY 2004) is earmarked for the Headquarters Working Capital Fund (WFC). The Department's Office of Management, Budget, and Evaluation (ME) established a WCF to provide funding for mandatory administrative costs, such as office space and telephone services. The FY 2005 estimate was provided by ME and requires an increase in the cost of building occupancy rates based on current General Services Administration (GSA) rates and an increase in telephone services.

	(dollars in thousands)		
	FY 2003	FY 2004	FY 2005

Also included in other expenses are costs associated with the Paris Office such as housing, training, office communications, supplies, miscellaneous expenses and International Cooperative Administrative Support Services (ICASS).

Total, Program Direction	**57,909**	**59,787**	**60,285**

Explanation of Funding Changes

	FY 2005 vs. FY 2004 ($000)
Salaries and Benefits	
▪ The increase of $205,000 is the net of an additional $330,000 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 $742,000 for a 2.5 percent escalation in accordance with established guidelines and funds for promotions and within-grade salary increases; and a decrease of $867,000 for a reduction of 1 field FTE at Livermore Site Office Oakland, 2 field FTEs at Chicago and 5 field FTEs at Idaho	+205
Other Related Expenses	
▪ The increase of $293,000 in other related expenses is primarily due to an increase for the WCF for the cost of building occupancy rates based on current GSA rates, and an increase in telephone services.	+293
Total Funding Change, Program Direction	**+498**

Support Services by Category

	(dollars in thousands)				
	FY 2003	FY 2004	FY 2005	$ Change	% Change
Technical Support Services	2,597	1,418	1,418	+0	+0.0%
Management Support Services	863	1,012	1,012	+0	+0.0%
Total, Support Services	3,460	2,430	2,430	+0	+0.0%

Other Related Expenses by Category

	(dollars in thousands)				
	FY 2003	FY 2004	FY 2005	$ Change	% Change
Other Related Expenses					
Working Capital Fund	1,930	2,068	2,334	+266	+12.9%
Nuclear Energy Research Advisory Committee	300	400	400	0	+0.0%
ADP/TeleVideo Hardware and Software...	428	588	591	+3	+0.5%
Subscriptions/Publications	20	28	28	0	+0.0%
Training	133	108	108	0	+0.0%
Other Miscellaneous	5,130	5,282	5,306	+24	+0.5%
Total, Other Related Expenses	7,941	8,474	8,767	+293	+3.5%

Civilian Radioactive Waste Management

Civilian Radioactive Waste Management

Energy Supply Research & Development

Office of Civilian Radioactive Waste Management (OCRWM)

Overview

Appropriation Summary by Program

(dollars in thousands)

	FY 2003 Comparable Appropriation	FY 2004 Original Appropriation	FY 2004 Adjustments	FY 2004 Comparable Appropriation	FY 2005 Request
Energy Supply	4,962	5,061	0	5,061	5,223
Total, Energy Supply	4,962	5,061	0	5,061	5,223

Preface

OCRWM will assume responsibility for the transportation of domestic and university research reactor spent nuclear fuel from NRC-licensed university reactors and from DOE's HFIR, and management and operations of two NRC-licensed, Department-owned independent spent fuel storage installations in FY 2005. One ISFSI, the Ft. St. Vrain facility, is located in Eagle County, Colorado, and stores commercial SNF from the shutdown Ft. St. Vrain high-temperature gas reactor. The second ISFSI is located on the Idaho National Environmental and Engineering Laboratory at the Idaho Nuclear Technology Engineering Center. This ISFSI stores SNF from the damaged TMI-2 reactor. Management of this activity will be transferred from the Office of Environmental Management. Funding for this activity includes management and operation of the ISFSIs and annual NRC license fees.

Within the Energy Supply Research and Development, OCRWM has only one program: Civilian Radioactive Waste Management.

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 address 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 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 GPRA and the President's Management Agenda (PMA).

Mission

The current mission of the Office of Civilian Radioactive Waste Management (OCRWM) is to manage and dispose of high-level radioactive waste and spent nuclear fuel in a manner that protects health, safety, and the environment; enhances national and energy security; and merits public confidence. In FY 2005, OCRWM's mission will be expanded to address certain SNF management and transportation responsibilities. The ultimate disposition of all SNF is geologic disposal in a repository.

Benefits

Spent nuclear fuel (SNF) and high-level radioactive waste (HLW) have accumulated in the United States during the last half-century from nuclear weapon production, nuclear-powered naval vessels usage, DOE test reactors, research reactors, and electricity generation. The United States has evaluated methods for the safe storage and disposal of SNF and HLW for more than 40 years. After analyzing a range of options, disposal in mined geologic repositories emerged as the preferred long-term environmental solution for the management of SNF and HLW. Congress assigned responsibility to the DOE to: site, apply for a license, construct, operate, and close a repository for the disposal of SNF and HLW. In addition, the Nuclear Waste Policy Act (NWPA) assigned responsibility to the generators and owners of SNF and HLW to pay the costs of disposal of such radioactive materials.

OCRWM's current mission is to "manage and dispose of high-level radioactive waste and spent nuclear fuel in a manner that protects health, safety, and the environment; enhances national and energy security; and merits public confidence." With site designation, OCRWM has initiated the next phase of repository development; namely, licensing in accordance with applicable U.S. Nuclear Regulatory Commission (NRC) regulations and authority and funding in accordance with DOE and Office of Management and Budget requirements and regulations. OCRWM, with the support of its management and operating contractor (M&O), is preparing a License Application for submittal to the Nuclear Regulatory Commission (NRC) in December 2004.

Strategic 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 five Environmental Management appropriations (Defense Site Acceleration Completion, Non-Defense Environmental Services, Uranium Enrichment Decontamination & Decommissioning Fund, Nuclear Waste Disposal, and Defense Nuclear Waste Disposal appropriations support the following goals:

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 the Nation's high-level radioactive waste.

General Goal 7, Nuclear Waste: License and construct a permanent repository for nuclear waste at Yucca Mountain and begin acceptance of waste by 2010.

The program funded within the Energy Supply Research and Development appropriation has one Program Goal that contributes to the General Goal in the "goal cascade". This goal is General Goal 7, Nuclear Waste.

Program Goal 7.25.00.0, Planned Annual Operational Rate: The Yucca Mountain repository is licensed, constructed, and operating; the national and Nevada waste transportation systems are in place; activities required to support receipt and emplacement of spent nuclear fuel (SNF) and high-level radioactive waste (HLW) at the repository are proceeding on schedule.

Contribution to General Goal

Within the Civilian Radioactive Waste Management Program, the Yucca Mountain Sub-Program contributes to General Goal 7 by preparing and submitting the license application to NRC by 2004 for a repository construction authorization by 2008 and subsequently constructing and operating the repository by 2010. The Transportation Sub-Program contributes to General Goal 7 by developing the transportation network, equipment, and facilities that are required for shipment of waste to the repository by 2010.

Funding by General Goal

(dollars in thousands)

	FY 2003	FY 2004	FY 2005	$ Change	% Change
General Goal 7, Energy Supply Research and Development					
Program Goal 7.25.00.0, Planned Annual Operational Rate	4,962	5,061	5,223	+162	+3.2%
Subtotal, General Goal 4					
Total, General Goal 7 (Energy Supply Research and Development)	4,962	5,061	5,223	+162	+3.2%

Means and Strategies

During FY 2005, the Civilian Radioactive Waste Management Program will focus its activities on work relating to repository licensing and design, especially repository license defense; and planning and acquisition of the required transportation network, equipment, and facilities to support waste acceptance at the repository. Memoranda of Agreement (MOA) have been negotiated between OCRWM and the Naval Nuclear Propulsion Program and between OCRWM and the Department's Office of Environmental Management. The Program also collaborates with several other nations to address common technical issues associated with radioactive waste management and disposal.

Validation and Verification

The Program's activities are subject to continuing review by the Congress, the General Accounting Office, the Department's Inspector General, the Nuclear Regulatory Commission, the Environmental Protection Agency, the Nuclear Waste Technical Review Board, and the Department's Office of Engineering and Construction Management. The latter performs external independent reviews and independent cost estimates prior to critical decisions. In addition, the Program Director reviews the progress and schedule and cost performance of the Yucca Mountain and Transportation Sub-Programs on a quarterly basis. The Yucca Mountain Sub-Program Manager conducts similar reviews monthly. The quality of the Program's work is subject to a Nuclear Regulatory Commission-approved quality assurance program. The Program's financial statements are audited annually by an independent public accounting firm. The Program has received an unqualified ("clean") auditors' opinion every year since inception. Finally, the Program conducts an annual internal controls review under the Federal Managers' Financial Integrity Act. The Program's performance measures and associated quarterly milestones are reviewed and approved by the OCRWM Director and then entered into and tracked in the Department's performance measurement database. Final performance results are audited and reported both in OCRWM's Annual Report to the Congress and the Department's Performance and Accountability Report.

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 structural framework of the PART provides a means through which programs can assess their activities differently than through traditional reviews.

The first PART review of OCRWM's Yucca Mountain Project resulted in the assignment of an "adequate" rating by OMB based on an overall score of 50. In many instances, the Yucca Mountain Project isn't at a stage where it can be effectively evaluated as a mature project. After last year's site designation, the project is transitioning from a site recommendation to a design, licensing, and construction project. A score of 100 was awarded in the "Project Purpose and Design" section. "Strategic Planning" and "Program Management" were scored 67 and 75, respectively. The score of 16 in the "Project Results" section reflects OMB's position that the Project lacks an adequate performance baseline, that its "Earned Value Management System" (EVMS) has not been certified, and that its "Capital Asset Management Plan," incorporating an acquisition strategy had not been finalized. The performance baseline and certification of EVMS is required by DOE Order 413.3 at the time of Critical

Decision 2 scheduled for September 2005. There had been consideration for an earlier start, but it was determined there would be a detrimental impact to the confidence in achieving the completion of the License Application submission. The project has a performance measurement baseline in place and performance data is being collected and reported using an earned value management system, which has been in place since 1991. Development of the Capital Asset Management Plan was in process at the time the PART was completed; and an update of a final draft was completed in November 2003.

Significant Program Shifts

In FY 2005, the Office of Civilian Radioactive Waste Management will assume responsibility for the oversight of or provide funding assistance for the transportation of domestic and university research reactor spent nuclear fuel from NRC-licensed university reactors and from DOE's High Flux Isotope Reactor (HFIR). Management of this activity will be transferred from the Office of Nuclear Energy, Science and Technology. Universities would pay the costs of DOE shipments from reactor sites to a Department-managed storage site. HFIR shipments will be funded by the HFIR operating budget.

Also in FY 2005, OCRWM will assume responsibility for the management and operations of two NRC-licensed, Department-owned independent spent fuel storage installations (ISFSI). The Ft. St. Vrain facility is located in Colorado and stores commercial SNF from the shutdown Ft. St. Vrain high-temperature gas reactor. The TMI-2 ISFSI is located at the Idaho National Environmental and Engineering Laboratory. This ISFSI stores SNF from the damaged TMI-2 reactor. Management of this activity will be transferred from the Office of Environmental Management. Funding for this activity includes management and operation of the ISFSIs and annual NRC license fees.

These functions being transferred to OCRWM in FY 2005 will be managed by the newly formed Office of DOE Spent Fuel Management, which will report to the OCRWM Director. This Office has responsibility for the management and integration of DOE spent fuel activities across the DOE complex as well as spent fuels from civilian domestic and foreign research reactors.

Office of Civilian Radioactive Waste Management

Funding Schedule by Activity

(dollars in thousands)

	FY 2003	FY 2004	FY 2005	$ Change	% Change
Energy Supply Research and Development					
Spent Nuclear Fuel Storage Responsibilities	4,762	4,861	5,023	+162	+3.3%
Domestic Research Reactor Spent Nuclear Fuel Transportation	200	200	200	0	0.0%
Total, Energy Supply Research and Development	4,962	5,061	5,223	+162	+3.2%

Description

The Office of Environmental Management (EM) and OCRWM have agreed to realign the responsibility for specific SNF storage responsibilities at the Idaho National Engineering and Environmental Laboratory from EM to RW. In addition, the Office of Nuclear Energy (NE) and OCRWM have agreed to consolidate specific functions related to planning and transportation of domestic research reactor spent nuclear fuel at certain NRC-licensed university research reactors and domestic HFIR research reactors within OCRWM.

Benefits

These responsibilities will maintain the safe transportation and interim storage, and proper resolution of DOE spent nuclear fuel that will ultimately be disposed of in a geologic repository.

Detailed Justification

	(dollars in thousands)		
	FY 2003	FY 2004	FY 2005
Spent Nuclear Fuel Storage Responsibilities	**4,762**	**4,861**	**5,023**

- The Office of Environmental Management (EM) and RW have agreed to realign the responsibility for specific SNF storage responsibilities of the Idaho National Engineering and Environmental Laboratory from EM to RW. Program responsibility for the management of the NRC-licensed Ft. St. Vrain Independent Spent Fuel Storage Installation (ISFSI) located in Colorado, and the NRC-licensed Three Mile Island–2 ISFSI located at the Idaho Nuclear Technology Engineering Center (INTEC) will be realigned from EM to RW because the spent nuclear fuel storage at these facilities originated at commercial reactors and is planned for disposal by RW pending availability of the geologic repository at Yucca Mountain. RW will be required to meet the NRC license conditions during interim storage, for ensuring these SNF forms are analyzed within the repository performance criteria, and for the eventual transportation related activities.

Domestic Research Reactor Spent Nuclear Fuel Transportation	**200**	**200**	**200**

- The Office of Nuclear Energy (NE) and RW have agreed to consolidate specific functions related to planning, oversight, and/or funding assistance for the transportation of domestic and university research reactor spent nuclear fuel at certain NRC-licensed university research reactors and DOE's High Flux Isotope research reactor within RW. Responsibility for University Reactor Infrastructure and Education Assistance will move from NE to RW. The ownership of the BMI transportation cask for university shipments will realign to RW. Transferring responsibility – including planning, coordination, receipt and transportation, allows for consistent planning and policy for the transportation of domestic research reactor SNF.

  Universities are responsible for the costs of transportation from their NRC-licensed reactors to a DOE storage site. The Office of Science would pay the costs for shipments of HFIR SNF to a DOE storage site. This change does not affect the storage and future packaging of SNF at Department-managed storage basins. The SNF is planned for ultimate disposal at the geologic repository at Yucca Mountain.

Total, Energy Supply Research and Development	**4,962**	**5,061**	**5,223**

Explanation of Funding Changes

	FY 2005 vs. FY 2004 ($000)
Spent Nuclear Fuel Storage Responsibilities	
The increase in funding is due to the Office of Environmental Management (EM) and OCRWM agreeing to realign the responsibility for the management of NRC-licensed independent spent fuel storage installations (ISFSIs) for TMI-2 SNF at the Idaho National Environmental and Engineering Laboratory and for spent fuel at the Ft. St. Vrain ISFSI in Colorado. These ISFSIs store commercial-origin non-legacy spent nuclear fuel.	+162
Total Funding Change, Energy Supply Research and Development	+162

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 2003 Comparable Appropriation	FY 2004 Original Appropriation	FY 2004 Adjustments	FY 2004 Comparable Appropriation	FY 2005 Request
Energy Supply (EH)					
Environment, Safety and Health Programs	6,746	7,000	-133[ab]	6,867	10,000
Program Direction	15,573	16,000	-303[ab]	15,697	20,474
Subtotal, Energy Supply (EH)	22,319	23,000	-436	22,564	30,474
General Reductions	0	-302	+302	0	0
Total, Energy Supply (EH)	22,319	22,698	-134	22,564	30,474
Other Defense Activities (EH)					
Environment, Safety & Health Programs	90,304	93,351	+8,662[acd]	102,013	99,105
Program Direction	20,077	18,910	-1,057[ad]	17,853	20,414
Subtotal, Other Defense Activities	110,381	112,261	+7,605	119,866	119,519
Use of Prior Year Balances	-1,287	0	-500	-500	-15,000
Total, Other Defense Activities (EH)	109,094	112,261	+7,105	119,366	104,519
Total, Energy Supply and Other Defense Activities (EH)	131,413	134,959	+6,971	141,930	134,993

[a] Distribution of the rescission from the Consolidated (Omnibus) Appropriations Bill for FY 2004.
[b] Spread of the Energy Supply $10 million reduction in the FY 2004 Energy and Water Appropriation Act.
[c] Amount includes a comparability reprogramming of $9,739,886 to the Department's Employee Compensation Program in September 2003 to expedite the processing of applications submitted to DOE under Subtitle D of the Energy Employees Occupational Illness Compensation Program Act (EEOICPA).
[d] Amount includes comparability transfer of $1,475,000 for the transfer of the Defense Nuclear Facilities Safety Board Liaison to the Office of Independent Oversight and Performance Assurance.

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: 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 – Perform work in compliance with environmental regulations; adopt management systems that integrate environmental considerations into work planning.

- 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 – Provide appropriate assistance for health issues of our former workers; assure current workers and the public are protected.

- Performance Assessment – Provide environment, safety and health performance measures to focus resources and attention of the Department.

- Price Anderson Enforcement – Carry out the statutory mandate of the Price Anderson Amendment Act of 1988 to enforce compliance with nuclear safety requirements.

Mission

The mission of the Office of Environment, Safety, and Health (EH) is to ensure the DOE performs work in a safe and environmentally compliant manner.

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 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.

Significant Program Shifts

None

Energy Supply
Office of Environment, Safety & Health
Funding by Site by Program

(dollars in thousands)

	FY 2003	FY 2004	FY 2005	$ Change	% Change
Chicago Operations Office					
Argonne Nat'l Laboratory					
Policy, Standards & Guidance ...	460	425	425	0	0.0%
Idaho Operations Office					
DOE-Wide ES&H Programs	355	250	250	0	0.0%
Livermore Site Office					
Lawrence Livermore Nat'l Laboratory					
DOE-Wide ES&H Programs	80	0	0	0	0.0%
Oak Ridge Operations Office					
Oak Ridge Nat'l Laboratory					
Policy, Standards & Guidance ...	200	600	600	0	0.0%
DOE-Wide ES&H Programs	300	850	850	0	0.0%
Total, Oak Ridge Operations Office...	500	1,450	1,450	0	0.0%
Richland Operations Office					
Pacific Northwest Nat'l Laboratory					
Policy, Standards & Guidance ...	75	125	125	0	0.0%
Washington Headquarters					
Policy, Standards & Guidance ...	303	649	3,055	+2,406	+370.7%
DOE-Wide ES&H Programs	4,973	3,968	4,695	+727	+18.3%
Program Direction	15,573	15,697	20,474	+4,777	+30.4%
Total, Washington Headquarters	20,849	20,314	28,224	+7,910	+38.9%
Total, Energy Supply (EH)	22,319	22,564	30,474	+7,910	+35.1%

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

Policy, Standards and Guidance

Argonne National Laboratory 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; provides technical support in the review of environmental impact statements (EIS) and other National Environmental Policy Act (NEPA) and related documents; provides specialized technical expertise for the development of DOE performance summaries on air resource protection and environmental releases; and provides specialized technical expertise to promote the efficient implementation of Clean Air Act requirements. Argonne also provides technical expertise for water resources, human and ecological risk assessments; and modeling capabilities for the analysis of radiological releases to the environment related to DOE operations.

Idaho Operations Office

DOE-Wide ES&H Programs

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. The Analytical Services Program (ASP) provides support for development of a web based reporting system in support of the Department of Energy's Consolidated Audit Program.

Lawrence Livermore National Laboratory Site Office

The Lawrence Livermore National Laboratory Site Office provides liaison between the National Nuclear Security Administration services center and the site contractor.

Lawrence Livermore National Laboratory

DOE-Wide ES&H Programs

Lawrence Livermore National Laboratory (LLNL), located in California's Tri-Valley region east of San Francisco, provides continuing support to the Marshall Islands program by providing environmental sampling and analysis to determine the radiological conditions at the affected atolls and performs epidemiological site surveillance. Lawrence Livermore participates in the Epidemiologic Surveillance program through the collection and transmission of worker health and demographics data. LLNL also provides software quality assurance expertise support to maintain the code registry that is important for nuclear safety analysis throughout the complex.

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

Policy, Standards and Guidance

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; 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. It also supports technical reviews and EISs and other NEPA related documents and supports technical reviews of the potential impacts of proposed environmental regulations on DOE operations.

DOE-Wide ES&H Programs

ORNL is also involved in project development, protocol development, etc., covering a wide range of Office of Health activities including descriptive epidemiologic studies, former worker medical surveillances, health studies reviews and communications, training and orientation developments related to health activities, beryllium surveillance activities of current and former workers, development of competencies and response to medical outcomes noted in worker populations, and input to developmental needs to revise or update worker protection requirements.

Richland Operations Office

Richland Operations Office, Richland, Washington, manages waste products; develops, applies, and commercializes technologies; manages environment, safety, and health activities; and supports cleanup and environmental restoration.

Pacific Northwest National Laboratory

Policy, Standards and Guidance

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, pollution prevention, and affirmative procurement of environmentally preferable products. 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. It also supports technical reviews of EISs and other NEPA and related documents.

Washington Headquarters

Policy, Standards and Guidance

The Environmental Studies Program requires technical support in reviewing cost and technical issues relating to implementing the requirements of proposed and new environmental legislation and regulations at DOE operations. Technical support is also required in the development of models and other tools to perform quantitative and trending analysis of DOE's environmental performance and in reviewing Environmental Impact Statements and other NEPA-related documents.

DOE-Wide ES&H Programs

The Office of health requires contractor support to facilitate the implementation of health studies reviews and communication. Additional contracted efforts involve support to the development of worker-based safety programs, the creation of model medical programs, and the assessment of core competencies and program development strategies for each of the organizational elements in the Office of Health.

Environment, Safety and Health Program

Funding Profile by Subprogram

(dollars in thousands)

	FY 2003 Comparable Appropriation	FY 2004 Original Appropriation	FY 2004 Adjustments	FY 2004 Comparable Appropriation	FY 2005 Request
Environment, Safety and Health					
Policy, Standards and Guidance	1,038	1,827	-28	1,799	4,205
DOE-Wide ES&H Programs	5,708	5,173	-105	5,068	5,795
Total, Environment, Safety and Health	6,746	7,000	-133	6,867	10,000

Public Law Authorizations:
Public Law 95-91, "Department of Energy Organization Act"
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 missions. 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, e.g., supporting accreditation programs for worker radiation protection monitoring, administering DOE's Voluntary Protection Program to promote excellence in safety management, and collecting and analyzing DOE-wide environment, safety, and health performance data to identify opportunities to advance the DOE mission through proactive intervention. 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; applying regulations (guidance on Environmental Protection Agency (EPA), Occupational Safety and Health Administration

(OSHA), the States, and Nuclear Regulatory Commission (NRC) regulation); 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; advocate cost-effective regulation from external sources and from 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.

Detailed Justification

	(dollars in thousands)		
	FY 2003	FY 2004	FY 2005
Policy, Standards and Guidance........................	**1,038**	**1,799**	**4,205**

Policy, standards and guidance are issued to assure that people, property and the environment are adequately protected from the hazards of DOE activities. The policies and standards being applied at DOE facilities must 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 authority for safety and health as provided by the Atomic Energy Act of 1954, as amended. Safety and quality assurance 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.

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 2005, DOE nuclear and facility safety policies and standards will be enhanced to reflect knowledge updated commercial codes and standards, changing DOE missions and work environments, and to 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 increased its fee to DOE by 100K in FY 2004, with a 4% annual escalation in FY 2005.

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. Activities in FY 2004 included the consolidation and integration of DOE safety and health standards and policy consistent with the principles of Integrated Safety Management and published their Congressionally mandated Occupational Safety and Health Rule, (10 CFR 851). The Rule will be implemented in FY 2005.

In FY 2004, a greater link was made between Epidemiologic Studies conducted to evaluate the adequacy of historical worker safety and health policy and implications to current policy. The need for new studies and surveillance to enhance worker standards and policy will be determined. In FY 2005 EH will implement the results of this evaluation through the modification of the epidemiologic and medical surveillance programs and modification, as appropriate, of worker safety and health standards policy.

Also, 29 CFR 1960 requires a documented Federal Employee Occupational Safety and Health (FEOSH) program for Federal employees. In FY 2005, the FEOSH program will focus on the conduct of facility and worker walkthroughs and inspections to identify opportunities to assure a safe work environment.

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 Policies, Standards and Guidance Program ensures the Department performs work in an environmentally sound and compliant manner. Environmental Protection Policy and Regulatory Activities ensure that the Department's policies, orders, and guides promote sound environmental practices and the reduction of environmental releases and waste generation during DOE's operations. EH's Environmental Requirements Compliance Support enables DOE elements to comply 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 request from DOE line management to assist in the development of cost-effective strategies for compliance with new environmental regulations. Environmental Regulatory Review and Comment Activities are essential to ensure that the unique circumstances posed by DOE operations and cleanups are accounted for in the regulatory development process. EH's Environmental Reporting Activities document 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.

(dollars in thousands)

	FY 2003	FY 2004	FY 2005
DOE-Wide Environment, Safety and Health Programs..	**5,708**	**5,068**	**5,795**

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. These Environment, Safety and Health Programs have two fundamental goals: improving worker and nuclear facility safety, and protecting 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; 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.

Several programs are specific to worker safety. 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 compilation and annual reporting of all DOE worker radiation exposures as required by Rule 10 CFR 835, "Occupational Radiation Protection." EH's nationally recognized Voluntary Protection Program (VPP) results in enhanced worker safety protection and cost savings. In FY 2005, DOE will continue to re-certify DOE contractor VPP status and evaluate new applications for VPP status. Also in FY 2005, 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 2005, EH will develop new DOE pollution prevention goals for recycling and toxic chemical use and release reductions. Pursuant to development of a new, Department-wide pollution prevention program plan during FY 2004, EH will provide a roadmap for continuous improvement in DOE's pollution prevention efforts. EH will provide instruction and guidance on a variety of issues related to Departmental responsibilities under Executive Orders related to pollution prevention and environment management systems.

In FY 2005, EH will continue to guide DOE programs in their planning and execution of complete National Environmental Policy Act (NEPA) analyses. EH will conduct independent compliance assurance reviews for more than 15 major Environmental Impact Statements and related documents. Policy and guidance will be developed to streamline the environmental review process and promote completing legally sufficient Environmental Impact Statements within 15 months.

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.

Explanation of Funding Changes

	FY 2005 vs. FY 2004 ($000)
Policy, Standards and Guidance	
▪ Reflects a net increase in FY 2005 requirements resulting from the following:	
– Activities involving the development of guidance for implementation of the Occupational Safety and Health Rule and other guidance and policy originally scheduled for FY 2004 have been moved into FY 2005 of work thereby increasing costs	
– Expenditures for increased INPO fee in FY 2005.	
– Transfer in FY 2005 of a major portion of the Technical Standards Program into DOE-Wide Environment, Safety and Health Programs.	
– Other minor program increases	+2,406
DOE-Wide Environment, Safety and Health Programs	
▪ Reflects an increase in FY 2005 requirements resulting from the following:	
– Transfer in FY 2005 of a major portion of the Technical Standards program into DOE-Wide Environment, Safety and Health.	
– Enforcement of the new Occupational Safety and Health Rule together with increases in other minor program activities	+727
Total Funding Change, Energy Supply, Environment, Safety and Health Programs	**+3,133**

Program Direction

Funding Profile

(dollars in thousands/whole FTEs)

	FY 2003	FY 2004	FY 2005	$ Change	% Change
Headquarters					
Salaries and Benefits	11,212	10,797	13,900	+3,103	+28.7%
Travel	300	500	800	+300	+60.0%
Other Related Expenses	4,061	4,400	5,774	+1,374	+31.2%
Total, Program Direction	15,573	15,697	20,474	+4,777	+30.4%
Full Time Equivalents	102	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 for 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 tuition for EH Federal employees. Also included is full funding of pension and annuitant health care benefits, and funding for competitive sourcing studies. DOE's Strategic and General Goals will be accomplished not only through the efforts of the major program office in the Department but with additional effort from staff offices, which 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 Environment, Safety and Health performs critical functions which directly support the mission of the Department. These functions include funding for a Federal staff that have 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 field 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 2003	FY 2004	FY 2005
Salaries and Benefits	**11,212**	**10,797**	**13,900**

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. Salaries and benefits are based on the latest OMB economic assumptions for Federal pay and personnel-related costs. The Civilian Pay Raise is 1.5% in FY 2005.

Travel	**300**	**500**	**800**

Overall, EH travel requirements are in line with the EH Federal staff levels and currently estimated needs.

Other Related Expenses	**4,061**	**4,400**	**5,774**

This provides for the Working Capital Fund, based on guideline estimates issued by the Working Capital Fund Manager. This funding 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 tuition costs for EH Federal employees. The tuition costs were transferred to Other Related Expenses from EH Management and Administration at the direction of Congress in the FY 1999 appropriation process. Funding is also provided for competitive sourcing studies.

There are no support services contracts in Program Direction.

Total, Program Direction	**15,573**	**15,697**	**20,474**

Explanation of Funding Changes

	FY 2005 vs. FY 2004 ($000)
Salaries and Benefits	
▪ Funding requirements are commensurate with the allocation on Federal staff among EH programs based on current staffing needs. Increases for Salaries and Benefits are based on the latest OMB economic assumptions (1.5% for civilian pay raises). This category includes funding for cost of living adjustments, locality pay, within-grade increases, lump sum payments, and awards. The rates are based on EH actual experience along with the OMB guidance	+3,103
Travel	
▪ Funding increase based on estimated needs to travel to EH sites	+300
Other Related Expenses	
▪ Increase due to higher estimated requirements from the Working Capital Fund, the need for various services procured related to the recent program reorganization	+1,374
Total Funding Change, Program Direction	**+4,777**

Other Related Expenses by Category

(dollars in thousands)

	FY 2003	FY 2004	FY 2005	$ Change	% Change
Training	50	100	100	+ 0	+ 0.0%
Working Capital Fund	3,811	4,000	4,712	+712	+17.8%
Other Services Procured	200	200	962	+762	+381.0%
Competitive Sourcing Studies	0	100	0	-100	-100.0%
Total, Other Related Expenses	4,061	4,400	5,774	+1,374	+31.2%

Future Liabilities

Future Liabilities

Energy Supply
Office of Future Liabilities

Overview

Appropriation Summary by Program

(dollars in thousands)

	FY 2003 Comparable Appropriation	FY 2004 Original Appropriation	FY 2004 Adjustments	FY 2004 Comparable Appropriation	FY 2005 Request
Energy Supply (Future Liabilities)					
Future Liabilities	0	0	0	0	3,000
Total, Energy Supply (Future Liabilities)	0	0	0	0	3,000
Other Defense Activities (Future Liabilities)					
Future Liabilities	0	0	0	0	5,000
Total, Other Defense Activities (Future Liabilities)	0	0	0	0	5,000
Total, Energy Supply and Other Defense Activities (Future Liabilities)	0	0	0	0	8,000

Preface

The Department of Energy will establish a new organizational element, the Office of Future Liabilities, to fund and manage environmental liabilities not assigned to the Office of Environmental Management or other organizations within the Department. These needs are expected to grow substantially due to the backlog of environmental liabilities at active DOE sites. It will also assume responsibility for long-term disposal of civilian-used radioactive sealed sources, or "Greater-Than-Class-C" wastes.

Within the Energy Supply appropriation, the Future Liabilities program has one program: the Greater-Than-Class-C Waste Disposal program. The other portion of the Office is proposed for funding from the Other Defense Activities appropriation.

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 Future Liabilities will perform critical functions which directly support the mission of the Department. These functions include planning and providing for disposition of civilian-used radioactive sealed sources, or "Greater-Than-Class-C" materials, and the cleanup of facilities and materials which are excess to the current program missions at active sites, enabling the Environmental Management program to complete its current cleanup scope and other Departmental programs to focus on their primary missions.

In FY 2005, the National Nuclear Security Administration's Defense Nuclear Nonproliferation program will assume responsibility for the collection and storage of "Greater-Than-Class-C" wastes. Management of this activity will be transferred from the Environmental Management program and expanded to aggressively address the potential domestic proliferation threat these radioactive sources could pose. However, no organization is currently responsible for disposal of the wastes, including identifying and selecting a disposal pathway, and managing disposal. The new Office of Future Liabilities will assume responsibility for the long-term disposal of this excess material. This is consistent with its other activities, which are focused on addressing excess facilities and nuclear materials and other environmental issues that are outside of the Environmental Management program's responsibility.

Mission

The mission of the Office of Future Liabilities is to address environmental liabilities at sites with continuing missions, which may include: the decontamination and decommissioning of facilities, cleanup of contaminated media, disposition of excess nuclear and hazardous materials and management of waste treatment and disposal facilities.

The mission includes policy management and funding responsibility for the Department "Greater-Than-Class-C" program to address civilian-used radioactive sealed sources currently stored by the Department and other wastes that have radioactive properties for which there is currently not a facility to dispose of them or other disposition pathway.

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. Future Liabilities performs critical functions which directly support the mission of the Department. These functions include the cleanup at active sites of facilities and materials which are excess to the current missions, enabling the Environmental Management program to complete its current cleanup scope and other Departmental programs to focus on their primary missions; and planning and providing for disposition of civilian-used radioactive sealed sources.

Benefits

With the establishment of the new Future Liabilities organization, the Environmental Management program will remain focused on completing their current scope. In addition, with this new organization completing the cleanup of future environmental liabilities, the sites with current programs will retain a strong focus on their missions of national nuclear security and science and energy technology.

The Office of Future Liabilities will also provide an organizational focus to establish a disposition pathway for civilian-used radioactive sealed sources. Since the terrorist attacks of September 11, 2003, there have been significant concerns raised about control and management of these sealed radioactive sources, which are used in medicine, agriculture, research and industry throughout the United States, because of the potential for their misuse, including their use in making a "dirty bomb." The Office of Future Liabilities will manage the Greater-than-Class-C program and develop a disposal pathway for this radioactive waste that will ensure the waste is managed safely and securely. Assignment of responsibility to the new organization will focus resources on the identification and development of safe and secure disposal for the materials.

Significant Program Shifts

The activities proposed for the Office of Future Liabilities in FY 2005 will address liabilities that were previously unassigned or are not being addressed because they are not aligned with the core mission of other Department programs and, as such, represent new Departmental activities.

Energy Supply
Office of Future Liabilities

Funding by Site

	(dollars in thousands)				
	FY 2003	FY 2004	FY 2005	$ Change	% Change
Washington Headquarters	0	0	3,000	+3,000	0.0%
Total, Energy Supply (Future Liabilities)	0	0	3,000	+3,000	0.0%

Site Description

Washington Headquarters

Activities include program planning and completion of the Environmental Impact Statement that is currently being conducted by the Office of Environment, Safety and Health. These initial organizational and planning activities will be managed through Headquarters.

Future Liabilities

Funding Profile by Subprogram

(dollars in thousands)

	FY 2003 Comparable Appropriation	FY 2004 Original Appropriation	FY 2004 Adjustments	FY 2004 Comparable Appropriation	FY 2005 Request
Future Liabilities					
Greater-Than-Class-C waste disposition...............	0	0	0	0	3,000
Total, Future Liabilities..............	0	0	0	0	3,000

Public Law Authorizations:
Low Level Radioactive Waste Policy Amendments Act of 1985 (P.L. 99-240)

Mission

The mission of the Office of Future Liabilities is to address environmental liabilities at sites with continuing missions, which may include: the decontamination and decommissioning of facilities, cleanup of contaminated media, disposition of excess nuclear and hazardous materials and management of waste treatment and disposal facilities.

The mission includes policy management and funding responsibility for the Department "Greater-Than-Class-C" program to address civilian-used radioactive sealed sources currently stored by the Department and other wastes that have radioactive properties for which there is currently not a facility to dispose of them.

Requirement/Activity Description

In FY 2005, the National Nuclear Security Administration's Defense Nuclear Nonproliferation program will assume responsibility for the collection and storage of these sealed source wastes. Management of this activity will be transferred from the Environmental Management program and expanded to aggressively address the potential domestic proliferation threat these radioactive sources could pose. The new Office of Future Liabilities will assume responsibility for the long-term disposal of this material, which is currently not being addressed elsewhere in the Department.

The Department is requesting appropriations for this new program activity to be managed by Future Liabilities, which will assume policy management and funding responsibility for the Department's "Greater than Class C" (GTCC) program. The GTCC program is being established to address civilian-used radioactive sealed sources currently stored by the Department and other wastes that have radioactive properties for which there is not currently a facility to dispose of them. The new program activity will take over the management of the completion of the ongoing Environmental Impact Statement (EIS) effort currently being managed by Office of Environment, Safety and Health. Future Liabilities will develop in FY 2005 a program plan and begin to initiate GTCC activities. These activities will include implementation of the EIS results, including selection and development, if not already existing, of a suitable disposal facility. This will entail preparation for certification or licensing for a new facility, and/or modification of certification and licensing of an existing facility. Future Liabilities will be responsible for all program aspects, including acceptance criteria, characterization plans and procedures, performance assessment processes, transportation planning and stakeholder interactions.

Benefits

The Department of Energy will establish a new organizational element, the Office of Future Liabilities, to fund and manage environmental liabilities that are not assigned to any Departmental organizations. These include responsibility for long-term disposal of civilian-used radioactive sealed sources, or "Greater-Than-Class-C" wastes.

The creation of a new Office of Future Liabilities to manage the Greater-than-Class-C program will facilitate the development of a disposal pathway for this radioactive waste that will allow the waste to be managed safely and securely. Since the terrorist attacks of September 11, 2003, there have been significant concerns raised about control and management of these sealed sources containing radioactive materials, which are used in medicine, agriculture, research and industry throughout the United States, because of the potential for their misuse. The National Nuclear Security Administration is responsible for the collection and safe storage of these materials. Assignment of responsibility to the new organization will to identify and develop safe and secure disposal for the materials.

Greater-Than-Class-C Waste Disposal Program

Funding Schedule by Activity

(dollars in thousands)

	FY 2003	FY 2004	FY 2005	$ Change	% Change
Greater-Than-Class-C Waste Disposal					
Greater-Than-Class-C Waste Disposal	0	0	3,000	+ 3,000	+ 0.0%
Total, Greater-Than-Class-C Waste Disposal	0	0	3,000	+ 3,000	+ 0.0%

Description

The mission of the Office of Futures Liabilities includes policy management and funding responsibility for the Department "Greater-Than-Class-C" program to address the civilian-used radioactive sealed sources currently stored by the Department and other wastes that have radioactive properties for which there is currently not a facility to dispose of them.

In FY 2005, the National Nuclear Security Administration's Defense Nuclear Nonproliferation program will assume responsibility for the collection and storage of these sealed source wastes. Management of this activity will be transferred from the Environmental Management program and expanded to aggressively address the potential domestic proliferation threat these radioactive sources could pose. The new Office of Future Liabilities will assume responsibility for the long-term disposal of this material, which is currently not being addressed elsewhere in the Department.

Activities include program planning and completion of the Environmental Impact Statement that is currently being conducted by the Office of Environment, Safety and Health.

Benefits

The creation of a new Office of Future Liabilities to manage the Greater-than-Class-C program will facilitate the development of long-term disposal of civilian-used radioactive sealed sources, or "Greater-Than-Class-C" wastes that will allow the waste to be managed safely and securely.

Detailed Program Justification

	FY 2003	FY 2004	FY 2005
Greater-than-Class-C Waste Disposition	**0**	**0**	**3,000**

The Environmental Impact Statement (EIS) to assess a pathway for disposal of GTCC waste will be completed.

A program plan to initiate GTCC activities will be developed. These activities will include initiating implementation of the EIS results, namely preparation for certification or licensing, if necessary, e.g., acceptance criteria development, characterization plans and procedures, performance assessment processes, transportation planning, stakeholder interactions, etc.

Explanation of Funding Changes

	FY 2005 vs. FY 2004 ($000)
Greater-Than-Class-C Waste Disposal In FY 2005, the Department is requesting funds to establish a new office to take on responsibilities for which no other Departmental element is responsible. This office will assume responsibility for disposal of Greater-Than-Class-C waste.	+3,000
Total Funding Change, Greater-Than-Class-C Waste Disposal	**+3,000**

Legacy Management

Legacy Management

Energy Supply
Office of Legacy Management

Appropriation Summary by Program

(dollars in thousands)

	FY 2003 Comparable Appropriation	FY 2004 Original Appropriation	FY 2004 Adjustments[a]	FY 2004 Comparable Appropriation	FY 2005 Request
Energy Supply					
Legacy Management………	21,093	29,705	-158	29,547	31,130
Subtotal, Energy Supply...…….	21,093	29,705	-158	29,547	31,130
Less Use of Prior Year Balances………………………..	0	0	0	0	0
Total, Energy Supply…………..	21,093	29,705	-158	29,547	31,130
Other Defense Activities					
Legacy Management………	43,333	38,163	-202	37,961	34,895
Subtotal, Other Defense Activities………………………...	43,333	38,163	-202	37,961	34,895
Less Use of Prior Year Balances………………………..	-2,369	-1,500	0	-1,500	0
Total, Other Defense Activities………………………..	40,964	36,663	-202	36,461	34,895
Total, Energy Supply and Other Defense Activities………	62,057	66,368	-360	66,008	66,025

Preface

During FY 2005, the Department continues its efforts to reduce risk to human health and the environment at its contaminated sites and mitigate the impacts to workers and communities caused by changing Departmental missions. By conducting the long-term surveillance and maintenance of

[a] Reduction for 0.59 percent recission

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 and Water, Energy Supply appropriation, the Office of Legacy Management (LM) has one program: Legacy Management.

This Overview will describe Strategic Content, 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 Office of Legacy Management was created in FY 2004 from existing programs within the Department of Energy. The mission of the portion of Office of Legacy Management funded by the Energy Supply appropriation is to: (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) perform storage, retrieval, and management of all records necessary for legacy management activities.

Benefits

The Office of Legacy Management programs provide benefits to the Department during mission changes or cleanup of sites in preparation for closure, during closure itself, and 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.
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Strategic 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 (Energy and Water/Energy Supply) support 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 within the Energy and Water/Other Defense Activities appropriation have one Program Goal that contributes to the General Goal in the "goal cascade". This goal is;

Program Goal 06.26.01.00: Legacy Management **:** Ensure that the Department's long-term agreements and legal commitments to environmental stewardship and to former contractor employees are satisfied.

Contribution to General Goal 6

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 existing pension and benefit programs to meet the Department's contractual commitments.

Funding by General Goal

	(dollars in thousands)				
	FY 2003	FY 2004	FY 2005	$ Change	% Change
General Goal 6, Environmental Management (Legacy Management)..	21,093	29,547	31,130	1,583	5.4%
Program Goal 06.26.01.00, Legacy Management……………..…	21,093	29,547	31,130	1,583	5.4%
Subtotal, General Goal 6…………….	21,093	29,547	31,130	1,583	5.4%
Less Use of Prior Year Balances...	0	0	0		
Total, General Goal 6 (Energy Supply/Legacy Management)……………………….	21,093	29,547	31,130	1,583	5.4%

Annual Performance Results and Targets

FY 2000 Results	FY 2001 Results	FY 2002 Results	FY 2003 Results	FY 2004 Target	FY 2005 Proposed Target
Legacy Management Program/Legacy Management Subprogram					
No comparable measures in FY 2000	No comparable measures in FY 2001	No comparable measures in FY 2002	Ensure continued effectiveness of cleanup remedies through surveillance and maintenance activities at 28 sites in accordance with legal agreements	Ensure continued effectiveness of cleanup remedies through surveillance and maintenance activities at 33 sites in accordance with legal agreements	Ensure continued effectiveness of cleanup remedies through surveillance and maintenance activities at 60 sites 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.

Success of the surveillance and maintenance program will depend upon the effectiveness of the remediation system or structure installed by the Environmental Management program. A failure of a functioning remediation system or structure to contain remediation would cause the return of the site to Environmental Management for future remediation.

LM's intention is to have no reportable risks at surveillance and maintenance sites and transfer unneeded land resources to other ownership. The long-term surveillance and maintenance goal will be achieved by performing surveillance and maintenance activities as specified in legal agreements.

Validation and Verification
To validate and verify program performance, Legacy Management (LM) will conduct various internal and external reviews and audits. LM's programmatic activities are subject to continuing review by the Congress, the General Accounting Office, the Department's Inspector General, the U.S. Environmental Protection Agency, state environmental and health agencies, and the Defense Nuclear Facilities Safety Board. Additionally, 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 are developed using the Joule system. For items not tracked by the Joule 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.

Significant Program Shifts
None

Energy Supply
Office of Legacy Management

Funding by Site by Program

(dollars in thousands)

	FY 2003	FY 2004	FY 2005	$ Change	% Change
Lexington Office					
Legacy Management………………………….	11,974	10,646	14,083	3,437	32.3%
Washington Headquarters					
Legacy Management…………………………...	9,119	18,901	17,047	-1,854	-9.8%
Subtotal, Office of Legacy Management.............	21,093	29,547	31,130	1,583	5.4%
Less Use of prior-year balances……………….	0	0	0	0	0%
Total, Energy Supply……………………………….	21,093	29,547	31,130	1,583	5.4%

Site Description

Lexington Office

Introduction

The two gaseous diffusion facilities operated by the United States Enrichment Corporation (USEC) are located at Paducah, KY, and Portsmouth, OH. They were formerly operated by the Department of Energy and were leased to USEC in 1993.

Legacy Management

Under the terms of the lease agreement, the Department of Energy continues to have responsibilities for post-retirement benefits for some of the former contractor employees.

Washington Headquarters

Introduction

The Office of Legacy Management has been organized as a Headquarters office with personnel located in the Washington, DC, area, Grand Junction, CO, Morgantown, WV, and Pittsburgh, PA.

Legacy Management

The legacy management functions of the Office include administration of the long-term surveillance and maintenance activities, including site inspections.

Legacy Management

Funding Profile by Subprogram

(dollars by thousands)

	FY 2003 Comparable Appropriation	FY 2004 Original Appropriation	FY 2004 Adjustments	FY 2004 Comparable Appropriation	FY 2005 Request
Legacy Management					
Legacy Management…..…	21,093	29,705	-158	29,547	31,130
Total, Legacy Management….	21,093	29,705	-158	29,547	31,130

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 106-377, Energy and Water Development Appropriations Act, 2001
Public Law 106-398, National Defense Authorization Act for Fiscal Year 2001
Public Law 107-66, Energy and Water Development Appropriations Act, 2002

Mission

The mission of the Office of Legacy Management is to (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) perform storage, retrieval, and management of all records necessary for legacy management activities.

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 2003	FY 2004	FY 2005	$ Change	% Change
Legacy Management…….					
Long-Term Surveillance and Maintenance………….	9,119	18,901	17,047	-1,854	-9.8%
Pension and Benefit Continuity………………	11,974	10,646	14,083	3,437	32.3%
Total, Legacy Management……………..	21,093	29,547	31,130	1,583	5.4%

Mission

The mission of the Legacy Management program 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, oversee the management of pensions and benefits for former contractor employees from the USEC facilities, and perform storage, retrieval, and management of all records necessary for legacy management activities.

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.

Detailed Justification

	(dollars in thousands)		
	FY 2003	FY 2004	FY 2005
Long-Term Surveillance and Maintenance…..…	**9,119**	**18,901**	**17,047**

The funding requested for FY 2005 will allow the Department to conduct the necessary activities including monitoring and performing long-term treatment on sites within the programs jurisdiction to ensure that standards contained in legal and regulatory agreements are achieved. 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.

	FY 2003	FY 2004	FY 2005
Pension and Benefit Continuity for Gaseous Diffusion Facilities…………………………..……	**11,974**	**10,646**	**14,083**

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 employees covered by the Uranium Enrichment Decontamination and Decommissioning Fund.

	FY 2003	FY 2004	FY 2005
Total, Legacy Management…………...……..	**21,093**	**29,547**	**31,130**

Explanation of Funding Changes

	FY 2005 vs. FY 2004 ($000)
Long-Term Surveillance and Maintenance	
▪ Although the net number of sites will increase, the cumulative level of activity on existing sites and the additional sites will be less than FY 2004.……………………………………………………………………...........	-1,854
Pension and Benefit Continuity	
▪ Costs for medical benefits have increased significantly more than the normal rate of inflation. ....……	+3,437
Total Funding Change, Legacy Management.................................…........	**+1,583**

General Provisions

Proposed Appropriation Language

SEC. 301. (a) None of the funds appropriated by this Act may be used to award a management and operating contract, or award a significant extension or expansion to an existing management and operating contract, unless such contract is awarded using competitive procedures or the Secretary of Energy grants, on a case-by-case basis, a waiver to allow for such a deviation. The Secretary may not delegate the authority to grant such a waiver.
(b) At least 60 days before a contract award for which the Secretary intends to grant such a waiver, the Secretary shall submit to the Subcommittees on Energy and Water Development of the Committees on Appropriations of the House of Representatives and the Senate a report notifying the Subcommittees of the waiver and setting forth, in specificity, the substantive reasons why the Secretary believes the requirement for competition should be waived for this particular award.

SEC. 302. None of the funds appropriated by this Act may be used to—
(1) develop or implement a workforce restructuring plan that covers employees of the Department of Energy; or
(2) provide enhanced severance payments or other benefits for employees of the Department of Energy, under section 3161 of the National Defense Authorization Act for Fiscal Year 1993 (Public Law 102–484; 42 U.S.C. 7274h).

SEC. 303. None of the funds appropriated by this Act may be used to prepare or initiate Requests For Proposals (RFPs) for a program if the program has not been funded by Congress.

(Transfers of Unexpended Balances)

SEC. 304. The unexpended balances of prior appropriations provided for activities in this Act may be transferred to appropriation accounts for such activities established pursuant to this title. Balances so transferred may be merged with funds in the applicable established accounts and thereafter may be accounted for as one fund for the same time period as originally enacted.

SEC. 305. None of the funds in this or any other Act for the Administrator of the Bonneville Power Administration may be used to enter into any agreement to perform energy efficiency services outside the legally defined Bonneville service territory, with the exception of services provided internationally, including services provided on a reimbursable basis, unless the Administrator certifies in advance that such services are not available from private sector businesses.

SEC. 306. When the Department of Energy makes a user facility available to universities and other potential users, or seeks input from universities and other potential users regarding significant *characteristics or equipment in a user facility or a proposed user facility, the Department shall ensure broad public notice of such availability or such need for input to universities and other potential users.*

For purposes of this section, the term ‘‘user facility’’ includes, but is not limited to:
(1) a user facility as described in section 2203(a)(2) of the Energy Policy Act of 1992 (42 U.S.C. 13503(a)(2));
(2) a National Nuclear Security Administration Defense Programs Technology Deployment Center/User Facility; and
(3) any other Departmental facility designated by the Department as a user facility.

SEC. 307. The Administrator of the National Nuclear Security Administration may authorize the plant manager of a covered nuclear weapons production plant to engage in research, development, and demonstration activities with respect to the engineering and manufacturing capabilities at such plant in order to maintain and enhance such capabilities at such plant: Provided, That of the amount allocated to a covered nuclear weapons production plant each fiscal year from amounts available to the Department of Energy for such fiscal year for national security programs, not more than an amount equal to 2 percent of such amount may be used for these activities: Provided further, That for purposes of this section, the term ‘‘covered nuclear weapons production plant’’ means the following:
(1) the Kansas City Plant, Kansas City, Missouri;
(2) the Y–12 Plant, Oak Ridge, Tennessee;
(3) the Pantex Plant, Amarillo, Texas;
(4) the Savannah River Plant, South Carolina; and
(5) the Nevada Test Site.

SEC. 308. Section 310 of the Energy and Water Development Appropriations Act, 2000 (Public Law 106–60), is hereby repealed.

SEC. 309. Funds appropriated by this or any other Act, or made available by the transfer of funds in this Act, for intelligence activities are deemed to be specifically authorized by the Congress for purposes of section 504 of the National Security Act of 1947 (50 U.S.C. 414) during fiscal year 2004 until the enactment of the Intelligence Authorization Act for fiscal year 2004.

Explanation of Change

Same language as in the FY 2004 Congressional Budget.