DOE/CF-016
Volume 3

Department of Energy

FY 2008 Congressional Budget Request

Energy Supply and Conservation

Energy Efficiency and Renewable Energy
Electricity Delivery and Energy Reliability
Nuclear Energy
Legacy Management

February 2007

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The Department of Energy's Congressional Budget justification is available on the Office of Chief Financial Officer/CFO homepage at http://www.cfo.doe.gov/budget.

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

	FY 2006 Current Approp.	FY 2007 Cong. Request	FY 2007 CR Rate	FY 2008 Cong. Request	FY 2008 Request vs. FY 2007 Request $	FY 2008 Request vs. FY 2007 Request %
Discretionary Summary By Appropriation						
Energy And Water Development, And Related Agencies						
Appropriation Summary:						
Energy Programs						
Energy supply and Conservation	1,812,397	1,923,361	1,817,487	2,187,943	+264,582	+13.8%
Fossil energy programs						
Clean coal technology	-20,000	——	-5,000	-58,000	-58,000	N/A
Fossil energy research and development	580,669	469,686	558,204	566,801	+97,115	+20.7%
Naval petroleum and oil shale reserves	21,285	18,810	18,275	17,301	-1,509	-8.0%
Elk Hills school lands fund	83,520	——	2,000	——	——	——
Strategic petroleum reserve	207,340	155,430	155,430	331,609	+176,179	+113.3%
Northeast home heating oil reserve	——	4,950	4,950	5,325	+375	+7.6%
Strategic petroleum account	-43,000	——	——	——	——	——
Total, Fossil energy programs	829,814	648,876	733,859	863,036	+214,160	+33.0%
Uranium enrichment D&D fund	556,606	579,368	556,525	573,509	-5,859	-1.0%
Energy information administration	85,314	89,769	85,185	105,095	+15,326	+17.1%
Non-Defense environmental cleanup	349,687	310,358	309,946	180,937	-129,421	-41.7%
Uranium Sales and Remediation	——	——	——	——	——	——
Science	3,632,044	4,101,710	3,605,000	4,397,876	+296,166	+7.2%
Nuclear waste disposal	148,500	156,420	141,511	202,454	+46,034	+29.4%
Departmental administration	120,595	128,825	102,582	148,548	+19,723	+15.3%
Inspector general	41,580	45,507	41,784	47,732	+2,225	+4.9%
Innovative Technology Loan Guarantee Program	——	——	——	8,390	+8,390	N/A
Total, Energy Programs	7,576,537	7,984,194	7,393,879	8,715,520	+731,326	+9.2%
Atomic Energy Defense Activities						
National nuclear security administration:						
Weapons activities	6,355,297	6,407,889	6,412,001	6,511,312	+103,423	+1.6%
Defense nuclear nonproliferation	1,619,179	1,726,213	1,620,901	1,672,646	-53,567	-3.1%
Naval reactors	781,605	795,133	780,343	808,219	+13,086	+1.6%
Office of the administrator	354,223	386,576	341,991	394,656	+8,080	+2.1%
Total, National nuclear security administration	9,110,304	9,315,811	9,155,236	9,386,833	+71,022	+0.8%
Environmental and other defense activities:						
Defense environmental cleanup	6,129,729	5,390,312	5,551,812	5,363,905	-26,407	-0.5%
Other defense activities	635,578	717,788	638,129	763,974	+46,186	+6.4%
Defense nuclear waste disposal	346,500	388,080	346,163	292,046	-96,034	-24.7%
Total, Environmental & other defense activities	7,111,807	6,496,180	6,536,104	6,419,925	-76,255	-1.2%
Cerro grande fire activities	742	——	——	——	——	——
Total, Atomic Energy Defense Activities	16,222,853	15,811,991	15,691,340	15,806,758	-5,233	-0.0%
Power marketing administrations:						
Southeastern power administration	5,544	5,723	5,544	6,463	+740	+12.9%
Southwestern power administration	29,864	31,539	29,864	30,442	-1,097	-3.5%
Western area power administration	231,652	212,213	212,213	201,030	-11,183	-5.3%
Falcon & Amistad operating & maintenance fund	2,665	2,500	2,500	2,500	——	——
Colorado River Basins	——	-23,000	——	-23,000	——	——
Total, Power marketing administrations	269,725	228,975	250,121	217,435	-11,540	-5.0%
Federal energy regulatory commission	——	——	——	——	——	——
Subtotal, Energy And Water Development and Related Agencies	24,069,115	24,025,160	23,335,340	24,739,713	+714,553	+3.0%
Uranium enrichment D&D fund discretionary payments	-446,490	-452,000	——	-463,000	-11,000	-2.4%
Excess fees and recoveries, FERC	-50,015	-19,221	——	-17,462	+1,759	+9.2%
Total, Discretionary Funding	**23,572,610**	**23,553,939**	**23,335,340**	**24,259,251**	**+705,312**	**+3.0%**

Strategic Performance Overview

The Overviews in these budget requests will describe, Mission, Benefits, Strategic Themes, and Funding by Strategic 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, the Overviews will address R&D Investment Criteria, and Program Assessment Rating Tool (PART).

Strategic Context

Following publication of the Administration's National Energy Policy, the Department developed a Strategic Plan that defines its mission, five strategic themes for accomplishing that mission, and 16 strategic goals to support the strategic goals. Each appropriation has developed quantifiable goals to support the strategic goals. Thus, the "performance cascade" is the following:

Department Mission → Strategic Theme → Strategic Goal → GPRA Unit Program Goal (GPRA Unit) → Annual Targets → Milestones

The performance 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).

To provide a concrete link between budget, performance, and reporting, the Department developed a "GPRA[1] 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.[2]

R&D Investment Criteria

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

The chief elements of the R&D investment criteria are quality, relevance, and performance. Programs must demonstrate fulfillment of these elements. For example, to demonstrate relevance, programs are expected to have complete plans with clear goals and priorities. To demonstrate quality, programs are expected to commission periodic independent expert reviews. There are several other requirements, many of which R&D programs have and continue to undertake.

An additional set of criteria were established for R&D programs developing technologies that address industry issues. Some key elements of the criteria include: the ability of the programs to articulate the

[1] Government Performance and Results Act of 1993
[2]The numbering scheme uses the following numbering convention: x.x.xx.xx. The first position identifies the Strategic Theme (01 through 05); the second position identifies the Strategic Goal; the third position identifies the GPRA Unit Program; the fourth position is reserved for future use.

appropriateness and need for Federal assistance; relevance to the industry and the marketplace; identification of a transition point to industry commercialization (or of an off-ramp if progress does not meet expectations), and; the potential public benefits, compared to alternative investments, that may accrue if the technology is successfully deployed.

OMB-OSTP on-going guidance describes the R&D investment criteria fully and identifies steps agencies should take to fulfill them. Where appropriate throughout these justification materials, especially in the Explanation of Funding Changes subheadings, specific R&D investment criteria and requirements are cited to explain the Department's allocation of resources.

Energy Supply

Energy Supply

Energy Supply and Conservation

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 and energy conservation 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 twenty passenger motor vehicles for replacement only, including one ambulance, $2,187,943,000, to remain available until expended.

Energy Efficiency and Renewable Energy

Energy Efficiency and Renewable Energy

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Energy Supply and Conservation
Office of Energy Efficiency and Renewable Energy

Overview

Appropriation Summary by Program

(dollars in thousands)

	FY 2006 Current Appropriation	FY 2007 Request	FY 2007 Continuing Resolution	FY 2008 Request
Energy Supply and Conservation				
Hydrogen Technology	153,451	195,801	157,066	213,000
Biomass and Biorefinery Systems R&D	89,776	149,687	91,891	179,263
Solar Energy	81,791	148,372	83,718	148,304
Wind Energy	38,333	43,819	39,236	40,069
Geothermal Technology	22,762	0	23,298	0
Hydropower	495	0	507	0
Vehicle Technologies	178,351	166,024	182,552	176,138
Building Technologies	68,190	77,329	69,796	86,456
Industrial Technologies	55,856	45,563	57,172	45,998
Federal Energy Management Program	18,974	16,906	19,421	16,791
Facilities and Infrastructure	26,052	5,935	26,665	6,982
Weatherization and Intergovernmental Activities	316,866	225,031	324,331	204,904
Program Direction	101,868	91,024	104,268	105,013
Program Support	13,321	10,930	13,635	13,281
Subtotal, Energy Supply and Conservation	1,166,086	1,176,421	1,193,556	1,236,199
Use of Prior Year Balances	-3,339	0	0	0
Total, Energy Supply and Conservation	1,162,747	1,176,421	1,193,556	1,236,199

Preface

The Office of Energy Efficiency and Renewable Energy (EERE) is requesting $1,236,199,000 for Fiscal Year (FY) 2008, an increase of 5.1 percent over the FY 2007 request. These funds support a diverse portfolio of energy efficiency and renewable energy research and development (R&D) and deployment programs designed to help meet the energy challenges of the 21st century. In announcing the Advanced Energy Initiative (AEI) in January 2006, the President called upon the Nation to break its dependence on foreign resources and transform how we power our economy. EERE's budget helps to address that challenge by growing critical elements of Hydrogen, Biomass, Vehicles, Buildings, and support programs, by maintaining key programs such as Solar, Industry, and the Federal Energy Management

Program (FEMP) and by reallocating resources requested for elements of Wind and Weatherization programs to support critical growth in R&D. Major reallocations are discussed in the Significant Changes section of the Overview and in detail in the individual program chapters. These funding levels will provide the foundation for a safer, cleaner, and sustainable energy future and expand efforts to get new technologies into the marketplace more quickly. This request also supports provisions of the Energy Policy Act of 2005, which builds upon work in progress in EERE. Working in partnership with organizations that can bring significant leverage to EERE program technologies, the EERE portfolio supports the Department's mission to power and secure America's future by developing cost-effective options for reliable, clean, and affordable energy, and by addressing barriers to their adoption that will increase the energy supply and productivity of all sectors of the economy.

The FY 2008 EERE budget maintains focus on key components of the AEI including: the *Biofuels Initiative* to develop affordable, bio-based transportation fuels from a wider variety of feedstocks and agricultural waste products; the *Solar America Initiative* to accelerate the development of materials that convert sunlight directly to carbon-free electricity; the *Hydrogen Fuel Initiative* to develop technology options for domestic hydrogen infrastructure and for hydrogen-powered fuel cells to power vehicles without greenhouse gases; wind energy research to reduce costs and address barriers to large-scale use of wind power in the U.S.; and *FreedomCAR*, to support advanced automobile performance, power and efficiency technologies including plug-in hybrid vehicles. Another hallmark of this budget is EERE's response to the Secretary's initiative to create a stronger link between the basic sciences and the applied energy programs and enabling market mechanisms that will more successfully leverage, focus, and accelerate the specific technology advances needed to overcome barriers and expand the value and use of emerging new technologies.

Within the Energy Supply and Conservation Appropriation EERE has 14 programs in FY 2008: Hydrogen Technology (12 subprograms), Biomass and Biorefinery Systems R&D (4 subprograms), Solar Energy (4 subprograms), Geothermal Energy (3 subprograms), Wind Energy (3 subprograms), Hydropower (2 subprograms), Vehicle Technologies (5 subprograms), Building Technologies (8 subprograms), Industrial Technologies (4 subprograms), Federal Energy Management Program (4 subprograms), Facilities and Infrastructure (1 subprogram), Weatherization and Intergovernmental Activities (9 subprograms), Program Support (3 subprograms), and Program Direction.

Mission

The mission of the Office of Energy Efficiency and Renewable Energy is to strengthen America's energy security, environmental quality, and economic vitality through public-private partnerships that result in 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 programs benefit both the supply and demand sides of the Department's energy security equation, making greater productive use of the energy we have and hastening the arrival and use of the new fuels and technologies that we need. Energy efficiency efforts benefit all sectors of the economy that use energy. Some key examples include: solid state lighting could transform conventional illumination and reduce commercial building lighting consumption by 50 percent or more; appliance standards could save energy for consumers and provide net benefits to the economy; cost-shared partnerships that target America's most energy-intensive industries could make them more productive and competitive; and strategies that reduce the energy use of one of the Nation's largest consumers, the Federal Government itself. Vehicle efficiency could be transformed by continued research to increase the productivity of key vehicle systems regardless of fuel. R&D that reduces the cost of high-power lightweight lithium ion batteries could usher in the era of plug-in hybrid vehicles as viable near- and mid-term options for the oil-dependent transportation sector. If successful, R&D on the "fuels of tomorrow," such as biofuels and hydrogen, could change our domestic energy economy's import dependence. EERE's budget continues to improve the system components of wind power and the conversion efficiencies of photovoltaic components, aggressively developing key technologies. When combined with our efforts to address market barriers, our investment in R&D will enable solar and wind energy to make a large-scale contribution to the expected growth in electricity demand across the Nation, while diversifying electricity supply and reducing greenhouse gases.

These integrated programs directly contribute to the Departmental goal by: (1) reducing demand-side pressure on our energy markets (mitigates costs); (2) reducing oil imports; (3) diversifying the mix of domestic energy production; (4) providing smaller and decentralized alternative and non-fuel based sources of electricity generation that are inherently less susceptible to interruption or attack; (5) resolving the technology and market components of barriers to widespread use of these solutions; and (6) providing principal energy technologies and pathways enabling the Nation to achieve its energy and Climate Change Technology Program goals. The EERE portfolio's proposed budget will deliver significant security, economic, and environmental benefits. Drawing upon the Energy Information Administration's (EIA) expectations of energy supply, demand, and cost, and modeling our programs' goals in integrated energy-economy models, we expect that achievement of EERE program goals would save consumers over $112 billion a year in 2030[a] and around $400 billion a year in 2050; and reduce annual costs to the electric power sector by $26 billion and $70 billion in those years, respectively. Similarly, we expect that our portfolio will annually avoid 220 million metric tons of carbon (MMTC) in 2030 and over 500 MMTC in 2050. Finally, we expect that our portfolio will offset two million barrels per day (MBPD) of imported oil in 2030 and seven MBPD in 2050, corresponding to an increase in transportation energy diversity of 24 percent and 42 percent, respectively. More detailed expected benefits estimates are provided in the Expected Program Outcomes section at the end of this Overview, and in the individual program sections.

Strategic Themes and Goals and GPRA Unit Program Goals

The Department's Strategic Plan identifies five Strategic Themes (one each for nuclear, energy, science, management, and environmental aspects of the mission) plus 16 Strategic Goals that tie to the Strategic Themes. The Energy Supply and Conservation appropriation supports the following goals:

Strategic Theme 1, Energy Security: Promoting America's energy security through reliable, clean, and affordable energy.

Strategic Goal 1.1, Energy Diversity: Increase our energy options and reduce dependence on oil, thereby reducing vulnerability to disruptions and increasing the flexibility of the market to meet U.S. needs.

Strategic Goal 1.2, Environmental Impacts of Energy: Improve the quality of the environment by reducing greenhouse gas emissions and environmental impacts to land, water, and air from energy production and use.

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[a] References in these justification documents to future years represent calendar years unless otherwise noted.

Strategic Goal 1.3, Energy Infrastructure: Create a more flexible, more reliable, and higher capacity U.S. energy infrastructure.

Strategic Goal 1.4, Energy Productivity: Cost-effectively improve the energy efficiency of the U.S. economy.

Strategic Theme 3, Scientific Discovery and Innovation: Strengthening U.S. scientific discovery, economic competitiveness, and improving quality of life through innovations in science and technology.

Strategic Goal 3.3, Research Integration: Integrate basic and applied research to accelerate innovation and to create transformational solutions for U.S. energy needs.

The programs funded within the Energy Supply and Conservation appropriation have twelve GPRA Unit Program Goals that contribute to the Strategic Goals in the "goal cascade." These goals are:

- GPRA Unit Program Goal 1.1.01.00: Hydrogen Technology. Develop fuel cell and hydrogen production, delivery and storage technologies to the point that they are cost and performance competitive and are being used by the Nation's transportation, energy, and power industries. Development of these technologies will also make our clean domestic energy supplies more flexible, dramatically reducing dependence on oil.
- GPRA Unit Program Goal 1.1.06.00: Biomass and Biorefinery Systems R&D. Develop biorefinery-related technologies associated with the different biomass resource pathways to the point that they can compete in terms of cost and performance and are used by the Nation's transportation, chemical, agriculture, forestry, and power industries to meet their respective market objectives. This helps the Nation expand its clean, sustainable energy supplies, improve its energy infrastructure, and reduce its greenhouse gases emissions, fossil energy consumption and dependence on oil.
- GPRA Unit Program Goal 1.1.03.00: Solar Energy. The Solar Program goal is to improve the performance and reduce the cost of solar energy systems to make solar power cost-competitive with conventional electricity sources, thereby accelerating large-scale usage across the Nation and making a significant contribution to a clean, reliable and flexible U.S. energy supply. The President's Solar America Initiative sets the goal of reaching cost-competitiveness across all sectors by 2015.
- GPRA Unit Program Goal 1.1.04.00: Wind Energy. The goal of the Wind Program is to enable wind to compete with conventional fuel throughout the Nation, creating a clean renewable energy option. We accomplish this through technology research and development, collaborative efforts, technical support and outreach to overcome barriers in energy cost, energy market and infrastructure rules and energy sector acceptance.
- GPRA Unit Program Goal 1.2.13.00: Hydropower. With the completion of testing on new turbine technologies and consistent with previous Congressional direction, the Hydropower Program's goal is to closeout this program and effectively transition remaining program activities and information (e.g., R&D results, technical data and findings) to private/public sector programs.
- GPRA Unit Program Goal 1.1.05.00: Geothermal Technology. With the completion of final reporting on funded projects, the Geothermal Technology Program's goal is to closeout this program and to effectively transition remaining program activities and information (e.g., R&D results, technical data and findings) to private/public sector programs.

- GPRA Unit Program Goal 1.1.02.00: Vehicle Technologies. The Vehicle Technologies Program goal is developing technologies that enable cars and trucks to become highly efficient, through improved power technologies and cleaner domestic fuels, while remaining cost- and performance-competitive. Manufacturers and consumers can then use these technologies to help the Nation reduce both petroleum use and greenhouse gas emissions.
- GPRA Unit Program Goal 1.4.20.00: Building Technologies. The Building Technologies Program goal is to develop cost effective tools, techniques and integrated technologies, systems and designs for buildings that generate and use energy so efficiently that buildings are capable of generating as much energy as they consume.
- GPRA Unit Program Goal 1.3.19.00: Industrial Technologies. The Industrial Technology Program goal is to partner with our most energy-intensive industries in strategic planning and specific RD&D to develop the technologies needed to use energy efficiently in their industrial processes and cost-effectively generate much of the energy they consume. The result of these activities will save feedstock and process energy, improve the environmental performance of industry, and help America's economic competitiveness.
- GPRA Unit Program Goal 1.4.07.00: Federal Energy Management Program. The Federal Energy Management Program goal is to provide assistance with project financing and technical assistance to Federal agencies to further the use of cost-effective energy efficiency and renewable energy. FEMP's activities enhance energy security, environmental stewardship and cost reduction within the Federal Government.
- GPRA Unit Program Goal 1.4.21.00: Weatherization. The goal of Weatherization Assistance Program grants is to increase the energy efficiency of dwellings occupied by low-income Americans, thereby reducing their energy costs. DOE works directly with States and certain Native American Tribes that contract with local governmental or non-profit agencies to deliver weatherization services.
- GPRA Unit Program Goal 1.4.22.000: State Energy Programs. The State Energy Program (SEP) goal is to strengthen and support the capabilities of States to promote energy efficiency and adopt renewable energy technologies, helping the Nation achieve a stronger economy, a cleaner environment and greater energy security.

Contribution to Strategic Goal

The EERE Programs – Hydrogen Technology, Biomass and Biorefinery Systems R&D, Solar Energy, Wind Energy, Geothermal Technology, Vehicle Technologies, Building Technologies, Industrial Technologies, Federal Energy Management Program, and Weatherization and Intergovernmental Activities – as well as our administrative activities – Facilities and Infrastructure, Program Direction, and Program Support – all combine to contribute to Strategic Theme 1. EERE works with science, supply, productivity, and process management programs to reduce both the probability and potential magnitude of energy-based disruptions and to improve the Nation's mix of clean affordable energy options. Individual program activities planned for and funded by this appropriation would contribute to these improvements in the following ways under business-as-usual conditions.[a]

- Hydrogen Technology contributes to this goal by developing cost-competitive hydrogen production, delivery, and storage technologies to enable a hydrogen fuel infrastructure from diverse, domestic resources, and by improving the durability of fuel cells while reducing their cost. Specific goals include reducing the cost of producing hydrogen to $2.00-3.00/gge, reducing the cost of automotive fuel cell systems to $30/kW, and developing storage technologies that enable greater than 300-mile vehicle driving range. The key intermediate technology target for fuel cells is reducing the production cost of the fuel cell power system to $45/kW by 2010. Collectively, and with enabling technologies from the Freedom Car Vehicle Technologies program, our modeling suggests that these technologies could displace 0.3 million barrels per day (mbpd) of oil in 2030, and as these technologies enter the market in significant numbers, oil displacement could increase to over 2 mbpd in 2050. Additionally, they provide the option for substantially faster growth in hydrogen use if energy markets demand more rapid change.
- Biomass and Biorefinery Systems R&D contributes to this goal by developing biorefinery related technologies associated with the different biomass resource pathways to the point that they can compete in terms of cost and performance and are used by the Nation's transportation, chemical, agriculture, forestry, and power industries to meet their respective market objectives. This helps the Nation expand its clean, sustainable energy supplies, improve its energy infrastructure, reduce its greenhouse gas emissions, reduce fossil fuel consumption and, thus, dependence on foreign oil. As outlined by the President's Advanced Energy Initiative (AEI), the Program's goal is to develop and demonstrate cost-competitive technology for the conversion of cellulosic biomass to ethanol by 2012. The program’s R&D will contribute key technologies that help in the displacement of significant gasoline demand.
- Solar Energy contributes to this goal by accelerating breakthroughs in advanced solar energy technologies to help address the critical national goal of energy security by changing the way we power our homes and businesses. The Solar America Initiative under the AEI aims to reduce the cost of solar photovoltaic technologies so that they become cost-competitive by 2015 which accelerates the technology development by five years compared to the program prior to the AEI. Solar energy also improves the environment by reducing greenhouse gases, creates more reliable infrastructure through on-site distributed systems, and is important to achieving the possibility of “zero energy buildings” that produce as much energy as they use (net on an annual basis), when coupled with energy efficient technologies and building designs.
- Wind Energy contributes to this goal by developing wind technologies that will provide large scale wind production in Class-4 wind conditions at $0.036/kWh for land-based applications by 2012, in Class-6 wind conditions at $0.07/kWh for offshore shallow water by 2014, and $0.07/kWh for transitional depth (up to 60 meters) by 2016. The program also addresses the barriers to large-scale use of wind energy in the United States which could significantly accelerate and expand wind generation of electricity.

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[a] Important information regarding benefits estimation assumptions and methods are discussed in the Expected Integrated Program Outcomes section in the Overview: e.g., individual program contributions are not strictly additive because of overlap in the markets addressed.

- Vehicle Technologies contributes to this goal by developing technologies for highly efficient cars and trucks, including more efficient combustion engines and corresponding clean fuels; power electronics, batteries, and hybrid systems for both conventional and plug-in hybrid vehicles; and lightweight vehicle materials. Technology goals include reducing the cost of a 25 kW hybrid vehicle battery pack from $3,000 in 1998 to $500 in 2010; improving advanced light-duty engine combustion efficiency from 30 percent in 2002 to 45 percent in 2010; and developing lightweight materials that could reduce the weight of a passenger car or light truck by 50 percent by 2010. Our modeling suggests that these and other vehicle technologies mean that the Vehicle Technologies Program could displace oil imports of nearly 2 million barrels per day (mbpd) by 2030 and nearly 6 mbpd in 2050, based on projected market conditions.
- Building Technologies contributes to this goal by developing advanced lighting and appliances, which when coupled with improved building system integration and design, could provide marketable technologies that can reduce energy use by up to 70 percent in homes by 2020 and 60-70 percent in commercial buildings by 2025. Interim goals by 2010 include: five Building America technology package research reports that can achieve an average of 40 percent reduction in whole house end use energy will be developed and evaluated; up to fourteen technology packages that can achieve 30 percent reduction in the purchased energy use in new, small commercial buildings relative to ASHRAE 90.1-2004 will be developed; and 13 formal proposals for product standards and test procedures will be issued. Improvements in equipment standards, building codes, and consumer access to these technologies could also facilitate marketable improvements in the efficiency of existing buildings by up to 20 percent. If successful, our modeling suggests that these activities could reduce building energy use by nearly 1.3 Quads per year in 2030 and nearly 2.1 Quads by 2050.
- Industrial Technologies contributes to the goal of cost-effectively improving the energy efficiency of the U.S. economy by helping to improve the energy efficiency of the Nation's industrial sector through a coordinated program of research and development, validation, and dissemination of energy-efficiency technologies and operating practices. Energy efficiency improvements in the industrial sector directly reduce the demand for oil, natural gas, and electricity, building economic strength for a more secure future that does not depend so heavily on imported fossil fuels and produces fewer carbon emissions. Our modeling suggests that the Industrial Technologies program could contribute to an 11.7 percent reduction in energy intensity in energy-intensive industries between 2002 and 2012.
- FEMP contributes to this goal through project financing, technical assistance, and project evaluation which will facilitate energy efficiency and renewable energy investments. Our analysis suggests that FEMP activities could result in lifecycle energy savings of approximately 20 trillion Btus each year from 2008 to 2011. FEMP is helping agencies reach the goal of Executive Order 13123 for all Federal agencies to reduce energy intensity in Federal buildings by 35 percent by 2010 from 1985 levels, and to reach the goal of the Energy Policy Act of 2005 to reduce energy consumption per square foot by 20 percent by 2015, at a rate of 2 percent per year.
- Weatherization and Intergovernmental Activities contributes to this goal by accelerating adoption of cost-effective efficient technologies through weatherization and state energy grants, and intergovernmental activities which will help reduce energy intensity in all sectors of the economy. If the targets are met and sustained, the activities could contribute to improved quality of life for millions of people. Additionally, our analysis suggests that Intergovernmental Activities will

contribute to the building of approximately 80 MW of new renewable energy generating capacity on American Indian lands by 2012.

- Program Direction contributes to EERE through direct staffing and support of the programs addressing the energy security goals and continued work to implement the President's Management Agenda.
- Program Support provides two types of corporately focused contributions. The Planning, Analysis, and Evaluation subprogram establishes and maintains the methods, information base, and standards for planning and policy analysis, budget formulation, and performance management and evaluation. The Technology Advancement and Outreach subprogram manages and creates regular, consistent outreach mechanisms and products that keep EERE stakeholders advised of corporate management issues affecting EERE operations.

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

Funding by Strategic and GPRA Unit Program Goal

	(dollars in thousands)		
	FY 2006	FY 2007	FY 2008
Strategic Goal 1.1, Energy Diversity			
GPRA Unit Program Goal 1.1.01.00, Hydrogen Technology	120,484	195,801	213,000
GPRA Unit Program Goal 1.1.06.00, Biomass and Biorefinery Systems R&D [a]	42,949	149,687	179,263
GPRA Unit Program Goal 1.1.03.00, Solar Energy	67,535	148,372	148,304
GPRA Unit Program Goal 1.1.04.00, Wind Energy	25,463	43,819	40,069
GPRA Unit Program Goal 1.1.05.00, Geothermal Technology [a]	19,050	0	0
GPRA Unit Program Goal 1.1.02.00, Vehicle Technologies	162,511	166,024	176,138
Total, Strategic Goal 1.1, Energy Diversity	437,992	703,703	756,774
Strategic Goal 1.4, Energy Productivity			
GPRA Unit Program Goal 1.4.20.00, Building Technologies [a]	62,844	77,329	86,456
GPRA Unit Program Goal 1.3.19.00, Industrial Technologies	55,856	45,563	45,998
GPRA Unit Program Goal 1.4.07.00, Departmental Energy Management Program/Federal Energy Management Program	18,974	16,906	16,791
GPRA Unit Program Goal 1.4.21.00, Weatherization	242,550	164,198	144,000
GPRA Unit Program Goal 1.4.22.00, State Energy Programs	36,135	49,457	45,501

[a] Also supports Strategic Goal 3.3, Research Integration.

	FY 2006	FY 2007	FY 2008
	(dollars in thousands)		
Total, Strategic Goal 1.4, Energy Productivity	416,359	353,453	338,746
Subtotal, Strategic Goals 1.1, 1.2, 1.4, and 3.3 (Energy Supply and Conservation)	854,351	1,057,156	1,095,520
All Other			
Hydrogen Technology/Congressionally Directed Activities	32,967	0	0
Biomass and Biorefinery Systems R&D/Congressionally Directed Activities	46,827	0	0
Solar Energy/Congressionally Directed Activities	14,256	0	0
Wind Energy/Congressionally Directed Activities	12,870	0	0
Geothermal Technology/Congressionally Directed Activities	3,712	0	0
Hydropower	495	0	0
Vehicle Technologies/Congressionally Directed Activities	15,840	0	0
Building Technologies/Congressionally Directed Activities	5,346	0	0
Weatherization and Intergovernmental Activities/Intergovernmental Activities	33,726	11,376	15,403
Weatherization and Intergovernmental Activities/Congressionally Directed Activities	4,455	0	0
Facilities and Infrastructure	26,052	5,935	6,982
Program Direction	101,868	91,024	105,013
Program Support	13,321	10,930	13,281
Total, All Other	311,735	119,265	140,679
Total, Strategic Goals 1.1, 1.2, 1.4, and 3.3 (Energy Supply and Conservation)	1,166,086	1,176,421	1,236,199

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 energy security, and improved environmental conditions. DOE has incorporated feedback from OMB into the FY 2008 Budget Request, and the Department will take the necessary steps to continue to improve performance.

All EERE programs have been assessed using the PART as of 2005, and no programs were re-assessed in 2006. However, program performance information and improvement plans were updated in the fall of 2006. The most recent information is available on www.ExpectMore.gov. Individual programs have taken action to address PART findings and recommendations within their direct control and many recommendations have been completely addressed. Many of EERE's FY 2008 performance targets are consistent with and support PART measures; the Department is striving to further improve consistency.

EERE is corporately addressing a recommendation common to all DOE applied R&D PARTs, which is to develop guidance that specifies a consistent framework for analyzing the costs and benefits of research and development investments, and use this information to guide budget decisions. The Department has specified common scenarios, common methodology, and standardized benefits measures to allow analyzing the costs and benefits of R&D investments. The Department continues to work on implementation of common assumptions and a consistent approach to incorporation of risk. EERE continues to address the challenges presented by PART, its constituent evidentiary support ─ the Research and Development Investment Criteria (RDIC) ─ and our internal Strategic Management System process through the consolidation of corporate planning, analysis, and evaluation activities as represented in this budget in the Program Support section.

EERE is working with other applied R&D programs to develop a consistent baseline for its administrative (overhead) efficiency measure. EERE is also working with Departmental and OMB staff to incorporate R&D Investment Criteria as appropriate, and expanding the lessons learned in EERE benefits framework methodology to the applied Energy R&D programs. The individual program responses are provided in their respective budgets.

Facilities Maintenance and Repair

The Department's Facilities Maintenance and Repair activities are tied to its programmatic missions, goals, and objectives. Facilities Maintenance and Repair activities funded by this budget are displayed below.

Indirect-Funded Maintenance and Repair

	(dollars in thousands)		
	FY 2006	FY 2007	FY 2008
National Renewable Energy Laboratory	2,121	2,543	2,512
Total, Indirect-Funded Maintenance and Repair	2,121	2,543	2,512

Direct-Funded Maintenance and Repair

	(dollars in thousands)		
	FY 2006	FY 2007	FY 2008
National Renewable Energy Laboratory	1,457	3,362	4,935
Total, Direct-Funded Maintenance and Repair	1,457	3,362	4,935

Significant Changes

Hydrogen Technology

Hydrogen Production and Delivery R&D will pursue the aggressive target of $2.00/gge by 2015 for hydrogen production from natural gas. Longer-term subsystem technologies will focus on key critical path problems, consistent with the National Academies' recommendations in their *Hydrogen Economy* report. (More than +$3 million)

Hydrogen Storage R&D will fund new awards and competitive, merit-reviewed, cost-shared R&D on materials-based hydrogen storage technologies and science based co-projects. (More than +$9 million)

Fuel Cell Stack Component R&D will examine innovative concepts to simplify, integrate or eliminate components or functions in fuel cell systems. (Nearly +$6 million)

Technology Validation will test and collect data from demonstration vehicles. (Nearly -$10 million)

Biomass and Biorefinery Systems R&D

Thermochemical and Biochemical Platform R&D has been accelerated to meet the 2012 goals of the Biofuels Initiative. (More than +$8 million)

Integration of Biorefinery Technologies will construct a commercial-scale biorefinery demonstration project and initiate activities towards biorefinery validation at the 10 percent commercial scale. (More than +$39 million)

Several bio-based products projects in Products Development have been completed in FY 2007. (More than -$24 million)

Wind Energy

The Wind Energy Program has increased focus on near-term actions to significantly accelerate use of wind energy technologies.

Distributed Wind Technology and Technology Acceptance are increased to support a new round of DWT partnerships in this immature technology for concept, component, and system prototype projects for moderately sized wind turbines, initiate state-based incentive programs, initiate a new partnership aimed at the community wind and farm market and to address siting, permitting, and environmental barriers to increased domestic energy production called out in EPACT 2005. (More than +$6 million)

Vehicle Technologies

Energy Storage R&D will accelerate the development of high energy batteries needed for plug-in hybrid electric vehicles and other advanced battery concepts. (More than +$10 million)

Heavy Truck Engine will reduce support for improving the efficiency of diesel engines for trucks and commercial vehicles and consolidate research into fewer competitive contracts. (More than -$11 million)

Materials Technology will expand support for plug-in hybrid materials, materials modeling, and addressing advanced combustion engine materials needs. (More than +$3 million)

Vehicle Technologies Deployment will provide support to further expand the use of alternative fuels. (More than +$5 million)

Building Technologies

Technology Validation and Market Introduction and Equipment Standards and Analysis will be increased to expand ENERGYSTAR® and to comply with the energy code and rulemaking recommendations of EPACT 2005. (More than +$6 million)

Industrial Technologies

Forest and Paper Products, Steel, Aluminum, Metal Casting, Chemicals, Materials, Combustion, Sensors and Automation subprograms will complete technology R&D and shift toward more crosscutting and higher impact R&D activities to dramatically improve the energy efficiency and environmental performance of the energy-intensive industries. (More than -$15 million)

Energy-Intensive Process R&D will begin to transition from industry-specific research and development (R&D) to more crosscutting research as funding and investigation for existing multi-year projects are completed. (More than +$6 million)

Interagency Manufacturing R&D will coordinate with other Federal agencies to fund next generation technologies such as industrial nano-manufacturing and integrated and intelligent manufacturing. (More than +$5 million)

Weatherization and Intergovernmental Assistance

Weatherization Assistance Program’s core delivery system will be maintained while redirecting the resources to enable greater investments in advanced R&D. (More than -$20 million)

Program Direction

The FY 2008 request for program direction reflects cost of living increases, provides for hires of new employees with critical skills, and supports additional mission-related work to improve project oversight. (+$14 million)

Key Accomplishments

In addition to the scheduled individual targets completed by the programs in FY 2006, several noteworthy system delivery accomplishments took place this year that put the individual R&D elements to work moving the Nation toward its energy security goals. Some noteworthy examples include:

The FreedomCAR and Vehicle Technologies Office partnership with Cummins will result in their development and manufacture of a family of high-performance, light-duty diesel engines for a variety of automotive applications in vehicles below 8,500 pounds gross vehicle weight, including standard pickup trucks and sport utility vehicles. Cummins indicated that the first vehicles with this diesel engine are expected to be ready for market by 2010, with an anticipated 30 percent fuel savings, on average (depending on the drive cycle), over comparable gasoline engine-powered vehicles.

The Solar Program’s R&D partner, the National Renewable Energy Laboratory (NREL) achieved a world record 19.5 percent efficient thin-film photovoltaic cell in June. Thin-film technology, such as NREL's copper indium gallium diselenide cell, offers significant cost savings potential over conventional solar technologies because it requires less raw material and enables higher manufacturing throughputs. Rapid progress being made in thin-film technologies is the basis for several new U.S. manufacturing facilities coming on-line this year.

The Wind Program partnership with Clipper Windpower, Inc. resulted in their agreements with wind energy developers to supply up to 900 wind turbines over the next five years. This collaboration is on the first U.S. wind turbine designed specifically for operation in lower wind speed (Class 4) wind resource areas. The prototype incorporates many innovations such as a distributed drivetrain, advanced blades with truncated root section airfoils, and advanced controls. The Liberty Wind Turbine will be manufactured in Cedar Rapids, IA, in a manufacturing plant that was opened in the fall of 2005. Cost effective wind turbine operation in the low wind regimes significantly increases the resource areas available for wind energy development in areas much closer to major population centers.

The Buildings Program met the considerable requirements of EPACT 2005 for energy efficiency standards and test procedures including publishing a final rule to codify fifteen energy efficiency standards for residential appliances and commercial equipment; four framework documents affecting nine products; and, the NOPRs for both a single-product test procedure (residential central air-conditioners and heat pumps) and multiple test procedures to be adopted *en masse.*

Federal Energy Management Program sent trained Energy Savings Expert Teams to Federal sites where large amounts of natural gas were consumed in response to the President's call for action in places where the effects of the Hurricane Katrina were most severe. The estimated potential savings from the recommended efficiency improvement measures for 28 Federal sites are 9.4 percent of the total natural gas consumption of all sites assessed and 1.8 percent of the total electricity consumption of all sites assessed.

The Industrial Program played a pivotal role in launching the "Save Energy Now" campaign in support of the Secretary's initiative "Easy Ways to Save Energy", providing U.S. industry with technical assistance and information to save energy and increase productivity. ITP's effort targeted 200 industrial facilities in 39 States which represent 14 percent of industry's natural gas use. Preliminary results have identified potential energy savings of over 25 trillion Btu of natural gas (equivalent to more than 355,000 U.S. homes energy use), nearly $240 million/year in potential energy cost savings if industry takes action to implement the recommendations.

Expected Integrated Program Outcomes

The program pursues its mission through an integrated portfolio of research, development, demonstration and deployment activities that improve the Nation's energy security, energy efficiency and productivity of our economy while minimizing environmental impacts. 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 cost of controlling regulated pollutants; enhanced energy security as petroleum and natural gas dependence is reduced and domestic fuel supplies increase; and greater energy security and reliability from improvements in energy infrastructure. Indicators of some of these program benefits are provided in the tables below. The results shown in the long-term benefits tables are estimates based on modeling of some of the possible program production technologies. The estimates generated by the model have been rounded to reduce the implied precision. Cumulative benefits of programs and costs to achieve these benefits have not been calculated.

The assumptions and methods underlying the modeling efforts have significant impact on the estimated benefits. Results could vary significantly if external factors, such as future energy prices, differ from the baseline case assumed for this analysis (essentially the EIA business as usual outlook for components of the economy affecting energy use). This modeling includes competing technologies. Possible changes in public policy and disruptions in the energy system which may affect estimated benefits are not modeled. The external factors such as unexpected changes in competing technology costs, identified in the Means and Strategies sections in each of the individual contributing programs, could also affect EERE's ability to achieve its strategic goals as could persistent directed funding. Projections of future benefits depend on assumptions relating to how the economy will evolve over time and how rapidly energy efficient technologies will be developed and adopted among other variables. The estimated benefits presented here are predicated on the assumptions included in EIA's Annual Energy Outlook 2006 Reference Case projections.

Some key assumptions about macroeconomic activity, energy demand, and technology results include the following "business-as-usual" assumptions used in the EIA Reference Case:

- Average economic growth of 3.0 percent annually between 2004 and 2030;
- Price per barrel of oil of about $36 (2004 dollars) in 2004, rising to $44 in 2010, then dropping to $43 in 2015, before rising to $50 in 2030. In nominal dollars, the price of oil in 2030 would be about $94; and
- Price per thousand cubic feet of natural gas is $5.49 (2004 dollars) in 2004, dropping to $4.52 by 2015, then rising slowly to $5.92 by 2030. In nominal dollars, the price of natural gas in 2030 would be about $11.10.

EIA also provides projections under alternative economic assumptions ranging from 2.4 to 3.5 percent annual growth between 2004 and 2030. Across this range, total energy consumption may grow by anywhere from 22 to 47 percent between 2004 and 2030. EIA also offers a range of technology assumptions. Across these cases total energy consumption may grow by anywhere from 45 percent between 2004 and 2030 if technology does not improve at all to 26 percent if technology improves rapidly. Changing assumptions on important variables such as these would likely affect the estimated benefits in this budget.

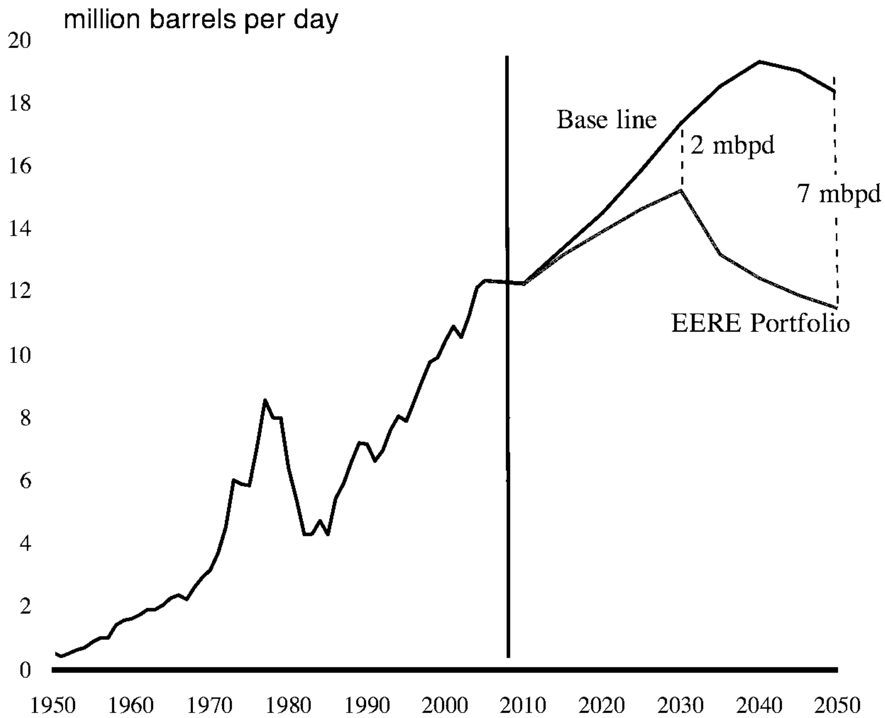
Benefits estimates are based on modeling of some of the possible program production technologies. While uncertainties are larger for longer term estimates, they provide a useful picture of the potential change in national benefits over time if the technology, infrastructure and markets evolve as expected. Estimated benefits which follow assume that individual technology plans and market assumptions occur. A summary of the methods, assumptions, and models used in developing these benefit estimates are provided at www.eere.energy.gov/office_eere/ ba/pba/gpra.html. Final documentation is estimated to be completed and posted by March 31, 2007.

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

The benefits of EERE's portfolio are broken down into three categories that align with DOE's strategic goals:

- Environmental benefits
- Economic benefits, and
- Benefits associated with security and reliability.

Figure 1. Effect of EERE's Portfolio on Projected Oil Imports



A summary of the modeled benefits for EERE's portfolio is shown below. The table shows, that if successful and the assumptions play out as expected, EERE's programs could provide:

- Annual savings to consumers of over $100 billion by 2030 and over $400 billion by 2050;
- Reductions of about 220 million metric tons of annual carbon emissions (MMTCE) in 2030 and over 500 million metric tons of annual carbon in 2050; and
- Reductions in oil imports of 2 million barrels per day in 2030 and 7 mbpd in 2050.

Figure 1 provides some context on how much impact the EERE portfolio has on reducing U.S. reliance on foreign oil. The long term savings of 7 million barrels per day in 2050 would bring U.S. imports below current levels of imports.

While point estimates are presented, both mid-term and long-term modeling are dependent upon the methodology and assumptions used and could vary substantially around those points. Many of the key variables affecting the benefits estimates are listed as the external factors that could affect expected results in the means and strategy sections of the individual programs, and include variables such as market and policy interactions and the future price of oil, natural gas and electricity generation. Long-term estimates should be considered preliminary as EERE refines its analytical approaches for the 2030-2050 timeframe.

FY 2008 GPRA Benefits for EERE's Integrated Program Portfolio[a,b,c]

	2010	2020	2030	2040	2050
Environmental Benefits (Goal 1.2)					
Avoided carbon emissions, annual (MMTC)	6	101	219	508	505
Avoided carbon emissions, cumulative (MMTC)	12	470	2,136	7,047	12,276
Reduced cost of criteria pollutant control, NPV (bil. [d]	-0.1	3	13	NC	NC
Economic Benefits (Goal 1.4)					
Consumer savings, annual (bil. 2004$)	4	43	110	319	401
Consumer savings, NPV (bil. 2004$)	6	148	632	1,878	3,113
Electric power industry savings, annual (bil. 2004$)	1	13	26	64	70
Electric power industry savings, NPV (bil. 2004$)	2	54	174	422	655
Household energy expenses reduced, annual (bil. 2004$)	0.3%	2%	5%	9%	10%
Energy intensity reduced (% change in E/GDP)	0.3%	4%	8%	13%	17%
Net energy system cost savings, annual (bil. 2004$)	NC	NC	NC	146	203
Natural gas price change, moving avg. (2004$ / TCF)[e]	ns	0.2	0.2	NC	NC
Security and Reliability Benefits (Goal 1.1 or 1.3)					
Avoided oil imports, annual (mbpd)	ns	0.6	2	7	7
Avoided oil imports, cumulative (bil. bbl)	ns	1.0	6	29	54
Security MPG improvement (%)[f]	ns	6%	21%	139%	181%
Transportation fuel diversity improvement (%)[g]	ns	4%	24%	86%	42%
Oil intensity reduced (% change in bil. bbl/GDP)	ns	3%	9%	32%	33%

[a] Estimates reflect the benefits that may be possible, if all of the program's technical targets are met and are funded at levels consistent with assumptions in the FY 2008 Budget through the program completion year, which varies by program. Benefits through 2030 are calculated with the NEMS-GPRA08 model. Benefits from 2035 through 2050 are calculated with the MARKAL-GPRA08 model. "NC" indicates situations in which no calculation was done because of specific model limitations. "ns" indicates results that were "not significant"—within the noise of the models.

[b] Projected benefits do not include any potential policy changes that might enhance technology deployment. In addition, most technologies show diminishing benefits by 2050, because of the assumption built in to the analysis that baseline industry progress will eventually catch up with the more accelerated progress associated with EERE program success.

[c] Energy and greenhouse gas emission savings associated with this new initiative have been updated for the individual WIP program case, but are not updated in the integrated program benefits presented here. The final published GPRA report will include updated EERE portfolio results.

[d] Net present value calculations throughout this table are performed for cumulative economic metrics, and are done using a 3% real discount rate, cumulative to 2008.

[e] The prices reflected here are average delivered prices to all sectors, and are based on a three year moving average. Thus the measure of benefit is the change in the three year moving average delivered price, in $ per thousand cubic foot.

[f] Security MPG is the ratio of vehicle miles traveled by light duty vehicles to their usage of oil. It captures oil avoidance by efficiency and fuel alternatives.

[g] Fuel diversity is measured by the Shannon-Weiner Index (SWI) of diversity. The SWI is a measure of "proportional diversity," and hence captures both abundance and richness, i.e., how many different fuels and how much of each fuel both factor into the calculation.

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

The following table highlights some of the benefits associated with each of EERE's programs. The results are not additive; integrated results are shown in the table above. The estimates are not directly comparable because of some differences in methodology and assumptions. Nevertheless, the table provides relative "order-of-magnitude" estimates while the Department continues to refine and standardize its methodology.

Estimates of Potential Benefits by Program[a]

	Consumer Expenditure Savings (Billion 2004$)		Annual Carbon Emission Reductions (MMTCE)		Avoided Oil Imports (mbpd)	
	2030	2050	2030	2050	2030	2050
Hydrogen Technology Program	5	80	14	31	0.3	2.1
Biomass and Biorefinery Systems R&D Program	3	ns	9	3	0.3	ns
Solar Energy Program	ns	50	23	50	ns	0.1
Wind Energy Program	8	-4	36	139	ns	ns
Vehicle Technologies Program	46	202	69	210	2	6
Building Technologies Program	27	71	57	77	0.1	0.1

[a] Projected benefits do not include any potential policy changes that might enhance technology deployment. In addition, most technologies show diminishing benefits by 2050, because of the assumption built in to the analysis that baseline industry progress will eventually catch up with the more accelerated progress associated with EERE program success.

	Consumer Expenditure Savings (Billion 2004$)		Annual Carbon Emission Reductions (MMTCE)		Avoided Oil Imports (mbpd)	
	2030	2050	2030	2050	2030	2050
Industrial Technologies Program	11	-12	40	18	ns	ns
Federal Energy Management Program	1	1	1	1	ns	ns
Weatherization and Intergovernmental Activities[a,b]	na	na	15	15	0.1	0.1

Note: EERE's portfolio approach to RD&D affects benefits and the way they are calculated. The total benefits reported for EERE's entire portfolio are usually less that the sum of the individual programs due to competition between these technologies and the resulting tradeoffs. For instance, efficiency improvements reduce the future need for new electricity generating capacity, including the potential size of the renewable electric market. In addition, a research failure in one area will not necessarily reduce the technology's overall benefits, as the lack of market penetration by the failed technology may create a market opportunity elsewhere in the EERE portfolio. An integrated benefit total may be higher than the individual sums because of the additive impact of multiple EERE programs. Estimates reflect the benefits that may be possible, if all of the program's technical targets are met and are funded at levels consistent with assumptions in the FY 2007 Budget through the program completion year, which varies by program. Benefits through 2030 are calculated with the NEMS-GPRA08 model. Benefits from 2035 through 2050 are calculated with the MARKAL-GPRA08 model. "NC" indicates situations in which no calculation was done because of specific model limitations. "ns" indicates results that were "not significant"— within the noise of the models.

[a] An estimate of renewable electricity generation associated with the Renewable Energy Production Incentive is included in the section for Intergovernmental Activities. Because this is not one of the common benefits estimated for all programs, it is not included in this table.

[b] Benefit estimates for the WIP program have been updated to reflect a new market transformation initiative. These changes are reflected in the oil and greenhouse gas savings. Consumer savings have been reported as "na" (not available) due to insufficient time to complete all of the benefits calculations. The final GPRA benefits report for FY 2008 will include a full set of benefits estimates.

Energy Supply and Conservation
Office of Energy Efficiency and Renewable Energy

Funding by Site by Program

	FY 2006	FY 2007	FY 2008
	(dollars in thousands)		
Ames Laboratory			
Vehicle Technologies	665	300	300
Industrial Technologies	276	500	540
Total, Ames Laboratory	941	800	840
Argonne National Laboratory (East)			
Hydrogen Technology	7,538	8,838	10,760
Biomass and Biorefinery Systems R&D	450	500	500
Vehicle Technologies	25,381	15,992	21,992
Industrial Technologies	2,085	1,315	813
International Renewable Energy Program	100	300	0
Program Support	1,089	900	900
Total, Argonne National Laboratory	36,643	27,845	34,965
Brookhaven National Laboratory			
Hydrogen Technology	970	2,165	1,607
Solar Energy	400	470	470
Vehicle Technologies	625	600	600
Building Technologies	454	803	0
Program Support	406	410	410
Total, Brookhaven National Laboratory	2,855	4,448	3,087
Central Regional Office			
Solar Energy	25	0	0
Wind Energy	100	0	0
Program Direction	3,255	0	0
Total, Central Regional Office	3,380	0	0

	FY 2006	FY 2007	FY 2008
	(dollars in thousands)		
Golden Field Office (Project Management Center)			
Solar Energy	150	550	500
Program Direction	16,485	22,124	24,531
Total, Golden Field Office	16,635	22,674	25,031
Idaho National Laboratory			
Biomass and Biorefinery Systems R&D	1,350	4,500	5,000
Wind Energy	90	250	150
Geothermal Technology	2,000	0	0
Hydropower	100	0	0
Vehicle Technologies	3,341	2,935	2,935
Industrial Technologies	573	425	400
Federal Energy Management Program	0	0	170
Total, Idaho National Laboratory	7,454	8,110	8,655
Lawrence Berkeley National Laboratory			
Hydrogen Technology	605	1,200	1,147
Wind Energy	200	250	250
Geothermal Technology	1,000	0	0
Vehicle Technologies	6,975	5,500	7,500
Building Technologies	8,781	7,131	8,185
Industrial Technologies	1,584	500	750
Federal Energy Management Program	2,007	1,887	1,866
International Renewable Energy Program	20	200	0
Program Support	515	520	520
Total, Lawrence Berkeley National Laboratory	21,687	17,188	20,218
Lawrence Livermore National Laboratory			
Hydrogen Technology	984	1,200	857
Geothermal Technology	500	0	0
Vehicle Technologies	3,330	2,962	2,962
Total, Lawrence Livermore National Laboratory	4,814	4,162	3,819

	(dollars in thousands)		
	FY 2006	FY 2007	FY 2008
Los Alamos National Laboratory			
Hydrogen Technology	7,590	9,347	11,526
Biomass and Biorefinery Systems R&D	50	1,200	50
Vehicle Technologies	250	332	332
Buildings Technologies	250	0	0
Industrial Technologies	307	80	60
Total, Los Alamos National Laboratory	8,447	10,959	11,968
Mid-Atlantic Regional Office			
Solar Energy	25	0	0
Wind Energy	50	0	0
Program Direction	3,039	0	0
Total, Mid-Atlantic Regional Office	3,114	0	0
Midwest Regional Office			
Solar Energy	25	0	0
Wind Energy	50	0	0
Program Direction	2,814	0	0
Total, Midwest Regional Office	2,889	0	0
National Energy Technology Laboratory (Project Management Center)			
Hydrogen Technology	0	150	57
Solar Energy	600	0	0
Geothermal Technology	2,696	0	0
Weatherization and Intergovernmental Activities	1,800	0	0
Federal Energy Management Program	2,211	2,211	2,361
Program Direction	6,835	10,470	13,052
Program Support	99	100	100
Total, National Energy Technology Laboratory	14,241	12,931	15,570

	(dollars in thousands)		
	FY 2006	FY 2007	FY 2008
National Nuclear Security Administration (NNSA) Service Center			
Vehicle Technologies	650	500	500
National Renewable Energy Laboratory			
Hydrogen Technology	11,537	14,748	18,448
Biomass and Biorefinery Systems R&D	14,662	27,500	27,500
Solar Energy	52,175	68,142	61,142
Wind Energy	19,051	34,500	25,500
Geothermal Technology	2,110	0	0
Hydropower	50	0	0
Vehicle Technologies	17,526	11,134	15,634
Building Technologies	4,338	3,076	3,531
Industrial Technologies	786	625	600
Federal Energy Management Program	2,817	2,648	3,187
Facilities and Infrastructure	26,052	5,935	6,982
Gateway Deployment	2,500	0	0
International Renewable Energy Program	170	350	0
Tribal Energy Activities	800	500	500
Program Support	5,544	2,010	2,010
Total, National Renewable Energy Laboratory	160,118	171,168	165,034
Northeast Regional Office			
Solar Energy	25	0	0
Wind Energy	50	0	0
Program Direction	2,970	0	0
Total, Northeast Regional Office	3,045	0	0
Oak Ridge National Laboratory			
Hydrogen Technology	3,247	6,416	6,416
Biomass and Biorefinery Systems R&D	746	3,500	3,000
Solar Energy	220	0	0

	(dollars in thousands)		
	FY 2006	FY 2007	FY 2008
Wind Energy	120	150	150
Hydropower	150	0	0
Vehicle Technologies	46,960	36,781	37,153
Building Technologies	4,409	5,387	6,183
Industrial Technologies	5,231	4,907	4,290
Federal Energy Management Program	2,456	2,309	2,294
Gateway Deployment	3,000	0	0
International Renewable Energy Program	40	0	0
Program Support	2,000	2,004	2,004
Total, Oak Ridge National Laboratory	68,579	61,454	61,490
Office of Scientific and Technical Information			
Wind Energy	15	10	10
Geothermal Technology	10	0	0
Total, Office of Scientific and Technical Information	25	10	10
Pacific Northwest National Laboratory			
Hydrogen Technology	2,220	6,870	4,086
Biomass and Biorefinery Systems R&D	4,264	6,200	6,500
Hydropower	150	0	0
Vehicle Technologies	7,849	6,355	6,355
Building Technologies	5,377	7,015	8,052
Industrial Technologies	1,462	235	40
Federal Energy Management Program	1,756	1,651	1,332
Gateway Deployment	3,500	0	0
Program Support	1,189	1,101	1,101
Total, Pacific Northwest National Laboratory	27,767	29,427	27,466
Sandia National Laboratories			
Hydrogen Technology	5,473	6,625	5,545
Solar Energy	10,430	18,440	11,440
Wind Energy	3,695	6,300	5,750

	(dollars in thousands)		
	FY 2006	FY 2007	FY 2008
Geothermal Technology	3,500	0	0
Vehicle Technologies	8,255	8,443	8,443
Industrial Technologies	1,038	331	0
Federal Energy Management Program	224	211	214
Tribal Energy Activities	300	250	250
Program Support	396	400	400
Total, Sandia National Laboratories	33,311	41,000	32,042
Savannah River National Laboratory			
Hydrogen Technology	650	1,389	873
Southeast Regional Office			
Solar Energy	25	0	0
Wind Energy	50	0	0
Program Direction	3,300	0	0
Total, Southeast Regional Office	3,375	0	0
Washington Headquarters			
Hydrogen Technology	112,637	136,853	151,678
Biomass and Biorefinery Systems R&D	68,254	106,287	136,713
Solar Energy	17,666	60,770	74,752
Wind Energy	14,697	2,209	8,059
Geothermal Technology	10,946	0	0
Hydropower	45	0	0
Vehicle Technologies	56,544	74,190	71,432
Building Technologies	44,581	53,917	60,505
Industrial Technologies	42,514	36,645	38,505
Federal Energy Management Program	7,503	5,989	5,367
Weatherization and Intergovernmental Activities	278,685	213,655	189,501
Gateway Deployment	14,600	0	0
International Renewable Energy Program	3,541	1,623	0
Tribal Energy Activities	2,860	3,207	2,207

	(dollars in thousands)		
	FY 2006	FY 2007	FY 2008
Renewable Energy Production Incentive	4,950	4,946	4,946
Asia Pacific	0	0	7,500
Program Direction	60,138	58,430	67,430
Program Support	2,083	3,485	5,836
Total, Washington Headquarters	742,244	762,206	824,431
Western Area Power Administration			
Wind Energy	90	150	200
Western Regional Office			
Solar Energy	25	0	0
Wind Energy	75	0	0
Program Direction	3,032	0	0
Total, Western Regional Office	3,132	0	0
Total, Energy Supply and Conservation	1,166,086	1,176,421	1,236,199
Use of Prior Year Balances	-3,339	0	0

Major Changes or Shifts by Site

National Renewable Energy Laboratory,

Wind Energy

- Funding decreases for NREL are due to a reduction in the level of cost-shared NREL sub-contracts to industry, in accordance with the shift in program priorities. Overall NREL staffing will not be affected by this funding shift.

Hydrogen Technology

- Funding for NREL increases by about ($3.7M) for increased efforts on hydrogen production, storage, safety, and manufacturing technologies. It is yet unclear if additional staffing will be needed to carry out these activities.

Solar Energy

- Funding decreases are due to a reduction in NREL sub-contracts to industry. (More funding will be dedicated to direct contracting by the EERE Project Management Center, reducing overhead and transferring contracting oversight responsibility to Federal employees.) Overall NREL staffing will not be affected by this funding shift.

Sandia National Laboratories

Solar Energy

- This reduction (-$7M) reflects completion of the Solar Hydrogen Earmark.

Washington Headquarters

Headquarters funding has increased to implement an expanded number of solicitations which are part of the AEI.

- The Geothermal Program is closing out program activities in FY 2007. Laboratory efforts in FY 2007 will focus on completing the documentation of technology partnerships, transferring research findings to industry, and archiving legacy documents.

Site Description

Ames Laboratory

Introduction

Ames Laboratory is a multi-discipline laboratory located in Ames, Iowa. Ames provides research for Vehicle Technologies in new materials. Ames conducts basic research on new materials with unique properties. It is a multi-discipline laboratory providing support to Vehicle Technologies and Industrial Technologies.

Vehicle Technologies

Ames Laboratory work for VT includes the development of low-cost powder metallurgy manufacturing methods for particle reinforced aluminum (PRA) composite components. Materials efforts are working to improve powder for permanent magnets.

Industrial Technologies

Ames Laboratory work for ITP includes the development of a new class of materials with extreme resistance to abrasive and erosive wear for use in industrial tools and components.

Argonne National Laboratory East

Introduction

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

Hydrogen Technology

ANL is conducting research and development of advanced hydrogen storage concepts including modeling of storage systems and life cycle analyses. ANL is the lead laboratory in all facets of the research and development of fuel processor catalysts and fuel cell system analysis. ANL provides technical assistance in the management of DOE cooperative agreements with industry. ANL develops catalysts, materials, and processes for the autothermal reforming of gasoline and other fuels including diesel with CO clean-up, investigates the effect of fuel additives on fuel processor performance, and characterizes the stability and degradation of fuels processing catalysts. ANL is using sulfonated polyarl ether dendrimers (highly branched macromolecules) and inorganic/organic composites to develop membrane electrolytes with high proton conductivity at low relative humidity and temperatures ranging from room temperature to above 100°C. To minimize the cost of fuel cell cathode catalysts, ANL is exploring transition metal carbides/nitrides based materials, especially the mixed transition metal carbides/nitrides (e.g. M_1M_2N, $M_1N_xC_y$, M = transition metal).

Biomass and Biorefinery Systems R&D

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

ANL will conduct R&D related to converting biomass to bio-based products with the goal of making the technologies more competitive with petroleum-based alternatives.

Vehicle Technologies

ANL provides simulation, analysis, and develops transient models for hybrid and fuel cell systems. Develops sophisticated software for hardware-in-the loop (HIL) testing. Provides technical support and analysis for heavy hybrids. Conducts research to reduce parasitic loads on heavy vehicles including reductions in idling losses, rolling resistance, aerodynamic drag, and under hood thermal management. Also, works to improve oil filtration, coolants, and regenerative shocks for trucks. Performs high-performance computing with particular focus on computational fluid dynamics (combustion, underhood cooling, HVAC, etc.). Utilizes the Advanced Photon Source facility to characterize fundamental mechanisms of friction, lubrication, and fuel spray from fuel injectors. Develops nano-fluid technology and new designs for higher efficiency heavy vehicle cooling systems. Monitors R&D in industry for underhood electrification for heavy vehicle components and new brake material developments. Provides technical and analytical expertise to the Graduate Automotive Technology Education (GATE) activities. Provides technical support for advanced vehicles student competition. Conducts HEV component and subsystem performance and emissions tests in a state-of-the-art test facility. Validates components and subsystems performance targets for hybrid and fuel cell technology using HIL testing to simulate vehicle operating environment. Develops test procedures for advanced vehicle testing and control strategies to improve overall vehicle efficiency and reduce emissions. Conducts research in energy storage for EVs and HEVs and high performance capacitors. Provides battery technical support, and testing of advanced batteries.

Conducts research and development of in-cylinder emission control techniques for CIDI engines and the evaluation of innovative technologies to reduce emissions and improve fuel efficiencies in heavy-duty diesel engines. Develops wide range of materials (both metals and ceramics), with particular expertise in nondestructive evaluation, rapid prototyping, sensors, and catalysts. Develops economic processes for automotive recycling. Develops permanent magnet materials for high performance motors. Characterizes the effect of micro-dimpling on reduction of surface friction and wear. Develops lower temperature, high strength bonding methods for ceramics and dissimilar materials. Conducts technology analysis (energy, environmental, and economic) as well as vehicle system and subsystem modeling.

Industrial Technologies

ANL performs research and development for the chemical industry R&D area. Argonne provides unique expertise in advanced separations process technologies and new innovative membrane systems. The laboratory also does research on refractory materials for the steel industry. The laboratory also has unique expertise in anode and cathode development for the aluminum industry using technology to analyze the surface effects conditions on the advanced candidate materials.

Weatherization and Intergovernmental Activities

Funding to ANL has supported international activities, primarily in the Asia-Pacific Economic Cooperation (APEC) area by providing technical assistance and support to the program's APEC related projects. No work is expected in FY 2008 at this time.

Program Support

Provide analytical support for major crosscutting issues, such as market and benefit analyses.

Brookhaven National Laboratory

Introduction

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

Hydrogen Technology

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

BNL conducts research and development of electrocatalysts alloys fuel cell focusing on synthesis and characterization of the materials.

Solar Energy

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

Vehicle Technologies

Performs analysis, studies and conducts research in advanced materials to improve the performance and abuse tolerance of lithium battery systems and provides research support for analysis of internal combustion (IC) engine emissions for the FreedomCAR partnership.

Building Technologies

BNL has conducted research and development activities for the space heating and cooling technologies for Building Technologies. No work is expected in FY 2008 at this time.

Program Support

Provides analytical support for crosscutting issues such as market and benefit analyses.

Central Regional Office

Introduction

The Central Regional Office, located in Golden, Colorado, provided (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) provided direction, guidance, and support deployment and outreach programs on a local and regional level. It provided support to Solar Energy, Wind Energy, and Program Direction. In FY 2007, EERE consolidated all Regional Office activities to the two Project Management Centers. The activities of the Central Regional Office was transferred to the Golden PMC.

Golden Field Office

Introduction

The Golden Field Office (GO) is located in Golden, Colorado. It provides project management and procurement support for Solar Energy, and Program Direction. In FY 2007, the Golden Field Office began the first full year of carrying out some deployment activities previously handled by the ROs. The Golden Field office provides support to Solar Energy and Program Direction.

Solar Program

Golden Field Office provides project management and procurement support for Solar Energy.

Program Direction

In FY 2008, functions formerly provided by the Regional Offices (consolidated in the third quarter of FY 2006) will be performed at the Project Management Center (PMC).

Program Direction funds the salary, benefits, and travel costs for FTE in order to support: (1) promotion of EERE renewable energy and hydrogen programs at the local and regional levels; (2) administration of grants to, and cooperative agreements with, States and local governments, particularly the Weatherization Assistance Program and State Energy Program grants; and (3) administration and implementation of locally- and regionally-focused deployment activities, such as Solar Powers America (formerly Million Solar Roofs), Wind Powering America, Clean Cities, Rebuild America, and the Federal Energy Management Program (FEMP), etc.

Idaho National Laboratory

Introduction

Idaho National Laboratory (INL) is located in Idaho Falls, Idaho. It is a multi-discipline laboratory providing support to Biomass and Biorefinery Systems R&D, Wind Energy, Vehicle Technologies, Industrial Technologies, Federal Energy Management Program. It also previously supported the Hydropower Program and Geothermal Technology Program, which have been closed out.

Biomass and Biorefinery Systems R&D

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

Wind Energy

INL provides technical support to the program to enhance government, military applications and Tribal use of Wind Energy, and to address technical and market barriers to wind.

Geothermal Technology

INL served as the lead laboratory for research and development in geosciences and reservoir management. INL conducted research in exploration technologies, Enhanced Geothermal Systems, and advanced heat and power systems.

Hydropower

INL provided engineering and technical support to the Hydropower Program. INL served as the engineering technical monitor for the Advanced Hydro Turbine Technology Subprogram and the Tribal Energy hydropower projects located in Alaska, and conducts hydropower resource and economic assessments. These efforts concluded in FY 2006 when the program was closed out. INL will, however, continue to house the Hydropower Program's documentation and make it available electronically.

Vehicle Technologies

INL develops and assesses advanced oil by-pass filter concepts for heavy vehicles; develops and assesses ultracapacitors for hybrid vehicles. The Laboratory also conducts tests of high-power batteries, develops battery test procedures, tests and simulates hybrid vehicle performance, and develops energy storage models for electric and hybrid vehicles (SIMPLEV). Additionally, INL develops and demonstrates spray forming process for rapid production on net-shape molds, dies, and related tooling for automotive components; models slurry performing for fiber reinforced composites, non-destructive evaluation of cylinder liners, intelligent welding and spray forming of aluminum, and characterizes metallic structures produced by equal channel angular extrusion process. INL conducts field testing and evaluation of electric, hybrid and hydrogen light duty vehicles and infrastructure, and supports Federal Fleet acquisition reporting as required.

Industrial Technologies

INL provides critical support in project management and analysis for the Forest Products and Steel activities. Work is ongoing for an advanced black liquor spray atomization process for the Forest Products industry, and on the development of controlled thermal-mechanical processing of tubes and pipes for enhanced manufacturing performance and in the development and application of laser-assisted arc welding in the steel industry.

Federal Energy Management Program

INL will support FEMP with continued enhancement and maintenance of the Federal Automotive Statistical Tool (FAST). In addition, it will provide management and organizational support to the Department of Energy (DOE) sponsored Interagency Committee on Alternative Fuels and Low Emission Vehicles (INTERFUEL).

Lawrence Berkeley National Laboratory

Introduction

Lawrence Berkeley National Laboratory (LBNL) is located in Berkeley, California. It is a multi-discipline laboratory providing support to Hydrogen Technology, Wind Energy, Vehicle Technologies, Building Technologies, Industrial Technologies, Federal Energy Management Program, Weatherization and Intergovernmental Activities, and Program Support.

Hydrogen Technology

Lawrence Berkeley National Laboratory develops electrocatalysts for membrane electrode assemblies (MEAs) with the goal of increasing understanding of fundamental electrochemical processes.

Wind Energy

LBNL performs analyses of opportunities for Wind Energy applications in the electricity market.

Geothermal Technology

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

Vehicle Technologies

LBNL conducts exploratory research in advanced battery technology, including development of new electrode and electrolyte materials and understanding of fundamental electrochemical phenomena. Develops devices to measure particulate matter from engines. Develops nondestructive testing techniques for evaluation of aluminum and composite structures in manufacturing environments.

Building Technologies

LBNL conducts research and development activities in lighting, windows, appliance standards, analysis tools and design strategies and space heating and cooling.

Industrial Technologies

LBNL supports technology delivery activities of the Best Practices Program including assistance in facilitating Allied Partners with supplier industry organizations (e.g., Hydraulic Institute, Compressed Air and Gas Institute). The laboratory supports the tracking of Best Practices implementation results including the impact of training, software tools and other program delivery mechanisms on manufacturing plants.

Federal Energy Management Program

LBNL facilitates projects, develops guidelines and provides expert advice on the monitoring and verification protocols for energy projects savings, laboratory sustainable design principles, public benefit funds, and lighting.

Weatherization and Intergovernmental Activities

LBNL performed research and technical assistance for the International Renewable Energy Program. These activities are now part of the Asia Pacific Partnership. Activities include technical assistance for U.S.-China energy cooperation, and support for Collaborative Labeling and Appliance Standards Projects (CLASP).

LBNL also provides technology transfer technical outreach for Rebuild America and ENERGY STAR® In FY 2007 both Rebuild America and ENERGY STAR® subprograms transferred to the Office of Building Technologies.

Program Support

LBNL provides analytical support for major crosscutting issues, such as market and benefit analyses.

Lawrence Livermore National Laboratory

Introduction

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

Hydrogen Technology

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

Geothermal Technology

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

Vehicle Technologies

LLNL provides application of advanced methods of conventional fluid dynamics to aerodynamic drag of heavy vehicle for increased energy efficiency. Performs studies of combustion under diesel and homogeneous charge compression ignition (HCCI) conditions using chemical kinetic modeling and other methods to determine means for increasing fuel efficiency, reducing emissions, and increasing peak output power of advanced internal combustion engines (ICEs). Research is directed at materials development and advanced automotive manufacturing concepts, such as metal treatment using Plasma Surface Ion Implantation (PSII) and development of low-cost aluminum sheet. Develops high-voltage, dielectric ultracapacitors based on nanostructure multilayer oxide materials. Develops aerogel-based NO_x catalysts for CIDI engines. Conducts nondestructive evaluation and develops in-line sensors for the design and product optimization of cast light metals. Applies equal channel angular extrusion to the fabrication of amorphous metallic materials for magnet applications. Chemical kinetic modeling of in-cylinder combustion process of advanced HCCI engine technology as it applies to natural gas engines.

LLNL is constructing and testing hydrogen sensors, both for safety and for fuel stream monitoring in a fuel cell vehicles.

Los Alamos National Laboratory

Introduction

Los Alamos National Laboratory (LANL) is located in Los Alamos, New Mexico. It is a multi-discipline laboratory providing support to Hydrogen Technology, Biomass and Biorefinery Systems R&D, Vehicle Technologies, Building Technologies, and Industrial Technologies.

Hydrogen Technology

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

LANL serves as the lead laboratory in research and development of fuel cell components, reduction of precious metal loading while maintaining performance, and characterization of the poisoning of fuel cell catalysts by impurities in air and fuel feeds. To facilitate heat rejection and simplify the fuel cell system, LANL is designing, synthesizing, and characterizing membranes which operate at low relative humidity and high temperatures, 120°C for transportation applications. Other fuel cell related work at LANL includes: development of direct methanol fuel cells at LANL will accelerate high-volume manufacturing processes for fuel cells; investigating the impact of sub-freezing temperatures on performance and durability of specific fuel cell components; and characterizing the durability of fuel cell stacks operating on hydrogen (targets are 5,000 hours for transportation applications and 40,000 hours for stationary applications), since the durability of fuel cell stacks has not been demonstrated. Additionally, LANL is developing low-cost, high surface area support materials to “replace” precious-metals supports and developing high performance MEAs from alternative ionomer (non-Nation) membrane materials, and is exploring pyrolized macrocycle transition metal catalyst as replacements for the expensive platinum catalysts in fuel cell electrodes.

Biomass and Biorefinery Systems R&D

LANL is supporting the program's technical analysis activity to enhance the probability of achieving cost reduction goals for the biorefinery concept.

Vehicle Technologies

Performs research on combustion in internal combustion engines using simulation and modeling to increase efficiency and reduce NO_x in lean-burn engines and develops microwave regeneration components and design tools for emission controls. Los Alamos is also performing R&D to discover and develop next-generation emission-control catalysts for lean burn engines and to develop technology for onboard generation of chemical reductants from diesel fuel.

Building Technologies

LANL conducted research and development for activities in Windows Technologies. No work is envisioned in FY 2008 at this time.

Industrial Technologies

LANL supports program work for the Chemical industry R&D area. The laboratory provides unique capabilities in theoretical scientific analysis modeling fluid flows and understanding chemical reactions and catalysis phenomena. LANL provided the computer analysis of industrial fluid flows, and the computer technology prepared for use by the civilian sector. LANL also supports the Industrial Materials of the Future activities in the development of new materials for membrane separation systems.

National Energy Technology Laboratory

Introduction

The National Energy Technology Laboratory (NETL) is located in Morgantown, West Virginia. It provides project management and procurement support to Hydrogen Technology, Solar Energy, Federal Energy Management Program, the Weatherization and Intergovernmental Activities, Program Direction and Program Support. In FY 2008, the National Energy Technology Laboratory will also carry out some deployment activities previously handled by the ROs.

Hydrogen Technology

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

Solar Energy

National Energy Technical Laboratory provides support for various solar deployment activities at the regional, state, and local level. No work is envisioned in FY 2008 at this point.

Geothermal Technology

The State Energy Program Special Project funding for Geothermal formerly went through the Regional Office (RO), and the contracting for the RO was conducted by NETL.

Weatherization and Intergovernmental Activities

National Energy Technology Laboratory provides technology transfer technical outreach, grants management system development, and tools development for many WIP activities. No work is envisioned in FY 2008 at this point.

Federal Energy Management Program

Providing technical and financial analyses support for the Biomass Alternate Methane Fuels Technology Specific Super Energy Savings Performance Contract activities.

Program Direction

In FY 2008, functions formerly provided by the Regional Offices (consolidated in the third quarter of FY 2006) will be performed at the Project Management Center (PMC).

Program Support

Program Support funds are provided to NETL for the purpose of assisting in utilizing enhanced planning, analytical, and evaluation methodologies and tools; supporting cost/benefits analyses, road maps, data collection, and performance methodologies to support the Government Performance and Results Act (GPRA) as well as OMB's Performance Assessment Rating Tool (PART) and the Research and Development Investment Criteria (RDIC).

National Nuclear Security Administration (NNSA) Service Center

Introduction

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

Vehicle Technologies

Solicits, awards, and administers research and development contracts, cooperative agreements, and grants with industry, academia, and other government organizations. Provides research in full scale aerodynamic stability tests for heavy vehicles.

National Renewable Energy Laboratory

Introduction

The National Renewable Energy Laboratory (NREL) is located in Golden, Colorado. It is a multi-discipline laboratory providing support to Hydrogen Technology, Biomass and Biorefinery Systems R&D, Solar Energy, Wind Energy, Vehicle Technologies, Building Technologies, Industrial

Technologies, Federal Energy Management Program, Facilities and Infrastructure, Weatherization and Intergovernmental Activities, Program Direction, and Program Support.

Hydrogen Technology

NREL serves as the lead laboratory in research and development of technologies using renewable resources that will offer longer-term solutions to the production and storage of hydrogen. NREL is conducting research and development on material systems for the storage of hydrogen using carbon nanotubes and the photoelectrochemical production of hydrogen using semiconductors. NREL also conducts 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.

National Renewable Energy Laboratory leads the Systems Integration and Analysis function for the program. Models of the technical, economic, and integration aspects of the hydrogen infrastructure and fuel cell vehicle systems provide guidance for the development of hydrogen fuel cell components and materials. In support of ORNL's metallic bipolar plate project, NREL will survey current commercially available alloys to determine the best combination of alloy composition and evaluate nitrided metal samples. NREL will explore pure heteropoly acids (HPAs) and HPA/organic polymer mixtures for high temperature membranes in fuel cells.

Biomass and Biorefinery Systems R&D

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

Solar Energy

NREL serves as 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.

Wind Energy

NREL is the lead laboratory for national wind R&D, performing research in aerodynamics, structural dynamics, and advanced components and control systems related to Wind Energy. The National Wind Technology Center (NWTC), located at NREL, provides research and testing facilities for fatigue testing of turbine blades, dynamometer testing of wind turbine drive trains and generators, atmospheric testing of turbines, and certification testing which are required for sales and operation in many overseas markets. NWTC staff also conducts the Department's cost-shared R&D industry partnerships for large (> 100kW) wind turbine systems, and provides technical assistance for the Wind Powering America activity.

Hydropower

NREL conducted hydropower/renewable energy integration studies and hydropower outreach activities. In FY 2006, the Hydropower Program was closed out.

Vehicle Technologies

NREL provides analysis of performance targets for passenger and commercial vehicles, including developing a Technical Targets Tool for government use. NREL also develops system models and provides analysis and simulation of advanced hybrid and fuel cell configurations using the ADVISOR software developed at the lab, as well as other tools; provides CAD/CAE for optimized vehicle system solutions in support of FreedomCAR partnership goals; and general engineering assessments of HEV and AFV technologies. The laboratory investigates and develops advanced battery thermal management for hybrid and fuel cell vehicles. For heavy duty vehicles, NREL provides analysis, modeling, and technical support for power electronics and electric machines; conducts engine/vehicle integration and platform studies; leads an effort to identify the effects of sulfur levels in diesel fuels on emissions control devices. Leads an effort to determine the lube oil effects on exhaust after treatment devices; and conducts tests of bio-based diesel fuel blending agents to determine their ability to act as reductants in the exhaust stream of diesel engines. NREL also supports EPACT 1992 regulatory programs including Federal Fleet, State and Fuel Provider, Private and Local, and Fuel petitions; and supports the Clean Cities deployment program with technical assistance to regional coalitions and fleet partners, and program analysis and evaluation.

Building Technologies

NREL conducts research and development for the following activities in Building Technologies: Building America, and High Performance Buildings and Windows.

Industrial Technologies

NREL supports the Best Practices Program in communication activities and products. NREL supports overall Industry Program analysis of the logic of individual program activities including the relationship between program goals, milestones and the budget formulation process for several areas including Industrial Materials of the Future, Aluminum and Metal Casting.

Federal Energy Management Program

NREL facilitates projects, develops guidelines and provides expert advice on sustainable and renewable facility designs, green power procurement, and alternative financing.

Facilities and Infrastructure

The Facilities and Infrastructure Program provides funding for plant and capital equipment (PCE) which provides routine upgrades of the laboratory's office, research and user facilities. The program also supports major construction projects, such as the Science Technology Facility that began construction in FY 2004 and was completed in FY 2007.

Weatherization and Intergovernmental Activities

NREL provided technical assistance to the transfer of renewable energy and energy efficiency technologies to Native American tribal lands. NREL analyzes the program's communications strategy and develops information outreach products for WIP and specific subprograms. NREL also provides technical assistance in identifying and developing energy policies that will reduce greenhouse gas emissions. In addition, NREL works cooperatively with the private sector.

Program Support

Provides analytical support for crosscutting issues, such as market and benefit analyses.

Oak Ridge National Laboratory

Introduction

Oak Ridge National Laboratory (ORNL) is located in Oak Ridge, Tennessee. It is a multi-discipline laboratory providing support to Hydrogen Technology, Biomass and Biorefinery Systems R&D, Solar Energy, Wind Energy, Vehicle Technologies, Building Technologies, Industrial Technologies, Federal Energy Management Program, Weatherization and Intergovernmental Activities, Program Direction, and Program Support.

Hydrogen Technology

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

Oak Ridge National Laboratory is the primary National Laboratory for materials R&D aimed at reducing cost and increasing the durability of fuel cell components. ORNL carries out R&D on metal bipolar plates with nitride surface layers and temperature sensors. It characterizes the structure of membranes and membrane electrode assemblies and it develops high-thermal-conductivity graphite fibers for fuel cell thermal management. To reduce sulfur in fuel gas stream, ORNL develops a catalyst to oxidize hydrogen sulfide to elemental sulfur.

Biomass and Biorefinery Systems R&D

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

ORNL provided assistance on biomass technology assessment and information transfer.

Wind Energy

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

Vehicle Technologies

ORNL develops models to estimate cost of advanced hybrid and fuel cell vehicles to perform trade-off studies, and also develops models to predict emissions from advanced after-treatment devices. ORNL performs research and development on high thermal conductivity carbon foams for high performance truck and automobile radiators, as well as R&D of advanced materials such as carbon fiber, aluminum, titanium, and magnesium. Conducts analysis, technical support, testing and research on power electronic devices and electric machines. Conducts research and provides technical/project management support in propulsion and vehicle system materials. Develops material analytical techniques and material related solutions for automotive and heavy vehicle systems. Conducts research in internal combustion engine technologies, in-cylinder diagnostics (such as application of chaos theory and emission studies), and exhaust after treatment (including catalytic converter research, development, and testing). Develops an understanding of NO_x absorber processes affecting regeneration, desulfation, and degradation under real-world conditions. Provides detailed characterization and speciation of combustion and emission products. Using primarily laboratory reactors and some engine experiments, acquires kinetic data for the development of computer models of after treatment devices. Evaluates the toxicity of unregulated emissions that are present in the exhaust streams of engines operating on advanced fuels. Leads an effort to evaluate the fuel effects on selective catalytic reduction systems on diesel engines. Evaluates the critical fuel properties that effect near term emissions control devices for diesel engines. Determines the effects and the mechanism of lube oil suspended phosphorous on the poisoning of exhaust catalysts in diesel engines. Conducts analysis, technical support, testing and research on power electronic devices (converters and controllers) and electric motors. Gathers heavy truck on-road performance data to improve models. Operates the High Temperature Materials Laboratory, which provides user facilities for materials characterization. Maintains the legislatively-mandated Fuel Economy Guide and its website: www.fueleconomy.gov.

Building Technologies

ORNL is part of a National Laboratory/industry/university consortium conducting research and development for the following activities: Building America; space heating and cooling; envelope and emerging technologies.

Industrial Technologies

In support of the Best Practices effort, ORNL provides support to Plant-Wide Assessments and other technical assistance and also assists in the tracking of program impacts. The lab also helps in the development and delivery of software tools and training. ORNL is the primary laboratory supporting the Industrial Materials of the Future activities to develop advanced materials for industrial use that meet technical requirements identified by industry in the visions and technology roadmaps.

Federal Energy Management Program

ORNL facilitates projects, develops guidelines, and provides expert advice on combine heat and power systems, biomass opportunities, whole building design, and alterative financing.

Program Support

ORNL provides analytical support for major crosscutting issues, such as market and benefit analyses.

Office of Scientific and Technical Information

Introduction

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

Wind Energy

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

Pacific Northwest National Laboratory

Introduction

Pacific Northwest National Laboratory (PNNL) is located in Richland, Washington. It is a multi-discipline laboratory providing support to Hydrogen Technology, Biomass and Biorefinery Systems R&D, Vehicle Technologies, Building Technologies, Industrial Technologies, Federal Energy Management Program, Weatherization and Intergovernmental Activities, and Program Support. PNNL also previously supported the Hydropower Program, prior to its closure in FY 2006.

Hydrogen Technology

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

Pacific Northwest National Laboratory develops compact, microchannel fuel reformers. PNNL is developing a model and a controller for solid oxide fuel cells (SOFCs) to be used with APUs. Shock and vibration characteristics applied to SOFC stacks and APU units during operation are being developed in the model. PNNL is identifying candidate filler and cladding alloys for lightweight, low cost, robust metal clad bipolar plates.

Biomass and Biorefinery Systems R&D

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

The Pacific Northwest National Laboratory conducts R&D in support of the development of the syngas platform and related products. Major program components include thermocatalysts for fuels and chemicals and wet biomass for syngas production.

Vehicle Technologies

Conducts research on predictive cruise control for heavy vehicles to increase energy efficiency. Evaluates advanced energy storage materials. Develops experimental and analytical methods to measure and improve technologies to reduce exhaust emissions and studies materials for lean-burn, high-durability NO_x sensors. Works to facilitate the scale-up process for depositing Si/SiGe super lattices, materials used in the development of thermoelectric devices for recovering waste heat in diesel engines thus improving fuel efficiency. Develops energy efficient production for magnesium, titanium, polymer composite and glass components for advanced automotive and heavy vehicle designs. Studies materials for lean-burn, high-durability spark plugs. Develops environmentally friendly processes for the manufacture of planar thin film ceramic sensors. Develops and tests a lightweight SUV frame prototype with performance equal to conventional steel components. Designs hybrid composite materials for weight critical heavy vehicle structures.

Building Technologies

The Pacific Northwest National Laboratory conducts research and development activities for the following activities: building codes; appliance standards; and emerging technologies.

Industrial Technologies

In support of the Industries of the Future (Specific) and (Crosscutting) activities, Pacific Northwest National Laboratory provides key support to track past program impacts including the over 150 commercial technologies, and their energy and environmental impacts. Other efforts include the evaluation of emerging technologies. The laboratory produces an impacts report summarizing commercial and emerging technologies and past program results and methodologies. The laboratory also performs support to Mining, Aluminum, Sensors and Controls, Glass, Industrial Materials of the Future and Forest Products.

Federal Energy Management Program

PNNL developed guidelines and provides expert advice on energy efficient buildings maintenance and operations, utility load management, utility restructuring, building commissioning, building diagnostic systems, resource energy management, and analytical support for benefits modeling.

Program Support

Provide analytical support for major crosscutting issues, such as market and benefit analyses.

Sandia National Laboratories

Introduction

Sandia National Laboratories (SNL) is located in Albuquerque, New Mexico and in Livermore, California. It is a multi-discipline laboratory providing support to Hydrogen Technology, Solar Energy, Wind Energy, Vehicle Technologies, Industrial Technologies, Federal Energy Management Program, Weatherization and Intergovernmental Activities, and Program Support.

Hydrogen Technology

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

SNL in Albuquerque is supporting the Hydrogen Technology program by developing alternative polymer electrolyte membranes that can operate at high temperature and low relative humidity to replace Nation in fuel cells.

Solar Energy

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

Wind Energy

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

Vehicle Technologies

Participates in the modeling and simulation for reduction of heavy vehicle aerodynamic drag. Conducts research on new, rugged high temperature film capacitors for power electronics. Conducts and evaluates electrode materials that would improve abuse tolerance of lithium based battery technologies. Performs abuse tests of various battery technologies. Conducts extensive fundamental research on piston engine combustion processes to reduce emissions formation while maintaining efficiency. Investigates optical and non-optical medium-duty HCCI engines and in an optically accessible light-duty gasoline engine. Develops laser diagnostics to measure diesel particulate matter concentration, size, morphology, and metallic ash content, which are vital to the successful development of robust diesel exhaust after treatment systems. Develops materials R&D to improve the performance of tires, engines, and automotive body structures. Performs analyses and laboratory demonstrations of improved manufacturing techniques and instrumentation for forging, heat treatment, coating, welding, and other factory processes. Studies the in-cylinder combustion processes of fuel-borne oxygen in diesel fuels using laser-induced incandescence observations.

Federal Energy Management Program

SNL develops guidelines and provides expert advice on renewable technologies for military applications and on distributed generation.

Weatherization and Intergovernmental Activities

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

Program Support

SNL provides analytical support for crosscutting issues such as market and benefit analyses.

Savannah River National Laboratory

Introduction

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

Hydrogen Technology

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

Washington Headquarters

Introduction

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

Western Area Power Administration

Introduction

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

Wind Energy

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

Hydrogen Technology

Funding Profile by Subprogram

	(dollars in thousands)		
	FY 2006 Current Appropriation	FY 2007 Request	FY 2008 Request
Hydrogen Technology			
Hydrogen Production and Delivery R&D	8,391	36,844	40,000
Hydrogen Storage R&D	26,040	34,620	43,900
Fuel Cell Stack Component R&D	30,710	38,082	44,000
Technology Validation[a]	33,301	39,566	30,000
Transportation Fuel Cell Systems	1,050	7,518	8,000
Distributed Energy Fuel Cell Systems	939	7,419	7,700
Fuel Processor R&D	637	4,056	3,000
Safety and Codes and Standards	4,595	13,848	16,000
Education	481	1,978	3,900
Systems Analysis	4,787	9,892	11,500
Manufacturing R&D	0	1,978	5,000
Congressionally Directed Activities	42,520	0	0
Total, Hydrogen Technology	153,451	195,801	213,000

Public Law Authorizations:

P.L. 93-275, "Federal Energy Administration Act" (1974)
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. 94-413, "Electric and Hybrid Vehicle Research, Development and Demonstration Act" (1976)
P.L. 95-91, "Department of Energy Organization Act" (1977)
P.L. 95-238, Title III – "Automotive Propulsion Research and Development Act" (1978)
P.L. 96-512, "Methane Transportation Research, Development and Demonstration Act" (1980)
P.L. 96-294, "Energy Security Act" (1980)
P.L. 100-494, "Alternative Motor Fuels Act" (1988)
P.L. 101-566, "Spark M. Matsunaga, Hydrogen Research, Development, and Demonstration Act of 1990" (1990)
P.L. 102-486, "Energy Policy Act" (1992)
P.L. 104-271, "Hydrogen Future Act of 1996" (1996)
P.L. 109-190, "Energy Policy Act" (2005)

[a] The FY 2007 budget request combines Technology Validation and Infrastructure Validation into one activity.

Mission

The mission of the Hydrogen Technology Program in DOE's Office of Energy Efficiency and Renewable Energy is to research, develop, and validate fuel cell and hydrogen production, delivery, and storage technologies. The program aims to make it technically and economically viable to produce hydrogen from diverse domestic resources and to use it in a clean, safe, reliable, and affordable manner in fuel cell vehicles and stationary power applications.

Benefits

Hydrogen Technology is one component of the President's Advanced Energy Initiative (AEI), which aims to break our Nation's dependence on foreign energy sources by changing the way we power buildings and vehicles. The AEI encompasses the activities under the Hydrogen Fuel Initiative and the Department's other light-duty transportation technology development activities, which include applied research related to advanced vehicle technologies, plug-in hybrid vehicles and biofuels. Together under the Advanced Energy Initiative, the Hydrogen Fuel Initiative and FreedomCAR aim to help to achieve technology readiness for hydrogen-powered fuel cell vehicles. If widespread commercialization of hydrogen-powered vehicles ensues, our energy security could be improved by reducing our reliance on oil. Hydrogen can be produced from domestic resources in an environmentally sound manner, providing significant reductions in transportation-related criteria pollutants and greenhouse gases. The program's economic, environmental and security benefits that are quantified as expected program outcomes are described in more detail under the "Expected Program Outcomes" sections.

Strategic and GPRA Unit Program Goals

The Department's Strategic Plan identifies five Strategic Themes (one each for the nuclear, energy, science, management, and environmental aspects of the Department's mission) plus 16 Strategic Goals that tie to the Strategic Themes. The Hydrogen Technology Program principally supports the following goal:

Strategic Theme 1, Energy Security

Strategic Goal 1.1, Energy Diversity: Increase our energy options and reduce dependence on oil, thereby reducing vulnerability to disruptions and increasing the flexibility of the market to meet U.S. needs.

The Hydrogen Technology Program has one program goal which contributes to Strategic Goal 1.1 in the "goal cascade:"

And concurrently supports:

Strategic Goal 1.2, Environmental Impacts of Energy: Improve the quality of the environment by reducing greenhouse gas emissions and environmental impacts to land, water, and air from energy production and use.

Strategic Goal 1.4, Energy Productivity: Cost-effectively improve the energy efficiency of the U.S. economy.

GPRA Unit Program Goal 1.1.01.00: Hydrogen/Fuel Cell Technology - Develop fuel cell and hydrogen production, delivery and storage technologies to the point that they are cost and performance competitive and are being used by the Nation's transportation, energy, and power industries. Development of these technologies will also make our clean domestic energy supplies more flexible, dramatically reducing or even ending dependence on foreign oil.

Contribution to GPRA Unit Program Goal 1.1.01.00 (Hydrogen/Fuel Cell Technology)

The key Hydrogen Technology contribution to General Goal 4, Energy Security, is domestic energy supply and energy efficiency through:

- Hydrogen Production and Delivery R&D, to reduce the cost of producing hydrogen from renewables from $6.20/ gallon of gasoline equivalent (gge) in 2003 to <$3.00/gge untaxed, delivered (at both 5,000 and 10,000 psi) by 2017[a];
- Hydrogen Storage R&D, to develop and demonstrate commercially-viable hydrogen storage technology that enables greater than 300-mile vehicle driving range, while meeting vehicular packaging, cost and performance requirements. Specifically, develop and demonstrate by 2010 a hydrogen storage technology with capacity of 2.0 kWh/kg, compared to 0.5-1.3 kWh/kg in 2003, and 1.5 kWh/L (kilowatt-hours per liter), compared to 0.5-0.6 kWh/L in 2003;
- Transportation Fuel Cell Systems and Fuel Cell Stack Component R&D, to improve fuel cell durability and performance while reducing cost. The manufacturing cost of hydrogen-fueled fuel cell power systems will be reduced from $275/kW in 2002 for a 50 kW system to $45/kW in 2010 for an 80 kW system at production levels of 500,000 units per year (projected cost);
- Distributed Energy Fuel Cell Systems and Fuel Processor R&D, to increase the electrical efficiency of 5-250 kW stationary fuel cell systems operating on natural gas or propane from 29 percent in 2002 to 40 percent in 2011;
- Technology Validation, to verify under real world conditions hydrogen fuel cell vehicle performance and 2,000 hour durability by 2011, and hydrogen infrastructure technologies with a cost of $3.00 per gge in 2009;
- Education activities, to increase the understanding of hydrogen and fuel cell technologies among key target audience groups including local and state governments, safety and code officials, potential

[a] The target for renewable production of hydrogen has slipped from the previous target of $2.85 in 2010 because of reductions in funding for renewable hydrogen production technologies that have been necessitated by prior-year appropriation levels and Congressionally-directed projects. The cost revision also reflects a changed assumption regarding the technology to be used: this target is based on distributed reforming of biomass liquids which include precursors to conventional biofuels such as ethanol. Producing hydrogen from fuels such as ethanol and ethanol precursors combined with fuel cell vehicles leads to lower carbon emissions and petroleum consumption than vehicles that use ethanol directly (such as a ethanol hybrid electric vehicle). Previous targets and status were based on electrolysis, which will not likely be a major renewable technology when used in distributed applications with grid power.

end-users, local communities, and students and teachers. By 2012[a], the program expects to increase the subject knowledge among these target audiences to 43 percent by 2012 relative to 2004 baseline of 33 percent, and thereby facilitate the market adoption of hydrogen technologies over the long-term; and

- Safety and Codes and Standards, to provide underlying research to enable codes and standards development for the safe use of hydrogen in all applications. The program also supports the preparation of a global technical regulation (GTR) for hydrogen fuel cell vehicles (GTR expected to be submitted in draft in 2008; approval anticipated in 2010). Global consistency in standards will ensure that different technologies need not be developed for each region of the world.

Funding by Strategic and GPRA Unit Program Goal

(dollars in thousands)

	FY 2006	FY 2007	FY 2008
Strategic Goal 1.1, Energy Diversity			
GPRA Unit Program Goal 1.1.01.00, Hydrogen/Fuel Cell Technology			
Hydrogen Production and Delivery R&D	8,391	36,844	40,000
Hydrogen Storage R&D	26,040	34,620	43,900
Fuel Cell Stack Component R&D	30,710	38,082	44,000
Technology Validation[b]	33,301	39,566	30,000
Transportation Fuel Cell Systems	1,050	7,518	8,000
Distributed Energy Fuel Cell Systems	939	7,419	7,700
Fuel Processor R&D	637	4,056	3,000
Safety and Codes and Standards	4,595	13,848	16,000
Education	481	1,978	3,900
Systems Analysis	4,787	9,892	11,500
Manufacturing R&D	0	1,978	5,000
Congressionally Directed Activities	9,553	0	0
Total, GPRA Unit Program Goal 1.1.01.00, Hydrogen/Fuel Cell Technology	120,484	195,801	213,000

[a] The target date for this activity has slipped from the previous target of 2011 in a prioritized response to funding reductions in previous years necessitated by appropriations actions and Congressionally directed projects.
[b] The FY 2007 budget request combined Technology Validation and Infrastructure Validation into one key activity.

	(dollars in thousands)		
	FY 2006	FY 2007	FY 2008
All Other			
Congressionally Directed Activities			
Hydrogen Fuel Cell Project Edison Materials Technology	2,475	0	0
Regional Transportation Commission Of Washoe County Hydrogen Fuel Cell Project	2,475	0	0
Fuel Cell Mine Loader and Prototype Locomotive	247	0	0
Hydrogen Regional Infrastructure Program in Pennsylvania	0	0	0
University of South Carolina Fuel Cell Design Project	1,980	0	0
Center For Intelligent Fuel Cell Materials Design, Multi-State	1,485	0	0
Indigenous Energy Development Center	990	0	0
Delaware State University Center For Hydrogen Storage	990	0	0
Florida International University Center For Energy and Technology Of The Americas	990	0	0
City Of Auburn Energy Production Issues At Wastewater Plant	891	0	0
Purdue Hydrogen Technologies Program	990	0	0
City Of Chicago Ethanol To Hydrogen Project	1,980	0	0
University Of Arkansas At Little Rock Hydrogen Storage Project	396	0	0
University Of Akron Fuel Cell Laboratory	495	0	0
Kettering University Fuel Cell Project	495	0	0
UNLV Research Foundation Solar-Powered Thermochemical Production of Hydrogen (partially supports goal)	1,683	0	0
UNLV Research Foundation Hydrogen Fuel Cell and Storage R&D	3,366	0	0
Montana Palladium Research Center (partially supports goal)	2,475	0	0
University Of Arkansas Little Rock Nanotechnology Center Production Of Hydrogen	495	0	0
UNLV Research Foundation Renewable Hydrogen Fueling Station System, Including Development Of High Pressure Electrolysis Using Photovoltaics (partially supports goal)	3,366	0	0

	(dollars in thousands)		
	FY 2006	FY 2007	FY 2008
UNLV Research Foundation Development Of Photoelectric Chemical Production Of Hydrogen (partially supports goal)	1,238	0	0
University Of Nevada-Reno Photoelectrochemical Generation Of Hydrogen By Solid Nanoporous Titanium Dioxide Project	2,970	0	0
Southern Nevada Alternative Fuels Demonstration Project	495	0	0
Total, All Other	32,967	0	0
Total, Strategic Goal 1.1 (Hydrogen Technology)	153,451	195,801	213,000

Annual Performance Results and Targets

FY 2003 Results	FY 2004 Results	FY 2005 Results	FY 2006 Results	FY 2007 Targets	FY 2008 Targets
GPRA Unit Program Goal 1.1.01.00 (Hydrogen/Fuel Cell Technology)					
Hydrogen Production and Delivery R&D - Renewable					
	Complete research for biomass syngas reforming catalysts to improve durability and reduce cost towards achieving 5,000 psi hydrogen produced for $5.70/gallon of gasoline equivalent (untaxed, modeled cost) at the station by 2005. [MET]	Model cost of hydrogen produced from renewable sources and assess versus the 2010 target of $2.85/gge, untaxed at the station at 5,000 psi. [MET]	Due to Congressionally Directed Activities, there will be little activity in FY 2006. Target has been delayed into FY 2007.	Complete lab-scale electrolyzer, test to determine whether it achieves 64 percent energy efficiency and evaluate systems capability to meet $5.50/gge hydrogen cost target, untaxed at the station, and with large equipment production volumes [e.g., 500 units/year].	Complete benchmark demonstration of natural gas reforming technologies transitioned to renewable liquids and identify development pathways to meet the 2012 target of producing hydrogen from distributed reforming of renewable liquids at 5,000 psi for $<3.80 gge at large equipment production volumes (e.g., 500 units/yr).
Hydrogen Production and Delivery R&D-Non Renewable					
	Complete research for natural gas-to-hydrogen production and dispensing component development and fabrication towards achieving 5,000 psi hydrogen for $3.00/gge (untaxed and without co-production of electricity) at the station in 2006. [MET]	Complete the research for a distributed natural gas-to-hydrogen production and dispensing system that can produce 5,000 psi hydrogen for $3.00/gge (untaxed and without co-producing electricity) at the station in 2006. [MET]	Complete the development of a laboratory scale distributed natural gas-to-hydrogen production and dispensing system that can produce 5,000 psi hydrogen for $3.00/gge. [MET]	Complete preliminary lab scale tests to identify technologies that produce 5,000 psi hydrogen from natural gas for $2.50/gge, untaxed at the station and with large equipment production volumes [e.g., 500 units/year].	
Hydrogen Storage R&D					
	Complete draft of standard test protocol and construction of test facility for solid-state hydrogen storage materials in support of the targets of 1.2 kWh/L and 4.5 wt. percent and the 2010 targets of 2.0kWh/kg (6 wt. percent), 1.5 kWh/L at $4/kWh. [MET]	Identify materials with the potential to meet 2010 targets of 2.0 kWh/kg (6 wt percent), 1.5 kWh/L, at $4/kWh. [MET]	Complete fabrication and testing of a sub-scale prototype materials-based storage system to demonstrate projected system capacity of 2.5 wt. percent (0.8 kWh/kg); evaluate progress toward the 2007 target of 4.5 wt. percent (1.5 kWh/kg). [MET]	Complete baseline on-board storage systems analyses, down select materials, and evaluate against 2007 targets of 1.5 kWh/kg (4.5 percent by weight) and 1.2 kWh/L.	Develop chemical hydrogen storage regeneration methods at laboratory-scale, obtain initial data for efficiency and cost analysis, and demonstrate lab-scale reactions capable of at least 40 percent energy efficiency.

FY 2003 Results	FY 2004 Results	FY 2005 Results	FY 2006 Results	FY 2007 Targets	FY 2008 Targets
Hydrogen Storage R&D: Tanks					
Complete design of the 5,000 psi cryogenic-gas tank and 10,000 psi compressed gas tank to achieve 1.3 kWh/kg and 0.6 kWh/L. [MET]	Complete development of 5,000 psi cryo-gas tank and 10,000 psi compressed gas tank achieving 1.3 kWh/kg and 0.8 kWh/L. [MET]	Complete testing of 10,000 psi hydrogen storage tanks; evaluating against the hydrogen storage system target of 1.5 kWh/kg (4.5 percent by weight), and identify approaches to meet the cost target of $6/kWh. [MET]			
Technology Validation					
Verify low electricity and hydrogen production cost (<$.08/kWh and <$3.60/gal equivalent untaxed when produced in quantity) through cost shared operation of a 50kWe stationary fuel cell and hydrogen co-production facility for six months. [MET]	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. [MET]	Complete validation of an energy station that can produce 5,000 psi hydrogen from natural gas for $3.60 per gallon of gasoline equivalent (including co-production of electricity) untaxed at the station with mature equipment production volumes (e.g., 100 units/year). [MET]	Complete installation and 1,000 hours of testing of a refueling station; determine system performance, fuel quality and availability; and demonstrate the ability to produce 5,000 psi hydrogen from natural gas for a projected cost of $3.00 per gallon of gasoline equivalent, untaxed at the station, assuming commercial deployment with large equipment production volumes (e.g., 100 units/year) by 2009. [MET]	Validate achievement of a refueling time of 5 minutes or less for 5 kg of hydrogen at 5,000 psi through the use of advanced sensor, control, and interface technologies.	
Plan technology validation activity. [MET]	Industry contracts are awarded and initial vehicles delivered that support the 1,000 hour durability target. [MET]	Fuel Cell demonstration vehicles' durability can be projected to 1,000 hours based on voltage measurements. [PARTIALLY MET]	Operate fuel cell vehicle fleets to determine if 1,000 hour vehicle fuel cell durability, using fuel cell degradation data, was achieved by industry. [MET]		Fuel Cell vehicle(s) demonstrate the ability to achieve 250 mile range without impacting cargo or passenger compartments.
Transportation Fuel Cell Systems and Fuel Cell Stack Component R&D					
Achieve $225/kW for a hydrogen-fueled 50kW fuel cell power system. [MET]	Achieve $200/kW for a hydrogen-fueled 50 kW fuel cell power system. [MET]	DOE-sponsored research will reduce technology cost to $125/kW for a hydrogen-fueled 50kW fuel cell power system. [MET]	DOE-sponsored laboratory scale research will reduce the modeled technology cost to $110/kW for a hydrogen-fueled 80 kW fuel cell power system. [MET]	DOE-sponsored laboratory scale research will reduce the modeled technology cost to $90/kW for a hydrogen-fueled 80kW fuel cell power system.	DOE-sponsored research will reduce the modeled technology cost of a hydrogen-fueled 80kW fuel cell power system to $70/kW.

FY 2003 Results	FY 2004 Results	FY 2005 Results	FY 2006 Results	FY 2007 Targets	FY 2008 Targets
Distributed Energy Fuel Cell Systems and Fuel Processor R&D					
Achieve 30 percent efficiency at full power for a natural gas or propane fueled 50 kW stationary fuel cell system. [MET]	Achieve 31 percent efficiency at full power for a natural gas or propane fueled 5-250 kW stationary fuel cell system. [MET]	Achieve 32 percent efficiency at full power for a natural gas or propane fueled 5-250 kW stationary fuel cell system. [MET]	Due to Congressionally Directed Activities, there will be no activity in this area in FY 2006.	DOE-sponsored research will improve electrical efficiency to 34 percent at full power for a natural gas or propane fueled 5-250 kW stationary fuel cell power system verified by a prototype (5-50 kW system).	DOE-sponsored research will improve electrical efficiency to 35 percent at full power for a natural gas or propane fueled 5-250 kW stationary fuel cell power system verified by a prototype (5-250 kW system).
Education					
	Determine the baseline level of knowledge and develop a plan for educating target audiences (students and teachers, state and local governments, and large-scale end-users nationwide). [MET]				
Safety and Codes and Standards					
	Complete the harmonized technical standard for high pressure vehicle storage that can be incorporated into a regulation (i.e., incorporating the various standards of different countries into a single regulation) for hydrogen storage. Complete the draft technical standard for vehicular safety. [MET]				Develop a hydrogen materials technical reference which reports on embrittlement issues for hydrogen usage up to 10,000 psi delivered. Publish a Best Practices Manual describing hydrogen safety guidelines and lessons learned.
Systems Analysis					
	Define requirements for system analysis and integration to link the program's technical objectives to cost and schedule. [MET]				Complete and validate Macro-System Model for complete hydrogen and delivery pathway analysis.

FY 2003 Results	FY 2004 Results	FY 2005 Results	FY 2006 Results	FY 2007 Targets	FY 2008 Targets
	Contribute proportionately to EERE's corporate goal of reducing corporate and program uncosteds to a range of 20-25 percent by reducing program annual uncosteds by 10 percent in 2004 relative to the program uncosted baseline (2003) until the target range is met. [MET]	Contribute proportionately to EERE's corporate goal of reducing corporate and program adjusted uncosted obligated balances to a range of 20-25 percent by reducing program annual adjusted uncosteds by 10 percent in 2005 relative to the Hydrogen/Fuel Cell Program FY 2004 end of year adjusted uncosted baseline ($29,283K) until the target range is met. [MET]	Maintained total administrative overhead costs (defined as program direction and program support excluding earmarks) in relation to total program costs of less than 12 percent.[a] [MET]	Maintain total administrative overhead costs (defined as program direction and program support excluding earmarks) in relation to total program costs of less than 12 percent.	Maintain total administrative overhead costs in relation to total program costs of less than 12 percent. Baseline for administrative overhead rate currently being validated.

[a] Baseline for administrative overhead rate currently being validated.

Means and Strategies

Hydrogen Technology will use various means and strategies to achieve its GPRA Unit 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 to implement the President's Hydrogen Fuel Initiative and carry out the program in accordance with the Energy Policy Act of 2005. Various external factors, as listed below, may impact the ability to achieve the program's goals. Collaborations are integral to the planned investments, means and strategies, and to addressing external factors.

Hydrogen Technology will implement the program through the following means:

- Develop hydrogen production, delivery and storage technologies to achieve cost, efficiency, and other required targets to meet program goals;
- 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;
- Conduct infrastructure validation activities in partnership with industry to develop and validate the feasibility of hydrogen generation stations that derive hydrogen from both renewable and fossil fuels for stationary and transportation fuel cell systems;
- Conduct research, development, and technology validation to address the key technical barriers of performance, cost and durability of fuel cell systems for transportation, stationary, auxiliary power units (APUs), and portable power applications;
- For transportation applications, focus R&D on critical requirements to enable technology readiness, primarily focusing on lowering the high-volume system cost of fuel cells to $45/kW by 2010, and then to $30/kW by the technology readiness target date of 2015. Other significant criteria for transportation fuel cell systems include the need to have fuel cell technologies developed and validated that enable: (1) full performance over 5,000 hours of life; (2) 60 percent efficiency (hydrogen-fueled) at peak power; and (3) operation in vehicles with comparable performance, safety, and reliability to the gasoline internal combustion engine;
- For stationary applications, work towards removing technical barriers to facilitate the near-term introduction of fuel cells in a variety of applications that include energy generation for buildings, uninterruptible power systems, and portable power devices such as consumer electronics;
- Support the introduction of fuel cell vehicles and stationary fuel cell systems to controlled user-groups such as utilities or military installations through real world demonstrations. These demonstrations validate technology performance, provide experience to both manufacturers and end-users supporting the successful introduction of commercial products, and help build early public awareness;
- Develop systems models and conduct trade-off analyses to guide effective technology decisions;
- Conduct cross-cutting analyses and focus on life cycle cost, emissions, and efficiency of transportation and stationary fuel cell systems in the near (2015), mid (2030), and long-term (post 2050);

- Conduct research, development and demonstration activities through competitive, cost-shared grants with industry and universities;
- Conduct research for safety and codes and standards, focused on ensuring the safety aspects of hydrogen technologies and enabling widely accepted codes and standards. Enabling effective codes and standards requires a substantial and verified database of scientific information on hydrogen properties. DOE will coordinate with and assist DOT and other code developing entities by providing this experimental database from research projects and the DOE "learning" demonstration project; and
- Develop and distribute educational materials and conduct training to facilitate greater understanding of hydrogen and fuel cell technologies.

Hydrogen Technology will implement the program through the following strategies:

- Ensure that activities follow the Hydrogen Posture Plan (which outlines the research and development needed); the Hydrogen, Fuel Cells and Infrastructure Technologies Program Multi-year Research, Development and Demonstration Plan (which establishes technical targets and schedules to address key technology barriers); and the National Hydrogen Energy Roadmap (which identifies research and development pathways to guide hydrogen and fuel cell R&D);
- Perform formal merit reviews across the Department's portfolio of Hydrogen activities (this process includes the merit review of EERE, Nuclear Energy, Science and Technology (NE); Fossil Energy; (FE) and Science (SC) hydrogen and related technologies). The Merit Review evaluation incorporates the principles of the Administration's R&D investment criteria and is conducted in compliance with the Department's Merit Review Guidelines. Additionally, field project managers and technology development managers evaluate progress formally on a quarterly basis;
- Compete the National Laboratories and the private sector side-by-side for new applied R&D activities;
- Conduct meetings of the Hydrogen and Fuel Cell Technical Advisory Committee (per the Energy Policy Act of 2005 (EPACT 2005)) to advise the Energy Secretary regarding the Department's hydrogen activities;
- Participate in the development of research data to enable uniform codes and standards at the international level to ensure that the U.S. industry can compete globally;
- Use Centers of Excellence as well as independent projects for R&D in hydrogen storage to support the storage goals for materials-based systems;
- Begin a Manufacturing R&D effort that will enable the mass production of both supply and end-use technologies for the hydrogen economy, and will foster a strong domestic supplier capability; and
- Investigate and implement the pilot use of inducement prizes and recognition in hydrogen and fuel cell technologies, aligned with the mission of the program, in accordance with the Energy Policy Act of 2005 (e.g., Title X, Section 1008) and other congressional direction, to complement current R&D efforts.

These means and strategies could 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.

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

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

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

- Coordinates across four Departmental elements – EERE (Biomass, Solar, Buildings, Wind, and Vehicles), Nuclear Energy, Fossil Energy and Science – and the Department of Transportation (DOT) to update the DOE Hydrogen Posture Plan periodically to support the Department's Hydrogen Fuel Initiative budget request. EERE is the Departmental lead and coordinates research, development and demonstration planning, budget formulation and budget execution activities under the Hydrogen Fuel Initiative;

	(dollars in thousands)
	FY 2008 Request
Hydrogen Fuel Initiative	
Energy Efficiency and Renewable Energy (EERE)	213,000
Nuclear Energy (NE)	22,600
Fossil Energy (FE)	12,450
Office of Science (SC)	59,500
Subtotal, Department of Energy	307,550
Department of Transportation (DOT)	1,425
Total, Hydrogen Fuel Initiative	308,975

- Participates in the Interagency Hydrogen and Fuel Cell Technical Task Force, in accordance with the Energy Policy Act of 2005, to leverage and coordinate Federal resources and activities;
- Participates in the International Partnership for the Hydrogen Economy to leverage R&D capabilities globally;
- Works with the DOT, the Environmental Protection Agency (EPA) and the National Institute for Standards and Technology (NIST) on research for safety and codes and standards. Develop an

annual coordination plan with DOT that outlines cooperative activities and establishes roles and responsibilities;

- Collaborates with EERE's Building Technologies Program, the Office of Electricity Delivery and Energy Reliability's Distributed Energy Resources Program and the Office of Fossil Energy's solid oxide fuel cell research and development effort; and

- For activities that support transportation applications, the program coordinates closely with the EERE Vehicle Technologies Program. The President's Hydrogen Fuel Initiative and activities in the FreedomCAR budget crosscut are implemented through technical teams, which provide a mechanism for developing requirements and industry consensus (see Technology goals below), evaluating R&D activities, and providing recommendations for program direction. These technical teams are composed of government and industry experts that meet regularly. The interdependency is depicted in the table that follows.

2010 Hydrogen Fuel Initiative and FreedomCAR Coordinated Technology Goals

Vehicle Technologies has responsibility for these goals:

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

Hydrogen Technology has responsibility for these goals:

- 60 percent peak energy-efficient, durable fuel cell power systems (including hydrogen storage) with 325 W/kg specific power and 220 W/l power density operating on hydrogen. Cost targets are $45/kW by 2010 and $30/kW by 2015.

- Demonstrate hydrogen refueling with developed commercial codes and standards and diverse renewable and non-renewable energy sources. Goal: cost of energy from hydrogen equivalent to gasoline at market price, assumed to be $2.00-3.00 per gallon gasoline equivalent produced and delivered to the consumer independent of pathway by 2015.
- On-board Hydrogen Storage Systems demonstrating specific energy of 2.0 kWh/kg (6 percent by weight hydrogen) and energy density of 1.5 kWh/L at a cost of $4/kWh by 2010 and specific energy of 3.0 kWh/kg (9 percent by weight hydrogen), 2.7 kWh/L, and $2.00/kWh by 2015.
- 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 the Vehicle Technologies Program.)

Validation and Verification

To validate and verify program performance, Hydrogen, Fuel Cells and Infrastructure Technologies will conduct internal and external reviews and audits. Programmatic activities are subject to continuing review by, for example, the Congress, the Government Accountability Office, the Department's Inspector General, as well as by reviewers from other agencies, such as the U.S. Environmental Protection Agency and state environmental agencies through the Program's Annual Merit Review and Peer Evaluation process. Specific milestones, go/no-go decision points, and technical progress are systematically reviewed through the program's merit review process and independent assessments conducted through the Systems Integration Office. The table below summarizes validation and verification activities.

Data Sources: Merit Review and Peer Evaluation of R&D, Program Peer Reviews, and independent assessments are conducted. Engineering models and experimental results are used to validate technical progress, with documentation provided through quarterly and annual reports. Learning demonstration activities also verify and validate technical progress towards meeting targets and help refocus R&D. Summary program plans and annual presentations by the program are used to communicate the status of verification/validation activities and to evaluate proposed approaches towards meeting technical targets.

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

- renewable hydrogen production (delivered) (2003): $6.20/gge
- non-renewable production (delivered) (2003): $5.00/gge
- electrolysis production efficiency (2003): 62 percent
- compressed hydrogen tank-only storage (2003): 1.3 kWh/kg (3.9 percent by weight) and 0.6 kWh/L system capacity

- solid state materials for storage systems (2003): 1 percent by weight system capacity and 0.5 kWh/L
- transportation systems/stack component R&D (2002): $275/kW fuel cell cost
- distributed energy systems/fuel processor R&D (2002): 29 percent electrical efficiency
- technology validation (2003, laboratory): 1,000 hours durability of fuel cell vehicle systems
- validated production (delivered) (2004): $3.60/gge (beginning of life testing)
- education (2004): Survey[a]

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

Data Storage: EERE Corporate Planning System

Evaluation: The program uses several forms of evaluation to assess progress and to promote program improvement:

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

  The National Academies (National Research Council and National Academy of Engineering) have performed an extensive review of the program and have published a 2004 report titled: "Hydrogen Economy: Opportunities, Costs,

[a] The Hydrogen Baseline Knowledge Assessment was completed in 2004 to measure the knowledge and awareness of hydrogen energy systems among key target audiences. Analysis of the baseline survey results has been completed and the report was published in May, 2006; see http://hydrogen.energy.gov/facts_figures.html#survey. Future surveys will be used to evaluate changes in knowledge over time.

Barriers and R&D Needs." The committee's report indicated the four most fundamental technological and economic challenges are: 1) to develop and introduce cost-effective, durable, safe and environmentally desirable fuel cell systems and hydrogen storage systems; 2) to develop the infrastructure to provide hydrogen for the light-duty vehicle user; 3) to reduce sharply the costs of hydrogen production from renewable energy sources over a time frame of decades; and 4) to capture and store the carbon dioxide byproduct of hydrogen production from coal.

Additionally, in 2005, the National Academies published a report titled: "Review of the Research Program of the FreedomCAR and Fuel Partnership".[a] The committee's report indicated that DOE's three-year-old FreedomCAR and Fuel Partnership "has already made an excellent start." The report noted that the partnership faces significant technical challenges, including hydrogen storage in vehicles, commercially viable fuel cells, and the need to build an infrastructure for hydrogen fueling. The report recommended that DOE pay special attention to the challenges of shifting from petroleum to hydrogen as a transportation fuel, including hydrogen safety issues and any environmental impacts of large-scale hydrogen production and use. It also recommended an overall program evaluation to help decide among trade-offs and determine priorities. Finally, the report noted that Congress has appropriated significant portions of the funding for specific projects that are not focused on the partnership's goals, and that the partnership will be unable to meet its milestones if the practice continues.

- Merit reviews and peer evaluations, conducted by energy, hydrogen, and fuel cell experts from outside of the U.S. Department of Energy, are held to evaluate the research, development and demonstration projects to ensure that they address the priorities and key technology barriers identified in the HT planning documents.
- The program develops and implements planning documents and supports the development of technology roadmaps with industry.[b] 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 hydrogen technical advisory committee will also be used to independently review the program.
- For new applied research activities, the program plans to compete both the National Laboratories and the private sector side by side. Industry and universities already receive funding through a competitive process that leads to cost-shared grants. Hydrogen and fuel cell industry experts review each university, laboratory and industry project at the annual Merit Review and Peer

[a] Report can be found at http://www.nap.edu/books/030909730/html.

[b] See the following documents: Fuel Cell Report to Congress, Feb. 2003; A National Vision of America's Transition to a Hydrogen Economy, March 2002; National Hydrogen Energy Roadmap, November 2002; FreedomCAR Fuel Cell Technical Roadmap; EERE Hydrogen Program Multi-Year Research, Development and Demonstration Plan; Hydrogen Posture Plan; The 2004 National Academies' Report, The Hydrogen Economy: Opportunities, Costs, Barriers, and R&D Needs; and the National Academies' Report, Review of the Research Program of the FreedomCAR and Fuel Partnership, First Report, August 2005.

Evaluation. Consistent with the principles of the Administration's R&D Investment Criteria, project peer reviews include evaluation of: 1) Relevance to overall DOE and Hydrogen Fuel Initiative objectives; 2) Approach to performing the research and development; 3) Technical accomplishments and progress toward project and DOE goals; 4) Technology transfer/collaborations with industry/universities/laboratories; and 5) Approach and relevance of proposed future research. The panel also evaluates the strengths and weaknesses of each project, and recommends additions to or deletions from the scope of work.

- Some projects are also evaluated by the FreedomCAR joint technical teams each year. The program facilitates supplier-customer relationships to ensure that R&D results from National Laboratories and universities are transferred to industry suppliers and that industry supplier developments are made available to automakers, energy industry and stationary power producers.
- Reviews are conducted by the Hydrogen Safety Panel to monitor the safety of procedures and facilities throughout the Hydrogen Technology Program.

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

Program Assessment Rating Tool (PART)

The Department implemented a tool to evaluate selected programs. PART was developed by OMB to provide a standardized way to assess the effectiveness of the Federal Government's portfolio of programs. The structured framework of the PART provides a means through which programs can assess their activities differently than through traditional reviews. The Hydrogen Technology Program has incorporated feedback from OMB into the FY 2008 Budget Request and has taken or will take the necessary steps to continue to improve performance.

The Hydrogen Technology Program was rated "moderately effective" in the latest PART assessment in 2003 (Purpose: 80 percent; Planning: 80 percent; Management: 100 percent; Program Results/Accountability: 58 percent). Most PART recommendations within program control have been addressed and results-based planning continues to improve. The 2002 PART review of Hydrogen Technology contained a recommendation to establish a partnership with the energy industry to complement the DOE's FreedomCAR budget. To fulfill this recommendation, FreedomCAR (the partnership between DOE and USCAR) was expanded to include energy industry partners and the expanded partnership was launched to coordinate hydrogen research activities with both automotive and energy industry partners. Many activities funded through the President's Hydrogen Fuel Initiative and FreedomCAR are now implemented through the government-industry FreedomCAR and Fuel Partnership.

The 2002 PART recommendation to expand high-risk R&D on hydrogen production from renewable resources and on hydrogen storage technologies was addressed with two solicitations for proposals that led to grants with universities and industry, and work agreements with National Laboratories. EERE and the DOE Office of Science (SC) coordinated extensively in developing a FY 2004 solicitation for basic research to support hydrogen production, storage and use.

Another 2002 PART recommendation suggested the development of adequate annual performance measures. Some annual performance measures that correlate with multi-year program plan technical targets have been included in budget requests. Work continues to better connect technical targets in the budget document with PART targets. These improvements in planning and accountability were reflected in Hydrogen Technology's improved 2003 PART score in those areas, resulting in an overall score improvement and a “moderately effective” rating, the second highest rating possible.

The 2003 PART also found that the program has coordinated well with other DOE programs (i.e., in developing the DOE Hydrogen Posture Plan) and with industry (i.e., in developing technology roadmaps) in establishing a plan to achieve the goals of the President’s Hydrogen Fuel Initiative. The PART noted that a significant level of congressionally directed activities in FY 2004 − nearly half of the program’s budget − jeopardizes progress on the President’s initiative by reducing program funding available to address the most important barriers to the hydrogen economy.

The Department has responded to the PART recommendation of “Develop guidance that specifies a consistent framework for analyzing the costs and benefits of research and development investments, and use this information to guide budget decisions.” The Department has specified common scenarios, common methodology, and standardized benefits measures to allow analyzing the costs and benefits of applied R&D investments. The Department continues to work on implementation of common assumptions and a consistent approach to incorporation of risk.

Consistent with the PART recommendation to implement management recommendations from the National Academies' reviews of the program, the Hydrogen Technology program has addressed or is taking steps to address all of the recommendations included in the National Research Council's hydrogen economy report. Examples of actions taken on the nearly 50 recommendations include: hiring a new lead systems analyst to coordinate the build-up of a comprehensive systems analysis capability; creation of an independent systems integration team at NREL, separate from the technology development teams, and creation of a Chief Engineer position to coordinate technical baselines, requirements, schedules, and interagency activities; formation of a hydrogen-safety expert panel to help DOE audit safety plans and practices; a significant increase in the number of universities funded to work on fundamental issues in hydrogen production and storage; establishing a go/no go decision point for funding of stationary PEM fuel cells (in 2011); and increasing focus on small scale reformers and electrolyzers for distributed hydrogen production for the transition to a hydrogen infrastructure. In a few cases, the program considered the recommendations but ultimately decided not to follow them. For instance, the program has not ended funding for stationary fuel cells because they offer an early market-entry opportunity for fuel cells and technical targets have not been met.

Expected Program Outcomes

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

Estimates of the security, economic and environmental benefits from 2008 through 2050 that would result from realization of the program's goals are shown in the table below. Absent any complementary policies and absent complementary R&D activities from other Federal programs, we estimate that the incremental oil import savings associated with successful achievement of EERE's Hydrogen Program goals are around 2 mbpd in 2050. The program would increase the energy diversity of the Nation's transportation system by enabling 38 percent of the light duty vehicle stock to be hydrogen fuel cell vehicles in 2050. These results, based on the GPRA08 analysis, include contributions from the relevant technology development efforts under EERE's FreedomCAR and Vehicle Technologies Program. The results incorporate different assumptions and are significantly below the 11 mbpd savings by 2040 that we estimated when we launched the initiative because hydrogen in now considered to be only one component of a more diverse portfolio of options. The lower value of oil savings due to hydrogen is based on the assumption that competing alternative fuels and vehicle technologies (such as biofuels and plug-in hybrids) will be available.

EERE's Hydrogen Technology Program Goal Case reflects the increasing penetration of hydrogen technology over time, as the program's goals are met. Not included are any policy or regulatory mechanisms, or other incentives not already in existence, that might be expected to support or accelerate the achievement of the program goals. Nor are the effects of competition from alternative technologies considered. The expected benefits reflect solely the achievement of the program's goals.

The goals are modeled in contrast to the "baseline" case, in which no DOE R&D exists. The baseline case is identical to those used for all DOE applied energy R&D programs.[a] Further, across EERE, and across all of DOE's applied energy R&D programs, the expected outcome benefits are being calculated using the same fundamental methodology. Finally, the metrics by which expected outcome benefits are measured are identical for all of DOE's applied energy R&D programs.[b] This standardization of methods and metrics has been undertaken to address the R&D investment criterion that "Programs and projects must articulate public benefits of the program using uniform benefit indicators across programs and projects with similar goals."[c]

The difference between the baseline case and the program goal case results in economic, environmental and security benefits. For example, achievement of program goals results in oil import savings of 0.3 mbpd in 2030 and 2 mbpd in 2050, with a corresponding increase in transportation energy diversity of 15 percent and 34 percent, respectively. Achieving these goals would also result in carbon emission

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[a] The starting point for the baseline case is the Energy Information Administration's "reference case," as published in the AEO 2006. Program analysts from across DOE examined the AEO to determine the extent to which their program goals are modeled (explicitly or implicitly). If program goals are modeled in the AEO, they are removed in the GPRA baseline. Further, some programs believe that the AEO's technology representation is too conservative, even in the absence of program goals, and thus in certain cases a modification is made to make the technology representation in the baseline case more optimistic than the AEO.

[b] The set of expected outcome metrics being used this year differs in substantial ways to that of previous years. In addition to the standardization across DOE's applied energy R&D programs, the list is expanded and more comprehensive than in past years. Further, the list maps to DOE strategic goals. The expected outcome metrics represent inherent societal benefits that stem from achievement of program goals.

[c] See OMB-OSTP priorities memo, p. 10. http://www.whitehouse.gov/omb/memoranda/m03-15.pdf.

savings of 14 million metrics tons in 2030 and 31 million metric tons in 2050. Finally, the program's advances would also result in consumer savings of $5 billion in 2030 and $80 billion in 2050. The results are generated by modeling the program goals within two integrated energy-economy models: NEMS-GPRA08 for benefits through 2030, and MARKAL-GPRA08 for benefits through 2050.[a] The full list of modeled benefits appears below.

FY 2008 GPRA Benefits Estimates for the Hydrogen Technology Program[b c]

	2010	2020	2030	2040	2050
Environmental Benefits (Goal 1.2)					
Avoided carbon emissions, annual (MMTC)	ns	ns	14	29	31
Avoided carbon emissions, cumulative (MMTC)	ns	ns	16	248	551
Reduced cost of criteria pollutant control, NPV[d] (bil. 2004$)	NC	NC	NC	NC	NC
Economic Benefits (Goal 1.4)					
Consumer savings, annual (bil. 2004$)	ns	ns	5	10	80
Consumer savings, NPV (bil. 2004$)	ns	ns	19	-69	92
Electric power industry savings, annual (bil. 2004$)	ns	ns	-3	1	10
Electric power industry savings, NPV(bil. 2004$)	ns	ns	-14	-28	-4
Household energy expenses reduced, annual (bil. 2004$)	0.1%	0.0%	0.3%	0.7%	2.1%
Energy intensity reduced (% change in E/GDP)	0.0%	0.0%	0.2%	1.3%	2.2%
Net energy system cost savings, annual (bil. 2004$)	ns	ns	0	5	10
Natural gas price change, moving avg. (2004$ / TCF)[e]	ns	ns	NC	NC	NC
Security and Reliability Benefits (Goal 1.1 or 1.3)					
Avoided oil imports, annual (mbpd)	ns	0.0	0.3	1.4	2.1
Avoided oil imports, cumulative (bil. bbl)	ns	0.0	0.4	3.8	10.5

[a] Final documentation on the analysis and modeling, including all of the methodologies and underlying assumptions, is expected to be completed and posted on the web by March 31, 2007. Past GPRA modeling and analysis documentation can be found at http://www.eere.energy.gov/ba/pba/gpra.html .

[b] Benefits through 2030 are calculated with the NEMS-GPRA08 model. Benefits from 2035 through 2050 are calculated with the MARKAL-GPRA08 model. "NC" indicates situations in which no calculation was done because of specific model limitations. "ns" indicates results that were "not significant"—within the noise of the models.

[c] Projected benefits do not include any potential policy changes that might enhance technology deployment. In addition, most technologies show diminishing benefits by 2050, because of the assumption built in to the analysis that baseline industry progress will eventually catch up with the more accelerated progress associated with EERE program success.

[d] Net present value calculations throughout this table are performed for cumulative economic metrics, and are done using a 3% real discount rate, cumulative to 2008.

[e] The prices reflected here are average delivered prices to all sectors, and are based on a three year moving average. Thus the measure of benefit is the change in the three year moving average delivered price, in $ per thousand cubic foot.

	2010	2020	2030	2040	2050
Security MPG improvement (%)[a]	0%	0%	4%	23%	89%
Transportation fuel diversity improvement (%)[b]	0%	2%	15%	33%	34%
Oil intensity reduced (% change in bil. bbl/GDP)	ns	ns	ns	0.6%	0.8%

[a] Security MPG is the ratio of vehicle miles traveled by light duty vehicles to their usage of oil. It captures oil avoidance by efficiency and fuel alternatives.
[b] Fuel diversity is measured by the Shannon-Weiner Index (SWI) of diversity. The SWI is a measure of "proportional diversity," and hence captures both abundance and richness, i.e., how many different fuels and how much of each fuel both factor into the calculation.

Hydrogen Production and Delivery R&D

Funding Schedule by Activity

	(dollars in thousands)		
	FY 2006	FY 2007	FY 2008
Hydrogen Production and Delivery R&D	8,391	35,798	38,880
SBIR/STTR	0	1,046	1,120
Total, Hydrogen Production and Delivery R&D	8,391	36,844	40,000

Description

Hydrogen Production and Delivery R&D encompasses distributed based renewable liquids reforming and electrolysis, and central based production through biomass gasification, wind based electrolysis, solar driven high temperature thermochemical cycles, biological and photoelectrochemical pathways. It also includes the technology for hydrogen delivery: transporting and distributing hydrogen at fueling sites. Work involving coal and nuclear-based hydrogen production is funded by the DOE Fossil Energy and Nuclear Energy offices, respectively. Areas of collaboration with other offices include production technologies such as gasification, reforming, separations, and purification.

Benefits

Production and Delivery R&D supports the mission of the program by developing new and advanced technologies to produce hydrogen from diverse domestic resources. The benefits of the R&D include the lowering of hydrogen cost on a cents/mile basis to a level less than or equivalent to gasoline used in conventional hybrid vehicles.[a] 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. The FY 2006 hydrogen cost target of $3.00 per gallon of gasoline equivalent (gge) for production from distributed natural gas was met and verified by an independent panel. Based on meeting the upper end of the overall Production Objective of $2.00 to $3.00/gge, focus will be shifted towards meeting the objective through renewable pathways.

[a] The hydrogen cost goal range of $2.00 to $3.00 per gasoline gallon equivalent (gge) is independent of the production pathway and is based on the National Academies' fuel efficiency improvement factors for gasoline and gasoline hybrid vehicles and the Energy Information Administration's "High A Case" 2015 gasoline price projection. This methodology will make hydrogen fuel less than or equivalent to gasoline on a cents-per-mile basis.

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

	($/gge)							
	2003	2004	2005	2006	2007	2008	2009	2010
Hydrogen from renewables								
Target	6.20	6.00			$4.30		4.10[c]	
Actual	6.20	5.45	5.88[b]	4.40[c]				

Hydrogen Production Costs (modeled)[c]: Non-renewable delivered at 5000 psi, untaxed, based on natural gas at $ 5.25/MBtu.

	($/gge)							
	2003	2004	2005	2006	2007	2008	2009	2010
Hydrogen from natural gas (distributed)								
Target	5.00			3.00		2.75		2.50
Actual	5.00		3.10	3.00				

Detailed Justification

	(dollars in thousands)		
	FY 2006	FY 2007	FY 2008
Hydrogen Production and Delivery R&D	**8,391**	**35,798**	**38,880**

The Production and Delivery R&D subprogram funds multiple pathways for hydrogen production, including: water electrolysis, reforming of biomass-derived liquids, biomass gasification, photoelectrochemical, biological, and solar high temperature water-splitting. The majority of the funding (minimum 75 percent) is directed toward technologies from renewable energy sources because this research was a priority area identified by the National Academy of Sciences in its comprehensive 2004 study, *The Hydrogen Economy*.

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[a] Hydrogen production cost estimates use laboratory data and assume high equipment manufacturing volumes, i.e., 500 units/year.

[b] The increase of the FY 2005 actual value of modeled cost of hydrogen produced from renewables is due to two factors: (a) increase in the assumed industrial electricity price from 5 cents/kWh to 5.5 cents/kWh from the EIA Annual Energy Outlook (2004 vs 2005) and (b) increase of capital cost estimate of electrolyzer. Targets and status post 2005 are based on distributed reforming of renewable liquids. Previous targets and status were based on electrolysis, which will not likely be a major renewable technology when used in distributed applications with grid power. In addition, the post-2005 timeline has been extended consistent with reduced funding available for renewable production due to previous years' appropriations and Congressionally-directed projects.

[c] Hydrogen production cost estimates use laboratory data and assume high equipment manufacturing volumes, i.e., 500 units/year.

Having achieved the upper end of the \$2.00 to \$3.00/gge cost objective through distributed natural gas reforming, further reforming R&D will focus on the development of pilot scale reforming systems that can use biofuels such as ethanol, glucose, and bio-oil (or fuel-flexible system) to achieve a delivered hydrogen cost of \$<3.00/gge by 2017. Novel reforming systems for conventional feedstocks and components such as membrane technologies for a one-step hydrogen separation and purification process and low energy pressurization options such as thermal compressors will be developed to reduce the delivered cost of hydrogen from \$3.00 (FY 2006 cost) to \$2.00/gge by 2015.

The program will conduct research on advanced electrolyzer systems, with the goal of achieving a plant gate hydrogen cost of \$3.10 per gasoline gallon equivalent (gge) for central renewable production and a delivered cost of \$3.70/gge for distributed electrolysis by 2012. Wind-powered electrolysis research will include advanced power electronics interface components for wind microgrid electrolysis and distributed power and complete technology-business case models for electrolysis pathways. Research on reforming of biomass and biomass derived liquids to reduce capital costs and improve efficiencies will be targeted to achieve a delivered hydrogen cost of \$3.80/gge by 2012. Centralized biomass gasification and reforming research will combine novel gasifier and slurry reforming technologies to reduce the plant-gate cost. Gasification technology research will be coordinated with the EERE Biomass Program and DOE's Fossil Energy Program. Separation technologies to reduce energy use and capital costs associated with reforming and gasification will be developed in coordination with DOE's Office of Fossil Energy. In photoelectrochemical water splitting production, the program will begin development of standard test protocols to validate and compare the efficiencies and durabilities of materials and devices under development by universities, industry, and National Laboratories, identify functional requirements for auxiliary photoelectrochemical (PEC) hydrogen production devices and systems, and test candidate materials. In collaboration with the Office of Science, the program will complete development of a photoelectrochemical material and evaluate device configurations that are projected to achieve 8 percent solar-to-hydrogen system efficiency with 1,000-hour durability by the end of 2013. Research will then shift to advanced photoelectrochemical materials that could achieve 10 percent solar-to-hydrogen system efficiency and 5,000-hour durability by 2018. In collaboration with the Office of Science, research will begin on biological micro-organism systems to improve hydrogen production efficiency. The program will conduct fermentation research to enable the use of a lower cost feedstock (10 cents/lb sugar feedstock cost in 2013) and achieve a 4 molar yield of hydrogen from glucose (2013). Naturally-occurring microorganisms will be examined to identify those that are relevant to the program's algae and fermentation pathways. The program will conduct research of biological technology that achieves 2 percent incident light energy-to-hydrogen efficiency with 30 minute duration of continuous photoproduction by 2015 and 5 percent efficiency with 4 hour duration by 2018. In solar-concentrator-based high-temperature water splitting, the program will verify the feasibility of chemical cycles including laboratory-scale industry projects that would be projected to achieve a hydrogen cost of $6.00/gge (plant gate) by 2012. The EERE Hydrogen and Solar Programs and the Nuclear Hydrogen Initiative in the Office of Nuclear Energy will work together to develop a thermo-chemical means of producing hydrogen using high temperature solar as the heat source. The goal of the project will be a pilot-scale demonstration by 2014.

(dollars in thousands)

The program will also conduct research to reduce capital costs and increase energy efficiency of hydrogen delivery systems. The focus in FY 2008 will be on compression, liquifaction and storage at refueling sites, with the goal of achieving the 2010 target of refueling-site delivery costs <$.80/gge of hydrogen. The program will develop energy-efficient conventional mechanical hydrogen compressors and liquefaction technology, novel thermal hydrogen compressors, and novel magnetic liquefaction techniques. Hydrogen delivery R&D will also include pipeline embrittlement research, novel solid and liquid hydrogen carrier research, and development of high-pressure tube trailers and tanks to achieve a hydrogen delivery cost of <$1/gge by 2017.

Research into carbon sequestration options for distributed reforming technology will be conducted to identify innovative options that could be economically viable.

In addition, these funds may be used to support efforts such as peer reviews; data collection and dissemination; and technical, market, economic, and other analyses.

	FY 2006	FY 2007	FY 2008
SBIR/STTR	**0**	**1,046**	**1,120**

In FY 2006, $178,000 was transferred to the SBIR program and $22,000 to the STTR program respectively. The FY 2007 and FY 2008 amounts shown are estimated requirements for the continuation of the SBIR and STTR program.

	FY 2006	FY 2007	FY 2008
Total, Hydrogen Production and Delivery R&D	**8,391**	**36,844**	**40,000**

Explanation of Funding Changes

	FY 2008 vs. FY 2007 ($000)
Hydrogen Production and Delivery R&D	
This activity will result in a highly focused effort on near-term technologies that support the introduction of hydrogen technologies. The primary focus will be on distributed production systems using electrolysis and reforming that minimize the need for a delivery infrastructure. Electrolysis will focus on advanced distributed electrolyzers that maximize efficiency and minimize capital cost. Distributed reforming R&D will include investigation of multiple feedstocks and result in prototype renewable liquid reformers and low-cost appliance type reformers focused on attaining the 2015 target of $2.00/gge. Support for longer-term technologies, such as central electrolysis from renewables, high-temperature solar thermochemical cycles, photoelectrochemical production, and biologically based hydrogen production is accelerated to include very high energy efficiency, advanced power-electronics components for wind-powered electrolysis, efficient and robust photobiological and fermentation organisms and processes. Delivery R&D will focus on development of advanced, low-cost hydrogen compressor and liquefaction technology and will include significant R&D of hydrogen carriers, pipelines or high pressure tube trailers. The hydrogen production budget request is consistent with the National Academies' recommendations in their *Hydrogen Economy* report and is supported by multiple RDIC factors: it is a Presidential priority; it addresses market barriers and provides a public benefit; it builds on existing technology and complements current R&D in support of the DOE Hydrogen Posture Plan; it incorporates industry involvement in planning, industry cost-sharing, performance indicators, "off ramps" (such as the phase-out between FY 2008 and FY 2010 of R&D on hydrogen production from natural gas, as production is validated in the target range of $2.00 to $3.00 per gge), and it is competitively awarded and peer reviewed.	+3,082
SBIR/STTR	
Changes in the SBIR/STTR funding are a direct result of changes in the funding of program activities and projected allocation among activities	+74
Total Funding Change, Hydrogen Production and Delivery R&D	**+3,156**

Hydrogen Storage R&D

Funding Schedule by Activity

(dollars in thousands)

	FY 2006	FY 2007	FY 2008
Hydrogen Storage R&D	26,040	33,651	42,671
SBIR/STTR	0	969	1,229
Total, Hydrogen Storage R&D	26,040	34,620	43,900

Description

Hydrogen Storage R&D will focus primarily on the research and development of on-board vehicular storage systems that allow for a driving range of more than 300 miles within the constraints of weight, volume, safety, durability, refueling time, efficiency, and total cost, to meet consumer expectations. The Hydrogen Storage portfolio will concentrate on materials-based technologies and will also explore advanced conformable and low cost tank technologies for hydrogen storage systems to meet 2010 and 2015 on-board system performance targets.

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 R&D activity supports the mission of the HT Program by focusing on the development of safe, compact, light-weight, low-cost, durable, and efficient storage systems to achieve a driving range of greater than 300 miles.

The research will enable the system volumetric (kWh/L) and gravimetric (kWh/kg or % by weight) storage capacities (while meeting cost targets) to be improved as indicated below.

Hydrogen Storage Performance Metrics

	2003[a]	2004[b]	2005	2006	2007	2008	2009	2010
Materials-Based								
Volumetric (kWh/L)								
Target					1.2			1.5
Actual	0.5	0.6	0.65					
Gravimetric (% by weight)								
Target	1	1.7		2.5	4.5			6.0
Actual	1	1.7	1.9					

Detailed Justification

	(dollars in thousands)		
	FY 2006	FY 2007	FY 2008
Hydrogen Storage R&D	**26,040**	**33,651**	**42,671**

To address the critical challenge of hydrogen storage, the program will continue with its overarching strategy to conduct research and development through the framework of the "*National Hydrogen Storage Project,*" consisting of both Centers of Excellence (which include teams of competitively selected university, industry and Federal Laboratory partners) and competitively selected independent projects aimed at meeting the following technical goals by 2010: storage density of 2.0 kWh/kg (6 percent hydrogen by weight), 1.5 kWh/L, and $4/kWh. This work is based in part on awards initiated in FY 2005 from the "Grand Challenge" solicitation issued in FY 2003. In addition, independent projects awarded through the annual solicitation process, initiated in FY 2006, will be part of the portfolio. It is expected that these projects will be started in FY 2007. To complement hydrogen storage R&D, the program may also implement an inducement prize to foster a broader spectrum of ideas and participants and to support the Energy Policy Act of 2005, Title X, section 1008 (e.g., Freedom Prize or other cash prizes).

Hydrogen storage efforts will focus on applied, target-oriented research of advanced concepts, innovative chemistries and novel materials, with the potential to meet long term performance metrics. Advanced concepts include high-capacity metal hydrides, solid and liquid chemical hydrogen carriers, boron-based materials, novel carbon nanostructures, metal-organic framework materials, and other nanostructured high surface area materials, as well as novel material synthesis and treatment processes. The R&D will be closely coordinated with the DOE Office of Science basic research

[a] 2 kWh/kg = 6 percent hydrogen by weight. 6 percent hydrogen by weight storage system contains 6 kg of hydrogen in a system weighing 100 kg. 1 kg of hydrogen contains 33.3kWh (on a lower heating value basis), so 6 kg contains approximately 200kWh. A 200 kWh hydrogen/100 kg system = 2kWh/kg.

[b] The program plans in effect in FY 2003 and 2004 did not include quantitative performance targets for these years.

efforts in hydrogen storage, through university, National Laboratory, and industry R&D. Along with the materials research, the applied R&D investment will increase critical engineering science efforts to enable compact, efficient and light-weight thermal integration and reactor designs for the storage system. In addition, emphasis will be increased on engineering science for systems issues, including thermal management during refueling. Overall technical progress for hydrogen storage in FY 2008 will be moving from the FY 2007 interim system target of 4.5 percent hydrogen by weight towards the 2010 system targets of 6 percent hydrogen by weight.

In FY 2008, the program will continue to focus hydrogen storage research and development on advanced metal hydrides, chemical hydrogen storage, carbon-based materials and new concepts. Building on the research conducted in FY 2005 through the end of FY 2007, R&D will focus on the most promising material technologies down-selected from the overall portfolio at the end of FY 2007

that have the potential to meet the DOE 2010 system targets. R&D work will further optimize the down-selected materials and concepts while ramping up engineering science efforts for the storage system. The down-selection process is part of the planned process to focus on key technologies to achieve the program goals.

Chemical hydrogen storage research will focus on further optimizing selected storage materials while initiating engineering development of the overall storage system via lab-scale experiments to optimize hydrogen release and regeneration process conditions for selected materials. Regeneration methods will be developed for chemical hydrides, including boron-based materials and organic compounds. Regeneration yields, reaction rates and their dependence on temperatures, catalysis and thermal management will be investigated. The program's key milestone for FY 2008 is to develop chemical hydrogen storage regeneration methods at the laboratory-scale, obtain initial data for efficiency and cost analysis, and demonstrate lab-scale reactions capable of at least 40 percent energy efficiency.

Metal hydride research will focus on designing and developing high-capacity metal hydride materials that have the potential to meet the 2010 system targets and offer pathways to meet the 2015 system targets. Following the FY 2007 materials down-select the research and development will continue to focus on improving volumetric, gravimetric and transient performance of the materials. In addition, engineering science investments will be continued to refine system performance projections based on the best available materials. The milestone for FY 2008 is to reproducibly demonstrate advanced metal hydrides at the lab-scale and update the system projections for volume and weight based on materials chosen in the down-selection process.

Research on carbon-based materials and sorbents will continue to focus on innovative ways to store hydrogen with lower binding energies as compared to metal hydrides and chemical hydrides. The carbon research portfolio in FY 2008 will continue investments towards the planned FY 2009 down-select decision point on advanced carbon-based materials. In addition to materials research, investment will also include engineering science to update projections of system volume and weight of a storage system based on the most promising materials in this category.

	(dollars in thousands)		
	FY 2006	FY 2007	FY 2008

Materials safety studies initiated in FY 2007 will be expanded to include a diverse set of material safety properties, such as tolerance to exposure in moisture, generating critical information for a safe, commercially viable storage technology. Independent testing to validate materials performance for selected, promising materials will also be conducted. In storage systems analysis, the Storage Systems Analysis Working Group (SSAWG) will continue its activities to rigorously assess the different emerging storage technologies based on performance, cost, life-cycle energy efficiencies, cost and environmental impact.

This subprogram is aligned with DOE's assessment of hydrogen storage as one of the highest priority, technically challenging barriers. These efforts will be coordinated with the Office of Science's efforts on basic science for hydrogen storage.

In addition, these funds may be used to support efforts such as peer reviews; data collection and dissemination; and technical, market, economic, and other analyses.

SBIR/STTR	**0**	**969**	**1,229**

In FY 2006, $498,000 and $62,000 were transferred to the SBIR and STTR programs respectively. The FY 2007 and FY 2008 amounts shown are estimated requirements for the continuation of the SBIR and STTR program.

Total, Hydrogen Storage R&D	**26,040**	**34,620**	**43,900**

Explanation of Funding Changes

	FY 2008 vs. FY 2007 ($000)

Hydrogen Storage R&D

The majority of the requested increase in hydrogen storage supports competitive, merit-reviewed, cost-shared R&D on materials-based hydrogen storage technologies by industry, universities and Federal Laboratories (DOE National Laboratories, the Jet Propulsion Laboratory, and the National Institute of Standards and Technology). The research focuses on metal hydrides, chemical hydrogen storage, and carbon-based materials, as well as initiation of engineering R&D of sub-systems and storage materials safety for the overall storage systems planned for FY 2010 (+$5 million).

The increased funding will also support new awards from a solicitation for new materials and concepts, including a hydrogen storage inducement prize (+$2.5 million) as well as a new Center of Excellence on applied and engineering sciences for hydrogen storage systems, to be competitively solicited, including industry, university,

	FY 2008 vs. FY 2007 ($000)
and National Laboratories (+$1.5 million). The Center of Excellence on engineering science for overall storage systems will increase its emphasis on R&D of components and engineering issues, including thermal management during refueling and hydrogen release. These new projects, planned to start in FY 2008, will complement the work being done at existing materials-based Centers of Excellence and in existing independent projects. The planned additional funding supports critical R&D that is required to meet the 2010 performance targets (2.0 kWh/kg and 1.5 kWh/l).	
The R&D of materials-based hydrogen storage technologies is consistent with the National Academies' recommendations in their *Hydrogen Economy* report and is supported by multiple RDIC factors: it is a Presidential priority; it addresses market barriers (e.g., no current market) and provides a public benefit; it builds on existing technology and complements current R&D in support of the DOE Hydrogen Posture Plan; it incorporates industry involvement in planning, industry cost-sharing, performance indicators, "off ramps" (such as a "no go" decision in the specific area of pure single walled carbon nanotubes for room temperature hydrogen storage), and it is competitively awarded and peer reviewed.	+9,020
SBIR/STTR	
Changes in the SBIR/STTR funding are a direct result of changes in the funding of program activities and projected allocation among activities.	+260
Total Funding Change, Hydrogen Storage R&D	**+9,280**

Fuel Cell Stack Component R&D

Funding Schedule by Activity

	(dollars in thousands)		
	FY 2006	FY 2007	FY 2008
Fuel Cell Stack Component R&D	30,710	37,016	42,768
SBIR/STTR	0	1,066	1,232
Total, Fuel Cell Stack Component R&D	30,710	38,082	44,000

Description

For fuel cell vehicles to be competitive, fuel cell systems must become less expensive and more durable than they are presently. The high cost and durability of polymer electrolyte membrane (PEM) fuel cell stack components (polymer electrolyte membranes, oxygen reduction electrodes, advanced catalysts, bipolar plates, etc.) currently are the biggest hurdles facing the adoption of complete fuel cell systems. The National Academies recognized the importance of stack component R&D in their 2004 recommendation to focus the research on breakthroughs in fuel cell costs and materials for durability. The program's collaborative R&D efforts with industry, National Laboratories and academia are focused on the critical technical barriers of cost, durability, efficiency, and overall performance of fuel cell stack components for both transportation and stationary applications. The 2005 National Academies' report recommended an expanded activity and raised the priority of membrane R&D, new catalyst systems, and electrode design (in collaboration with DOE's Office of Basic Energy Sciences (BES)). In particular, National Laboratories and other appropriate scientific centers will focus on failure mechanisms, including a better understanding of the chemistry, physics and materials involved. Technical targets established at the component level support the technology goals for fuel cell vehicles.

Benefits

Stack Component R&D supports the program's mission by focusing on overcoming critical technical barriers at the *component level* to improve overall fuel cell performance and durability, while lowering cost. The improvements will help to make fuel cells competitive with conventional technologies so that their potential benefits in energy security and environmental quality can then be realized.

Detailed Justification

	(dollars in thousands)		
	FY 2006	FY 2007	FY 2008
Fuel Cell Stack Component R&D	**30,710**	**37,016**	**42,768**

A key to meeting the program's goals for fuel cell systems will be developing proton-conducting membranes that are low-cost, durable, and operate at low relative humidity (25-50 percent) over the target temperature range (-20 to 120°C). These membranes must have good mechanical and chemical stability under highly oxidizing conditions. In FY 2008, Stack Component R&D will evaluate membranes operating at ≤ 80 °C against 2010 targets and will complete initial startup tests of cells and stacks from -20 °C. New experimental setup and diagnostic techniques will be developed to probe properties of the fuel cell and characterize fuel cell operation. Degradation mechanisms for fluorocarbon-based membranes operating at > 80 °C will be identified. Strategies to increase the lifetime of hydrocarbon-type membranes operating at ≤ 80 °C to more than 5,000 hours will be developed.

The results from Basic Energy Science membrane and catalyst research projects feed into the Stack Component projects. Membrane development activities such as exchange of materials and scientists between countries will be coordinated through an International Partnership for the Hydrogen Economy (IPHE) project.

The performance of membrane electrode assemblies (MEAs) in a single cell and short stacks will be evaluated and compared to the 2010 targets. Transportation fuel cell system cost projections based on achievement of 2010 and 2015 technical targets will be generated. The cost of a hydrogen-fueled 80 kW fuel cell power system based on current technology will be analyzed and compared to the FY 2008 target of $70/kW. Models will be developed that relate the loss in performance (mV/hr at a current density of 0.6 A/cm^2) to a given concentration of impurity.

The size, weight and cost of bipolar plates must be reduced to meet specific power, power density and cost targets. The program will continue to develop bipolar plates that offer at least 95 percent of the in-stack performance that an equivalent stack using machined graphite plates would provide, while costing significantly less than graphite plates and potentially offering greater durability.

Gas diffusion layers (GDLs) between the membrane electrode assembly and bipolar plates enhance fuel cell performance and ease water management. Research will optimize the GDL physical properties (conductivity and hydrophobicity) and pore structure and will improve GDL coatings.

Seals between bipolar plates ensure the purity and integrity of the fuel cell stack environment. In FY 2008, Stack Components research will decrease the leak rate and increase the operating temperature range of fuel cell seals.

In FY 2008, participation in the European Commission's Fuel Cell Testing, Safety and Quality Assurance Program will include evaluation of test protocols for global, harmonized fuel cell testing as part of an IPHE project.

	FY 2006	FY 2007	FY 2008

(dollars in thousands)

In addition, these funds may be used to support efforts such as peer reviews; data collection and dissemination; and technical, market, economic, and other analyses.

SBIR/STTR	**0**	**1,066**	**1,232**

In FY 2006, $787,000 and $98,000 were transferred to the SBIR and STTR programs respectively. The FY 2007 and FY 2008 amounts shown are the estimated requirements for the continuation of the SBIR and STTR program.

Total, Fuel Cell Stack Component R&D	**30,710**	**38,082**	**44,000**

Explanation of Funding Changes

	FY 2008 vs. FY 2007 ($000)
Fuel Cell Stack Component R&D	
The requested increase will allow examination of innovative concepts to simplify, integrate or eliminate components or functions in fuel cell systems. Fuel cell performance will be improved with alternative designs, materials, and configurations. The fuel cell stack component R&D activity is consistent with the National Academies' recommendations and is supported by multiple RDIC factors: it is a Presidential priority; it addresses market barriers and provides a public benefit; it builds on existing technology and complements current R&D in support of the DOE Hydrogen Posture Plan; it incorporates industry involvement in planning, industry cost-sharing, performance indicators, "off ramps" (such as the shift after FY 2005 from building full-scale 50kW fuel cell systems to focusing on materials and component R&D), and it is competitively awarded and peer reviewed.	+5,752
SBIR/STTR	
Changes in the SBIR/STTR funding are a direct result of changes in the funding of program activities and projected allocation among activities.	+166
Total Funding Change, Fuel Cell Stack Component R&D	**+5,918**

Technology Validation

Funding Schedule by Activity

	(dollars in thousands)		
	FY 2006	FY 2007	FY 2008
Technology Validation	33,301	39,400	29,874
SBIR/STTR	0	166	126
Total, Technology Validation	33,301	39,566	30,000

Description

Technology Validation includes both Fuel Cell Technology Validation and Hydrogen Infrastructure Validation. This activity funds the Controlled Hydrogen Fleet and Infrastructure Demonstration and Validation Project. The project is both a "Learning Demonstration" to manage the hydrogen and fuel cell component and materials research and a validation of the technology under real-world operating conditions against time-phased performance-based targets. This project is a 50/50 cost-shared effort between the government and industry, including automobile manufacturers, energy companies, suppliers, universities, and state governments. Extensive data will be collected on vehicles operating on-road and during dynamometer testing. Validation of the hydrogen infrastructure includes verification of hydrogen production cost and fill times while gaining experience in the safe operation of stations.

Benefits

Technology Validation will provide the most accurate assessment of technology readiness and the risks to success facing continued government and industry investment. To enable the automotive, energy and utility industries to determine if technology readiness has been achieved, integrated vehicle and infrastructure systems need to be validated and individual component targets need to be met under real-world operating conditions. This activity will support the Hydrogen Technology Program's mission by providing critical statistical data to predict whether fuel cell vehicles can meet the 2015 targets of 5,000-hour fuel cell durability, 300+ mile range hydrogen storage, and hydrogen fuel costs between $2.00 and $3.00 per gallon gasoline equivalent (gge). Specifically, the program will validate the performance and vehicle interfaces of hydrogen fuel cell vehicles to demonstrate a 250 mile range by 2008 and an increase in durability from approximately 1,000 hours in 2003 (laboratory) to 2,000 hours by 2011 in a vehicle fleet. (2,000 hours is equal to approximately 50,000 vehicle miles.). Technology Validation also provides information in support of codes and standards development and for the development of best practices regarding safety.

Specifically, the research will enable validation of the parameters indicated in the table below.

Performance Targets to be Verified by the Technology Validation Subprogram

	2004[a]	2005	2006	2007	2008	2009	2010	2011
Durability (hours)								
Target		1,000 (Projected)[b]	1,000					2,000
Actual			950 (max)					
Range (miles)								
Target					250+			
Actual								
Cost of hydrogen production[c] ($/gge untaxed)								
Target		3.60				3.00		
Actual	3.60	3.60						
Fill Time (minutes)								
Target				5				
Actual								

Detailed Justification

(dollars in thousands)

	FY 2006	FY 2007	FY 2008
Technology Validation	**33,301**	**39,400**	**29,874**

Five automobile manufacturers and energy company partnerships were selected in April 2004 to design and construct hydrogen fuel cell vehicles and fueling stations to support "learning demonstrations" in the Controlled Hydrogen Fleet and Infrastructure Technology Demonstration and Validation Project. The primary goals are to validate progress towards the 2011 target of 2,000 hours fuel cell durability and 250+ mile range. The fuel cell vehicle technology validation effort will quantify the performance, reliability, durability, maintenance requirements and environmental

[a] The program plan in effect in 2004 did not include quantitative targets for that year. The $3.60/gge includes co-production of electricity and hydrogen fuel, and is only for limited testing.
[b] FY 2005 durability target was changed to 1,000 hours "projected" due to the delay in selecting projects from the Controlled Hydrogen Fleet and Infrastructure Demonstration and Validation Solicitation.
[c] The validation activity will confirm the 2006 laboratory data for estimated hydrogen production costs in real world conditions. Hydrogen production cost estimates use real world data and assume high equipment manufacturing volumes, e.g., hundreds of units/year.

benefits of fuel cell vehicles under real world conditions and provide valuable information to researchers to help refine and direct future R&D activities related to fuel cell vehicles.

In FY 2008, the Controlled Hydrogen Fleet and Infrastructure Demonstration and Validation Project will complete the fourth year of data collection on first generation vehicles, including chassis dynamometer tests. This data collection will facilitate a better understanding of vehicle and infrastructure interface issues of hydrogen fueled vehicles. An initial composite system efficiency assessment and an interim evaluation of data collected from first-generation hydrogen-fueled vehicles will be completed. Second generation vehicles, introduced in FY 2007, will begin their first full year of testing with more advanced fuel cell and storage systems that will ultimately validate the 2011 fuel cell system durability and range targets.

To support fueling of the fuel cell vehicles, the partnerships will design and construct hydrogen refueling stations and associated infrastructure using new hydrogen production technology to validate whether the new technologies reach the 2009 target of $3.00/gge hydrogen (untaxed) with 68 percent natural-gas-based well-to-pump efficiency.

The infrastructure efforts through FY 2008 will include installing and operating stations in Northern and Southern California, Michigan, Washington, D.C., and Florida. Hydrogen production concepts being demonstrated will explore viable options for the near and long term. Additional stations for low-cost hydrogen production will be deployed by FY 2008 that will explore the use of local distributed natural gas reformation plants, renewable systems, and mid-size natural gas reformation plants with pipelines and mobile refueling systems to local distribution stations. High-efficiency energy stations that co-produce electricity and hydrogen fuel for vehicles will be deployed as potential low-cost fuel providers and early infrastructure options in FY 2008. Data relevant to key vehicle and refueling interface issues such as refueling times, hydrogen purity impacts, energy efficiency of the hydrogen generation plant, and plant availability and reliability will be produced and published to provide a data base for system modelers.

In past budgets this funding was requested as two budget items: validation of fuel cell vehicles and validation of hydrogen infrastructure, although the work was performed as an integrated project. In FY 2006 the funding split was $22.912 million for fuel cell vehicles and $10.389 million for infrastructure. In FY 2007 the split is $24.625 million for fuel cell vehicles and $14.775 million for infrastructure. In FY 2008 funding is requested as a single budget item, but the anticipated comparable split is approximately $15.933 million for fuel cell vehicles and $13.941 million for infrastructure.

Activities will also include participation in the California Fuel Cell Partnership, through which field evaluations of hydrogen fuel cell vehicles under real world conditions will continue to validate system durability and performance. In addition, these funds may be used to support efforts such as peer reviews; data collection and dissemination; and technical, market, economic, and other analyses.

	FY 2006	FY 2007	FY 2008
	(dollars in thousands)		
SBIR/STTR	**0**	**166**	**126**

In FY 2006, $164,583 and $12,500 were transferred to the SBIR and STTR programs respectively. The FY 2007 and FY 2008 amounts shown are estimated requirements for the continuation of the SBIR and STTR program.

Total, Technology Validation	**33,301**	**39,566**	**30,000**

Explanation of Funding Changes

	FY 2008 vs. FY 2007 ($000)
Technology Validation	
Funding for acquisition and testing of second-generation fuel cell vehicles is adequate for current needs. We have acquired and are testing 69 demonstration vehicles to date and will purchase and test 62 more in 2007 and 2008.	
The Technology Validation Subprogram is supported by multiple RDIC factors: it is a Presidential priority; it addresses market barriers and provides a public benefit; it builds on existing technology and complements current R&D in support of the DOE Hydrogen Posture Plan; it incorporates industry involvement in planning, industry cost-sharing, performance indicators, and it is competitively awarded and peer reviewed.	-9,526
SBIR/STTR	
Changes in the SBIR/STTR funding are a direct result of changes in the funding of program activities and projected allocation among activities.	-40
Total Funding Change, Technology Validation	**-9,566**

Transportation Fuel Cell Systems

Funding Schedule by Activity

	(dollars in thousands)		
	FY 2006	FY 2007	FY 2008
Transportation Fuel Cell Systems	1,050	7,307	7,776
SBIR/STTR	0	211	224
Total, Transportation Fuel Cell Systems	1,050	7,518	8,000

Description

Transportation Fuel Cell Systems R&D conducts research, development and analyses that address key barriers to fuel cell systems for transportation. Key system-level barriers addressed in this subprogram include lack of compressor/expanders, sensors, water-management devices, and heat exchangers that meet automotive packaging and cost requirements of the fuel cell system. Because of the increased ability of industry to develop complete systems, Transportation Fuel Cell Systems R&D does not develop complete, integrated systems for transportation applications. Instead, Transportation Fuel Cell Systems R&D supports the development of individual component technologies critical to systems integration as well as systems-level modeling activities that serve to guide R&D, benchmark systems progress, and explore alternate systems configurations on a cost-effective basis. Other activities include studies that appraise the status of critical metrics (such as cost) and evaluate water and thermal management strategies. Transportation Fuel Cell Systems R&D also supports limited development of fuel cells for vehicle Auxiliary Power Units (APUs) for automotive or heavy vehicle applications and fuel cells for portable power applications. Fuel cell issues such as vibration, dust, and contaminants that could have a deleterious effect on stack performance and life are also addressed in this subprogram

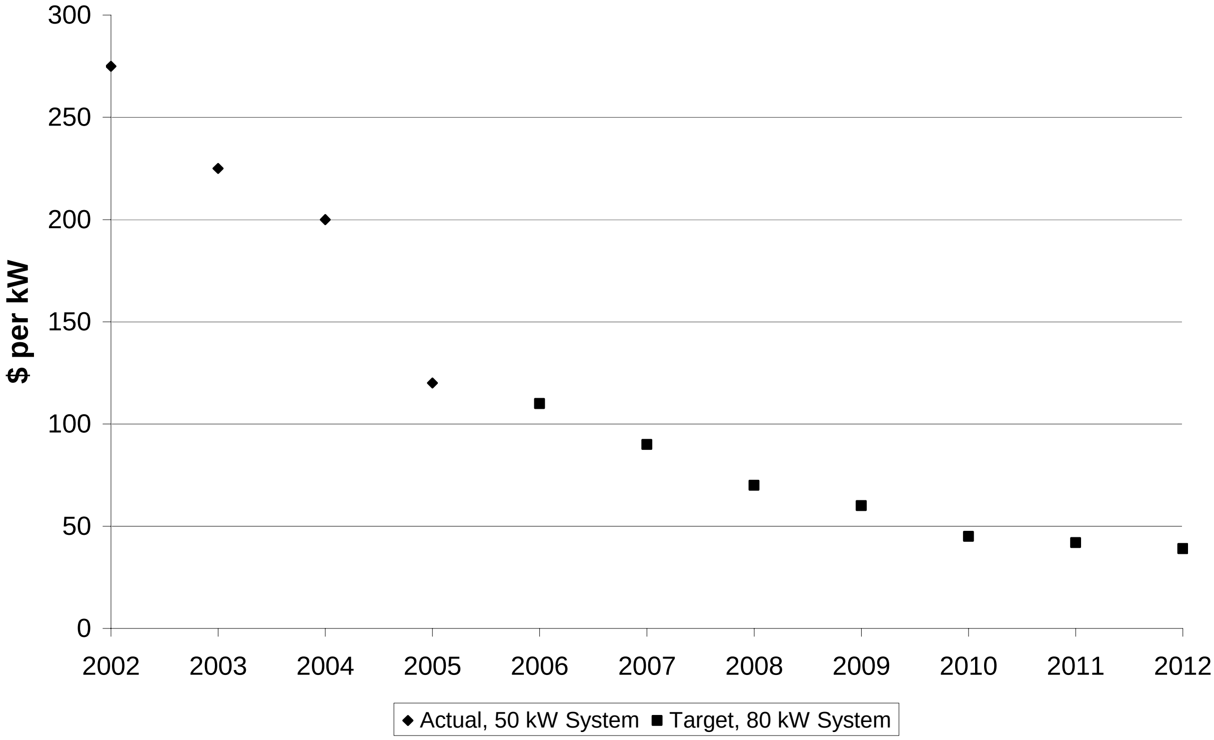
Benefits

Transportation Fuel Cell Systems R&D supports the program's mission by improving performance and durability, while lowering the cost of components and materials, and optimizing operating strategies that enable the widespread use of fuel cells. The improvements will help to make fuel cells competitive with conventional technologies so that their potential benefits in energy security and environmental quality can then be realized.

Research activities for transportation applications (including transportation systems and stack component R&D) will reduce the cost of the hydrogen-fueled, 80 kW vehicle fuel cell power systems as indicated below[a].

[a] Cost of 80 kW vehicle fuel cell power systems estimated for production rate of 500,000 units yearly and includes fuel cell stack, balance of plant, and hydrogen storage.

Cost of Hydrogen-Fueled, Vehicular Fuel Cell Power System



Detailed Justification

	(dollars in thousands)		
	FY 2006	FY 2007	FY 2008
Transportation Fuel Cell Systems	**1,050**	**7,307**	**7,776**

In FY 2008, fuel cell system cost and trade-off analyses will be conducted to support technology readiness. Scenarios for operating fuel cell systems at low relative humidity and under sub-freezing conditions will be evaluated.

By FY 2008, a go/no-go decision will determine whether to initiate further development of compressor/expander technology.

Fuel cell thermal and water management research projects will continue to explore novel means to increase performance and efficiency, while decreasing size, weight and cost of heat exchangers, humidifiers and other balance of plant devices needed to manage the heat and water generated in the fuel cell system.

	(dollars in thousands)		
	FY 2006	FY 2007	FY 2008

Fuel cell systems for portable power are being developed as an early market application where the market accepts a higher cost per kilowatt. Commercialization of fuel cells for portable power will aid in developing the manufacturing base and will introduce the technology to consumers, thus paving the way for fuel cell systems being used in other applications. In FY 2008, existing research for portable power applications will be completed and the performance will be evaluated against 2010 targets.

Fuel cell systems for auxiliary power in heavy duty trucks are being developed as alternate power supplies to avoid idling the diesel engine to provide overnight power to the cab Fuel-cell Auxiliary Power Units (APUs) would operate using hydrogen from diesel reformed on-board. The development of fuel-cell APUs will feed new technologies into the Vehicle Technologies program's 21st Century Truck initiative. Solid-oxide fuel cell (SOFC) technology is being explored for these APU applications, and its development is conducted in coordination with the Office of Fossil Energy's Solid Oxide Fuel Cell R&D effort. FE is responsible for developing improved solid-oxide stack materials, and they also have responsibility for stationary SOFC applications. Hydrogen Technology has responsibility for developing prototype SOFC systems at the smaller size appropriate for APU applications, and EERE's Vehicle Technologies program will be responsible for vehicle system integration.

In FY 2008 the Hydrogen Technology program will complete the assembly of an APU solid-oxide fuel cell stack and reformer, and an APU system will be tested and evaluated in the lab and on the road in cooperation with the Vehicle Technologies program. This activity will also develop a system to protect the fuel cell from air contaminants such as particulates and chemical aerosols.

Various pathways to lower fuel cell system cost by improving one or more system parameters will be investigated. Examples of these potential pathways include: ambient vs. pressurized stack operation, high-temperature/low-humidity operation, advanced membranes, alternate stack constructions, and alternate compression mechanisms.

In addition, these funds may be used to support efforts such as peer reviews; data collection and dissemination; and technical, market, economic, and other analyses.

SBIR/STTR	**0**	**211**	**224**

In FY 2006, $27,000 and $3,000 were transferred to the SBIR and STTR programs respectively. The FY 2007 and FY 2008 amounts shown are the estimated requirements for the continuation of the SBIR and STTR program.

Total, Transportation Fuel Cell Systems	**1,050**	**7,518**	**8,000**

Explanation of Funding Changes

	FY 2008 vs. FY 2007 ($000)
Transportation Fuel Cell Systems	
This increase will expand fuel cell system cost and trade-off analyses including ambient vs. pressurized stack operation, high-temperature/low-humidity operation, advanced membranes, alternate stack constructions, and alternate compression mechanisms. The Transportation Fuel Cell Systems Subprogram is supported by multiple RDIC factors: it is a Presidential priority; it addresses market barriers and provides a public benefit; it builds on existing technology and complements current R&D in support of the DOE Hydrogen Posture Plan; it incorporates industry involvement in planning, industry cost-sharing, performance indicators, and "off ramps" (such as the upcoming go/no-go decision point in the second quarter of FY 2008 on whether to initiate new R&D activities in the area of compressor/expander technology development) and it is competitively awarded and peer reviewed.	+469
SBIR/STTR	
Changes in the SBIR/STTR funding are a direct result of changes in the funding of program activities and projected allocation among activities.	+13
Total Funding Change, Transportation Fuel Cell Systems	**+482**

Distributed Energy Fuel Cell Systems

Funding Schedule by Activity

	(dollars in thousands)		
	FY 2006	FY 2007	FY 2008
Distributed Energy Fuel Cell Systems	939	7,242	7,516
SBIR/STTR	0	177	184
Total, Distributed Energy Fuel Cell Systems	939	7,419	7,700

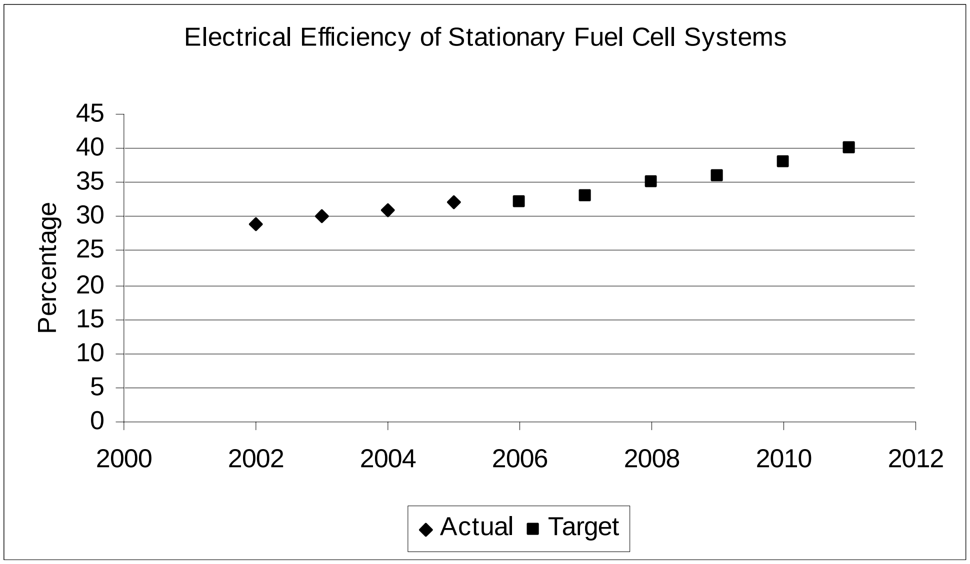
Description

Distributed Energy Systems supports development of high-efficiency Polymer Electrolyte Membrane fuel cell power systems as alternative power sources to grid-based electricity for buildings and other stationary applications. Distributed Energy Systems research focuses on overcoming the barriers to stationary fuel cell systems, including cost, durability, heat utilization, start-up time, and managing power transients and load-following requirements. Improved heat usage and recovery are addressed for combined heat and power generation to maximize overall efficiency of (thermal and electrical) systems. This subprogram also takes advantage of the synergy between transportation systems and distributed energy systems, particularly in the areas of developing improved materials for high-temperature membranes and improving fuel cell component durability. While the National Academies recommended that the DOE discontinue the PEM applied R&D program for stationary systems, DOE has elected to continue this work because of the synergy between transportation and stationary applications in this area, and has provided an explanation to the National Academies. In addition, DOE has established a go/no-go milestone for the distributed energy systems activity in 2011, which will determine whether DOE believes funding is appropriate after 2011.

Benefits

Distributed Energy Systems R&D supports the program's mission by focusing on overcoming barriers to stationary fuel cell systems, including improving durability and performance, while lowering cost to enable the widespread use of fuel cells in distributed energy and other small stationary applications. The improvements will help to accelerate commercialization of fuel cells by achieving an ultimate durability requirement of 40,000 hours and cost range of $400-$750 per kW, making fuel cells competitive with conventional technologies.

Research activities will improve the electrical efficiency of 5-250kW stationary fuel cell systems fueled by natural gas, liquefied petroleum gas (LPG), or biomass-derived fuels. Specifically, stationary fuel cell R&D activities will increase the electrical efficiency of these systems as indicated in the performance indicator graph below.



Target and Actual are the same for FY 2002-2005.[a]

Detailed Justification

	(dollars in thousands)		
	FY 2006	FY 2007	FY 2008
Distributed Energy Fuel Cell Systems	**939**	**7,242**	**7,516**

In FY 2008, the development of a prototype 50 kW stationary fuel cell power system will be completed and demonstrated in a commercial application. Research and development to increase the durability of a 5-250kW stationary fuel cell system will be conducted. Durability of membranes will be improved to move towards the 2011 durability target of 40,000 hours. The development of a 150 kW stationary fuel cell power system will be completed, and PEM stack components and power plant design concepts will undergo field evaluations. The development of critical balance of plant components for stationary fuel cells will continue. An international and an intergovernmental stationary fuel cell project will continue in support of the IPHE and the Hydrogen Interagency Task Force.

In addition, these funds may be used to support efforts such as peer reviews; data collection and dissemination; and technical, market, economic, and other analyses.

[a] No change in 2006: virtually all work is deferred due to congressionally directed funding and reduced total funding.

	(dollars in thousands)		
	FY 2006	FY 2007	FY 2008
SBIR/STTR	**0**	**177**	**184**

In FY 2006, $20,417 and $2,500 were transferred to the SBIR and STTR programs respectively. The FY 2007 and FY 2008 amounts shown are the estimated requirements for the continuation of the SBIR and STTR program.

Total, Distributed Energy Fuel Cell Systems	**939**	**7,419**	**7,700**

Explanation of Funding Changes

	FY 2008 vs. FY 2007 ($000)
Distributed Energy Fuel Cell Systems This increase supports the intergovernmental stationary fuel cell demonstration. The Distributed Energy Systems Subprogram is supported by multiple RDIC factors: it addresses market barriers and provides a public benefit; it builds on existing technology and complements current R&D in support of the DOE Hydrogen Posture Plan; it incorporates industry involvement in planning, industry cost-sharing, performance indicators, and "off ramps" (such as the planned go/no go decision point in 2011); and it is competitively awarded and peer reviewed.	+274
SBIR/STTR Changes in the SBIR/STTR funding are a direct result of changes in the funding of program activities and projected allocation among activities.	+7
Total Funding Change, Distributed Energy Fuel Cell Systems	**+281**

Fuel Processor R&D

Funding Schedule by Activity

	(dollars in thousands)		
	FY 2006	FY 2007	FY 2008
Fuel Processor R&D	637	3,942	2,916
SBIR/STTR	0	114	84
Total, Fuel Processor R&D	637	4,056	3,000

Description

Fuel Processor R&D develops fuel processors for integrated stationary applications and fundamental catalysts suitable for a variety of fuel processing applications. Fuel processing technology can be fuel-flexible – capable of processing multiple fuels – such as methanol, ethanol, biomass derived liquids, natural gas, propane or diesel – into hydrogen.

Benefits

Fuel Processor R&D supports the program's mission by developing the subsystem that aids the widespread use of fuel cell power technology in stationary applications. Processing fuels, such as natural gas, propane, methanol, ethanol, biomass derived liquids, or diesel, will enable environmental and efficiency advantages of hydrogen fuel cell technologies to be realized in an integrated fuel cell system. The option of using a diversity of fuels to produce hydrogen to power fuel cells will be a significant contributor to energy independence. The technologies for distributed hydrogen production may also prove applicable to integrated fuel flexible stationary fuel cell systems.

Detailed Justification

	(dollars in thousands)		
	FY 2006	FY 2007	FY 2008
Fuel Processor R&D	**637**	**3,942**	**2,916**

In FY 2008, the program will initiate development of a fuel-flexible (ethanol, propane, diesel, biodiesel, natural gas, kerosene, etc) stationary fuel processor in a partnership between the U.S. and other International Partnership for the Hydrogen Economy (IPHE) countries, with the goal of achieving 99.9 percent hydrogen purity and increased reformer efficiency.

Exploratory R&D to improve understanding of reforming reaction mechanisms, catalyst deactivation, and sulfur poisoning will also be undertaken. The program will develop technology to reduce sulfur content in reformate, to continue development of advanced fuel processing catalysts that meet

	(dollars in thousands)		
	FY 2006	FY 2007	FY 2008

performance requirements for distributed generation applications, to define operating parameters to optimize catalyst performance and life, and to research ways to increase the use of base-metal catalysts to reduce the cost of fuel processors.

SBIR/STTR	**0**	**114**	**84**

In FY 2006, $15,000 and $2,000 were transferred to the SBIR and STTR programs respectively. The FY 2007 and FY 2008 amounts shown are the estimated requirements for the continuation of the SBIR and STTR program.

Total, Fuel Processor R&D	**637**	**4,056**	**3,000**

Explanation of Funding Changes

	FY 2008 vs. FY 2007 ($000)
Fuel Processor R&D This decrease reflects a ramp-down of funding for stationary fuel processors as stationary fuel cells approach their 2011 go/no-go decision. Fuel processor R&D for vehicle applications has already been completed, and fuel cell development for vehicle applications is now focused on direct hydrogen-fueled fuel cells. Fuel processor efforts in FY 2008 and beyond will be only what is necessary to support stationary fuel cells as they reach for their 2011 technical goals and the go/no-go decision on further development after that.	-1,026
SBIR/STTR Changes in the SBIR/STTR funding are a direct result of changes in the funding of program activities and projected allocation among activities.	-30
Total Funding Change, Fuel Processor R&D	**-1,056**

Safety and Codes and Standards

Funding Schedule by Activity

	(dollars in thousands)		
	FY 2006	FY 2007	FY 2008
Safety and Codes and Standards	4,595	13,460	15,552
SBIR/STTR	0	388	448
Total, Safety and Codes and Standards	4,595	13,848	16,000

Description

The Safety and Codes and Standards subprogram funds research to provide the technical data on hydrogen technologies (such as fuel cells and hydrogen production, storage, and distribution systems) that is necessary to support and inform the codes and standards development process. Its work in FY 2008 includes fundamental studies to determine the flammability, explosive, reactive, and dispersion properties of hydrogen. It will also subject components, subsystems, and systems to environmental conditions that could result in failure in order to check design practices and failure-mode prediction analysis. Once the critical failure modes and safety issues for hydrogen and fuel cell technologies are identified, this technical data will be provided to the appropriate codes and standards developing organizations (e.g., International Code Council, National Fire Protection Association) to write and publish applicable codes and standards for hydrogen production and delivery processes as well as for hydrogen storage and fuel cell systems for both transportation and stationary applications. The DOE will not be involved directly in writing codes and standards, but instead will facilitate the development of these standards through R&D and support for appropriate technical representation in working groups. Safety-related information will be disseminated through a hydrogen incident and safety bibliographic database, publication and presentation of safety-related R&D results, and reports on investigations of hydrogen-related incidents. The subprogram will also support the development of passive and active safety systems based on new sensor technologies, and will fund comprehensive safety analysis of hydrogen components and systems. DOE and DOT will closely coordinate hydrogen safety and codes/standards development activities.

Benefits

Wide acceptance of hydrogen technologies depends on meeting safety standards in which the public has confidence. This requires a comprehensive and defensible database on component reliability and safety to enable the publishing of performance-based domestic standards and international standards or regulations that will allow the technologies to compete in a global market. This activity supports the Hydrogen Technology Program's mission by providing the critical data needed to write and adopt standards, and the safety criteria and systems that meet or exceed current technologies, and will eventually lead to new Federal Motor Vehicle Safety Standards for fuel cell vehicles issued by the Department of Transportation.

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

Detailed Justification

	(dollars in thousands)		
	FY 2006	FY 2007	FY 2008
Safety and Codes and Standards	**4,595**	**13,460**	**15,552**

The program will support the drafting and adoption of hydrogen codes and standards through the development of hydrogen characterization and behavior data and through limited direct support of Standards Development Organizations (SDOs) and Codes Development Organizations (CDOs). Hydrogen release data and incident scenario analysis will support codes and standards development activities focused on enabling technology readiness. DOE will collaborate with DOT, EPA, NIST and other government agencies to ensure that hydrogen codes and standards development proceeds in agreement with existing regulatory authorities. The cooperating agencies will maximize available resources and expertise in areas such as hydrogen dispensing measurement (NIST), vehicle safety (DOT National Highway Traffic Safety Administration) and international standards development (DOT, EPA).

DOE will begin drafting a handbook on Best Practices for Safety, which will provide guidance for ensuring the safe use of hydrogen, to be published in 2008. This will be a living document that compiles “lessons learned” from safety reviews and incident analysis. The handbook will also compile hydrogen safety information available from other resources such as state and international hydrogen programs.

DOE will compile and update a hydrogen incident database. The Hydrogen Safety Review Panel will continue to monitor the safety of DOE hydrogen projects. The Panel will conduct site visits, interviews and safety plan reviews of DOE projects.

The Safety and Codes and Standards subprogram will design and build safety training devices that enable firefighters and first responders to conduct “hands on” training related to likely hydrogen fuel safety incidents. The resources and expertise available at the Volpentest HAMMER Training and Education Center will be leveraged in the development of mobile and stationary training devices, also known as “props,” which will be designed to simulate devices such as hydrogen bulk storage, fuel dispensing and piping systems. These training devices will be used as part of a comprehensive training program developed in collaboration with the Hydrogen Technology program Education activity. The program's training efforts will target fire marshals, code officials, first responders and other stakeholders.

The program will conduct an analysis of potential accident scenarios to identify both potential hydrogen systems weaknesses and the R&D required to improve systems safety. The scenarios report

	FY 2006	FY 2007	FY 2008

(dollars in thousands)

will also help guide a risk analysis effort that uses Probabilistic Risk Analysis (PRA) and Failure Modes Effects Analysis (FMEA) methods to quantitatively estimate hydrogen systems risk. Risk assessment activities will provide information to guide the codes and standards development process. This information also will be made available to key industry stakeholders such as fuel providers and the insurers.

FY 2008 funding will also support the development of computational fluid dynamics models to support the risk assessment activities for fueling, production infrastructure, and vehicle operation in tunnels and garages.

The program will conduct comprehensive R&D to provide critical data and develop a database to characterize the properties of releases of hydrogen when impeded by obstacles/equipment for input into calculation of code on setback distances.

Practical tests to be performed in FY 2008 include high-pressure refueling tests to determine optimal temperature and flow rate characteristics and verification tests of systems components (e.g., valves, regulators) to determine their performance relative to appropriate component standards and to highlight areas where existing standards or equipment need to be changed.

In FY 2008 the program will quantify the effects of hydrogen contaminants on system components to support development of a hydrogen quality standard, and it will also develop analytical methods to allow verification of hydrogen purity on a cost-effective basis. Hydrogen metering technologies will also be supported to allow accurate measurement of delivered hydrogen.

In addition, these funds may be used to support efforts such as peer reviews; data collection and dissemination; and technical, market, economic, and other analyses.

SBIR/STTR	**0**	**388**	**448**

In FY 2006, $117,000 and $15,000 were transferred to the SBIR and STTR programs respectively. The FY 2007 and FY 2008 amounts shown are estimated requirements for the continuation of the SBIR and STTR program.

Total, Safety and Codes and Standards	**4,595**	**13,848**	**16,000**

Explanation of Funding Changes

	FY 2008 vs. FY 2007 ($000)
Safety and Codes and Standards	
The increase will fund studies necessary to determine the flammability, explosive, reactive, and dispersion properties of hydrogen in FY 2008. These studies are critical to establish the underlying basis for codes and standards. Development of on-board and off-board hydrogen leak detection technologies such as sensors will be started, while the cost of risk analyses will be reduced by conducting them in a more qualitative manner. The Safety and Codes and Standards subprogram is supported by multiple RDIC factors: it addresses market barriers and provides a public benefit; it builds on existing activities and complements current efforts in support of the DOE Hydrogen Posture Plan; it incorporates industry involvement in planning, industry cost-sharing, performance indicators, and it is competitively awarded and peer reviewed.	+2,092
SBIR/STTR	
Changes in the SBIR/STTR funding are a direct result of changes in the funding of program activities and projected allocation among activities.	+60
Total Funding Change, Safety and Codes and Standards	**+2,152**

Education

Funding Schedule by Activity

	(dollars in thousands)		
	FY 2006	FY 2007	FY 2008
Education	481	1,923	3,791
SBIR/STTR	0	55	109
Total, Education	481	1,978	3,900

Description

Education activities are designed to increase understanding of hydrogen and fuel cell technologies, the facts about hydrogen safety, and the role that certain key target audiences can play in advancing the development and use of hydrogen as an energy carrier. Target audiences, identified by key government and industry stakeholders in the National Hydrogen Energy Roadmap, include state and local government representatives, safety and code officials, potential end-users, and the public. Over the long term, education of teachers and students will also be required. The education activity responds to the President's National Energy Policy recommendation to the Secretary of Energy to develop an education campaign that communicates the benefits of alternative energy, including hydrogen. The Energy Policy Act of 2005 also calls for enhanced education relating to hydrogen and fuel cells, including activities in conjunction with hydrogen demonstrations to raise awareness among the public, information exchange to facilitate the development and adoption of codes and standards, and support for institutes of higher education.

Benefits

Education aids in overcoming institutional barriers to widespread use of hydrogen. DOE's 2004 Hydrogen Baseline Knowledge Assessment measured the technical knowledge and opinions of hydrogen among key target audiences, including the public. This national, statistically-valid survey was developed to help guide the program's hydrogen education activities and provide a baseline from which to measure changes over time. The 2004 baseline results show a direct correlation between technical understanding and opinions about the safe use of hydrogen – across all surveyed populations, respondents who scored lower on technical knowledge questions about hydrogen fuel cell technology also expressed the greatest fear about the use of hydrogen as an energy carrier. With an emphasis on hydrogen safety, near-term education activities will enable not only the successful implementation of early hydrogen demonstration projects, but also future market adoption and acceptance, which are required to realize the long-term benefits of using hydrogen as an energy carrier.

State and local governments lay the foundation for long-term change and, with safety and code officials, facilitate the adoption of appropriate codes and approve hydrogen project installations. As they are with other commonly-used fuels, safety officials and emergency responders must be trained to handle potential hydrogen incidents. Public misunderstanding and false perceptions about the safe use of hydrogen threaten the implementation of near-term hydrogen fueling station demonstrations, as well as the success of a future hydrogen economy. Education can overcome these significant challenges and build public confidence in hydrogen and the safe use of hydrogen as an energy carrier. In addition, hydrogen education at universities will ensure the availability of scientists and engineers needed for critical near-term research in government, industry, and academia, as well as foster development of a trained workforce required to maintain hydrogen fuel cell equipment in the future. Over the long term, hydrogen education can engage younger students in the study of science and technology and enable an informed first-generation of hydrogen technology users.

Hydrogen Education Survey Targets[a]

	2004	2005	2006	2007	2008	2009 [b]	2012 [b]
State and local government representatives	66%					73% (10% increase)	80% (20% increase)
General public	33%					38% (15% increase)	43% (30% increase)
End users[c]	44%					50% (15% increase)	57% (30% increase)
Students	32%					35% (10 % increase)	38% (20% increase)

Detailed Justification

(dollars in thousands)

	FY 2006	FY 2007	FY 2008
Education	**481**	**1,923**	**3,791**

The Education subprogram will collaborate with Safety and Codes and Standards to develop and expand the availability of hydrogen training for first responders to facilitate the approval and implementation of hydrogen demonstration projects. The target audiences include fire fighters, police, and emergency medical technicians, as well as code officials, fire marshals, city planners, and other

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[a] The 2004 Hydrogen Baseline Knowledge Assessment measured key target audiences' understanding of hydrogen technologies. The results provide a baseline from which to evaluate future increases in knowledge. Modified targets reflect analysis of the results; target dates have been shifted because Education activities were not funded as originally expected. The baseline and outyear targets are a population's average score on technical knowledge questions. Target increases refer to an increase in the average number of correct answers relative to the 2004 baseline.

[b] The target increases for state and local government officials were determined according to a higher baseline (average score on technical questions). The target increases for students reflect near-term program priorities and interest in educating this target audience over the long term.

[c] Survey for this target audience includes safety and code officials.

hydrogen users. Education activities will leverage training resources available at the Volpentest HAMMER Training and Education Center. In FY 2008 the subprogram will complete the development of hydrogen training for code officials and will work with partners to make it available to a national audience through distance learning and in-person "train-the-trainer" courses. The subprogram will also build on prior-year efforts by working with partners to expand the availability of introductory hydrogen safety training for first responders and to develop the next, more advanced level of responder safety training modules that will incorporate the use of hands-on training devices or props.

In cooperation with automotive and energy industry partners involved in hydrogen infrastructure validation projects, the program will conduct activities to educate the public and key target audiences in communities where new hydrogen fueling stations will be implemented. The subprogram will develop and conduct targeted outreach, including training seminars, to educate the community and build public familiarity and confidence with the safe use of hydrogen as an energy carrier.

The Education subprogram will also work in partnership with state hydrogen and fuel cell initiative leaders and state energy offices to expand the availability of training opportunities for state and local government officials. Training will include “Hydrogen 101” overview workshops as well as more intensive “hydrogen energy institute” seminars to help ensure an understanding of hydrogen technologies, hydrogen safety issues, and opportunities to facilitate the emergence of a new energy economy.

In support of the Hydrogen Program’s overall market transformation efforts and related provisions in the Energy Policy Act of 2005, the Education subprogram will fund new activities to educate potential end users in early markets for hydrogen and fuel cell applications. In collaboration with related DOE programs, the Education subprogram will develop new resources and reach out to potential end users with technically-accurate and objective information to help them make informed decisions about near-term opportunities for early adoption.

The Education subprogram will also fund new efforts to develop and expand hydrogen and fuel cell undergraduate and graduate programs at universities and to train the future workforce of scientists and engineers needed for hydrogen fuel cell research in government, industry, and academia. These efforts will be coordinated with leading universities in other countries through the International Partnership for the Hydrogen Economy. The subprogram will also ramp up prior-year efforts to develop classroom guides and hands-on activities for middle and high school students, and will provide training and professional development for teachers, whose understanding of the technology is critical to the successful introduction of the subject to their students in the classroom.

In addition, these funds may be used to support efforts such as peer reviews; data collection and dissemination; and technical, market, economic, and other analyses.

	(dollars in thousands)		
	FY 2006	FY 2007	FY 2008
SBIR/STTR	**0**	**55**	**109**

In FY 2006, $12,000 and $2,000 were transferred to the SBIR and STTR programs respectively. The FY 2007 and FY 2008 amounts shown are estimated requirements for the continuation of the SBIR and STTR program.

Total, Education	**481**	**1,978**	**3,900**

Explanation of Funding Changes

	FY 2008 vs. FY 2007 ($000)
Education	
In support of the Hydrogen Program's overall market transformation effort and related provisions in the Energy Policy Act of 2005, the increase will fund new activities to educate potential end users in early markets for hydrogen and fuel cell technologies. The requested increase will also support efforts to develop and expand university programs, as well as ramp up secondary school teacher professional development activities, that will help build the cadre of educated graduates needed to support research and development efforts in government, industry, and academia.	
The Education subprogram is supported by multiple RDIC factors: it is a Presidential priority; it addresses market barriers and provides a public benefit; it builds on existing activities and complements current efforts in support of the DOE Hydrogen Posture Plan; and it is competitively awarded and peer reviewed.	+1,868
SBIR/STTR	
Changes in the SBIR/STTR funding are a direct result of changes in the funding of program activities and projected allocation among activities.	+54
Total Funding Change, Education	**+1,922**

Systems Analysis

Funding Schedule by Activity

	(dollars in thousands)		
	FY 2006	FY 2007	FY 2008
Systems Analysis	4,787	9,615	11,178
SBIR/STTR	0	277	322
Total, Systems Analysis	4,787	9,892	11,500

Description

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

Benefits

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

Detailed Justification

	(dollars in thousands)		
	FY 2006	FY 2007	FY 2008
Systems Analysis	**4,787**	**9,615**	**11,178**

Systems Analysis provides the analytical and technical basis for understanding how hydrogen can perform a significant role in transportation and other sectors and supports informed decision-making with regard to research and development direction and prioritization. The subprogram will build on the efforts of FY 2007 to examine the details of hydrogen supply and demand associated with how vehicle market penetration and hydrogen production and delivery might evolve. In FY 2008, the subprogram will complete and validate the new analytical models and tools developed in FY 2007. The new models, combined with existing systems analysis models, will enable the program to identify resource limitations, production options for hydrogen supply, the hydrogen supply evolution, delivery restrictions and the potential environmental impacts of wide scale commercialization.

Building on efforts initiated in 2007 to develop the Macro System Model to provide overarching and hierarchal economic analysis for the program, additional linkages will be developed in FY 2008 for the Macro System Model to provide analytical capabilities for higher-level economic analysis in the near- and mid-term. This analysis supports the National Academies' recommendation (in *The Hydrogen Economy: Opportunities, Costs, Barriers, and R&D Needs*, February 2004) to evaluate a transition phase consistent with developing the infrastructure and hydrogen resources.

In collaboration with the Technology Validation and Hydrogen Production and Delivery R&D Subprograms, the Systems Analysis subprogram will:

- Validate the models utilized for program analysis with emerging cost, performance, yield and environmental information from demonstration programs, independent reviews, and research projects. Model experts and project representatives will perform required model maintenance to improve model capabilities and representation of actual technology performance.
- Develop and update models for new renewable production and delivery technologies based on the results of technology research and development.
- Determine the relationship between hydrogen purity changes and production cost among all key program elements of Production and Delivery, Storage, Fuel Cells and Safety and Codes and Standards. Evaluate the purity/cost relationship for various pathways and technologies and the impact of hydrogen purity on fuel cell performance.
- Provide system analysis support and input for all the program elements such as go/no-go decisions.
- Provide analysis of CO_2 sequestration effects by working with the Carbon Sequestration program within the Office of Fossil Energy.
- Update and maintain the Analysis Portfolio, the prioritized analysis list, and the Hydrogen

	(dollars in thousands)	
FY 2006	FY 2007	FY 2008

Analysis Resource Center database, which were all developed in FY 2005 to insure analysis consistency and transparency. The program will also update the Systems Analysis Plan, Technical Requirements Document and the Posture Plan.

The research results and validation data of the Production and Delivery, Storage, Fuel Cells and Technical Validation program elements will be used in the benefits analysis of reducing petroleum dependency and greenhouse gas emissions.

In FY 2008, Systems Analysis subprogram will fund analysis of mid-term and long-term well-to-wheels, hydrogen pathways and cross-cutting issues including examination of benefits. The cross-cutting analysis will identify the infrastructure limitations of the rail and pipeline systems for delivering resources for hydrogen production systems and will identify the feedstock availability and water resource limitations for hydrogen production for various pathways. The analysis of the hydrogen purity/cost relationship on the impact on production pathways and fuel cell performance will be accelerated.

In addition, these funds may be used to support efforts such as peer reviews; data collection and dissemination; and technical, market, economic, and other analyses.

	FY 2006	FY 2007	FY 2008
SBIR/STTR	**0**	**277**	**322**

In FY 2006, $123,000 and $15,000 were transferred to the SBIR and STTR programs respectively. The FY 2007 and FY 2008 amounts shown are estimated requirements for the continuation of the SBIR and STTR program.

	FY 2006	FY 2007	FY 2008
Total, Systems Analysis	**4,787**	**9,892**	**11,500**

Explanation of Funding Changes

	FY 2008 vs. FY 2007 ($000)
Systems Analysis	
Mid-term and long-term well-to-wheels analysis will be conducted. Hydrogen pathways and cross-cutting issues including examination of benefits through "well-to-wheels" analysis will be expanded. The analysis of the purity/cost relationship on the impact on production pathways and fuel cell performance will be accelerated. The systems analysis subprogram is consistent with the National Academies' recommendations and is supported by multiple RDIC factors: it is part of a Presidential priority; it builds on existing technology and complements current R&D in support of the DOE Hydrogen Posture Plan; and it is competitively awarded and peer reviewed.	+1,563

	FY 2008 vs. FY 2007 ($000)
SBIR/STTR	
Changes in the SBIR/STTR funding are a direct result of changes in the funding of program activities and projected allocation among activities.	+45
Total Funding Change, Systems Analysis	**+1,608**

Manufacturing R&D

Funding Schedule by Activity

	(dollars in thousands)		
	FY 2006	FY 2007	FY 2008
Manufacturing R&D	0	1,923	4,860
SBIR/STTR	0	55	140
Total, Manufacturing R&D	0	1,978	5,000

Description

The Manufacturing R&D subprogram will support the development of manufacturing processes in parallel with technology development critical for hydrogen and fuel cell components and systems. The program's activities will address the challenges of moving today's laboratory-produced technologies to high-volume, commercial manufacturing, thereby driving down the cost of hydrogen and fuel cell systems. Research will be conducted in coordination with the Department of Commerce and the White House Office of Science and Technology Policy's Interagency Working Group on Manufacturing R&D. The subprogram will address an array of fabrication and process techniques amenable to high volume production of fuel cells, hydrogen production, delivery, and storage components and systems. A research and development technology roadmap has been developed with industry to identify critical technology development needs for high volume manufacturing of fuel cell and hydrogen systems. The subprogram's initial focus will be manufacturing processes and techniques that are synergistic in terms of cross-cutting applications, such as high volume membrane fabrication techniques for both fuel cell stacks and electrolyzers.

Benefits

Manufacturing R&D supports the mission of the Hydrogen Technology Program by developing advanced fabrication and process technologies to meet the cost targets of critical hydrogen and fuel cell technologies. These activities will help realize fuel cell and hydrogen system costs that are equivalent to internal combustion engines and gasoline. The manufacturing technology research will focus on enabling technology readiness.

Detailed Justification

	(dollars in thousands)		
	FY 2006	FY 2007	FY 2008
Manufacturing R&D	**0**	**1,923**	**4,860**

In FY 2008, the subprogram will significantly expand its collaborative research efforts involving universities, industry, and National Laboratories in the development of fabrication processes amenable to low-cost, high-volume manufacturing. Near-term activities will encompass research and development of technologies critical to an early start-up of high-volume commercialized products, such as: 1) membrane-electrode assemblies and gas diffusion layers for fuel cells, 2) distributed production systems and components, and 3) vessels for hydrogen storage and dispensing. Specific manufacturing research and development projects will be identified as technology roadmaps are updated.

In addition, these funds may be used to support efforts such as peer reviews; data collection and dissemination; and technical, market, economic, and other analyses.

SBIR/STTR	**0**	**55**	**140**

The FY 2007 and the FY 2008 amounts shown are the estimated requirements for the continuation of the SBIR and STTR program.

Total, Manufacturing R&D	**0**	**1,978**	**5,000**

Explanation of Funding Changes

	FY 2008 vs. FY 2007 ($000)
Manufacturing R&D The increase will be used to ramp up manufacturing R&D projects initiated in FY 2007. The focus will be on technologies critical to an early start-up of high-volume, low-cost commercialized products, such as membrane-electrode assemblies for fuel cells and electrolyzers, distributed hydrogen production technologies, carbon fiber for storage tanks, and storage dispensing systems. The Manufacturing R&D Subprogram is consistent with the National Academies' recommendations and is supported by multiple RDIC factors: it is a Presidential priority; it builds on existing technology and complements current R&D in support of the DOE Hydrogen Posture Plan; it incorporates industry involvement in planning, industry cost-sharing, performance indicators, and it is competitively awarded and peer reviewed.	+2,937

	FY 2008 vs. FY 2007 ($000)
SBIR/STTR	
Changes in the SBIR/STTR funding are a direct result of changes in the funding of program activities and projected allocation among activities.	+85
Total Funding Change, Manufacturing R&D	**+3,022**

Congressionally Directed Activities

Funding Schedule by Activity

(dollars in thousands)

	FY 2006	FY 2007	FY 2008
Congressionally Directed Activities	42,520	0	0
Total, Congressionally Directed Activities	42,520	0	0

Description

In FY 2006, there were 28 Congressionally directed activities funded out of the Hydrogen Technology Program. In general, such activities do not support program goals because they are not well-aligned with established research pathways or focused on overcoming the technical barriers as identified in the program's detailed planning documents. As such, the program does not request any funds to continue these projects.

Detailed Justification

(dollars in thousands)

	FY 2006	FY 2007	FY 2008

In FY 2006, there were 28 Congressionally Directed activities funded out of the Hydrogen Technology Program. The program does not request any funds to continue these projects as they do not further the achievement of DOE's goals.

The following projects were directed by Congress to be included in this program:

Hydrogen Fuel Cell Project Edison Materials Technology	**2,475**	**0**	**0**

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

Hydrogen Fuel Cell Project Washoe County, Nevada	**2,475**	**0**	**0**

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

	(dollars in thousands)		
	FY 2006	FY 2007	FY 2008
Fuel Cell Mine Loader and Prototype Locomotive	**247**	**0**	**0**

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

Renewable Hydrogen Fueling Station System, University of Nevada at Las Vegas	**3,366**	**0**	**0**

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

Indigenous Energy Development Center for Hydrogen Storage in Pennsylvania	**990**	**0**	**0**

This project continues work earmarked in FY 2006 for Concurrent Technologies, Inc. in Pennsylvania. It is expected to include R&D in the areas of: materials, modeling, and off-board hydrogen storage.

Expanding Clean Energy Research and Education Program at the University of South Carolina	**1,980**	**0**	**0**

This project is researching production of hydrogen by electrolysis of anhydrous gaseous HCl, HBr and SO_2; hydrogen storage in complex metal and chemical hydrides; and fuel cell design and development.

Hydrogen Storage and Fuel Cells, University of Las Vegas	**3,366**	**0**	**0**

This project plans to create the basis for an academic research center that will combine theory and experiment to address specific aspects of hydrogen storage and utilization. It will emphasize a fundamental understanding of the interactions of atomic and molecular hydrogen with materials pertinent to hydrogen storage and utilization.

California Hydrogen Infrastructure, Storage and Systems	**1,386**	**0**	**0**

This project will develop several technological approaches to deploy refueling stations that will include mobile platforms, stations at pipelines, alternative delivery systems, and electrolysis systems. In FY 2006, it is anticipated that Air Products and Chemicals, Inc. will design and develop a chemical hydride storage system and advanced infrastructure and delivery systems in support of the Technology Validation activity.

	(dollars in thousands)		
	FY 2006	FY 2007	FY 2008
Fuel Cell Freeze/Cold Start Program	**990**	**0**	**0**

This project is anticipated to investigate thermal management, system design and components to be able to operate fuel cells under cold climate conditions.

Center for Intelligent Fuel Cell Materials Design	**1,485**	**0**	**0**

The Center for Intelligent Fuel Cell Materials Design is a multi-state collaboration, headed by Chemsultants International, to design fuel cells for manufacturability.

Delaware State University Center for Hydrogen Storage	**990**	**0**	**0**

This project will research and develop novel materials that can store and release large quantities of hydrogen gas at moderate temperatures and pressures.

Florida International University Center for Energy and Technology of the Americas	**990**	**0**	**0**

The Florida International University Center for Energy and Technology of the Americas (CETA) works to increase reliable energy supplies, improve energy efficiency, and promote cooperation in policy and technology transfer in the western hemisphere.

City of Auburn Energy Production Issues at Wastewater Plant	**891**	**0**	**0**

This project seeks to incorporate hydrogen technologies into the wastewater plant in Auburn.

Hydrogen Fleet Infrastructure Demonstration Project	**1,980**	**0**	**0**

This project will support BP's infrastructure research and development efforts under DOE's Hydrogen Fleet and Infrastructure Demonstration Program.

Purdue Hydrogen Technologies Program	**990**	**0**	**0**

This project is anticipated to research the various aspects of hydrogen generation, storage, and utilization.

Detroit Commuter Hydrogen Project	**1,287**	**0**	**0**

Ford Motor Company and the Southeast Michigan Council of Governments (SEMCOG) will use this project to support Ford's vehicle research and development efforts under DOE's Hydrogen Fleet Infrastructure Demonstration Program.

	(dollars in thousands)		
	FY 2006	FY 2007	FY 2008
City of Chicago Ethanol to Hydrogen Project	**1,980**	**0**	**0**

This project plans to build a refueling station in the city of Chicago that will convert renewable liquid ethanol into hydrogen gas.

University of Arkansas at Little Rock Hydrogen Storage Project	**396**	**0**	**0**

The program funds research and development of hydrogen storage technologies.

University of Akron Fuel Cell Laboratory	**495**	**0**	**0**

This project is anticipated to develop a coal-based fuel cell for power generation.

Kettering University Fuel Cell Project	**495**	**0**	**0**

The project seeks to accelerate the development and commercialization of fuel cells for stationary and mobile applications through engineering research, testing and evaluation.

Hydrogen Optical Fiber Sensors	**495**	**0**	**0**

This project seeks to develop advanced optical fiber sensors for detecting hydrogen leaks and ensuring the safety for fuel cell vehicles.

UNLV Research Foundation Solar-Powered Thermochemical Production of Hydrogen	**3,366**	**0**	**0**

This project will develop a pilot plant design and implementation plan for a solar-powered hydrogen production system based on thermochemical cycles.

Montana Palladium Research Center	**2,475**	**0**	**0**

This project seeks to develop palladium-based materials for use in hydrogen production and end-use technologies.

University of Arkansas Little Rock Nanotechnology Center Production of Hydrogen	**495**	**0**	**0**

This program will include hydrogen production research at UALR's new nanotechnology laboratory, which will house both production and application research laboratories.

UNLV Research Foundation Development Of Photoelectric Chemical Production Of Hydrogen	**2,475**	**0**	**0**

This project will develop and characterize state-of-the-art photovoltaic components coupled to durable photoactive oxide films immersed in suitable electrolytes for the purpose of direct water splitting.

	(dollars in thousands)		
	FY 2006	FY 2007	FY 2008
University of Southern Mississippi's School of Polymers and High Performance Materials Improved Materials for Fuel Cell Membranes Program	**495**	**0**	**0**

This project seeks to develop advanced, durable, low-cost membranes for polymer electrolyte membrane fuel cells.

University Of Nevada-Reno Photoelectrochemical Generation Of Hydrogen By Solid Nanoporous Titanium Dioxide Project	**2,970**	**0**	**0**

This project seeks to develop direct water-splitting technology for hydrogen generation based by improving the efficiency and durability of solid nanoporous titanium dioxide semi-conducting materials.

Southern Nevada Alternative Fuels Demonstration Project	**495**	**0**	**0**

This project seeks to speed the transition to alternative transportation fuels that are cleaner, domestically produced, and less expensive.

Total, Congressionally Directed Activities	**42,520**	**0**	**0**

Biomass and Biorefinery Systems R&D

Funding Profile by Subprogram

(dollars in thousands)

	FY 2006 Current Appropriation	FY 2007 Request	FY 2008 Request
Biomass and Biorefinery Systems R&D			
Feedstock Infrastructure	492	9,967	10,000
Platforms Research and Development	19,542	50,530	59,400
Utilization of Platform Outputs R&D	22,915	89,190	104,863
Cellulosic Ethanol Reverse Auction	0	0	5,000
Congressionally Directed Activities	46,827	0	0
Total, Biomass and Biorefinery Systems R&D	89,776	149,687	179,263

Public Law Authorizations:

P.L. 93-577, "Federal Non-nuclear Energy Research and Development Act" (1974)
P.L. 94-163, "Energy Policy and Conservation Act" (EPCA) (1975)
P.L. 94-385, "Energy Conservation and Production Act" (ECPA) (1976)
P.L. 95-91, "Department of Energy Organization Act" (1977)
P.L. 95-618, "Energy Tax Act" (1978)
P.L. 95-619, "National Energy Conservation Policy Act" (NECPA) (1978)
P.L. 95-620, "Powerplants and Industrial Fuel Use Act" (1978)
P.L. 96-294, "Energy Security Act" (1980)
P.L. 100-12, "National Appliance Energy Conservation Act" (1987)
P.L. 100-615, "Federal Energy Management Improvement Act" (1988)
P.L. 101-218, "Renewable Energy and Energy Efficiency Technology Competitiveness Act" (1989)
P.L. 101-549, "Clean Air Act Amendments" (1990)
P.L. 101-575, "Solar, Wind, Waste, and Geothermal Power Production Incentives Act" (1990)
P.L. 102-486, "Energy Policy Act" (1992)
P.L. 106-224, "Biomass Research and Development Act" (2000)
P.L. 107-171, "Farm Security and Rural Investment Act" (2002)
P.L. 108-148, "Healthy Forest Restoration Act" (2003)
P.L. 109-190, "Energy Policy Act" (2005)

Mission

The mission of the Biomass and Biorefinery Systems R&D Program ("Biomass Program") is to partner with U.S. industry to develop our abundant biomass resources and foster research, development, and deployment of advanced technologies to transform these resources into clean, cost competitive, high performance biofuels, biopower, and high value bioproducts through the development of biorefineries. A well established, economically viable, sustainable, biorefinery industry will strengthen U.S. energy independence by reducing our dependence on foreign oil, protecting and enhancing our environment, creating new economic opportunities for rural communities, and delivering improved, affordable, environmentally sustainable, and domestically produced fuels, power, and products (i.e., chemicals and materials) to American consumers.

Benefits

The Biomass Program's research focus is to develop and validate technologies to support the successful deployment of biorefineries that can utilize a wide range of biomass resources to accelerate the growth of the bioindustry, increase and diversify domestic energy supply, increase energy security, emit less carbon, and reduce petroleum imports. The request includes the Biofuels Initiative that directly supports the President's AEI, aimed at dramatically reducing our dependency on imported oil, by increasing domestic, renewable liquid transportations fuels production. The program's R&D will contribute key technologies necessary to make cellulosic ethanol cost competitive by 2012, which could enable a much more significant volume of gasoline to be displaced than through corn ethanol alone. The program supports the President's goal to reduce our gasoline consumption by 20 percent in ten year (20 in 10), as outlined in his 2007 State of the Union Address.

The program partners with existing biorefineries as well as the chemical industry to develop the next generation of biorefineries that will produce transportation fuels, value-added chemicals, and/or power from non-conventional, lower cost feedstocks such as agricultural residues (i.e., corn stover). Fuels from biomass have great potential to displace petroleum because ethanol and biodiesel are highly compatible with today's major transportation fuels (i.e., gasoline and diesel). Program efforts could lead to cost effective cellulosic ethanol from various biomass feedstocks. This will enable biorefineries to be geographically dispersed, leading to increased domestic energy production (increasing energy security) and benefits to rural economies. Utilization of biomass for transportation fuels reduces greenhouse gas emissions and allows renewable carbon resources to be sequestered via photosynthesis. The program's economic, environmental and security benefits that are quantified and described in more detail under the "Expected Program Outcomes" sections.

Strategic and GPRA Unit Program Goals

The Department's Strategic Plan identifies five Strategic Themes (one each for nuclear, energy, science, management, and environmental aspects of the mission) plus 16 Strategic Goals that tie to the Strategic Themes. The Biomass and Biorefinery Systems R&D Program supports the following goal:

Strategic Theme 1, Energy Security

Strategic Goal 1.1, Energy Diversity: Increase our energy options and reduce dependence on oil, thereby reducing vulnerability to disruptions and increasing the flexibility of the market to meet U.S. needs.

Strategic Theme 3, Scientific Discovery and Innovation

Strategic Goal 3.3, Research Integration: Integrate basic and applied research to accelerate innovation and to create transformational solutions for U.S. energy needs.

And concurrently supports:

Strategic Goal 1.2, Environmental Impacts of Energy: Improve the quality of the environment by reducing greenhouse gas emissions and environmental impacts to land, water, and air from energy production and use.

The Biomass and Biorefinery Systems R&D Program has one GPRA Unit Program goal which contributes to Strategic Goal 1.1 in the "goal cascade:"

GPRA Unit Program Goal 1.1.06.00: Develop biorefinery-related technologies associated with the different biomass resource pathways to the point that they can compete in terms of cost and performance and are used by the Nation's transportation, chemical, agriculture, forestry, and power industries to meet their respective market objectives. This helps the Nation expand its clean, sustainable energy supplies, improve its energy infrastructure, and reduce its greenhouse gases emissions, fossil energy consumption and dependence on foreign oil.

Contribution to GPRA Unit Program Goal 1.1.06.00 (Biomass and Biorefinery Systems R&D)

The program directly supports the DOE's Energy Security theme by developing our biomass resource availability and conducting research, development and deployment on technologies that increase the production of biomass-based substitutes for petroleum-derived fuels, chemicals, materials, and/or heat and power, and thereby diversifying and expanding energy supply. It also addresses the goals and recommendations of the Biomass R&D Act of 2000, the Farm Security and Rural Investment Act of 2002, and the Energy Policy Act of 2005.

To increase the probability of success, the program funds key technology pathways that contribute to the achievement of this goal:

Feedstock Infrastructure contribution:

- Reduced costs associated with feedstock production, collection, storage and transportation address major barriers impeding the growth of the cellulosic ethanol industry. These feedstock activities are required to meet the Biofuels Initiative's target of $35 per dry ton of cellulosic feedstock by 2012 which is tied to the target of $1.07/gallon of cellulosic ethanol. Indicators of progress toward the goal include developing a conceptual, novel harvesting system and testing a wet storage system by 2009.

Platforms Research and Development contribution:

- The program will continue to focus on Biochemical Conversion R&D towards reducing the cost of producing mixed, dilute sugars to enable biorefinery pathways. An overarching challenge is the recalcitrance of biomass (i.e., compared to starch, cellulose is not easily broken down into sugars). Biochemical Platform R&D will make further improvements to feedstock interface, pretreatment and conditioning, and enzymes, in addition to process integration in order to reduce sugar costs as the springboard to launching the next generation of cellulosic ethanol from a wide range of feedstocks.
- Thermochemical Platform R&D will focus on gasification technologies for synthesis gas production but also includes an increase of funding for pyrolysis R&D from FY 2007 through FY 2008. The work in each of the platforms will support the Biofuels Initiative goal of producing cost competitive cellulosic ethanol at $1.07 per gallon.

Utilization of Platform Outputs R&D contribution:

- In view of the integrated biorefinery emphasis, the program will continue to support companies with the intent of commercializing biorefineries at a small commercial scale for the production of transportation fuels and co-products (such as materials and chemicals) as authorized by EPACT of 2005, Section 932. The program will also support industry in its efforts to validate biomass conversion technologies developed under each of the platforms and integrate them into biorefineries at a scale equal to approximately 10 percent of commercial scale (equivalent to 1-3 million gallons/year ethanol produced) for the production of transportation fuels and co-products (such as materials and chemicals). Additionally, the program will continue to cost-share 2-3 industry partnership projects for developing a commercially ready ethanologen (critical to producing ethanol from cellulosic feedstocks) at a cost sufficiently low to achieve the Biofuels Initiative's 2012 target. These organisms could jump start the cellulosic ethanol industry.

An indicator of progress toward achieving those benefits includes:

- In FY 2008, the program will conduct an independent engineering review to validate contractor costs and scheduled timeline included in the design package of at least one commercial scale biorefinery capable for processing up to 700 metric tonnes per day of lignocellulosic feedstocks. In order to ensure project efficacy, the independent review will include at a minimum analysis of the following: commitments from essential project participants including the EPC contractor and major suppliers, establishment of construction milestones including a construction draw schedule, approved permits that allow construction to begin, a resource loaded work breakdown structure for construction, evaluation of project risk factors and project management schedules. In addition, an analysis of the schedule for financial closings and disbursement schedules will be included.

Funding by Strategic and GPRA Unit Program Goal

(dollars in thousands)

	FY 2006	FY 2007	FY 2008
Strategic Goals 1.1, Energy Diversity and 3.3, Research Integration			
GPRA Unit Program Goal 1.1.06.00, Biomass and Biorefinery Systems R&D			
Feedstock Infrastructure	492	9,967	10,000
Platforms Research and Development	19,542	50,530	59,400
Utilization of Platform Outputs R&D	22,915	89,190	104,863
Cellulosic Ethanol Reverse Auction	0	0	5,000
Total, GPRA Unit Program Goal 1.1.06.00, Biomass and Biorefinery Systems R&D	42,949	149,687	179,263

	(dollars in thousands)		
	FY 2006	FY 2007	FY 2008
All Other			
Congressionally Directed Activities			
Texas A&M – Renewable Energy from Animal Biowaste	990	0	0
Sugar-Based Ethanol Biorefinery at Louisiana State University	495	0	0
Biotech-to-Ethanol Project	990	0	0
Research Triangle Biomass, North Carolina	1,238	0	0
Iowa Switchgrass Project - Chariton Valley	742	0	0
Biorefinery at Louisiana State University	495	0	0
Vermont Biomass Energy Center	495	0	0
Consortium for Plant Biotechnology Research	3,465	0	0
University of Georgia Biomass Pyrolysis Biorefinery Project	1,238	0	0
Wood Debris Bioenergy Project	990	0	0
Clarkson University Dairy Waste Partnership	247	0	0
Madison County Landfill Gas-to-Energy	990	0	0
Asphalt Roofing Shingles into Energy, Xenia	990	0	0
Ohio State University 4-H Green Building	990	0	0
Solid Waste Authority Pyramid Resource Center	1,980	0	0
City of Stamford Waste-to-Energy Project	1,485	0	0
Iowa State University Biomass Energy Conversion Project	495	0	0
Iroquois Bioenergy Consortium Ethanol Project	3,465	0	0
New York Biomass/Methane Gas Power Fuel Cell	1,980	0	0
Western Massachusetts Biomass Project	495	0	0
Greenville Composite Biomass Project	742	0	0
Laurentian Bioenergy Project	1,238	0	0
Kona Carbon Biomass Project	990	0	0
Sustainable Energy Center at Mississippi State University	10,890	0	0
Missouri Biodiesel Demonstration Project	990	0	0
Auburn Alternative Fuel Source Study of Cement Kilns	990	0	0
Canola-Based Automotive Oil Research	990	0	0
Center for Advanced Bio-based Binders	792	0	0
Development of Applied Membrane Technology	495	0	0
Michigan Biotechnology Institute	990	0	0

	(dollars in thousands)		
	FY 2006	FY 2007	FY 2008
Washington State Ferries Biodiesel Demonstration	495	0	0
UNLV Research Foundation for Developing Biofuels	2,970	0	0
Total, Congressionally Directed Activities	46,827	0	0
Total, All Other	46,827	0	0
Total, Strategic Goals 1.1 and 3.3 (Biomass and Biorefinery Systems R&D)	89,776	149,687	179,263

Annual Performance Results and Targets

FY 2003 Results	FY 2004 Results	FY 2005 Results	FY 2006 Results	FY 2007 Results	FY 2008 Results
GPRA Unit Program Goal 1.1.06.00 (Biomass and Biorefinery Systems R&D)					
Feedstock Infrastructure					
				Complete a core R&D engineering design and techno-economic assessment of an integrated wet storage - biomass field pre-processing assembly system with a pretreatment process that could potentially be scaled up to produce feedstocks to achieve a reduction to $35 per ton by 2012 from $53 per ton as of 2003.	Conduct replicated field trials across regions to determine the impact of residue removal on grain yield (in subsequent years); field trials (including genetic evaluations) to develop energy crops within a geographical region; resource assessments to determine regional feedstock supply curves (variable costs of feedstock across various sites); and economic studies that identify the best site conditions and general locations for biorefineries within a region, all of which can demonstrably contribute to the goal of producing feedstocks at $35 per dry ton by 2012.
Platforms Research and Development					
Completed the thermochemical options analysis to assess various process pathways to fuels (e.g., F-T, gasoline, diesel, alcohols). [MET] Developed an improved enzyme preparation for reducing the cost of producing ethanol from biomass. Evaluate its impact on production costs using an updated computer model of the production process. [MET]		Completed a technical and economic evaluation of integrated biomass to fuels systems to validate the sugar cost of $0.135 per pound and syngas cost of $6.13 per million Btu. [MET]	Complete laboratory and economic assessment of 2 different feedstocks, identifying operating conditions that link pretreatment with enzymes that could be scaled-up and have the potential of achieving the goal of $0.125 per pound sugar by 2007. [MET]	Complete integrated tests of pretreatment and enzymatic hydrolysis in conjunction with existing fermentation organisms at bench-scale on com stover that validate $0.125 per pound sugars on the pathway to achieving $0.064 per pound in 2012. Demonstrate conversion of 50 percent of non-methane (C2+ higher) hydrocarbons that result in a syngas cost of $7.15/MBtu in 2007.	Achieve a modeled cost target of $0.11 per pound of sugars (equivalent to $2.09 per gallon of cellulosic ethanol) through the formulation of improved enzyme mixtures and pretreatments. Achieve a modeled cost target of $6.88/MBtu of biomass-derived syngas or oils by demonstrating pilot-scale technology capable of economically converting biomass residues, pulping liquors, or waste fats and greases.

FY 2003 Results	FY 2004 Results	FY 2005 Results	FY 2006 Results	FY 2007 Results	FY 2008 Results
Utilization of Platform Outputs R&D					
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. [MET: Greater than 80 percent but less than 100 percent – Completion was delayed by 5 months.]	Demonstrated clean syngas production in three thermochemical conversion systems. [MET] Completed testing of ethanol production from corn fiber in partnership with industry in order to achieve a 3 percent increase in ethanol production from each corn ethanol plant that successfully implements the technology without requiring additional corn feedstock. [MET]			Complete a preliminary engineering design package, market analysis, and financial projection for at least one industrial-scale project for near term agricultural pathways (corn wet mill, corn dry mill, oilseed) to produce a minimum of 15 million gallons of biofuels per year (as mandated by the Energy Policy Act.	Approve a final engineering design package of at least one commercial scale biorefinery capable of processing up to 700 metric tones per day of lignocellulosic feedstocks. The approved design package must address any findings from an independent engineering review to validate contractor costs and scheduled timeline.
In partnership with industry, completed pilot-scale demonstration of two new biobased product technologies for economic, technical, and product performance. [MET] A 2-cycle engine oil derived from soy oil was commercialized for the emerging bioproducts industry. [NOT MET: 2-cycle engine oil commercialized in FY 2004]	Completed validation of one new biobased product technology, with long-term potential of greater than 2 billion lbs. /yr. sales, at the pilot-scale for economic, technical, and product viability in partnership with industry. [MET] With industry partners, a new biobased product technology advanced to scale-up partners' intention to commercialize in a new industrial biorefinery by FY 2008. The biorefinery will be at pilot-scale. [MET]	Established the technical and market potential of a new biobased product. [MET]	Identify at least one sugar-derived or biomass oil-derived bio-based chemical or material (among those being evaluated) that possesses sufficient potential to enter into the scaled-up developmental phase of R&D from the previous bench-scale phase. [MET]		

FY 2003 Results	FY 2004 Results	FY 2005 Results	FY 2006 Results	FY 2007 Results	FY 2008 Results
	Contributed proportionately to EERE's corporate goal of reducing corporate and program uncosteds to a range of 20-25 percent by reducing program annual uncosteds by 10 percent in 2004 relative to the program uncosted baseline (in 2003) until the target range is met. [NOT MET: EERE actively accelerating costing of funds]	Contributed proportionately to EERE's corporate goal of reducing corporate and program adjusted uncosted obligated balances to a range of 20-25 percent by reducing program annual adjusted uncosteds by 10 percent in 2005 relative to the Biomass & Biomass Refinery Systems Program FY 2004 end of year adjusted uncosted baseline ($62,235K) until the target range is met. [MET]	Maintain total administrative overhead costs (defined as program direction and program support excluding earmarks) in relation to total program costs of less than 12 percent. [a] [MET]	Maintain total administrative overhead costs (defined as program direction and program support excluding earmarks) in relation to total program costs of less than 12 percent.	Maintain total administrative costs in relation to total program costs of less than 12 percent. Baseline for administrative overhead rate currently being validated.

[a] Baseline for administrative overhead rate currently being validated.

Means and Strategies

Fuels from biomass have great potential because ethanol and biodiesel are compatible with today's major transportation fuels (gasoline and diesel). Biofuels can begin to reduce oil consumption immediately and for the long-term and provide an environmentally sustainable alternative to petroleum based fuels. Additionally, biofuels increase farm incomes and strengthen rural economies.

The Biomass Program will use various means and strategies to achieve its GPRA Unit 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.

The Biomass Program will implement the following means in order to improve the cost-competitiveness of biomass technologies:

- R&D through competitive solicitations for industrial partnerships with appropriate cost sharing to attract innovation and ensure investment value for industry and university contracts;
- Management of R&D by a series of objectives, milestones, and Stage Gate and Peer Reviews, which are tracked by the Project Management Center[a] and verified with reviews from industry and university experts;
- Industrial-scale validation of integrated biorefineries through competitive solicitations to validate their economic and technical validity in order to help facilitate commercialization; and
- Input from peer reviews.[b] Peer reviews of program plans and activities are aimed at obtaining expert, independent opinion on the program's goals and objectives; feasibility of reaching the goals; appropriateness of technical barriers being addressed; appropriateness of the Federal role, and whether the level of Federal funding for projects is commensurate with technical objectives.

The Biomass Program will implement the following strategies:

- The Biofuels Initiative will take advantage of R&D platforms and technology development strategies already in place. Accelerating these R&D strategies will make significant inroads into achieving the goals of the Initiative. DOE has strategies in the basic sciences as well as feedstock, conversion and biorefinery technology advancement that map directly to Initiative goals. The program will employ the extensive technical expertise available throughout the Federal sector, industry, academia and laboratories. Partnerships are already in place with the DOE Office of Science, the U.S. Department of Agriculture and other Federal agencies. The basic approach to implementing the program will include developing and employing a mix of basic and applied sciences related to biomass feedstocks and conversion technologies as well as efforts to help bridge the gap from technology validation to deployment.

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[a] EERE implemented the Project Management Center approach at the Golden Field Office and the National Energy Technology Laboratory to enhance the management of projects.

[b] The most recent program review was held in November 2005.

- For each feedstock targeted, program research will develop handling and conversion technologies specific to feedstock properties and validate the technical performance and projected economics at industrial scale.
- The program will further basic research in the areas of feedstock development, technical and market barriers to the greater use of biomass, such as overcoming the recalcitrance of certain biomass feedstocks, and optimizing collection, storage, transportation and conversion processes. For example, the Biomass Program will collaborate with the DOE Office of Science to target and conduct research on the development of new organisms and techniques that are able to process the various sugars in biomass collectively. This will consolidate several steps in bioprocessing and lead to a significant reduction in tanks and associated equipment currently needed to convert biomass feedstocks into ethanol. This will result in a large reduction in plant costs.
- The program will continue to support Regional Biomass Feedstock Development Partnerships, thus leveraging the local resources through partnerships with agriculture producers, universities, and industry which understand the regional opportunities and challenges. These Partnerships will fund research to develop new feedstocks tailored to industrial applications for conversion to specific fuels and applications. This will allow the availability of biomass fuels and chemicals to continue to grow beyond the limitations of present commodity crop and forest resources.
- The program will support R&D on high-opportunity, high-impact technologies for converting biomass feedstocks to ethanol. R&D will include developing process integration methodologies, identifying effective pretreatment catalysts effective on multiple biomass feedstocks, and targeting efficient enzymes. Moreover, as biorefinery plants mature, advanced thermochemical technologies (e.g., pyrolysis oils) will be pursued to increase biofuels production and value.
- The program will utilize guidance from the Biomass Technical Advisory Committee and the Biomass R&D Board established under the Biomass R&D Act of 2000 to in integrate R&D across agencies. In 2006, the board began preparation of an interagency action plan. This plan will be followed by a comprehensive interagency coordination and planning document that will be reviewed by the National Academy of Sciences. In addition to assessing the goals and plans for interagency biomass research, the Academy will be tasked with considering economic and other impacts of increased biomass utilization under various energy price and policy scenarios.
- The program will use the Administration's R&D Investment Criteria and DOE's internal assessment modeled after the Administration's Program Assessment Rating Tool (PART), along with various inputs provided by external and internal entities to help target Federal investments.

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

- Cost and availability of conventional fossil energy sources and infrastructure adjustments;
- Federal and state farm policies and grower's actual adoption rate for new crops;
- Widespread adoption of sustainable crop management practices;
- Consumer acceptance;
- Cost of competing technologies;

- Loan guarantee programs as authorized by EPACT 2005 and other future regulatory changes (i.e., 2007 Farm Bill) could accelerate the adoption and positively impact the deployment of biorefinery technologies; and
- The market penetration rate of bio-based technologies which is a function of all the external factors listed and technical breakthroughs, incentives; price trends of coal, oil and natural gas; and policy factors.

Collaborations are integral to achieving the planned investments, means and strategies, and to addressing external factors. In carrying out its mission, the program performs the following collaborative activities:

- Partnering with DOE's Office of Science on feedstock development and consolidated bioprocessing (technology aimed at reducing the number of unit operations needed in a biorefinery);
- Collaboration on advanced conversion processes and techniques with the DOE Office of Science will help define the future of advanced biorefineries;
- Coordination with the Hydrogen Program to evaluate biomass as a feedstock for hydrogen production;
- Coordination with the Vehicle Technologies Program's efforts to increase the use of biofuels in vehicle fleets and address biofuels infrastructure issues;
- The Regional Feedstock Partnerships will be used to enhance the coordination of feedstock R&D efforts with USDA and the Sun Grant Initiative recipients which includes land grant universities. Regional information is needed by potential biorefiners in order to assess and improve resource availability and feedstock economics;
- Annual USDA/DOE solicitation for biomass technologies R&D and other coordination under the Biomass Research and Development Act of 2000. The program will utilize guidance from the Biomass Technical Advisory Committee and the Biomass R&D Board established under the Biomass R&D Act of 2000 to in integrate R&D across agencies. In 2006, the Board began preparation of an interagency National Biofuels Action Plan. This plan will be followed by a comprehensive interagency coordination and planning document that will be reviewed by the National Academy of Sciences. In addition to assessing the goals and plans for interagency biomass research, the Academy will be tasked with considering economic and other impacts of increased biomass utilization under various energy price and policy scenarios; and
- Partnerships with existing biorefineries to develop technologies resulting in more cost-effective use of current feedstock and/or utilization of additional, and new feedstocks such as cellulosic residues.

Validation and Verification

To validate and verify program performance, the Biomass Program will conduct internal and external reviews and audits. For example, during program peer reviews the programmatic activities are reviewed by experts from universities, state agencies, industry, and the U.S. Department of Agriculture. The table below summarizes validation and verification activities.

Data Sources: The Renewable Fuels Association's production statistics; the National Renewable Energy Laboratory's Renewable Electric Plant Information System (REPIS); the Energy Information Administration's (EIA) Annual Energy Review, Renewable Energy Annual and Annual Energy Outlook; the Gas Technology Institute Survey of Distributed Resources; EIA Form 860 data analyzed by the Resource Dynamics Corporation. Individual projects develop production cost and quantity estimates for sugar, syngas, ethanol, and other fuels and chemicals (these are reviewed and monitored by managers).

Baselines: The following are the key baselines used in the Biomass Program:

- Biomass delivered cost (2003): $53 per dry ton for wheat straw and corn stover;
- Mixed, dilute, unfermented sugars produced in a greenfield facility (2003): 15 cents per pound (equivalent to $2.75 per gallon of ethanol);
- Cost of cleaned and reformed biomass-derived synthesis gas from a mature gasification plant (2005): $7.25 per million Btus (equivalent to 6.86 cents per kWh); and
- Industrial-scale projects validating the cost of producing fuels, chemicals, and power utilizing biomass feedstocks: 2005 baseline = 0.

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

- Stage-Gate review, technology validation and operational field measurement, as appropriate;
- Peer review by independent outside experts of both the program and subprogram portfolios;
- Biennial Technical Program Review of the Biomass Program;
- Specialized program evaluation studies to examine process, impacts, or market baseline and effects, as appropriate;
- Quarterly and annual assessment of program and management results based performance through Joule (the DOE quarterly performance progress review of budget targets), PMA (the President's Management Agenda -- annual departmental and PSO based goals whose milestones are planned, reported and reviewed quarterly) and PART (common government wide program/OMB reviews of management and results); and
- Annual review of methods, and updated analysis of potential benefits for the Government Performance and Results Act (GPRA).

The National Laboratories receive direct funds for technology research and development, based on their capabilities and performance. Advisory panels consisting of non-Federal and industry experts review each laboratory and industry project at scheduled Stage-Gate reviews and peer evaluation of R&D.

	Projects are evaluated based on the following criteria: 1) Relevance to overall DOE objectives; 2) Approach to performing the research and development; 3) Technical accomplishments and progress toward project and DOE goals; 4) Technology transfer/collaborations with industry/universities/laboratories; and 5) Approach and relevance of proposed future research. The panels also evaluate the strengths and weaknesses of each project, and recommend additions to or deletions from the scope of work. The program organization facilitates relationships to ensure that Federal R&D results are transferred to industry.
Frequency:	Potential benefits are estimated annually. Independent evaluation of R&D projects are performed according to schedule per the Stage-Gate process for moving each project through an independent review "gate", from a less costly stage (such as preliminary paper studies) to a more costly stage (such as bench-scale experiments). Program Peer Reviews are conducted annually.
Data Storage:	EERE Benefits website, the EERE Corporate Planning System, and other computer-based data systems.
Verification:	DOE technology managers verify the achievement of targets through project reviews, including reviews of cost and performance modeling results. Project leaders in the field must provide to the technology managers documentation of experimental and/or analytic results as evidence of success. The evidence is listed in material supporting the DOE Joule performance tracking system. Various trade associations review the data and the modeling processes (e.g., REPIS renewable), and the EIA verifies the REPIS database. Peer reviews are conducted by independent personnel from industry, academia and governmental agencies other than the U.S. Department of Energy.

Program Assessment Rating Tool (PART)

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

The Biomass Program received its first OMB PART review in 2005. The 2005 PART review included ratings of 80 percent for program purpose, 90 percent for planning, 73 percent for management and 42 percent for program results and accountability with an overall rating of Adequate. These ratings reflect the commitment of EERE program management to good management and planning principles and the implementation of the EERE reorganization employing those principles. The program recognizes the need to improve consistency in its use of performance measures, a major cause for the program's lower scores on results and accountability. Congressionally directed projects have accounted for approximately 40 to 57 percent of the program's budget in recent years, slowing program progress and reducing the management score because directed projects are not competitively selected, generally do not contribute to program goals, and sometimes result in high uncosted balances.

The Department has responded to the PART recommendation of "Develop guidance that specifies a consistent framework for analyzing the costs and benefits of research and development investments, and uses this information to guide budget decisions." The Department has specified common scenarios, common methodology, and standardized benefits measures to allow analyzing the costs and benefits of applied R&D investments. While progress has been made, benefits estimates across programs are still not completely comparable. The Department continues to work on implementation of common assumptions and a consistent approach to incorporation of risk.

Expected Program Outcomes

The Biomass Program pursues its mission through integrated activities designed to increase the use of domestic renewable resources. Achievement of the program's technology goals will yield an incremental market response of 11 billion gallons/year of ethanol usage in 2030 and 7 bg/y in 2050. Enabling policy and market activities could significantly increase market response. Incremental ethanol usage associated with the program's achievements declines over time because of the assumption that this industry would develop and succeed eventually without DOE's program, but later at a much slower rate. This ethanol will displace imported oil, and thus yield energy security, economic and environmental benefits.

Estimates of the security, economic and environmental benefits from 2008 through 2050 that would result from realization of the program's goals are shown in the table below. If the program's technology goals are met, 0.3 million barrels per day (mbpd) and 0.005 mbpd of imported oil could be avoided in 2030 and 2050, respectively.[a] Further, the program would increase the energy diversity of the Nation's transportation system by 20 percent and 2 percent in 2030 and 2050, respectively.

EERE's Biomass Program Goal Case reflects the increasing penetration of ethanol over time, as the program's goals are met. Not included is any policy or regulatory mechanisms, or other incentives, not already in existence, that might be expected to support or accelerate the achievement of the program goals. The expected benefits reflect solely the achievement of the program's goals.

The goals are modeled in contrast to the "baseline" case, in which no DOE R&D exists. The baseline case is identical to those used for all DOE applied energy R&D programs.[b] Further, across EERE and all of DOE's applied energy R&D programs, the expected outcome benefits are being calculated using the same fundamental methodology. Finally, the metrics by which expected outcome benefits are measured are identical for all of DOE's applied energy R&D programs.[c] This standardization of methods and metrics has been undertaken as part of the Department's efforts to respond to the Under Secretary for Energy, Science, and Environment's Strategic Management System initiative and OMB's request to make all programs' outcomes comparable.

[a] The disproportionately declining oil import savings over time are due to the fact that lower ethanol prices lead to increased overall fuel demand (including petroleum derived fuels).

[b] The starting point for the baseline case is the Energy Information Administration's "reference case," as published in the AEO 2006. Program analysts from across DOE examined the AEO to determine the extent to which their program goals are modeled (explicitly or implicitly). If program goals are modeled in the AEO, they are removed in the GPRA baseline. Further, some programs believe that the AEO's technology representation is too conservative, even in the absence of program goals, and thus in certain cases a modification is made to make the technology representation in the baseline case more optimistic than the AEO.

[c] The set of expected outcome metrics being used this year differs in substantial ways to that of previous years. In addition to the standardization across DOE's applied energy R&D programs, the list is expanded and more comprehensive than in past years. Further, the list maps to DOE strategic goals. The expected outcome metrics represent inherent societal benefits that stem from achievement of program goals.

Benefits are estimated by modeling the program goals within two energy-economy models: NEMS-GPRA08 for benefits through 2030, and MARKAL-GPRA08 for benefits through 2050.[a] The full list of modeled benefits appears below.

FY 2008 GPRA Benefits Estimates for Biomass and Biorefinery Systems R&D Program[b c]

	2010	2020	2030	2040	2050
Environmental Benefits (Goal 1.2)					
Avoided carbon emissions, annual (MMTC)	2	3	9	81	3
Avoided carbon emissions, cumulative (MMTC)	3	20	46	1,052	1,502
Reduced cost of criteria pollutant control, NPV[d] (bil.	ns	ns	ns	NC	NC
Economic Benefits (Goal 1.4)					
Consumer savings, annual (bil. 2004 $)	ns	ns	3	13	ns
Consumer savings, NPV (bil. 2004 $)	ns	ns	25	94	128
Electric power industry savings, annual (bil. 2004 $)	ns	ns	ns	3	0
Electric power industry savings, NPV(bil. 2004 $)	ns	ns	ns	43	51
Household energy expenses reduced, annual (bil. 2004	ns	ns	0.4%	0.3%	-0.1%
Energy intensity reduced (% change in E/GDP)	ns	ns	0.6%	-2.1%	-0.6%
Net energy system cost savings, annual (bil. 2004 $)	NC	NC	NC	7	2
Natural gas price change, moving avg. (2004 $ / TCF)[e]	ns	ns	ns	NC	NC
Security and Reliability Benefits (Goal 1.1 or 1.3)					
Avoided oil imports, annual (mbpd)	ns	0.1	0.3	1.3	0.005
Avoided oil imports, cumulative (bil. bbl)	ns	ns	0.7	5.7	8.2
Security MPG improvement (%)[f]	ns	ns	4%	15%	0%
Transportation fuel diversity improvement (%)[g]	ns	7%	19%	34%	2%
Oil intensity reduced (% change in bil. bbl/GDP)	0.0%	0.3%	1.5%	6.2%	0.0%

[a] Results are presented as savings due to the programs. Final documentation on the analysis and modeling, including all of the methodologies and underlying assumptions, is expected to be completed and posted on the web by March 31, 2007. Past GPRA modeling and analysis documentation can be found at http://www1.eere.energy.gov/ba/pba/gpra.html.
[b] Benefits through 2030 are calculated with the NEMS-GPRA'08 model. Benefits from 2035 through 2050 are calculated with the MARKAL-GPRA'08 model. "NC" indicates situations in which no calculation was done because of specific model limitations. "ns" indicates results that were "not significant"—within the noise of the models.
[c] Projected benefits do not include any potential policy changes that might enhance technology deployment. In addition, most technologies show diminishing benefits by 2050, because of the assumption built in to the analysis that baseline industry progress will eventually catch up with the more accelerated progress associated with EERE program success.
[d] Net present value calculations throughout this table are performed for cumulative economic metrics, and are done using a 3% real discount rate, cumulative to 2008.
[e] The prices reflected here are average delivered prices to all sectors, and are based on a three year moving average. Thus the measure of benefit is the change in the three year moving average delivered price, in $ per thousand cubic foot.
[f] Security MPG is the ratio of vehicle miles traveled by light duty vehicles to their usage of oil. It captures oil avoidance by efficiency and fuel alternatives.
[g] Fuel diversity is measured by the Shannon-Weiner Index (SWI) of diversity. The SWI is a measure of "proportional diversity," and hence captures both abundance and richness, i.e., how many different fuels and how much of each fuel both factor into the calculation.

The difference between the baseline case and the program goal case results in economic, environmental and security benefits. In addition to oil import and transportation fuel diversity benefits described previously, the success of the program would result in carbon emission savings of 9 million metrics tons in 2030 and 3 million metric tons in 2050. Finally, the program would result in consumer savings of $3 billion in 2030.

Feedstock Infrastructure

Funding Schedule by Activity

	(dollars in thousands)		
	FY 2006	FY 2007	FY 2008
Feedstock Infrastructure	492	9,722	9,737
SBIR/STTR	0	245	263
Total, Feedstock Infrastructure	492	9,967	10,000

Description

The success of the biorefinery is critically dependent on having a large, sustainable supply of reasonable-cost, high-quality biomass. Feedstock Infrastructure is focused on increasing the availability and accessibility of our domestic biomass resources and improving the infrastructure technologies to supply reasonable cost lignocellulosic feedstocks to future large-scale biorefinery. It is necessary to make these improvements in resource availability and infrastructure costs because of the low bulk energy density (light weight nature) of biomass as compared to other fuel sources.

Specifically, the Feedstock Infrastructure R&D focuses on developing biomass production, harvesting, collection, preprocessing, storage, transport, and handling technologies, for wet and dry processes, different feedstock types, and various climatic regions. In addition, the Regional Feedstock Partnerships will be used to enhance the coordination of these R&D efforts with USDA and land grant universities. Regional information is needed by potential biorefiners in order to assess and improve resource availability and feedstock economics.

In the near term, Feedstock Infrastructure activities are aimed at producing cost-competitive and sustainable feedstock supplies to begin entering the "marketplace" at $35 per dry ton by 2012 in support of the Initiative's target of $1.07/gallon of cellulosic ethanol. The longer term goal of Feedstock Infrastructure activities is to make progress toward realizing the full biomass resource potential of the U.S. as estimated in USDA/DOE *Billion Ton Study.*[a] This study estimates that enough biomass is available in the U.S. to produce 60 billion gallons of ethanol (from both corn and cellulosic biomass resources) by 2030. While the study did not consider economics or mandates or other policies that would need to be implemented in order to produce such a large volume of ethanol, the Department believes that the potential for cellulosic ethanol is significant.

[a] DOE and USDA, Biomass as Feedstock for a Bioenergy and Bioproducts Industry: The Technical Feasibility of a Billion-Ton Annual Supply (Billion Ton Study), February 2005. See also The Economic Impacts of Bioenergy Crop Production on U.S. Agriculture (de la Torre, et al): www.usda.gov/oce/reports/energy/AER816Bi.pdf and Biomass from Crop Residues: Cost and Supply Estimates (Gallagher, et al): www.usda.gov/oce/reports/energy/AER819.pdf. A proposed future study by the National Academy of Sciences will also estimate the biomass resource and consider the economic and other impacts of increased biomass utilization under various energy price and policy scenarios.

Benefits

These activities will reduce biomass infrastructure costs for agricultural residues such as wheat straw and corn stover in order to facilitate the growth of the biomass industry so that the delivered cost will be reduced from $53 per dry ton in 2003 to $35 per dry ton by 2012. Indicators of progress toward that goal include the completion of a core R&D engineering design and techno-economic assessment of an integrated wet storage system by 2009. This biomass field pre-processing assembly system will have a pretreatment process that could potentially be scaled up to produce feedstocks at a reasonable cost. By 2008, all 5 Regional Feedstock Partnerships will be established representing Farm Bill, Section 9011 land grant university regions of the U.S. and will continue to address regional infrastructure needs in conjunction with USDA and land grant universities.

Detailed Justification

(dollars in thousands)

	FY 2006	FY 2007	FY 2008
Feedstock Infrastructure	**492**	**9,722**	**9,737**

In FY 2008, feedstock infrastructure systems work will continue for single-pass harvester development for wheat straw and corn stover collection, and storage and transportation options to minimize costs for delivering these agricultural feedstock residues to a conversion plant. Analysis of infrastructure systems and supply curves will continue in order to integrate economic and environmental considerations. DOE will continue to work in close collaboration with USDA's Agricultural Research Service, Forest Service, other USDA agencies, land grant universities, and regional consortia through the Regional Feedstock Partnerships. It is anticipated that funds will be leveraged with USDA through the Biofuels Initiative. Goals for the regional feedstock development effort will include R&D, such as replicated field trials across regions to determine the impact of residue removal on grain yield (in subsequent years); field trials (including genetic evaluations) to develop energy crops within a geographical region; resource assessments to determine regional feedstock supply curves (variable costs of feedstock across various sites); and economic studies that identify the best site conditions and general locations for biorefineries within a region. In addition, we will fund studies to determine the implications of increased feedstock development and use for sustainable agricultural practices and environmental issues. It is anticipated that these feedstock partnerships may also be able to function as information repositories and serve as liaisons to growers, biorefinery developers, and other interested parties such as state officials. The program will continue to partner with the genomics research activity within the DOE Office of Science and at USDA to further feedstock efforts.

	FY 2006	FY 2007	FY 2008
SBIR/STTR	**0**	**245**	**263**

In FY 2006, a total of $12,000 was transferred to the SBIR program and $1,000 to the STTR program. The FY 2007 and FY 2008 amounts shown are estimated requirements for the continuation of the SBIR and STTR programs.

Total, Feedstock Infrastructure	**492**	**9,967**	**10,000**

(dollars in thousands)

Explanation of Funding Changes

	FY 2008 vs. FY 2007 ($000)
Feedstock Infrastructure	
No significant change.	+15
SBIR/STTR	
Changes in the SBIR/STTR funding are a direct result of changes in the funding of program activities.	+18
Total Funding Change, Feedstock Infrastructure	**+33**

Platforms Research and Development

Funding Schedule by Activity

	(dollars in thousands)		
	FY 2006	FY 2007	FY 2008
Platforms Research and Development			
Thermochemical Platform R&D	5,628	16,455	19,537
Biochemical Platform R&D	13,914	32,832	38,300
SBIR/STTR	0	1,243	1,563
Total, Platforms Research and Development	19,542	50,530	59,400

Description

Platform R&D will focus on developing technologies for converting biomass to intermediates (such as sugars, synthesis gases, or bio-oils) of sufficient quality and quantity that they could produce cost-competitive transportation fuels, materials, and chemicals. Thermochemical Platform R&D areas include thermochemical processing, cleanup and conditioning, and upgrading for fuels synthesis. The initial focus will be on gasification technologies for synthesis gas production with a gradual increase in pyrolysis R&D. Biochemical Platform R&D will focus on further improvements to feedstock interface (pre-processing), pretreatment, and enzymatic hydrolysis, and process integration. These integrated steps are required to reduce sugar costs and enable ethanol to be produced as part of a biorefinery. The accelerated targets for both Platforms support the Biofuels Initiative's 2012 cost target of $1.07 per gallon of cellulosic ethanol (See Figures 1 and 2). This accelerated research could also lower the conversion cost from a wide variety of biomass feedstocks.

Benefits

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

- Reduce the costs of mixed biomass sugars to 6.4 cents per pound and clean syngas to $5.25 per million Btus. Sugars and syngas from biomass are the key biorefinery intermediates that are subsequently converted to biofuels, chemicals and materials within the biorefinery.

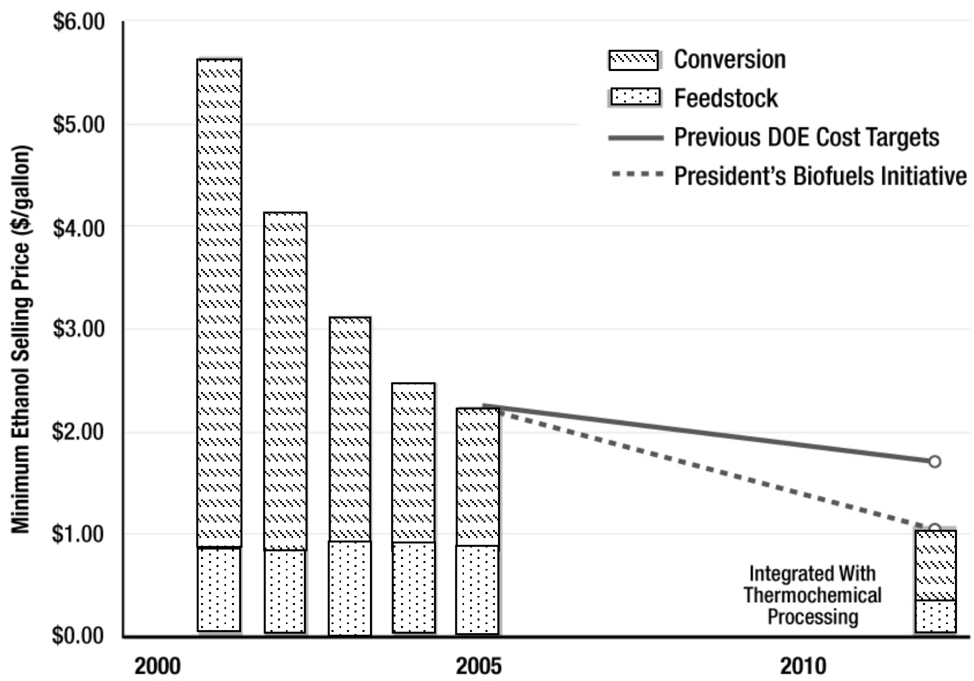

Figure 1. Research state-of-technology assessments for biochemical ethanol production to reach the $1.07/gallon market target, Foust et al, 2006

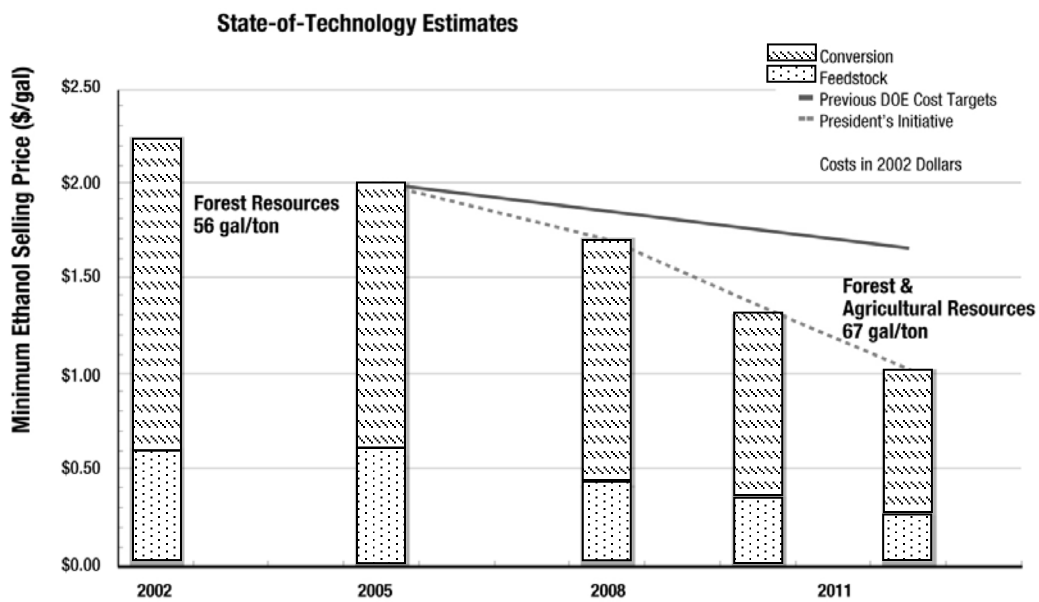

Figure 2. Research state-of-technology assessments for thermochemical ethanol production to reach the $1.07/gallon market target, Foust et al, 2006

Detailed Justification

	(dollars in thousands)		
	FY 2006	FY 2007	FY 2008
Thermochemical Platform R&D	**5,628**	**16,455**	**19,537**

Thermochemical Platform R&D is designed to reduce the cost of converting biomass and process residues from biorefineries into clean syngas or bio-oils for further upgrading to transportation fuels and chemicals. The Thermochemical Platform conducts research, testing, integration, and feasibility studies on thermochemical conversion of biomass to provide the technology for advanced and integrated biorefinery systems. These activities support the goal of $1.07 per gallon cellulosic ethanol for the Biofuels Initiative. The Thermochemical Platform also supports integration activities with Utilization of Platform Outputs because the intermediate feedstocks of the Thermochemical Platform (e.g., clean syngas and bio-oils) can be utilized in a biorefinery to make biofuels and other co-products.

In FY 2008, the program will continue to develop technologies for the production, cleanup and conditioning, and upgrading of biomass syngas or bio-oils so they are suitable for fuels and chemicals synthesis. This will be done in collaboration with competitively selected industrial partners from the biofuels and petroleum industries. Cleanup and conditioning efforts will focus on the syngas and pyrolysis streams for the removal of particulates and other inorganic materials, on the conversion of tars, and improving syngas yields. In addition, these funds may be used to support efforts such as peer reviews; data collection and dissemination; and technical, market, economic, and other analyses.

Biochemical Platform R&D	**13,914**	**32,832**	**38,300**

The Biochemical Platform is defined by the work to reduce the costs of producing mixed, dilute sugar streams from a wide range of biomass feedstocks by focusing on the key activities that support the $1.07 per gallon cellulosic ethanol cost goal for the Biofuels Initiative. These activities include: feedstock interface, pretreatment and conditioning, enzyme production and sacharification (sugars production), and technology integration. This Biochemical Platform R&D will help launch into the next generation of cellulosic ethanol technologies. The Biochemical Platform also supports integration activities with Utilization of Platform Outputs because the intermediate feedstocks of the Biochemical Platform (e.g., clean, mixed sugars) can be utilized in a biorefinery to make cellulosic ethanol and other co-products.

To date, the program's focus has been on the agricultural residue (corn stover) and its conversion to ethanol. Funding in FY 2008 allows for the acceleration of research into cellulosic ethanol conversion from a wide range of feedstocks in order to meet the near and longer term goals of the Biofuels Initiative. Sugar cost reductions will reflect the results of work in the areas of pretreatment, conversion of cellulosic components of biomass to mixed, dilute sugar streams; and process integration. Specific objectives include determining which feedstock types will be used in pioneer (first-of-a-kind) plants, and reducing the severity (harshness) of thermochemical pretreatment while optimizing the digestibility of the pretreated material. The selection of optimal pretreatment chemistries along with improving the overall effectiveness of the pretreatment process; further reduction of enzyme costs; and increasing the solids loading for the process to reduce equipment size, energy requirements, and reagent requirements will further reduce overall process costs.

(dollars in thousands)

In FY 2008, pilot-scale examination of one or more additional chemistries or configurations for thermochemical pretreatment will continue from 2007. Pretreated biomass will be reduced to simple sugars and residue by the action of hydrolytic enzymes. Further improvements are needed to: (increase the specific activity of cellulases; (b) exploit the synergy between cellulase and non-cellulase hydrolases that attack the hemicellulose, protein, waxes, perhaps lignin, and other compounds that contribute to recalcitrance; and (c) optimizate the cellulase preparations to specific thermochemical pretreatment regimes.

Process integration is another important area of the program and addresses the interaction between all technology elements in the pathway. On-going work addresses: (a) process intensification, the ability to run conversion at high solids; (b) solid-liquid separations; and (c) the feedstock issues of carbohydrate composition variability. Demonstration of a model process at pilot-scale is expected to show successful integration of developed unit operations. In FY 2008, the program will continue efforts initiated under the FY 2006 solicitation aimed at integrating thermochemical pretreatment technology.

The program will formulate improved enzyme mixtures and pretreatment processes based on improved understanding of the structure and function of plant cell walls. Targeted research that utilizes the Biomass Surface Characterization Laboratory Facility, located within the National Renewable Energy Laboratory, supports the more applied technology core research by allowing researchers to view plant components down to the nanometer level and to obtain images of the actual deconstruction of plant cell walls and other components vis-à-vis various pretreatment and enzyme treatments under various conditions.

In addition, these funds may be used to support efforts such as peer reviews; data collection and dissemination; and technical, market, economic, and other analyses.

SBIR/STTR	**0**	**1,243**	**1,563**

In FY 2006, a total of $ $325,000 was transferred to the SBIR program and $40,000 to the STTR program. The FY 2007 and FY 2008 amounts shown are estimated requirements for the continuation of the SBIR and STTR programs.

Total, Platforms Research and Development	**19,542**	**50,530**	**59,400**

Explanation of Funding Changes

	FY 2008 vs. FY 2007 ($000)
Thermochemical Platform R&D	
The funding increase will be applied to developing, validating and demonstrating technologies that thermochemically convert biomass to syngas and/or pyrolysis oils that are integrated with synthesis to transportation fuels. Specific focus areas seek to achieve higher production yields, and improved quality (out of the reactor) of the syngas and bio-oils, thus reducing the overall cost of the synthesized fuel.	+3,082
Biochemical Platform R&D	
The funding increase is needed to broaden the range of feedstocks that are amenable to enzymatic hydrolysis in partnership with industry.	+5,468
SBIR/STTR	
Changes in the SBIR/STTR funding are a direct result of changes in the funding of program activities.	+320
Total Funding Change, Platforms Research and Development	**+8,870**

Utilization of Platform Outputs R&D

Funding Schedule by Activity

	(dollars in thousands)		
	FY 2006	FY 2007	FY 2008
Utilization of Platform Outputs R&D			
Integration of Biorefinery Technologies	14,975	53,065	92103
Products Development	7,940	33,931	10,000
SBIR/STTR	0	2,194	2,760
Total, Utilization of Platform Outputs R&D	22,915	89,190	104,863

Description

Utilization of Platform Outputs R&D consists of two key activities, Integration of Biorefinery Technologies and Products Development. Utilization of Platform Outputs R&D aims at integrating enabling technologies developed in the Biochemical and Thermochemical Platform, and Products Development into a biorefinery with the goal of producing cost-competitive fuels, chemicals and materials, and/or heat and power.

Funding for Integration of Biorefinery Technologies, increasing from FY 2007, will be used to continue the validation of the near term biorefinery pathways that could ultimately allow the production of cost competitive cellulosic ethanol. The requested funding increase will support the commercial-scale biorefinery solicitation authorized by EPACT 2005, Section 932(d). The cost shared projects were selected for award in FY 2007. Additionally, the funding increase supports the validation of additional biomass conversion technologies and feedstocks in biorefineries at approximately 10 percent of commercial scale. The technical and economic performance of these biorefineries will be assessed as a result of these efforts.

Products Development is focused on the conversion of sugars from the biochemical platform into ethanol. The program supports public/private partnerships focused on developing a commercially viable fermentation organism which can help reduce the cost of cellulosic ethanol production

Benefits

Validation of biorefinery concepts at a demonstration scale could reduce technological risk and attract additional sources of capital at more competitive rates. As more technologies and feedstocks are demonstrated and validated the risk reward relationship will continue to improve and accelerate commercialization and oil displacement.

An indicator of progress toward achieving those benefits includes:

- In FY 2008, the program will conduct an independent engineering review to validate contractor costs and scheduled timeline included in the design package of at least one commercial scale biorefinery capable for processing up to 700 metric tonnes per day of lignocellulosic feedstocks. In order to ensure project efficacy, the independent review will include at a minimum analysis of the following: commitments from essential project participants including the EPC contractor and major suppliers, establishment of construction milestones including a construction draw schedule, approved permits that allow construction to begin, a resource loaded work breakdown structure for construction, evaluation of project risk factors and project management schedules. In addition, an analysis of the schedule for financial closings and disbursement schedules will be included.

Detailed Justification

	(dollars in thousands)		
	FY 2006	FY 2007	FY 2008
Integration of Biorefinery Technologies	**14,975**	**53,065**	**92,103**

In FY 2008, the program will continue projects resulting from the prior year solicitation to increase validation of various biorefinery technologies. Increased funding will support the design, engineering and construction of a commercial-scale biorefinery demonstration facility. Further, projects will be initiated and awarded for a 10 percent commercial scale biorefinery demonstration and validation solicitation. In addition, the program will continue to support industry partners as they refine engineering and economic evaluations, and develop commercialization plans for a biorefinery system. The program's selection of projects for funding will be based on strict criteria similar to those used by investment bankers in high risk project finance decisions. With DOE support, the projects will result in technological risk reduction and economic validation, thereby enhancing the probability of success for the private sector's commercialization and replication of the processes. University and National Laboratory personnel will conduct research to support industrial partners in overcoming barriers identified by these projects and continually improve the biorefineries effectiveness and efficiency.

Products Development	**7,940**	**33,931**	**10,000**

In FY 2008, the program will need no new funding for existing bio-based products R&D projects as they are scheduled for completion. Priorities for the program are shifting to integration of biorefinery. The program will continue the fermentation R&D activities initiated in FY 2007, which include competitively selected R&D projects aimed at developing fermentation organisms that have increased productivity, stability, robustness, and lower cost through an ethanologen solicitation which would include 2-3 industrial cost-share projects. The ethanologen solicitation is designed to accelerate the development of advanced micro-organisms to ferment mixed sugars from cellulosic residues, thus increasing the ethanol output from future biorefineries. These organisms will have the ability to ferment mixed sugars from cellulosic residues to ethanol.

	(dollars in thousands)		
	FY 2006	FY 2007	FY 2008
SBIR/STTR	**0**	**2,194**	**2,760**

In FY 2006, a total of $505,000 was transferred to the SBIR program and $59,000 to the STTR program. The FY 2007 and FY 2008 amounts shown are estimated requirements for the continuation of the SBIR and STTR programs.

	FY 2006	FY 2007	FY 2008
Total, Utilization of Platform Outputs R&D	**22,915**	**89,190**	**104,863**

Explanation of Funding Changes

	FY 2008 vs. FY 2007 ($000)
Integration of Biorefinery Technologies	
The increase will allow for the construction of a commercial-scale biorefinery demonstration project and initiate activities towards biorefinery validation at the 10 percent commercial scale. The focus will be on the integration of advanced technologies, improved efficiencies and the establishment and enhancement of value-added co-products on a systems level for the production of biofuels.	+39,038
Products Development	
The decrease resulted from the completion of several bio-based products projects in FY 2007. Priorities for the program are shifting to integration of biorefinery technologies.	-23,931
SBIR/STTR	
Changes in the SBIR/STTR funding are a direct result of changes in the funding of program activities.	+566
Total Funding Change, Utilization of Platform Outputs R&D	**+15,673**

Cellulosic Ethanol Reverse Auction

Funding Schedule by Activity

	(dollars in thousands)		
	FY 2006	FY 2007	FY 2008
Cellulosic Ethanol Reverse Auction	0	0	5,000
Total, Cellulosic Ethanol Reverse Auction	0	0	5,000

Description

The implementation of a cellulosic ethanol reverse auction will be conducted in accordance with Section 942 of the Energy Policy Act of 2005.

Benefits

Accelerated rate of introduction of cellulosic ethanol into the market place, in line with production incentives outlined in Section 942 of the Energy Policy Act of 2005.

Detailed Justification

	(dollars in thousands)		
	FY 2006	FY 2007	FY 2008
Cellulosic Ethanol Reverse Auction	**0**	**0**	**5,000**

The Biomass Program will establish the framework for an ethanol reverse auction in accordance with Section 942 of the Energy Policy Act of 2005. The auction will award incentives on a per gallon basis of cellulosic biofuels produced as determined through the first reverse auction.

Total, Cellulosic Ethanol Reverse Auction	**0**	**0**	**5,000**

Explanation of Funding Changes

	FY 2008 vs. FY 2007 ($000)
The increase will be used to establish the framework to implement a cellulosic ethanol reverse auction.	+5,000
Total, Cellulosic Ethanol Reverse Auction	**+5,000**

Congressionally Directed Activities

Funding Schedule by Activity

	(dollars in thousands)		
	FY 2006	FY 2007	FY 2008
Congressionally Directed Activities	46,827	0	0
Total, Congressionally Directed Activities	46,827	0	0

Description

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

In FY 2006, there were 32 congressionally directed activities funded out of the Biomass Program. The program does not request any funds to continue these projects as they do not further the achievement of DOE's goals. The following projects were directed by Congress to be included in this program.

Detailed Justification

	(dollars in thousands)		
	FY 2006	FY 2007	FY 2008
Texas A&M – Renewable Energy from Animal Biowaste	**990**	**0**	**0**

Research on co-firing of animal wastes (including carcasses) with coal in power boilers to reduce emissions during combustion.

Sugar-Based Ethanol Biorefinery at Louisiana State University	**495**	**0**	**0**

Development of technology for converting sugarcane residues from harvesting and processing operations (cane leaf matter, bagasse and molasses) to ethanol and co-products.

Biotech-to-Ethanol Project	**990**	**0**	**0**

Research on fractionating biomass for conversion to various products; development of a process model for techno-economic analysis.

	(dollars in thousands)		
	FY 2006	FY 2007	FY 2008
Research Triangle Biomass, North Carolina	**1,238**	**0**	**0**

In FY 2005, develop new and optimized catalysts and catalytic processes that can efficiently convert biomass-derived syngas into diesel fuel and C_2 to C_4 alcohols. In FY 2006, develop catalysts capable of removing contaminants in the synthesis gas stream to levels enabling catalytic conversion of the synthesis gas to liquid transportation fuels.

Iowa Switchgrass Project - Chariton Valley	**742**	**0**	**0**

Testing of co-firing coal and switchgrass, conducting field research to enable the use of switchgrass for energy, and developing this market.

Biorefinery at Louisiana State University	**495**	**0**	**0**

Development of technology for converting sugar cane wastes and molasses into fuels and chemicals.

Vermont Biomass Energy Center	**495**	**0**	**0**

Accelerating adaptation of near-term renewable biomass technologies.

Consortium for Plant Biotechnology Research	**3,465**	**0**	**0**

Competitive awards to universities based on industry needs and focusing on plant-derived energy resources and plant-based energy industries. The membership is comprised of three dozen institutions of higher education and over 30 companies.

University of Georgia Biomass Pyrolysis Biorefinery Project	**1,238**	**0**	**0**

Research on pyrolysis of biomass for hydrogen production and fuel cell fabrication techniques.

Wood Debris Bioenergy Project	**990**	**0**	**0**

Develop technology for utilizing wood wastes.

Clarkson University Dairy Waste Partnership	**247**	**0**	**0**

Anaerobic digestion of dairy waste, cheese whey and other strong food wastes.

Madison County Landfill Gas-to-Energy	**990**	**0**	**0**

Power generation using landfill gas in internal combustion engines.

Asphalt Roofing Shingles into Energy, Xenia	**990**	**0**	**0**

Develop technology for converting roofing shingles to energy.

	(dollars in thousands)		
	FY 2006	FY 2007	FY 2008
Ohio State University 4-H Green Building	**990**	**0**	**0**

Use of a heat pump for the heat source for a new building.

Solid Waste Authority Pyramid Resource Center	**1,980**	**0**	**0**

Convert organic components into energy products such as methanol, compressed natural gas, biodiesel, and hydrogen for power production using a fuel cell.

City of Stamford Waste-to-Energy Project	**1,485**	**0**	**0**

Use a low emission combustion process to convert dried sewage sludge pellets to 10 MW of power using conventional steam turbine technology.

Iowa State University Biomass Energy Conversion Project	**495**	**0**	**0**

Conduct research on the use of supercritical fluids to extract fermentable sugars from biomass.

Iroquois Bioenergy Consortium Ethanol Project	**3,465**	**0**	**0**

Construction of starch-based ethanol plant in Indiana.

New York Biomass/Methane Gas Power Fuel Cell	**1,980**	**0**	**0**

Testing of simulated landfill or digester gas in solid oxide fuel cells.

Western Massachusetts Biomass Project	**495**	**0**	**0**

Develop the requirements necessary to establish a biomass feedstock infrastructure to serve the needs of various industries. Modeling will be developed to identify the costs associated with different processing and handling costs.

Greenville Composite Biomass Project	**742**	**0**	**0**

Project on biomass technology or utilization.

Laurentian Bioenergy Project	**1,238**	**0**	**0**

Develop tree plantations that are to be part of a biomass-to-combined heat and power project. Forest products residues will be used in the interim.

Kona Carbon Biomass Project	**990**	**0**	**0**

Convert macadamia nut shells into carbon products (activated carbon, carbon for tire manufacture, etc.).

	(dollars in thousands)		
	FY 2006	FY 2007	FY 2008
Sustainable Energy Center at Mississippi State University	**10,890**	**0**	**0**
Establish a center focusing on energy studies and related activities.			
Missouri Biodiesel Demonstration Project	**990**	**0**	**0**
Validate biodiesel utilization in specific application.			
Auburn Alternative Fuel Source Study of Cement Kilns	**990**	**0**	**0**
Study the potential use of alternative fuel sources for cement kiln operation.			
Canola-Based Automotive Oil Research	**990**	**0**	**0**
Research on automotive oil made from oil seed crops.			
Center for Advanced Bio-based Binders	**792**	**0**	**0**
Establish center for development of binders made from biomass-derived intermediates.			
Development of Applied Membrane Technology	**495**	**0**	**0**
Research on innovative membranes for use in chemical processes.			
Michigan Biotechnology Institute	**990**	**0**	**0**
Research on new chemical and bio-chemical processes.			
Washington State Ferries Biodiesel Demonstration	**495**	**0**	**0**
Test biodiesel in ferries and evaluate the effect on air quality in Puget Sound.			
UNLV Research Foundation for Developing Biofuels	**2,970**	**0**	**0**
Use of novel ionic transfer membranes to recover ethanol from fermentation broths.			
Total, Congressionally Directed Activities	**46,827**	**0**	**0**

Solar Energy

Funding Profile by Subprogram

(dollars in thousands)

	FY 2006 Current Appropriation	FY 2007 Request	FY 2008 Request
Solar Energy			
Photovoltaic Energy Systems	58,802	139,472	137,304
Concentrating Solar Power	7,284	8,900	9,000
Solar Heating and Lighting Systems	1,449	0	2,000
Congressionally Directed Activities	14,256	0	0
Total, Solar Energy	81,791	148,372	148,304

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. 95-590, "Solar Photovoltaic Energy Research, Development and Demonstration Act" (1984)
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 of 1989" (1989)
P.L. 101-575, "Solar, Wind, Waste, and Geothermal Power Production Incentives Act of 1990" (1990)
P.L. 102-46, "Solar, Wind, Waste, and Geothermal Power Production Incentives Technical Amendments Act" (1991)
P.L. 102-486, "Energy Policy Act (EPACT)" (1992)
P.L. 109-190, "Energy Policy Act" (2005)

Mission

The mission of the Solar Energy Technologies Program ("Solar Program") is to conduct research, development, demonstration and deployment activities to accelerate widespread commercialization of clean solar energy technologies across America, diversifying the Nation's electricity supply options, while increasing national security and improving the environment.

Benefits

Through its research and development activities, the Solar Program aims to develop solar energy technologies –photovoltaics (PV), concentrating solar power (CSP), and solar heating (SH) – that are reliable, affordable, and environmentally sound. Transforming the Nation's vast supply of direct solar energy into a widely available, affordable, low emission energy resource will increase energy security both by diversifying domestic energy supply options in both normal market conditions and emergency situations. Achievement of the program's goals could also yield economic benefits to consumers and the electric power industry, and will provide environmental benefits by reducing carbon emissions.

Greater use of solar energy will also reduce the growth of greenhouse gas emissions associated with long-term climate change.

The Solar America Initiative (SAI) will fund R&D efforts designed to achieve market competitiveness for solar electricity by 2015, five years sooner than the program had targeted under the 2006 Budget. The R&D effort focuses on technology pathways that have the greatest potential to lower costs and improve performance. The new industry-led R&D partnerships, known as "Technology Pathway Partnerships," will address the issues of cost, performance and reliability associated with each technology pathway. Members of the Technology Pathway Partnerships will include industry, universities, laboratories, and other governmental entities broadening the base and increasing the likelihood of achieving the goals. Our modeling suggests that, in 2015, outcomes and benefits could include 4 GW of cumulative new capacity and 1 million metric tons per year of avoided carbon emissions.

The Solar Program provides additional types of public benefits in the areas of reliability, security, and environment.[a] PV systems can either be integrated with the electricity grid or work independently as distributed systems, a flexibility which increases our national energy security by providing a widely available and flexible source of power not dependent on our aging and vulnerable electricity grid system. CSP systems use dishes for smaller, decentralized systems, and dish arrays and parabolic troughs for larger, centralized power applications that meet the large output needs of utilities.

Solar energy is particularly valuable in reducing the need for new generating and transmission capacity because its natural availability matches daily and seasonal electricity peaks. The addition of thermal energy storage to CSP systems is of particular interest to utilities because it allows them to use solar energy during their entire periods of peak demand. Solar energy promotes energy security during emergencies by providing power and hot water that is not dependent on fuel deliveries or overhead wires that are subject to disruption and which will not contribute to local air pollution during a protracted emergency. Solar energy displaces demand on the electricity grid most during the hottest, sunniest days of the year when demand for space cooling peaks reducing the potential for blackouts. If solar energy can displace conventional power plants, greenhouse gas emissions and criteria pollutant emissions can be significantly reduced.

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

Strategic and GPRA Unit Program Goals

The Department's Strategic Plan identifies five Strategic Themes (one each for nuclear, energy, science, management, and environmental aspects of the mission) plus 16 Strategic Goals that tie to the Strategic Themes. The Solar Energy Program supports the following goal:

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

Strategic Theme 1, Energy Security

Strategic Goal 1.1 – Energy Diversity: Increase our energy options and reduce dependence on oil, thereby reducing vulnerability to disruptions and increasing the flexibility of the market to meet U.S. needs.

Solar energy can decrease natural gas demand and potentially help slow any growth in foreign supplies.

And concurrently supports:

Strategic Goal 1.2 – Environmental Impacts of Energy: Improve the quality of the environment by reducing greenhouse gas emissions and environmental impacts to land, water, and air from energy production and use.

Strategic Goal 1.3 – Energy Infrastructure: Create a more flexible, more reliable, and higher capacity U.S. energy infrastructure.

The Solar Energy Program has one GPRA Unit program goal which contributes to Strategic Goals 1.1, 1.2, and 1.3 in the "goal cascade":

GPRA Unit Program Goal 1.1.03.00: Solar Energy - The Solar Program goal is to improve the performance and reduce the cost of solar energy systems to make solar power cost-competitive with conventional electricity sources by 2015, thereby accelerating large-scale usage across the Nation and making a significant contribution to a clean, reliable and flexible U.S. energy supply.

Contribution to GPRA Unit Program Goal 1.1.03.00 (Solar Energy)

The key Solar Program contributions to this goal are through increased production of electricity and diversification of energy supply. The Solar Program works to improve the performance of next-generation solar energy technologies which reduce system, manufacturing, and installation costs to levels competitive with conventional energy sources. When Federal solar energy research increased 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 by the Solar R&D Program over the last two decades have contributed to reduced solar electricity costs by more than 90 percent. Today, in areas with favorable conditions, solar electricity can be produced at costs as low as $0.12/kWh for CSP and as low as $0.18 for PV applications.

The Solar Program goal of achieving cost-competitive solar electricity translates to a range of costs based on specific markets. For PV, the estimated cost ranges for market-specific cost-competitive electricity generation in 2015 are:

- $0.05/kWh - $0.07/kWh for centralized power markets,
- $0.06/kWh - $0.08/kWh for commercial markets, and
- $0.08/kWh - $0.10/kWh for residential markets.

The long-term cost goal (2020) for CSP systems in the utility market is $0.05/kWh - $0.07/kWh with up to 12 hours of thermal storage, which would enable it to compete effectively as base load power.

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

- By 2010, reduce the 30-year user cost for PV electric energy to $0.10 - $0.18/kWh from $0.18 - $0.23/kWh in 2005.
- By 2010, reduce the cost of large-scale CSP power plants in the Southwest to $0.10 - $0.12/kWh from $0.12 - $0.14/kWh in 2006.

Funding by Strategic and GPRA Unit Program Goal

(dollars in thousands)

	FY 2006	FY 2007	FY 2008
Strategic Goal 1.1, Energy Diversity			
GPRA Unit Program Goal 1.1.03.00, Solar Energy			
Photovoltaic Energy Systems	58,802	139,472	137,304
Concentrating Solar Power	7,284	8,900	9,000
Solar Heating and Lighting Systems	1,449	0	2,000
Total, GPRA Unit Program Goal 1.1.03.00, Solar Energy	67,535	148,372	148,304
All Other			
Congressionally Directed Activities			
Rensselaer Polytechnic Institute Syracuse University "Green Building"	742	0	0
Crowder College Alternative Renewable Energy Center	990	0	0
University of Arkansas Research in Solar Energy Field	495	0	0
Oregon Nanoscience and Microtechnologies Institute	1,485	0	0
Conductive Coating Solar Cell Research Project	1,485	0	0
Ultra Thin Film Photovoltaic Charging System	990	0	0
Brightfield Solar Energy	693	0	0
National Orange Photovoltaic Demonstration	446	0	0
Sandia National Lab Development Of Advanced Cells and Modules	990	0	0
Sandia National Lab Megawatt Demonstration Concentrating Solar Project	3,465	0	0
UNLV Research Foundation For Photonics Research, Including Evaluation Of Advanced Fiber Optics For Hybrid Solar Lighting	2,475	0	0
Total, Congressionally Directed Activities	14,256	0	0
Total, All Other	14,256	0	0
Total, Strategic Goal 1.1 (Solar Energy)	81,791	148,372	148,304

Annual Performance Results and Targets

FY 2003 Results	FY 2004 Results	FY 2005 Results	FY 2006 Results	FY 2007 Targets	FY 2008 Targets
GPRA Unit Program Goal 1.1.03.00 (Solar Energy)					
Photovoltaic Energy Systems					
Reduce manufacturing cost of PV modules to $2.10 per Watt (equivalent to a range of $0.19 to $0.24 per kWh price of electricity for an installed solar system). [MET]	Verify, with standard laboratory measurements, U.S.-made commercial production crystalline silicon PV modules with 12.5 percent conversion efficiency.	Verify, using standard laboratory measurements, a conversion efficiency of 13.5 percent of U.S.-made, commercial crystalline silicon PV modules. Production cost of such modules is expected to be $1.95 per Watt. [MET]	Verify, using standard laboratory measurements, a conversion efficiency of 13.8 percent of U.S.-made, commercial crystalline silicon PV modules. Production cost of such modules is expected to be $1.90 per Watt. [MET]	Verify, using standard laboratory measurements, a conversion efficiency of 14.5 percent of U.S.-made, commercial crystalline silicon PV modules. Production cost of such modules is expected to be $1.80 per Watt.	Complete R&D that will reduce the direct manufacturing cost of silicon PV modules to $1.70 per Watt, roughly equivalent to a modeled levelized cost of energy of $0.14-$0.23.kWh.
	Verify, with standard laboratory measurements, U.S.-made commercial production thin-film PV modules with 10 percent conversion efficiency. [MET]	Develop thin-film PV modules with an 11.0 percent conversion efficiency that are capable of commercial production in the U.S. [MET]	Develop thin-film PV modules with an 11.2 percent conversion efficiency that are capable of commercial production in the U.S. [MET]	Develop thin-film PV modules with an 11.8 percent conversion efficiency that are capable of commercial production in the U.S.	Complete R&D that will reduce the direct manufacturing cost of thin film PV modules to $1.60 per Watt, roughly equivalent to a modeled levelized cost of energy of $0.14-$0.23.kWh.
Concentrating Solar Power					
			Conduct advanced research on trough collectors and receivers that will lead to a reduction in the modeled cost of energy from CSP troughs to $0.12-$0.14/kWh. [MET]	Develop CSP trough collector and receiver technologies that enable a system conversion efficiency of 13.1%. The levelized cost of energy from such a system is expected to be in the range of $0.11-$0.13/kWh.	Develop CSP trough collector, receiver, and storage technologies that enable a levelized cost of energy in the range of $0.11-$0.13/kWh.
Solar Heating and Lighting Systems					
	Developed conceptual designs of a low-cost polymer solar water heater capable of operation in freezing climates. [MET]	Achieve 5.0 cents per kilowatt-hour modeled cost of energy from solar water heater capable of operating in non-freezing climates. [MET]			
	Contributed proportionately to EERE's corporate goal of reducing corporate and program uncosteds to a range of 20-25 percent by reducing	Contributed proportionately to EERE's corporate goal of reducing corporate and program adjusted uncosted obligated balances to a range of	Maintain total administrative overhead costs (defined as program direction and program support excluding earmarks) in relation to total program costs	Maintain total administrative overhead costs (defined as program direction and program support excluding earmarks) in relation to total program costs	Maintain total administrative overhead costs in relation to total program costs of less than 12 percent. Baseline for administrative overhead rate

FY 2003 Results	FY 2004 Results	FY 2005 Results	FY 2006 Results	FY 2007 Targets	FY 2008 Targets
	program annual uncosteds by 10 percent in 2004 relative to the program uncosted baseline (in 2003) until the target range is met. [MET]	20-25 percent by reducing program annual adjusted uncosteds by 10 percent in 2005 relative to the program FY 2004 end of year adjusted uncosted baseline ($19,342K) until the target range is met. [MET]	of less than 12 percent. [a] [MET]	of less than 12 percent.	currently being validated.

[a] Baseline for administrative overhead rate currently being validated.

Means and Strategies

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

The Solar Program will implement the program using the following means:

- Perform research, development, demonstration and deployment activities in partnership with coalitions of industry members, universities, National Laboratories and/or States to reduce costs;
- Increase photovoltaic module and system efficiency, system reliability, and manufacturing capability and efficiency;
- Select technology pathways for accelerated development of improved manufacturing methods, materials use, defect control and throughput;
- Increase the efficiency and reliability of CSP systems;
- Develop low-cost thermal storage for CSP systems;
- Perform research and development on advanced, building-integrated solar heating and lighting systems, such as hybrid solar electric/thermal systems;
- Coordinate with the Buildings Technologies Program on the integration of solar technology into zero energy homes;
- Conduct technology acceptance activities to identify and address market barriers to solar technology usage, and promote market expansion opportunities;
- Conduct technology analysis and systems driven analysis to help identify research priorities; and
- Develop lower cost production processes for cells and modules.

The Solar Program uses the following strategies:

- The SAI features "Technology Pathway Partnerships," public-private, industry-led partnerships to achieve SAI goals. These private sector teams will match taxpayer dollars one for one. Key solar technologies which have the greatest potential for cost competitiveness in this accelerated time frame will be selected for development. Based on a stage-gate evaluation process, only the technology pathways with the greatest potential for achieving the 2015 goal will be continued;
- Work with cost-shared partnerships consisting of industry members, universities, National Laboratories, States and/or other governmental entities to solve scientific and technical barriers necessary to improve performance and reliability, while reducing cost in PV technology pathways;
- Use cost-sharing arrangements with industry and other partners to leverage Federal resources;

- Work with States, industry, and other entities to leverage Federal taxpayer resources, communicate technology advances and opportunities effectively, reduce barriers, and accelerate market penetration of technology applications; and
- Work with the Office of Science, the Building Technologies Program (EERE) and the Federal Energy Management Program on solar R&D and deployment opportunities. This includes work with other agencies such as the Defense Advanced Research Projects Agency (DARPA), etc.

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

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

- material costs and availability (e.g., silicon supply, etc.);
- labor costs;
- currency exchange rates;
- the price and availability of alternative technologies and conventional fuels;
- international R&D and deployment efforts;
- financial incentives and other policies;
- interest rates and inflation;
- state and local regulation; and
- market participant withdrawal or entry.

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

- research, development, demonstration and deployment activities, as well as information sharing, with DOE programs and other governmental entities to improve coordination and collaboration across Departmental organizational boundaries;
- work with solar energy and other industry experts outside of the Department to:
    - ensure that the Solar Program's research directions and priorities address the needs of manufacturers, utilities, state agencies, consumers, and other stakeholders;
    - ensure that program activities are within the realm of technical feasibility and properly aligned with market forces; and
    - develop technology roadmaps and peer reviews, versions of which have been completed within the last two years for each of the primary solar subprograms.

Validation and Verification

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

Data Sources: Annual Energy Review 2006 (EIA); Renewable Energy Annual 2006 (EIA); Annual Energy Outlook 2007 (EIA); Zero Energy Homes Roadmap (2002); Peer Review of the U.S. Department of Energy's Solar Buildings Technology Research Program (2001); National Research Council, Renewable Power Pathways: A Review of the Department of Energy's Renewable Energy Programs (2000). National Research Council, Critique of the Sargent and Lundy Draft Assessment of Cost and Performance Forecasts for Concentrating Solar Power (2002); Sargent and Lundy, Assessment of Parabolic Trough and Power Tower Solar Technology Cost and Performance Forecasts (2003); Peer Review of the DOE Photovoltaic Program (2003); Our Solar Power Future: The U.S. Photovoltaic Industry Roadmap for 2005; Beyond (2004); and Potential Impact of Zero Energy Homes (2006).

Baselines: The Solar Program's 2003 baselines for system production cost reduction goals are: \$0.19 – \$0.24/kWh for PV electric energy (See the Solar Program Multi-Year Technical Plan) and; \$0.12 - \$0.14/kWh for electricity from CSP technologies (See the CSP Technology Transition Plan 2004). Documents can be found at: www.eere.doe.gov/solar/about.html. A baseline has not yet been established for a hybrid solar electric/thermal system.

Frequency: Annual.

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

- Technology validation and operational field measurement;
- Implementation of a consistent methodology across the program for analyzing levelized cost of energy (LCOE);
- Critical peer review of both the program and subprogram portfolios and activities by independent outside experts;
- Annual internal Technical Program Review of the Solar Program;
- A Technical Review Team specific to the SAI is under development;
- Specialized program evaluation studies to examine process, impacts, or market baseline and effects, as appropriate;
- Quarterly and annual assessment of program and management results based performance through Joule (the DOE quarterly performance progress review of budget targets); PMA (the President's Management Agenda -- annual Departmental and PSO based goals whose milestones are planned, reported and reviewed quarterly); and PART (common government wide program/OMB reviews of management and results); and
- Annual review of methods, and re-computation of potential benefits for the Government Performance and Results Act (GPRA).

Data Storage:	EIA and other organizations, such as National Laboratories (including the National Renewable Energy Laboratory (NREL), Sandia National Laboratories (Sandia), store data on computer servers.
Verification:	Peer reviews; National Laboratory system and component test data; trade association reviews; National Laboratory survey of PV manufacturing cost/capacity data from U.S. industry; EIA survey of solar manufacturers; literature reviews.

Program Assessment Rating Tool (PART)

The Department implemented a tool to evaluate selected programs. PART was developed by OMB to provide a standardized way to access the effectiveness of the Federal Government's portfolio of programs. The structured framework of the PART provides a means through which programs can assess their activities differently than through traditional reviews. The Solar Program has incorporated feedback from OMB into the FY 2008 Budget Request and has taken or will take necessary steps to continue to improve performance.

The 2003 PART rated the Solar Program "moderately effective" - the second highest rating category- with the following scores: purpose (80%), planning (80%), management (100%), results and accountability (58%) . The 2003 PART review and score, and subsequent follow-up activities by the Solar Program, provided suggestions that resulted in refined long-term and annual measures incorporated in this FY 2008 budget request. The PART review also recognized that the Solar Program has implemented a new "systems driven" approach to help prioritize activities in its portfolio by analyzing present and potential markets, technology trade-off studies, and research and development reviews, and recognized that the program had developed a Multi-Year Technical Plan to guide its research efforts. In addition, the PART review also recognized that Congressionally Directed activities reduce the program funding available for competitive solicitations and core National Laboratory research designed to support program goals. The Solar Program is attempting to adhere to the specific direction of congressional appropriation earmark language while increasing the contribution to program goals to the maximum extent possible.

The program is developing and using peer reviewed cost models to assess the levelized cost of energy and the installed cost for various applications. These tools will be used for technology "down-selects" and stage gate decisions.

The Department has responded to the PART recommendation of "Develop guidance that specifies a consistent framework for analyzing the costs and benefits of research and development investments, and use this information to guide budget decisions." The Department has specified common scenarios common methodology, and standardized benefits measures to allow analyzing the costs and benefits of applied R&D investments. While progress has been made, benefits estimates across programs are still not completely comparable. The Department continues to work on implementation of common assumptions and a consistent approach to incorporation of risks.

Expected Program Outcomes

The Solar Program pursues its mission through integrated activities designed to increase the use of domestic renewable resources. We expect that these improvements will provide economic, environmental and security benefits. We expect the most significant benefits to be in reduction of carbon emissions, and in reduction of costs to the electric power industry. In the long-term, we also expect economic benefits to accrue to consumers.

Of particular importance to national security, solar energy technologies can produce emergency power without fuel and connection to the grid. Fuel-free generation obviates the need to transport fuel during emergency situations in which critical fuel and transportation infrastructure may be damaged or incapacitated.

EERE's Solar Energy Program Goal Case reflects the increasing penetration of solar energy over time, as the program's goals are met. Not included are any policy or regulatory mechanisms, or other incentives not already in existence, that might be expected to support or accelerate the achievement of the program goals. The expected benefits reflect solely on the achievement of the program's goals.

The goals are modeled in contrast to the "baseline" case, in which no DOE R&D exists. The baseline case is identical to those used for all DOE applied energy R&D programs.[a] Further, across EERE, and across all of DOE's applied energy R&D programs, the expected outcome benefits are being calculated using the same fundamental methodology. Finally, the metrics by which expected outcome benefits are measured are identical for all of DOE's applied energy R&D programs.[b] This standardization of methods and metrics has been undertaken as part of the Department's efforts to respond to the Strategic Management System initiative and OMB's request to make all programs' outcomes comparable.

The difference between the baseline case and the program goal case results in economic, environmental and security benefits. For example, achievement of program goals results in avoided carbon emissions of 23 million metric tons in 2030 and 50 million metric tons in 2050. If technology targets and market expectations are met under SAI, activities are expected to result in an estimated 60 gigawatts (GW) of electric capacity additions and $8 billion in electric power industry energy savings annually by 2030, rising to 190 GW of electric capacity additions and $31 billion in electric power industry savings annually by 2050. Finally, the program would result in consumer savings of $50 billion in 2050. The results are generated by modeling the program goals within two energy-economy models: NEMS-GPRA08 for benefits through 2030, and MARKAL-GPRA08 for benefits through 2050.[c] The full list of modeled benefits appears below.

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[a] The starting point for the baseline case is the Energy Information Administration's "reference case," as published in the AEO 2006. Program analysts from across DOE examined the AEO to determine the extent to which their program goals are modeled (explicitly or implicitly). If program goals are modeled in the AEO, they are removed in the GPRA baseline. Further, some programs believe that the AEO's technology representation is too conservative, even in the absence of program goals, and thus in certain cases a modification is made to make the technology representation in the baseline case more optimistic than the AEO.

[b] The set of expected outcome metrics being used this year differs in substantial ways to that of previous years. In addition to the standardization across DOE's applied energy R&D programs, the list is expanded and more comprehensive than in past years. Further, the list maps to DOE strategic goals. The expected outcome metrics represent inherent societal benefits that stem from achievement of program goals.

[c] Final documentation on the analysis and modeling, including all of the methodologies and underlying assumptions, is expected to be completed and posted on the web by March 31, 2007. Past GPRA modeling and analysis documentation can be found at http://www.eere.energy.gov/ba/pba/gpra.html.

Program Indicators

	2010	2020	2030	2040	2050
Additional Billion MWh Generated	0	35	145	547	527
Additional GW Installed	0	16	61	206	187

FY 2008 GPRA Benefits Estimates for Solar Energy Program[a, b]

	2010	2020	2030	2040	2050
Environmental Benefits (Goal 1.2)					
Avoided carbon emissions, annual (MMTC)	0	10	23	47	50
Avoided carbon emissions, cumulative (MMTC)	2	33	177	554	1,047
Reduced cost of criteria pollutant control, NPV[c] (bil. 2004 $)	ns	ns	ns	NC	NC
Economic Benefits (Goal 1.4)					
Consumer savings, annual (bil. 2004 $)	ns	ns	ns	52	50
Consumer savings, NPV (bil. 2004 $)	ns	ns	ns	138	328
Electric power industry savings, annual (bil. 2004 $)	0	1	8	37	31
Electric power industry savings, NPV(bil. 2004 $)	0	4	28	168	291
Household energy expenses reduced, annual (bil. 2004 $)	ns	ns	ns	0.8%	0.7%
Energy intensity reduced (% change in E/GDP)	0.0%	0.2%	0.5%	1.2%	1.1%
Net energy system cost savings, annual (bil. 2004 $)	NC	NC	NC	8	9
Natural gas price change, moving avg. (2004 $ / TCF)[d]	ns	ns	ns	NC	NC
Security and Reliability Benefits (Goal 1.1 or 1.3)					
Avoided oil imports, annual (mbpd)	ns	ns	ns	0.0	0.1
Avoided oil imports, cumulative (bil. bbl)	ns	ns	ns	0.1	0.4

[a] Benefits through 2030 are calculated with the NEMS-GPRA08 model. Benefits from 2035 through 2050 are calculated with the MARKAL-GPRA08 model. "NC" indicates situations in which no calculation was done because of specific model limitations. "ns" indicates results that were "not significant"—within the noise of the models.
[b] Projected benefits do not include any potential policy changes that might enhance technology deployment. In addition, most technologies show diminishing benefits by 2050, because of the assumption built in to the analysis that baseline industry progress will eventually catch up with the more accelerated progress associated with EERE program success.
[c] Net present value calculations throughout this table are performed for cumulative economic metrics, and are done using a 3% real discount rate, cumulative to 2008.
[d] The prices reflected here are average delivered prices to all sectors, and are based on a three year moving average. Thus the measure of benefit is the change in the three year moving average delivered price, in $ per thousand cubic foot.

	2010	2020	2030	2040	2050
Security MPG improvement (%)[a]	ns	ns	ns	ns	ns
Transportation fuel diversity improvement (%)[b]	ns	ns	ns	ns	ns
Oil intensity reduced (% change in bil bbl/GDP)	ns	ns	ns	0.6%	0.8%

[a] Security MPG is the ratio of vehicle miles traveled by light duty vehicles to their usage of oil. It captures oil avoidance by efficiency and fuel alternatives.
[b] Fuel diversity is measured by the Shannon-Weiner Index (SWI) of diversity. The SWI is a measure of "proportional diversity," and hence captures both abundance and richness, i.e., how many different fuels and how much of each fuel both factor into the calculation.

Photovoltaic Energy Systems

Funding Schedule by Activity

(dollars in thousands)

	FY 2006	FY 2007	FY 2008
Photovoltaic Energy Systems			
Applied Research	26,393	28,927	24,350
Systems Development	19,668	92,925	79,720
Technology Acceptance	12,741	14,306	16,340
Technology Evaluation	0	0	14,658
SBIR/STTR	0	3,314	2,236
Total, Photovoltaic Energy Systems	58,802	139,472	137,304

Description

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

The basic building block of a photovoltaic system is the solar cell that converts sunlight into electricity. Solar cells are connected together to form modules, and the modules can be further connected together to form arrays. The modules and/or arrays are used to power electrical appliances, such as security lighting or highway signs, or feed electricity directly into the grid via inverters such as a roof-top system on a home. R&D efforts are focused on improving performance of systems (i.e. increasing efficiency) and reducing manufacturing and installation costs.

Benefits

Consistent with EPACT of 2005, Section 931, the Photovoltaic Energy Systems subprogram focuses on the development of highly-reliable PV systems with user lifetime energy costs competitive with electricity from conventional resources. The PV subprogram attempts to achieve this goal by: 1) increasing the sunlight-to-electricity conversion efficiency (performance) of cells, modules and systems; 2) reducing the manufacturing cost of cells, modules, balance of plant components, and overall systems; 3) reducing the installation, interconnection and certification costs for residential, commercial and utility systems, and 4) increasing system operating lifetime and reliability.

Photovoltaics are never sold as individual solar cells; the fundamental commercial unit is the photovoltaic module. Module size is typically one square meter with a power output of 140 Watts (W) roughly 1½ times the energy needed for the typical light bulb. The module comprises 50-60 percent of the cost of an installed PV system and presents a significant opportunity for cost savings. Current crystalline silicon power modules produced in the U.S. are approximately 13.8 percent efficient and produce electricity at 17 to 22 cents/kWh[a]. Crystalline silicon is the most mature technology and comprises greater than 90 percent of the market. New technologies have the potential for lower costs include thin films and high performance multi-junction cells for use in concentrating collectors.

To more rapidly lower costs and improve performance, the PV subprogram is accelerating and realigning its R&D activities under the Solar America Initiative (SAI) to focus on technology pathways that have the highest potential to reach cost competitiveness by 2015. New industry-led partnerships, known as "Technology Pathway Partnerships," will be funded to address the technical issues associated with each pathway. Milestones and metrics will be used in a stage-gate process to monitor progress.

The SAI strategy to reach the program's 2015 cost-competitiveness goal is to promote and compete the best technology options. Following a stage gate evaluation process significant funding will be expended only on those technology pathways that have the most potential and can produce tangible results. This strategy is aimed to maximize public funding benefits while increasing the chance of achieving program goals.

PV activities will be coordinated with the Office of Science, Office of Electricity Delivery and Energy Reliability, the Building Technologies Program and the Federal Energy Management Program (FEMP). The Solar Program is working with the Office of Science to coordinate the Department's basic research activities that are crucial to addressing fundamental technical problems associated with current technologies, as well as new 3rd and 4th generation technologies such as polymers, organics and nano-technologies. This coordination will be documented in the DOE Solar Energy National Solar Action Plan, September 2007. Likewise, closely coordinated planning and research with the Building Technologies Program's zero energy buildings activities will lead to PV products that are easily integrated in new and existing building designs. The Solar Program will work with FEMP to seek Federal deployment opportunities for PV systems. Coordinating this research with other Federal offices both ensures the most efficient use of resources and the best opportunity for the Department to achieve its goals.

For FY 2008, the PV subprogram's priorities are:

- Align R&D activities to concentrate on the most promising technology pathways and market acceptance activities.
- Produce R&D results and meet all technical milestone commensurate with the first full year of industry-led multi-year 50-50 cost-shared contracts under competitive solicitations to reduce costs. The Technology Pathway Partnerships and Technology Acceptance activities will include teams with industrial, university, National Laboratory, and/or state agency partners.
- Work closely with the Office of Science and the Building Technologies Program on the scientific, technical, and strategic issues that limit PV performance and application. Improved understanding of the scientific underpinnings of PV materials and devices, deposition and fabrication processes, and the optimal methods for fitting PVs to buildings—ultimately providing a key component of the zero energy buildings—will help the Solar Program achieve its goals.

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[a] Data from 2006. Lifetime system user cost over 30 years in areas with a wide range of favorable conditions. Costs could be greater in certain areas depending upon climate and financing available.

- Advance module and system manufacturing technologies to achieve higher performance and lower-cost products with faster throughput.

- Continue systems reliability research to increase the lifetime of thin-film modules and the mean time to failure of DC-to-AC current inverters for low-cost, grid-tied distributed PV systems.

Increasing module efficiency is a critical component to lowered system production costs (per Watt) and successful entry of PV systems into energy markets. Although a main focus of SAI is on reducing system costs and improving manufacturing processes through industry-led consortia, module efficiency levels remain an important component of lowering the cost of energy from PV systems.

U.S.-Produced PV Module Efficiency Targets and Actuals

(Conversion Efficiency (%))

	Historic				Planned					
	2003	2004	2005	2006	2007	2008	2009	2010	2011	2015
Efficiency										
Target	12.5	13.0	13.5	13.8	14.5	15.5	16.0	16.5	17.0	20.0
Actual	12.5	13.0	13.5	-	-	-	-	-	-	-

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

Historic and Projected Solar Energy Costs

	Historic				Planned					
	2003	2004	2005	2006	2007	2008	2009	2010	2011	2015
Manufacturing Cost PV Modules ($/Watt)										
Target	2.10	1.95	1.95[a]	1.90	1.80[b]	1.70	1.60	1.50	1.40	1.00
Actual[c]	2.10	1.95	1.92	-	-	-	-	-	-	-

[a] PV cost targets were adjusted for 2005 and outward due to verification processes. No technical targets were changed but the target verification process caused the stated targets to slip one year due to availability of market data.
[b] Outyear cost targets have been modified based on recent increases in material costs (e.g., silicon).
[c] "Actual" cost data represents the lowest costs reported by a major U.S. module manufacturer during an annual manufacturing survey.

	Historic				Planned					
	2003	2004	2005	2006	2007	2008	2009	2010	2011	2015
Cost of Power from PV Modules ($/kWh) [a]										
Target	0.19-0.24	0.18-0.23	0.18-0.23	0.17-0.22	0.16-0.27	0.14-0.23	0.12-0.20	0.10-0.18	0.09-0.16	0.05-0.10
Actual	0.19-0.24	0.18-0.23	0.18-0.23	-	-	-	-	-	-	-

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 an internal multi-year program planning (MYP) process. These exercises guided program budget planning, management decisions, and performance goals and targets.

Detailed Justification

	(dollars in thousands)		
	FY 2006	FY 2007	FY 2008
Applied Research	**26,393**	**28,927**	**24,350**

Applied Research is essential to the advancement of photovoltaic technology to meet the Solar Program's accelerated goal of making solar electricity cost-competitive by 2015. The activity's main emphasis is on cross-cutting research focused on semiconductor material, device and processing issues that benefit multiple companies and/or technologies. Applied Research supports the SAI through laboratory and university research that addresses the needs of the industry-led partnerships. Key to this support are the research activities in the new Process Development Integration Laboratory (PDIL) within the Science and Technology Facility (S&TF) at NREL. The research conducted in these laboratories is designed to shorten the time lag between laboratory bench results and the introduction of commercial product. In the PDIL, laboratory researchers will work side-by-side with industry researchers to improve larger-scale processing of thin films and crystalline silicon. The Solar Program is also working with the Office of Science (OS) to help coordinate and accomplish OS's basic and EERE's applied solar research needs.

[a] Cost of power is expressed in ranges due to the diversity of PV module applications. The low end of costs reflect commercial applications under good conditions, such as advantageous financing terms and sunny locations, while the higher end of the range is more common in residential applications. Costs could be impacted by changing key factors, such as interest rates, labor costs, raw material costs, Federal, State and local incentives, global deployment efforts, and geography of installation. The Solar Program has a better sample of data across U.S. installations and has used it to calibrate our cost analysis tool. This has resulted in higher cost estimates for residential PV installations.

In the re-organized Applied Research area there will be three main research activities performed in FY 2008: the University and Exploratory Research Project, the High Performance Project, and the Electronic Materials and Devices research activity. The Measurements and Characterization research activity (previously in Fundamental Research) has been moved into a new PV area called Technology Evaluation. These changes will provide more focused support to the SAI.

The University and Exploratory Research Project works on cross-cutting research to help solve fundamental scientific problems associated with all PV materials and devices, as well as investigating innovative ideas that may lead to next-generation technologies. The high-risk research on the next-generation technologies opens the door to new solutions and concepts that could dramatically improve cost effectiveness in the mid- to long-term. In FY 2008, two competitive solicitations will be issued for universities, one to conduct research in support of the SAI Technology Pathway Partnerships and a second for research on next-generation technologies. This research is primarily designed to help achieve the SAI 2015 goals, but the university research on longer-term, next generation technologies will also provide industry with pathways for even lower cost solutions in the post-2015 timeframe.

The High Performance project supports research to substantially increase the efficiency of two promising next-generation technologies: 1) monithically inconnected multi-junction thin films; and 2) high-efficiency multi-junction concentrating cells. In FY 2008, these three-year contracts with industry will be completed. All future work on in this area will be conducted through the competitive solicitations mentioned above under the University and Exploratory Research project.

Electronic Materials and Devices is a core laboratory research activity that is cross-cutting and supportive of all technologies. The Electronic Materials and Devices Project carries out research in semiconductor materials, device properties, and fabrication processes to improve the efficiency, stability, and cost of photovoltaic solar energy conversion. This research supports technology in near, mid- and long-term time frames. Applied research includes collaborative assistance to industry in solving current problems, exploration of specific techniques and processes to develop improvements that industry needs, and creating new, next-generation technologies with lower costs to open larger markets for PV. Through these activities the project supports both flat-plate and concentrator PV technologies at the cell and module level, as well as next-generation technologies. Most of these research activities will be conducted in the Science and Technology Facility (S&TF) in support of the Technology Pathway Partnerships (TPPs).

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

	(dollars in thousands)		
	FY 2006	FY 2007	FY 2008
Systems Development	**19,668**	**92,925**	**79,720**

The Systems Development activity works primarily through cost-shared contracts with industry to advance the development of PV systems and components. This activity has two primary projects, the Technology Pathway Partnerships (TPPs) and Component Development. The Technology Pathway Partnerships project will build on the industry sub-contracts funded under the Component Development Project, which are due for completion in FY 2008.

The industry-led Technology Pathway Partnerships will execute projects segmented into three manageable three-year phases, with new funding opportunities released at the completion of each phase – for both continuing teams and new applicants. These phases will progressively reduce the cost of commercially-available PV systems and components, and will ultimately yield commercial products and production processes that achieve the LCOE and support installed capacity targets by 2015.

Funding for R&D projects during the first of these phases is being offered through a Funding Opportunity Announcement (FOA) that was issued in FY 2007. This FOA solicited partnerships with U.S. industry for projects that focus on development, testing, demonstration, validation, and interconnection of new PV components, systems, and manufacturing equipment. In addition to PV industry members, potential team members within the Technology Pathway Partnerships include builders, universities, National Laboratories, States and other entities.
Partnerships will develop new PV solutions for the residential, commercial, and utility market sectors of grid-tied electric power. These are described as follows:

> Residential Rooftop Market: Typically mounted on rooftops and range in size from under 1kW to 10kW, most commonly in the 3 – 4 kW range. These systems are connected to the grid on the retail (customer) side of the utility meter. These systems can be retrofitted onto existing homes or integrated into new construction through building-integrated PV (BIPV) designs.
>
> Commercial Rooftop Market: Typically mounted on the large flat roofs of commercial, institutional, and industrial buildings, ranging in size from less than 10kW to 500kW and connected on the retail side of the utility meter. Retrofits and BIPV are possible applications in this market as well.
>
> Utility Market: Large-scale (multi-megawatt) systems that displace conventional utility generated intermediate load electricity (e.g. natural gas CCT plants) on a wholesale basis. Typical utility PV systems are ground-mounted and range in size from 1MW to10MW, although much larger systems are possible. Designs include both fixed and tracking configurations.

Under the Technology Pathway Partnerships, key photovoltaic technologies which have the greatest potential for cost-competitiveness by 2015 will be selected for development. Examples of promising PV technologies include crystalline silicon modules and systems and thin film modules and systems. Other component and system technologies could be selected as well. SAI partnerships will also consider development and testing of balance-of-system component designs that address emerging requirements for modularity, interface standardization, reliability, and decreased installation cost.

In order to focus industry-led teams on the technology improvements that they are best-prepared to address, the Partnerships will include two "classes" of varying technical scope and funding level:

Systems Class projects (Integrated systems) - These larger projects will address multiple technology improvements in PV system and component design, integration, and installation.

Subsystems Class projects (Component-based/cross-cutting) – These smaller projects will focus on fewer technology developments to improve PV systems.

Both Systems Class and Subsystems Class projects will be required to demonstrate the benefits of a project on system-level LCOE and installed capacity. New PV components and systems developed through these projects will be required to meet all applicable codes, standards, and environment, safety, and health regulations.

The Component Development activity will use industry, laboratories and universities to help advance the state-of-the-art of individual components as opposed to fully integrated systems development which is the main emphasis of the Technology Pathway Partnerships. There are four project activities under Component Development: The Thin Film Partnerships, Advanced Module Manufacturing, Module Packaging, and Inverter and Balance of System (BOS) development.

To accommodate SAI, the Thin Film Partnership and Advanced Manufacturing R&D cost-shared contracts with industry will be brought to successful completion in FY 2008. All work considered valuable under these two activities will have been recompeted under the Technology Pathway Partnership solicitations.

The existing Thin Film Partnership Program has maintained strong research teams to focus R&D on promising thin-film technologies. These research teams are comprised of university, industry, and laboratory researchers who work to solve generic issues as well as industry specific problems. In FY 2008, the program will be brought to conclusion by completing the final year of the three-year cost-shared contracts.

In Advanced Manufacturing R&D, partnerships with the domestic PV industry were formed with the goal of reducing costs, and increasing efficiency and manufacturing capacity to help enhance industry's competitiveness. University, industry, and National Laboratory researchers have worked to identify deficiencies and develop solutions that will improve sunlight-to-electricity conversion efficiencies, while lowering manufacturing costs. In FY 2008, the final year of the PV Manufacturing R&D three-year 50-50 cost-shared subcontracts will be brought to conclusion.

In the Module Packaging activity, researchers will work to solve reliability issues such as degradation mechanisms and intrinsic instabilities of pre-commercial thin film modules, and to improve packaging for 30-year outdoor lifetime. This important activity will continue to strongly support the Technology Pathway Partnerships.

Inverter and Balance of System (BOS) development focuses on the critical need to improve the reliability of the inverter and other BOS components. Emphasis is placed on reducing life-cycle costs by increasing mean-time-between-failure (MTBF) of inverters and battery charge controllers, by developing higher performance technologies through advanced solutions to thermal management and surge protection, and by optimizing designs to achieve "plug and play" ability.

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

Technology Acceptance	**12,741**	**14,306**	**16,340**

All of the work under Technology Acceptance is focused on achieving the cost competitiveness of solar energy technologies, by minimizing market barriers to solar commercialization and promoting opportunities for solar technology market penetration.

The first area of work involves codes and standards. The Solar Program will continue to fund the Solar Codes and Standards Working Group, the State & Regional Code Proceedings Team, and the National PV Module Performance Rating System efforts, each in the second year of funding. Areas of work include providing assistance on interconnection standards, building codes and net metering regulations; developing and promoting national module performance rating systems. DOE will work closely with many stakeholders in this area, including State and local governments, the solar manufacturing community, non-profits, and others.

Secondly, the program will continue to fund activities supporting the training and certification of solar installers and code officials, and working to create a sufficiently large and qualified workforce that can install PV systems in sufficient quantities to meet the goals of the SAI.

The third area of work involves building integration and system finance activities. The Solar Program will continue to coordinate with the Building Technologies Program in the areas of building-integrated photovoltaics (BIPV), solar system finance and Zero Energy Buildings (ZEB). Activities will seek to more fully integrate PV into buildings by working with building and solar industry sector stakeholders. Input from ZEB activities will also provide insight into how best to integrate PV technologies into building designs in order to maximize cost-effective energy production. Also within this area of work is the Solar Decathlon, a high-profile university competition held biannually in Washington, D.C., that promotes awareness of solar energy technologies among the general population and encourages incorporation of solar technologies into engineering and architecture school curricula. In system finance, the results of the comprehensive financing study conducted in FY 2007 should be available in FY 2008, and the recommendations from that study will inform the program's course of action in this area.

In the fourth area, technical partnerships and demonstrations, the program will focus on providing technical assistance (but not hardware purchases) to large-scale, high-visibility installations, such as new building communities, big box retailer installations, and utility-scale solar. Two activities entering their second year will be the Solar America Cities activity (formerly City Strategic Partnerships) and Solar America Showcases. Both activities involve partnerships between DOE and stakeholders to leverage the advanced solar efforts occurring throughout the U.S. on a local level. The Solar America Cities activity features assistance to U.S. cities that have committed to solar, while the Solar America Showcases effort provides technical assistance to companies, States, and other entities for large-scale, high-visibility solar projects.

The fifth and final area of Technology Acceptance features technical outreach and communications activities. Efforts here include the second year of both the Utilities Technical Outreach activity and the State Technical Outreach activity, both begun in FY 2007. The purpose of these activities is to provide technical information on solar technologies and related topics (interconnection) to utilities and States as needed. Technology Acceptance also includes the communication and international activities of the Solar Program. Communications, education and outreach activities are necessary to increase user acceptance and communicate advancements in a rapidly changing energy sector. In FY 2008, such activities will be targeted at select stakeholder groups to best promote the SAI and achieve high return for each dollar invested.

	FY 2006	FY 2007	FY 2008
Technology Evaluation	**0**	**0**	**14,658**

Technology Evaluation is a new activity area for FY 2008 that contains no new R&D work, but rather contains ongoing activities transferred from the other three PV areas. By combining all evaluation activities into a single subtask, greater efficiency will be obtained.

Technology Evaluation activities focus on evaluation of technical advances throughout the Solar Program using independent testing and analysis, including the evaluation of ongoing system-level progress of the Technology Pathway Partnerships. Technology Evaluation activities also include the development of models that predict system performance and cost based on industry data and data taken from systems operating throughout the country. Also included are detailed analysis of industry's technology, manufacturing capability, and business plans. Many of these technical evaluation activities will be used to conduct the necessary stage-gate reviews and periodic downselects critical to the success of the SAI.

Technology Evaluation will contain three primary activities: Systems Analysis, System Test and Evaluation, and Component Test and Evaluation.

System Analysis activities will continue benchmarking, modeling and analysis for the systems driven approach. Also included are market, value and policy analysis necessary to support the SAI.

Systems Test and Evaluation activities will focus on the critical need to test and evaluate all the deliverables developed under the Technology Pathway Partnerships. The information will be used to determine if the Partnerships are meeting their milestones and goals on time. This independent testing activity will provide the data necessary to conduct stage-gate reviews and periodic downselects as the SAI proceeds through its series of competitive phases. The Systems Test and Evaluation activity also includes laboratory R&D to help reduce the cost of installed systems and

	(dollars in thousands)	
FY 2006	FY 2007	FY 2008

improve their reliability (because the Systems Engineering and Reliability activity formally under Technology Development has been folded into the new Systems Test and Evaluation activity). The laboratory R&D emphasizes 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.

In FY 2008, performance evaluation of thin-film systems will be conducted in the field by the Regional Experiment Stations (RESs) to compare against benchmark data in both hot, humid climates representative of the southeastern U.S. and hot, dry climates representative of the southwestern U.S. Accelerated lifetime testing in the laboratory will be conducted in parallel of the field testing. Any failures found in the field or in the laboratory will be analyzed to determine the degradation mechanisms. Work at the RESs will also continue to improve the reliability of distributed grid-tied systems, especially in the buildings sector.

The Measurements and Characterization activity, formerly under Applied Research, has been transferred to this area and now comprises the new Component Test and Evaluation activity. Under the Component Test and Evaluation activity, researchers work in partnership with universities, industry and the National Laboratories to improve the efficiency of cell materials and devices by investigating their fundamental properties and operating mechanisms. This teamed research approach identifies efficiency-limiting defects in cell materials and analyzes their electrical and optical properties. In FY 2008, the Component Test and Evaluation activity will focus its efforts on supporting the new Technology Pathway Partnerships under Systems Development. Researchers will work with the partnerships to improve the understanding of materials, impurities and defects and their impact on device performance and reliability.

SBIR/STTR	**0**	**3,314**	**2,236**

In FY 2006, a total of $1,023,000 was transferred to the SBIR program and $142,000 to the STTR program. The FY 2007 and 2008 amounts shown are estimated requirements for the continuation of the SBIR and STTR program.

Total, Photovoltaic Energy Systems	**58,802**	**139,472**	**137,304**

Explanation of Funding Changes

	FY 2008 vs. FY 2007 ($000)
Applied Research	
Applied Research will undergo realignment in FY 2008 as much of the Measurements and Characterization activity is transferred to the Component Test and Evaluation activity under Technology Evaluation.	-4,577
Systems Development	
Systems Development will be reduced in funding because the contracts under the Thin Film Partnership Program and the Advanced Manufacturing R&D project will be completed. Also, the module and systems test and evaluation activities previously under this area, Systems Development, have been transferred to the Technology Evaluation activity.	-13,205
Technology Acceptance	
Market Transformation activities will be increased to meet the SAI market goal of achieving cost-competiveness for solar by 2015. Specific activities will include the addition of more cities under the more expansive Solar America Cities activity, and the development of a new solar financing activity.	+2,034
Technology Evaluation	
Technology Evaluation is a new activity area starting in FY 2008. It contains no new R&D work, but rather contains ongoing activities transferred from the other three PV areas: Measurements and Characterization from Applied Research; Systems Engineering and Evaluation from Systems Development; and systems analysis activities from Technology Acceptance.	+14,658
SBIR/STTR	
Changes in the SBIR/STTR funding are a direct result of changes in the funding of program activities.	-1,078
Total Funding Change, Photovoltaic Energy Systems	**-2,168**

Concentrating Solar Power

Funding Schedule by Activity

	(dollars in thousands)		
	FY 2006	FY 2007	FY 2008
Concentrating Solar Power	7,284	8,720	8,874
SBIR/STTR	0	180	126
Total, Concentrating Solar Power	7,284	8,900	9,000

Description

Consistent with Sections 931 and 934, EPACT of 2005, the Solar Program will develop concentrating solar technologies that address market barriers for generating electricity and fuels. Concentrating solar power (CSP) systems utilize the heat generated by concentrating and absorbing the sun's energy to produce electric power. The concentrated sunlight produces thermal energy to run heat engines or steam turbines for generating power or producing clean fuels such as hydrogen. Although CSP plants can be configured in all sizes, they are most cost effective when they produce greater than 100 MW. Therefore, CSP systems are strong candidates for centralized power applications by utilities.

The Solar Program is working with industry on the development of parabolic trough and dish-engine systems. Trough systems use linear parabolic concentrators to focus the sun's radiation on a receiver located at the focus of the parabola, producing temperatures of about 390ºC. Dish-engine systems comprise a parabolic dish concentrator, a thermal receiver, and a heat engine/generator. The heat engine/generator, located at the focus of the dish, operates at over 790ºC to generate power.

Trough systems are best suited for large-scale power applications (30 - 200 MW plants) and have the valuable attribute of dispatchability due to their use of thermal storage. Dish-engine systems are well suited for distributed mini-grid applications ranging in size from 2 to 25 kilowatts (kW), but can also be configured for large power applications in the hundreds of megawatts. The prospects for CSP brightened considerably the last two years with the completion of a 1 MW trough plant in Arizona, construction of a 64 MW trough plant in Nevada, and the initiation of several projects in California that, if built, would become the largest solar power plants in the world.

Benefits

The CSP subprogram contributes to the overall program goal by developing energy supply technologies that are reliable, affordable, and environmentally sound. Expanding the national electricity generation fuel portfolio will increase energy security by diversifying domestic energy supply options for use both in normal and emergency situations. In addition, CSP plants can be placed so as to relieve the transmission congestion problem.

The subprogram has benefited from several rigorous technology reviews which have established CSP as one of the most attractive renewable energy options in the U.S. Southwest, with a cost target of $0.09-

0.11/kWh by 2012 and the possibility of eventually achieving $0.035-0.062/kWh.[a] Utilities have indicated CSP will become a serious option for them when its cost is below $0.09/kWh.

The CSP performance metric focuses on system efficiency, which is defined as the annual solar-to-electricity conversion efficiency of the entire CSP system. This measure reflects the technical progress in certain activities funded by the Solar Program, allows for simple verification and validation of results, and minimizes the potential for target achievement disruption or overstatement caused by market factors beyond the program's control.[b] Of equal importance to the public is the cost of energy, as the cost of energy is seen in the consumers' bills and the producers' cost in a competitive market. Therefore, the program uses cost as its metric for accountability in the PART process.

Similar to the relationship between conversion efficiency of PV modules and PV electricity cost, CSP system efficiency correlates strongly with the cost of CSP produced electricity. As with PV efficiency measures, CSP system efficiency measures are by no means the exclusive factor affecting cost, but provide a valuable method of tracking technical progress. The Solar Program will continue to track cost data, as cost measures remain useful indicators of market trends and assist the program in responding to a changing marketplace. Therefore, the program is using a combination of targets for its work that emphasizes technical accomplishments, but maintains a strong connection to modeled, or projected, cost of energy from CSP.

U.S.-Produced Parabolic Trough System Efficiency Targets and Actuals

	Historic				Planned					
	2003	2004	2005	2006	2007	2008	2009	2010	2011	2015
Annual Solar-to-Electric Conversion Efficiency (%)										
Target	n/a	n/a	n/a	11.9	13.1	13.4	13.7	14.0	14.2	14.6
Actual	11.1	11.9	11.9	11.9	-	-	-	-	-	-

The Solar Program uses the below historical cost data and projections as indicators of progress toward achieving program benefits.

[a] R. Charles, et al., "Assessment of Parabolic Trough and Power Tower Solar Technology Cost and Performance Forecasts," Sargent & Lundy Consulting Group, SL-5641, May 2003.
[b] Market factors outside the program's control that could affect the achievement of cost goals include, but are not limited to, raw material costs, labor costs, currency exchange rates, interest rates, inflation, foreign competition, state and local regulations, and market participant withdrawals or entries.

CSP Solar Energy Cost Targets and Actuals[a]

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

Detailed Justification

(dollars in thousands)

	FY 2006	FY 2007	FY 2008
Concentrating Solar Power	**7,284**	**8,720**	**8,874**

Parabolic trough R&D will include the development of a more efficient thermal receiver and a lightweight solar collector. In addition, the test of a single tank thermocline energy storage system begun in FY 2007, will be evaluated and compared against a two-tank storage system. Utilities are particularly interested in trough technology because of its ability to store energy. Storage mitigates the intermittency of the solar resource, increases the time by which the trough system can produce electricity (i.e., capacity factor) and increases the value of the electricity. The addition of 12 hours of storage, for example, increases the capacity factor from 22 percent to 56 percent. Thus, CSP plants can be designed to meet either peaking power needs or base load power requirements depending on the size of the thermal storage system. Most importantly, storage enables utilities to dispatch energy into the electrical grid when they need it most. In addition, technical support will be provided for the 64 MW trough project in Nevada, which is the largest solar power plant built since 1990.

The focus of Dish/engine R&D will be on assisting industry in developing its 1 MW project in California. This will be the largest solar dish-engine array ever built and, if successful, could be the precursor to several much larger plants. Efforts will focus on engineering solutions to reliability issues related to the Stirling engine (e.g., valves, seals and controls) while gaining valuable experience on the operation of multiple dishes in a power plant configuration. Researchers will also work with industry to improve the manufacturability of dish systems in preparation for upcoming projects

The Solar Program will provide technical and economic analysis in support of the Western Governors Association (WGA) initiative to install 1,000 MW of CSP in the U.S. Southwest within the next ten years. In addition, the Program will provide technical information to utilities on an as-needed basis.

[a] In this table, years indicate the years in which field verification of modeled cost occurs.

	FY 2006	FY 2007	FY 2008
(dollars in thousands)			
SBIR/STTR	**0**	**180**	**126**

In FY 2006, a total of $141,000 was transferred to the SBIR program and $0 to the STTR program. The FY 2007 and 2008 amounts shown are estimated requirements for the continuation of the SBIR and STTR program.

	FY 2006	FY 2007	FY 2008
Total, Concentrating Solar Power	**7,284**	**8,900**	**9,000**

Explanation of Funding Changes

	FY 2008 vs. FY 2007 ($000)
Concentrating Solar Power	
Increased funding will be applied to the thermal storage project.	+154
SBIR/STTR	
Changes in the SBIR/STTR funding are a direct result of changes in the funding of program activities.	-54
Total Funding Change, Concentrating Solar Power	**+100**

Solar Heating and Lighting Systems

Funding Schedule by Activity

	(dollars in thousands)		
	FY 2006	FY 2007	FY 2008
Solar Heating and Lighting Systems	1,449	0	1,972
SBIR/STTR	0	0	28
Total, Solar Heating and Lighting Systems	1,449	0	2,000

Description

Consistent with Section 931, EPACT of 2005, the solar program will develop solar hot water and space heating technologies. This activity represents an increased collaboration between the Solar Technologies and Building Technologies Programs to integrate solar technologies into Zero Energy Buildings (ZEB). Specifically, this work will address the integration of photovoltaic systems, solar water heating, and solar space heating into home design and structure. The role of the Solar Technologies Program will continue to include research and development on solar technologies meant to be placed on a building. However, the solar technologies will be analyzed and designed in the context of the building's structure and energy requirements. The role of Buildings Technologies will be to provide those requirements and assist in those areas where integration is required, such as, system requirements, efficiency opportunities, roof integration approaches and HVAC control interfaces. Integration would also be required when the solar energy system replaces part of the building's structure. This activity will establish cost goals for the solar technologies that are consistent with Building Technologies' ZEB goal.

In the past, the Solar Heating and Lighting Systems (SHL) subprogram developed solar water heating and hybrid solar lighting technologies for residential and commercial buildings in collaboration with industry partners. The program achieved most of its research goals and those technologies were sufficiently developed that they were transferred to industry for commercialization. New Solar Water Heating tasks will be developed based on a strategic plan for the wider deployment of the technology. In addition, based on a systems analysis being done in collaboration between the Solar Technologies and Buildings Technologies Programs, a new set of cost goals and proposed tasks for building integrated solar systems will be developed. One concept that will undergo evaluation in FY 2008 is a hybrid electrical/thermal solar system. In order to provide all the electrical and thermal energy required for a zero energy home on an average sized roof, a hybrid system may sometimes be required. Such a system would minimize the roof area dedicated to the solar system and could result in an overall reduction in the cost of the building's solar energy. It would provide electrical power and thermal energy used for water and/or space heating. Another activity will address the development of solar water heaters for freezing climates, which complements previous R&D on development of a solar water heater applicable to non-freezing climates.

Benefits

The objectives of this activity are to provide solar technology that can provide the thermal energy needed for a zero energy building and to coordinate with the Buildings Technologies Program the integration of solar technologies (thermal and electric) into a zero energy home. Benefits specific to this activity would be associated with energy savings due to solar technology that provides water heating and space heating.

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

Detailed Justification

	(dollars in thousands)		
	FY 2006	FY 2007	FY 2008
Solar Heating and Lighting Systems	**1,449**	**0**	**1,972**

Analytical work done in conjunction with the Building Technologies Program will establish the most beneficial areas of solar heating R&D to be conducted by the Solar Program. A promising concept is a hybrid solar electric/thermal system sized for an average single-family home. Conceptual designs will be developed of hybrid systems will be developed to provide electricity, water heating, space heating, and possibly space cooling. R&D will include the development of a low-cost polymer water heater capable of operation in freezing climates. Tasks in hybrid solar lighting will be dependent on a stage-gate evaluation of the technology. Possible tasks include redesign of the mirror, redesign of the fiber-receiver, and refurbishing field projects that failed to operate properly due to overheating of the fiber optics.

	FY 2006	FY 2007	FY 2008
SBIR/STTR	**0**	**0**	**28**

In FY 2006, a total of $15,700 was transferred to the SBIR program and $0 to the STTR program. The FY 2008 amount shown is the estimated requirement for the continuation of the SBIR and STTR program.

	FY 2006	FY 2007	FY 2008
Total, Solar Heating and Lighting Systems	**1,449**	**0**	**2,000**

Explanation of Funding Changes

	FY 2008 vs. FY 2007 ($000)
Solar Heating and Lighting Systems	
No funds were requested for this activity in FY 2007 as the program had achieved most of its research goals. New funding will concentrate on initiatives to accelerate cost-competitive applications of solar heating and lighting systems in zero energy buildings.	+1,972
SBIR/STTR	
Changes in the SBIR/STTR funding are a direct result of changes in the funding of program activities.	+28
Total Funding Change, Solar Heating and Lighting Systems	**+2,000**

Congressionally Directed Activities

Funding Schedule by Activity

	(dollars in thousands)		
	FY 2006	FY 2007	FY 2008
Congressionally Directed Activities	14,256	0	0
Total, Congressionally Directed Activities	14,256	0	0

Description

In general, Congressionally Directed activities do not support program goals because such activities do not result from the program's multi-year planning effort, which is focused on overcoming technical barriers.

In FY 2006, there were 12 Congressionally Directed activities funded out of the Solar Energy Program. The program does not request any funds to continue these projects as they do not further the achievement of DOE's goals. The following projects were directed by Congress to be included in this program.

Detailed Justification

	(dollars in thousands)		
	FY 2006	FY 2007	FY 2008
Photonics Research and Development, UNLV	**2,475**	**0**	**0**

In FY 2006, the U.S. Congress directed funds to assist the University of Nevada – Las Vegas with photonics research and development activities.

Conductive Coatings for Solar Cells Project	**1,485**	**0**	**0**

In FY 2006, the U.S. Congress directed funds to assist with conductive coatings for solar cells activities.

Rensselaer Polytechnic Institute Syracuse University "Green Building"	**742**	**0**	**0**

In FY 2006, the U.S. Congress directed funds to assist Rensselaer Polytechnic Institute (RPI), in Troy, New York, and Syracuse University, in Syracuse, New York, with "green building" activities.

(dollars in thousands)	FY 2006	FY 2007	FY 2008
Crowder College Alternative Renewable Energy Center	**990**	**0**	**0**

In FY 2006, the U.S. Congress directed funds to assist Crowder College, in Neosho, Missouri, in solar energy activities within the college's alternative renewable energy center.

University of Arkansas Research in Solar Energy Field	**495**	**0**	**0**

In FY 2006, the U.S. Congress directed funds to assist the University of Arkansas with solar energy activities.

Oregon Nanoscience and Microtechnologies Institute	**1,485**	**0**	**0**

In FY 2006, the U.S. Congress directed funds to assist the Oregon Nanoscience and Microtechnologies Institute in their research and commercialization efforts to accelerate innovation-based economic development in Oregon and the Pacific Northwest.

Ultra Thin-Film Photovoltaic Charging System	**990**	**0**	**0**

In FY 2006, the U.S. Congress directed funds to assist Coherent Systems International Corporation, in Tampa, Florida, with ultra thin-film photovoltaic charging system research activities.

Brightfield Solar Energy	**693**	**0**	**0**

In FY 2006, the U.S. Congress directed funds to assist the city of Brockton, Massachusetts with ongoing "brightfield" solar activities.

National Orange Photovoltaic Demonstration	**446**	**0**	**0**

In FY 2006, the U.S. Congress directed funds to assist the National Orange Show Events Center, in San Bernardino, California, with photovoltaic demonstration activities.

Sandia National Lab Development Of Advanced Cells and Modules	**990**	**0**	**0**

In FY 2006, the U.S. Congress directed funds to assist Sandia National Laboratory in the development of advanced photovoltaic cells and modules.

Sandia National Lab Megawatt Demonstration Concentrating Solar Project	**3,465**	**0**	**0**

In FY 2006, the U.S. Congress directed funds to assist Stirling Energy Systems in the deployment of a 1-megawatt concentrating solar power system at or near Sandia National Laboratory.

Total, Congressionally Directed Activities	**14,256**	**0**	**0**

Wind Energy

Funding Profile by Subprogram

	(dollars in thousands)		
	FY 2006 Current Appropriation	FY 2007 Request	FY 2008 Request
Wind Energy			
Technology Viability	17,829	35,905	27,200
Technology Application	7,634	7,914	12,869
Congressionally Directed Activities	12,870	0	0
Total, Wind Energy	38,333	43,819	40,069

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. 102-486, "Energy Policy Act (EPACT)" (1992)
P.L. 109-190, "Energy Policy Act" (2005)

Mission

The mission of the Wind Energy Program is to lead the Nation's research and development efforts to improve wind energy generation technology, enhance domestic economic benefit from development, and to address barriers to the use of wind energy in coordination with stakeholders, resulting in greater energy security and a cleaner and more diversified electricity supply.

Benefits

The Wind Energy Program's mission and activities contribute directly to EERE's and DOE's mission of improving national, energy and economic security and address the call set forth by the President's National Energy Policy, the Advanced Energy Initiative and the Energy Policy Act of 2005 for increasing the diversity of our Nation's energy resources.

The program graduated its high speed wind effort, and since 2002, has focused most of its research expenditures on low wind speed technologies to enable greater penetration of wind energy installations closer to load centers. In addition, through its public/private partnerships, the program has improved the cost of energy for large systems in Class 4 land-based winds from $0.055/kWh in 2002 to $0.039/kWh in 2006, based on modeling of a composite turbine that includes improved and new technology, using assumptions tied to the 2002 baseline.[a]

[a] Goals using Cost of Energy are tracked to a fixed technology baseline that reflects a set of standard financial and technology assumptions for each technology (Land-based (onshore), Offshore and Distributed Wind Technologies). Cost of energy targets differ from actual market conditions, as baseline technology assumptions do not include such factors as the on and off nature of the Production Tax Credit that leads to turbine demand spikes; changing financial variables; fluctuating commodity prices and currency exchange rates; and changes in expected equipment life.

Since 2000, wind energy has demonstrated significant expansion and promise as an affordable energy supply, increasing from about 2.5 GW to nearly 11 GW by the end of 2006. Dramatic growth has occurred on an annual percentage basis.

The program is concentrating on improving cost, performance and reliability of large scale land-based technology; facilitating wind energy's rapid market expansion by anticipating and addressing potential barriers (i.e., integrating wind into the electric transmission system, siting, permitting, environmental issues); and investigating wind energy's application to other areas -- from offshore wind technology to distributed and community-owned wind projects. New opportunities will be explored in water treatment and transport and hydrogen applications to help contribute to transportation fuel supplies.

The program's new focus aims to significantly increase wind energy use, thereby increasing and diversifying the domestic energy supply, boosting environmental benefits by avoiding pollutant emissions, and strengthening the Nation's infrastructure posture by reducing economic effects of fuel price or supply disruptions while increasing system reliability.

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

Strategic and GPRA Unit Program Goals

The Department's Strategic Plan identifies five Strategic Themes (one each for nuclear, energy, science, management, and environmental aspects of the mission) plus 16 Strategic Goals that tie to the Strategic Themes. The Wind Energy Program supports the following goal:

Strategic Theme 1, Energy Security

Strategic Goal 1.1, Energy Diversity: Increase our energy options and reduce dependence on oil, thereby reducing vulnerability to disruptions and increasing the flexibility of the market to meet U.S. needs.

And concurrently supports:

Strategic Goal 1.2, Environmental Impacts of Energy: Improve the quality of the environment by reducing greenhouse gas emissions and environmental impacts to land, water, and air from energy production and use.

Strategic Goal 1.3, Energy Infrastructure: Create a more flexible, more reliable, and higher capacity U.S. energy infrastructure.

The Wind Energy Program has one GPRA Unit Program goal which contributes to Strategic Goals 1.1, 1.2, and 1.3 in the "goal cascade:"

GPRA Unit Program Goal 1.1.04.00: Wind Energy - The goal of the Wind Program is to enable wind to compete with conventional fuel throughout the Nation, creating a clean renewable energy option. We accomplish this through technology research and development, collaborative efforts, technical support and outreach to overcome barriers in energy cost, energy market and infrastructure rules and energy sector acceptance.

Contribution to GPRA Unit Program Goal 1.1.04.00 (Wind Energy)

The Wind Energy Program's key contribution to Strategic Theme 1, Energy Security, is through supply growth and diversification of energy resources. Key technology pathways that contribute to achievement of these benefits include (annual performance indicators are provided in the individual technology benefits narrative):

- Low Wind Speed Technology (LWST):[a]
  - By 2012, reduce the cost of electricity from large wind systems in Class 4 winds to \$0.036/kWh for land-based systems (from a baseline of \$0.055/kWh in 2002);
  - By 2014, reduce the cost of electricity from large wind systems in Class 6 winds to \$0.07/kWh for shallow water (depths up to 30 meters) offshore systems (from a baseline of \$0.095 in FY 2005); and
- Distributed Wind Technology (DWT): By 2015, expand by five-fold the number of distributed wind turbines deployed in the U.S. market from a 2007 baseline.
- Technology Acceptance: By 2010, facilitate the installation of at least 100 MW in at least 30 States, from a baseline of 8 States in 2002.

Funding by Strategic and GPRA Unit Program Goal

	(dollars in thousands)		
	FY 2006	FY 2007	FY 2008
Strategic Goal 1.1, Energy Diversity			
GPRA Unit Program Goal 1.1.04.00, Wind Energy			
Technology Viability	17,829	35,905	27,200
Technology Application	7,634	7,914	12,869
Total, GPRA Unit Program Goal 1.1.04.00, Wind Energy	25,463	43,819	40,069
All Other			
Congressionally Directed Activities			
St. Francis, Pennsylvania Wind Farm Feasibility Study	0	0	0
North Dakota Hydrogen Wind Pilot Project	495	0	0
Great Plains Wind Energy Transmission Development Project	0	0	0
Alaska Wind Energy	1,485	0	0
Renewable Energy for Rural Economic Development Program, Utah State University	495	0	0
Iowa Lakes Community College Wind Turbine Project	0	0	0
National Center for Energy Management and Building Technologies	0	0	0
Mt. Wachusett Community College Wind Project	990	0	0
Wyandotte Wind Energy on Brownfields Initiative	990	0	0
Illinois State University Wind Energy Resources	990	0	0
Texas Tech. University Great Plains Wind Power Facility	1,485	0	0

	(dollars in thousands)		
	FY 2006	FY 2007	FY 2008
Brigham City Turbine	990	0	0
TowerPower Wind Project	743	0	0
White Earth Tribal Nation Wind Project	990	0	0
Coastal Ohio Wind Project	990	0	0
Randall's and Ward's Island Wind Project	990	0	0
Synchronous Wind Turbines	495	0	0
Fox Ridge Renewable Energy Education Center	495	0	0
PowerJet Wind Turbine Project	247	0	0
Total, Congressionally Directed Activities	12,870	0	0
Total, All Other	12,870	0	0
Total, Strategic Goal 1.1 (Wind Energy)	38,333	43,819	40,069

Annual Performance Results and Targets

FY 2003 Results	FY 2004 Results	FY 2005 Results	FY 2006 Results[a]	FY 2007 Targets[a]	FY 2008 Targets[a]
GPRA Unit Program Goal 1.1.04.00 (Wind Energy)					
Technology Viability/Low Wind Speed Technology (LWST)					
Complete low wind speed turbine conceptual design studies, and fabricate and begin testing advanced wind turbine components optimized for low wind speed application initiated under industry partnership projects. [MET]	Complete testing of prototypes of first advanced low wind speed technology components, and complete detailed design under first public-private partnership project for full system low wind speed turbine development. [MET]	Complete fabrication and begin testing advanced variable speed power converter. Test first advanced blade, incorporating improved materials and manufacturing techniques. Field test the first full-scale Low Wind Speed Technology prototype turbine. This contributes to the Annual LWST COE Target: 4.3 cents per kWh in Class 4 winds. [MET]	Annual COE Target: 4.2 cents per kWh in onshore Class 4 winds; 9.3 cents per kWh for offshore systems in Class 6 winds. [MET]	Annual COE target: 4.1 cents per kWh in onshore Class 4 winds; 9.25 cents per kWh for shallow water offshore systems in Class 6 winds; 11.93 cents per kWh for transitional offshore systems in Class 6 winds.	COE Annual Target: 4.0 cents per kWh in land-based Class 4; 9.2 cents per kWh for shallow offshore systems;
Technology Viability/Distributed Wind Technology (DWT)					
		Complete prototype testing of 1.8 kW Small Wind Turbine, finishing the International Electrotechnical Commission suite of tests for acoustics, power, durability, and safety. This contributes to the Annual DWT COE Target: 12-18 cents per kWh in Class 3 winds. [MET]	COE Target: 11-16 cents per kWh in Class 3 winds. [MET]	COE Target: 10-15 cents per kWh in Class 3 winds. New effort: Distributed Wind Technology (DWT): 2200 units of distributed technology in market. [baseline]	500 new units of distributed technology in market.
Technology Application					
		32 States with over 20 MW installed; 16 States with over 100 MW installed. [PARTIALLY MET]	19 States with over 100 MW wind installed. [PARTIALLY MET]	22 States with over 100 MW wind installed.	25 States with over 100 MW wind installed.

[a] Annual targets using Cost of Energy are tracked to a fixed technology baseline that reflects a set of standard financial and technology assumptions for each technology (Land-based, Offshore and Distributed wind technologies). Cost of energy targets differ from actual market conditions, as baseline technology assumptions do not include such factors as the impact of the on and off nature of the Production Tax Credit that leads to turbine demand spikes; changing financial variables; fluctuating commodity prices and currency exchange rates; and changes in expected equipment life.

FY 2003 Results	FY 2004 Results	FY 2005 Results	FY 2006 Results	FY 2007 Targets	FY 2008 Targets
	Contribute proportionately to EERE's corporate goal of reducing corporate and program uncosteds to a range of 20-25 percent by reducing program annual uncosteds by 10 percent in 2004 relative to the program uncosted baseline (in 2003) until the target range is met. [MET]	Contribute proportionately to EERE's corporate goal of reducing corporate and program adjusted uncosted obligated balances to a range of 20-25 percent by reducing program annual adjusted uncosteds by 10 percent in 2005 relative to the program FY 2004 end of year adjusted uncosted baseline ($18,371K) until the target range is met. [MET]	Maintain total administrative overhead costs (defined as program direction and program support excluding earmarks) in relation to total program costs of less than 12 percent. [a] [MET]	Maintain total administrative overhead costs (defined as program direction and program support excluding earmarks) in relation to total program costs of less than 12 percent.	Maintain total administrative overhead costs in relation to total program costs of less than 12 percent. Baseline for administrative overhead rate currently being validated.

[a] Baseline for administrative overhead rate currently being validated.

Means and Strategies

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

The Wind Energy Program will be implemented through the following means:

- Rather than focusing on large grants to support public/private partnerships, the Wind Program will increasingly use Cooperative Research and Development Agreements (CRADAs) for large wind system technology for Low Wind Speed land-based systems. CRADAs will allow collaborative development activities, closely supported by laboratory based research and testing, that will assist private organizations in expanding the applicability of wind technology to allow its implementation in lower wind speed or higher cost environments. Due to the variable strengths of wind industry companies, the use of collaborative partnerships will vary depending on specific needs and desired results. Some projects whose results will be made publicly available will require higher Federal cost share while other technology development will rely on strong industry support. Through the collaboration with governmental and industry partners, combined with laboratory-based research, the program will assess the market for a U.S. based offshore wind industry in preparation for a program review planned for FY 2009.
- Under the Distributed Wind Technology (DWT) activity, the program is initiating a new effort to reinvigorate distributed and community-owned wind technology to meet the growing demand for local power generation. This market encompasses systems that connect to the lower voltage distribution grid, either directly or on the consumer side of the electric meter, including: 1) small turbines for residential and small business applications; 2) mid-sized turbines for farm and small industry; and 3) locally owned community projects using larger turbines tied to distribution lines. The development of turbines in this market segment that can provide power at lower costs and with attractive payback would allow average Americans, farmers, and businesses to take an active role in the Nation's drive for energy independence.
- Laboratory-based Supporting Research and Testing (SR&T) works to advance technologies that have shown potential to reduce the cost or improve the performance and reliability of large utility-scale and distributed wind systems. Activities under this area also address more basic technology assessments, identifying the underpinnings of new applications for wind technology, such as offshore applications and wind/hydrogen technology development. These efforts also improve the basic understanding of wind phenomena such as advanced blade aerodynamics and upper air resource assessment and modeling.
- The integration of wind into the national electricity network is a critical barrier to increased deployment of wind technology. To best address this barrier, the Wind Energy Program has established a collaboration with the Department's Office of Electricity Delivery and Energy Reliability (OE) to enhance knowledge development and transfer to stakeholders supported by that office. Through the use of resource analysis and wind generator model development, the program will work to facilitate the addition and operation of wind energy technologies in the electric power system; to develop information to describe wind energy to power system operators, transmission

owners and regulators; and to mitigate barriers associated with wind interconnection. OE is the partner responsible for leading expansion of regulator and operator education.

- Dedicated outreach efforts will be funded through the Technology Acceptance activity. Laboratory and contract staff supply information on a range of wind energy technologies and related issues to national, state, local and regional interested parties, decision makers, and potential customers and investors so that there is a transparent exchange of credible information. Open and clear dialogue is necessary for making informed and long-lasting energy and environmental decisions.

The Wind Energy Program will implement the following strategies:

- The Wind Energy Program will provide leadership to the wind industry and focus priorities on removing the barriers to the use of wind energy technology. Additionally, the state of progress in advanced wind energy technology research and development projects and the strength of an emerging utility market for wind turbine systems are decreasing the level of government support needed for technology development in large scale, land-based wind turbine systems.
- In FY 2008, the program will implement a number of program changes. The first shift is to dedicate a greater proportion of funding to near- to mid-term market facilitation for wind technologies. Initially this shift will support activities to move currently available technology into the existing power generation market. Funding for activities to address siting, permitting, and environmental barriers will increase as the available wind resource is captured by advanced wind technologies closer to load/major population centers.

  The second shift is to emphasize land-based technology research, development and supporting technology activities while continuing limited, balanced activities to explore emerging markets and applications for wind generation in the mid-to-longer term, such as water treatment and offshore wind technology.

  Another shift is to establish a new, broader focus on distributed wind technologies and applications to advance the full scope of diverse opportunities for wind energy on the distribution side of the meter. This will follow the expected successful completion of the 2007 goal focused on small wind systems (less than 100 kW in size). Backed by recommendations from industry partners and peer review, and the program's annual strategic planning meeting, the program sees a clear need to support technology deployment, as described above.

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

- the availability of conventional energy supplies;
- the cost of competing technologies;
- the ability of the industry to learn quickly as wind installation demand increases;
- fluctuating material costs (i.e., steel, cable and concrete) and currency exchange rates;
- state and international efforts to support wind energy;
- Federal, state and regional regulatory actions affecting land-based and offshore wind installations;
- continuation of Federal tax incentives; and

- implementation of other policies at the national level, including Federal efforts to reduce carbon and criteria emissions.

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

- program activities dependent upon outputs from academia, manufacturers, developers, and National Laboratories (e.g., the Offshore Wind Collaborative, a joint Federal/state/ industry/ academia collaboration to address barriers to U.S. offshore wind development);
- research plans and priorities, as set forth in the Wind Vision Plan prepared cooperatively by the American Wind Energy Association (AWEA), DOE and NREL;
- systems integration, with DOE's Office of Electricity Distribution and Energy Reliability (OE), and the electric transmission and distribution system industry on policy and R&D issues;
- Federal Aviation Administration (FAA) and the Department of Defense on radar and other military issues affected by wind turbines;
- industry and R&D directions for the production of hydrogen for energy use, and for other non-energy uses;
- cooperative research and development with the International Energy Agency (IEA); and
- peer review of the Wind Energy Program's overall strategies and its activities by academia, industry representatives, National Laboratories, and independent experts.

Validation and Verification

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

Data Sources:	"Musial, W.D.; Butterfield, S.; Laxson, A.; Heimiller, D.; Ram, B – *"Large-Scale Development of Offshore Wind Power in the United States"* Spring 2007, Golden, Colorado, National Renewable Energy Laboratory. NREL/TP-500-40745. "Market Assessment and Summary of Barriers for Distributed Wind Applications"; Forsyth T.; Baring-Gould, E.I.; NREL, to be published Winter 2007. "Low Wind Speed Technologies Annual Turbine Technology Update (ATTU): Process for Land-Based Utility-based Technology," NREL Report #TP-50037505, June 2005. "Assessment of Potential Improvements in Large-Scale Low Wind Speed Technology," J. Cohen, Proceedings of Global Wind Power 2004, Chicago, Illinois, March 28-31, 2004, published by American Wind Energy Association. "Low Wind Speed Turbine Technology Characterization," Migliore and Cohen, presented at Wind Power 2003; "Wind Energy Technology Characterization, 1997," published by EPRI. "Low Wind Speed Turbine Technology Benefits," internal analysis for the FY 2002 request, peer reviewed by A.D. Little. FY 2001, FY 2002, FY 2003, FY 2004, FY 2005 and FY 2006 Wind Energy Program Peer Reviews. American Wind Energy Association (AWEA)/Global Energy Concepts Wind Plant Database, reviewed by EIA, contain proprietary data. Various published and unpublished data on wind projects economics. AWEA Small Wind Turbine Industry Roadmap.

Baselines: Low Wind Speed Technology: $0.055/kWh in FY 2002 for onshore applications in Class 4 winds; $0.095/kWh in FY 2005 for shallow water offshore applications in Class 6 winds; and $0.12/kWh for transitional offshore applications in FY 2006 in Class 6 winds. Distributed Wind Technology: 2200 turbines installed in distributed wind applications**.** Technology Acceptance: Eight States in 2002 with at least 100 MW wind installed.

Frequency: Annual.

Data Storage: Web, paper publications and on-line storage.

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

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

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

Program Assessment Rating Tool (PART)

The Department implemented a tool to evaluate selected programs. PART was developed by OMB to provide a standardized way to assess the effectiveness of the Federal Government's portfolio of programs. The structured framework of the PART provides a means through which programs can assess their activities consistently.

The 2003 PART found that the program has a clear purpose, strong planning and management. OMB gave the program fairly high scores (80 percent), (80 percent), and (88 percent) respectively, in Purpose, Planning, and Management. A lower score (67 percent) in Results/Accountability is being addressed by developing better performance measures. The PART findings acknowledged the role of the program in commercial success of high wind speed technologies and encourages greater focus on low wind speed technologies, as reflected in the budget priorities. The program has also focused on improved performance of outreach activities (along with measures to assess performance), which is described in the technology acceptance activity section.

The 2002 PART review of the Wind Energy Program contained a recommendation to continue emphasis on wind technology development for low wind speed areas; Low Wind Speed Technologies are the Wind Energy Program's budget focus. Another PART recommendation suggested the development of practical, but meaningful annual performance measures; the Wind Energy Program has developed annual performance targets for its three PART goals and Budget technology pathways (see the "Contribution to Program Goals" section), covering about 90 percent of its budget request. The Wind Energy 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 Energy Program's significantly improved 2003 score in the results/accountability area, resulting in a modest overall score improvement, and a "moderately effective" rating, the second highest rating possible.

The Department has responded to the PART recommendation of "develop guidance that specifies a consistent framework for analyzing the costs and benefits of research and development investments, and use this information to guide budget decisions." The Department has specified common scenarios, common methodology, and standardized benefits measures to allow analyzing the costs and benefits of applied R&D investments. While progress has been made, benefits estimates across programs are still not completely comparable. The Department continues to work on implementation of common assumptions and a consistent approach to incorporation of risk.

Expected Program Outcomes

The Wind Energy Program pursues its mission through integrated activities designed to increase the use of domestic renewable resources. Estimates of the security, economic and environmental benefits from 2008 through 2050 that would result from realization of the program's goals are shown in the table below.

EERE's Wind Energy Program Goal Case reflects the increasing penetration of wind over time, as the program's goals are met. Not included are policy or regulatory mechanisms, or other incentives not already in existence, that might be expected to support or accelerate the achievement of the program goals. The expected benefits reflect solely the achievement of the program's goals. The program does not currently estimate the mid- and long-term benefits of distributed wind activities or explicitly estimate the impact of barrier removal or market acceleration activities included under the Technology Application portion of the program. Activities will be undertaken in FY 2007 to allow assessment of these program elements explicitly through the GPRA process, beginning with the FY 2009 budget request.

The goals are modeled in contrast to the "baseline" case, in which no DOE R&D exists. The baseline case is identical to those used for all DOE applied energy R&D programs.[a] Further, across EERE, and across all of DOE's applied energy R&D programs, the expected outcome benefits are being calculated using the same fundamental methodology. Finally, the metrics by which expected outcome benefits are measured are identical for all of DOE's applied energy R&D programs.[b] This standardization of methods and metrics has been undertaken as part of the Department's efforts to respond to Under Secretary Garman's Strategic Management System initiative and OMB's request to make all programs' outcomes comparable.

The difference between the baseline case and the program goal case results in economic, environmental and security benefits. For example, achievement of program goals results in a reduction in net consumer expenditures of $8 billion in 2030. Savings to the electric power industry are expected to be 3 billion dollars in both 2030 and 2050. Finally, the program would also result in carbon emissions reductions of 36 million metrics tons in 2030 and 139 in 2050. The results are generated by modeling the program goals within two energy-economy models: NEMS-GPRA08 for benefits through 2030, and MARKAL-GPRA08 for benefits through 2050.[c] The full list of modeled benefits appears below.

Program Indicators

	2010	2020	2030	2040	2050
Additional Billion kWh Generated	3	185	213	579	852
Additional GW Installed	.7	46	52	130	177

[a] The starting point for the baseline case is the Energy Information Administration's "reference case," as published in the AEO 2006. Program analysts from across DOE examined the AEO to determine the extent to which their program goals are modeled (explicitly or implicitly). If program goals are modeled in the AEO, they are removed in the GPRA baseline. Further, some programs believe that the AEO's technology representation is too conservative, even in the absence of program goals, and thus in certain cases a modification is made to make the technology representation in the baseline case more optimistic than the AEO.
[b] The set of expected outcome metrics being used this year differs in substantial ways to that of previous years. In addition to the standardization across DOE's applied energy R&D programs, the list is expanded and more comprehensive than in past years. Further, the list maps to DOE strategic goals. The expected outcome metrics represent inherent societal benefits that stem from achievement of program goals.
[c] Final documentation on the analysis and modeling, including all of the methodologies and underlying assumptions, is expected to be completed and posted on the web by March 31, 2007. Past GPRA modeling and analysis documentation can be found at http://www1.eere.energy.gov/ba/pba/gpra.html .

FY 2008 GPRA Benefits Estimates for Wind Energy Program[a,b]

	2010	2020	2030	2040	2050
Environmental Benefits (Goal 1.2)					
Avoided carbon emissions, annual (MMTC)	1	30	36	113	139
Avoided carbon emissions, cumulative (MMTC)	2	139	457	1,631	2,877
Reduced cost of criteria pollutant control, NPV[c] (bil. 2004$)	0.3	2	5	NC	NC
Economic Benefits (Goal 1.4)					
Consumer savings, annual (bil. 2004$)	ns	9	8	12	-4[d]
Consumer savings, NPV (bil. 2004$)	ns	26	61	136	150
Electric power industry savings, annual (bil. 2004$)	0	4	3	9	3
Electric power industry savings, NPV (bil. 2004$)	0	14	31	90	107
Household energy expenses reduced, annual (bil. 2004$)	ns	ns	ns	0.2%	0.0%
Energy intensity reduced (% change in E/GDP)	0.0%	0.7%	0.7%	2%	2%
Net energy system cost savings, annual (bil. 2004$)	NC	NC	NC	3	6
Natural gas price change, moving avg. (2004$ / TCF)[e]	ns	0.12	ns	NC	NC
Security and Reliability Benefits (Goal 1.1 or 1.3)					
Avoided oil imports, annual (mbpd)	ns	ns	ns	ns	ns
Avoided oil imports, cumulative (bil. bbl)	ns	ns	ns	ns	ns
Security MPG improvement (%)[f]	ns	ns	ns	ns	ns
Transportation fuel diversity improvement (%)[g]	ns	ns	ns	ns	ns
Oil intensity reduced (% change in bil. bbl/GDP)	ns	ns	ns	0.1%	0.1%

[a] Benefits through 2030 are calculated with the NEMS-GPRA08 model. Benefits from 2035 through 2050 are calculated with the MARKAL-GPRA08 model. "NC" indicates situations in which no calculation was done because of specific model limitations. "ns" indicates results that were "not significant"—within the noise of the models.
[b] Projected benefits do not include any potential policy changes that might enhance technology deployment. In addition, most technologies show diminishing benefits by 2050, because of the assumption built in to the analysis that baseline industry progress will eventually catch up with the more accelerated progress associated with EERE program success.
[c] Net present value calculations throughout this table are performed for cumulative economic metrics, and are done using a 3% real discount rate, cumulative to 2008.
[d] The lower price of electricity drops causes a small shift towards less expensive and less efficient end-use equipment. This results in increased consumer savings in investment costs throughout the timeframe (especially 2030 on). However, by the end of the modeling period (i.e., 2040 to 2050) the average electricity price begins to increase which results in negative consumer savings. The increase in electricity price is caused by increasing investment costs in the electric sector for both wind turbines and back up combustion turbines.
[e] The prices reflected here are average delivered prices to all sectors, and are based on a three year moving average. Thus the measure of benefit is the change in the three year moving average delivered price, in $ per thousand cubic foot.
[f] Security MPG is the ratio of vehicle miles traveled by light duty vehicles to their usage of oil. It captures oil avoidance by efficiency and fuel alternatives.
[g] Fuel diversity is measured by the Shannon-Weiner Index (SWI) of diversity. The SWI is a measure of "proportional diversity," and hence captures both abundance and richness, i.e., how many different fuels and how much of each fuel both factor into the calculation.

Technology Viability

Funding Schedule by Activity

	(dollars in thousands)		
	FY 2006	FY 2007	FY 2008
Technology Viability			
Low Wind Speed Technology (LWST - Large Systems)	4,662	19,142	5,843
Distributed Wind Technology (DWT - Small Systems)	553	481	3,850
Supporting Research and Testing (SR&T)	12,614	15,310	16,966
SBIR/STTR	0	972	541
Total, Technology Viability	17,829	35,905	27,200

Description

Technology Viability activities are aimed at advancing wind turbine components and systems, through targeted research and development projects using competitively selected public/private partnerships and Cooperative Research and Development Agreements (CRADAs). All work is closely coordinated with Supporting Research and Testing conducted by National Laboratories.

Benefits

Technology Viability key activities focus on research, development and testing for improving the performance, cost effectiveness and reliability of large and distributed wind energy systems, which are primary barriers to wind energy competing without disadvantage to serve the Nation's energy needs. Achieving the Wind Energy Program's goals will help wind energy compete in energy markets. The Distributed Wind Technology goal for small wind cost of energy was completed as expected in FY 2007. The goal for the next phase of distributed wind technology development will be to expand the market for distributed wind technologies five-fold from where it exists in 2007, the baseline year.

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	13	14	15	16
Low Wind Speed Technology – Land-based (Class 4 in cents/kWh)															
Target	5.5	5	4.6	4.3	4.2	4.1	4	3.9	3.8	3.7	3.6				
Actual	5.5	5	4.4	4.3	3.9										
Low Wind Speed Technology – Shallow Offshore Systems (Class 6 in cents/kWh)															
Target				9.5	9.3	9.25	9.2	9.15	9.1	8.9	8.3	7.6	7.0		
Actual				9.5	9.5										

(fiscal year)

	02	03	04	05	06	07	08	09	10	11	12	13	14	15	16
Distributed Wind Technology – (Class 3 in cents/kWh for historical program activity)															
Target	17-22	14-20	13-19	12-18	11-16	10-15									
Actual	17-22	14-20	13-19	12-18	11-11.5										
Distributed Wind Technology: Factor expansion of market (new effort)															
Target						2,200 (expected baseline)	2,700	3,300	4,000	5,000	6,000	7,000	8,300	11,000	
Actual															

The Wind Energy Program also has developed a methodology for measuring and tracking program performance. Levelized cost of energy (COE), in constant dollars, is the primary performance indicator for the LWST efforts. Achieving the planned COE target will be possible through the development of technology improvement opportunities being addressed by the portfolio of LWST, DWT, and Supporting Research and Testing (SR&T) efforts. Cost of energy estimates for full-scale prototypes are based on industry experience in maturation of technologies and manufacturing processes. Determining the COE impact of improvements in individual components and subsystems are based on comparisons against a baseline turbine composite with a well-understood cost of energy. Using a peer reviewed process, the impact of technology improvements is assessed each year throughout the course of the LWST project. Forecasts of COE impact are based on progress of existing subcontracts and results of research efforts at the time of the assessment, thereby allowing a clear picture of the impact of improvements against the overall goals and objectives.

The program will also assess the number of distributed wind turbines deployed each year. While deployment levels are impacted by many outside factors (Federal tax incentives, state renewable portfolio standards, and other factors listed under "Means and Strategies" above), the program believes that this metric can be used to quantify the program's success in the removal of technology, market, and implementation barriers for distributed wind technologies.

Detailed Justification

	(dollars in thousands)		
	FY 2006	FY 2007	FY 2008
Low Wind Speed Technology (LWST - Large Systems)	**4,662**	**19,142**	**5,843**

The Low Wind Speed Technology (LWST) project supports public/private partnerships and Cooperative Research and Development Agreements for large wind system technology pathways (turbines over 100 kilowatts) to achieve the following goals:

- $0.036/kWh for land-based systems in Class 4 winds by 2012; and
- $0.07/kWh for shallow water offshore systems in Class 6 winds by 2014;

For land-based systems, public/private partnerships to catalyze industry adoption of technology developments and emerging innovation, in collaboration with National Laboratory expertise, are supported through a series of three LWST competitive solicitations - Phase I was initiated in FY 2002 (expected completion in FY 2009), Phase II began in FY 2004 (expected completion in FY 2010), and Phase III is planned to commence in FY 2008. Phase I and II concentrate on three technical areas: 1) conceptual design studies, 2) component development and testing; and 3) full turbine prototype development and testing. To date, the LWST land-based portfolio includes 3 partnerships for full turbine prototypes and 2 for components, with 10 conceptual design studies completed as of the end of FY 2006. Due to the refocus of program efforts to support targeted research rather than full systems development to reduce costs and improve the long-term reliability of land-based wind systems, the Phase III solicitation will address component improvements to existing low wind speed turbine designs.

For offshore systems, technology assessment and evaluation are supported through collaboration between National Laboratories and private industry. A laboratory led, industry supported Sea Based concept study (SeaCon) effort for offshore systems was initiated in FY 2006 and will continue in FY 2007 to examine system design tradeoffs across ranges of size, configuration, and available technology innovations. These Sea-Con studies will narrow the range of viable options and establish sustainable links to the existing offshore industries. The project will provide the base knowledge for establishment of a mature understanding and design basis for offshore wind systems, characterizing wind and wave loads, developing and verifying dynamics modeling capability, and assessing marinization and anchoring technologies. Further refinement of the Sea-Con studies will take place in FY 2008. In addition, in FY 2008, the program will work with industry partners to obtain information and allow the accurate assessment of offshore wind technology's potential from a technical, financial and insurability perspective. These studies will benefit from the expected establishment and test of regulatory mechanisms for alternative energy development on land-based and offshore Federal lands (Interior Department's Minerals Management Service and Bureau of Land Management), proposed development of the Long Island Power Authority's Offshore Wind Project, and others in TX, MA, NJ, DE, and GA; and efforts to define the role of wind in water treatment and production of hydrogen (Texas Tech; Hull; MA; and North Dakota/Basin Electric). Study results will be used for deciding whether to proceed with further technology development for offshore wind components in FY 2009.

	(dollars in thousands)		
	FY 2006	FY 2007	FY 2008

The LWST portfolio and related Supporting Research and Testing activities are continuously coordinated to facilitate technology transfer and transition of 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 2008, the program expects to achieve the following major milestones under the LWST development effort: 1) complete the acquisition process for a Phase III LWST project solicitation for component technology development to enhance the performance of existing low wind speed turbines; 2) complete field-testing performance documentation of the sub-scale wind turbine research-blade series; 3) continue collaborations with wind plant operators to determine operations and maintenance experience and target reliability enhancements; and 4) complete tradeoff studies for offshore wind turbine systems.

Distributed Wind Technology	**553**	**481**	**3,850**

Distributed Wind Technology is expected to achieve its goal of 10-15 cents per kilowatt-hour in Class 3 wind resources in FY 2007 for turbines under 100 kW. This goal was targeted at those consumers that have relatively high retail costs of electricity. In FY 2008, the program is proposing to start a new effort focused on distributed wind systems. The emphasis on distributed wind technologies will allow focused technology development and application support for wind energy systems serving residential, small commercial, farm, and community wind markets. Focusing on these market sectors could allow mid-term expansion of wind energy use and allow the average American a method to control their energy costs, and support local economic development.

In FY 2008 the new DWT activity aims to improve the market availability and affordability of distributed wind technologies for more consumers. To assist state incentive programs that require some certification on the performance and safety of small wind turbines, the program, in conjunction with the industry, state-based organizations and other stakeholders, will initiate an activity to support the testing and certification of turbines for distributed applications. Additionally activities will focus on other market and accessibility barriers to distributed technologies, primarily for rural homeowners, farmers, and small businesses.

In addition, the program has identified a significant potential market for mid-to-large turbines installed on the distribution side of the meter in low wind speed areas. This encompasses distributed applications, such as farming and community wind, which are generally served by older generation technology. Manufacturers focused on this market tend to be small and undercapitalized companies that do not have the means to individually invest in high rates of R&D needed to effect the cost and performance improvements necessary for commercial success.

The program will also initiate an activity to allow laboratory field testing of distributed turbines to verify technology that can be used to meet state and other renewable incentive programs.

	(dollars in thousands)		
	FY 2006	FY 2007	FY 2008
Supporting Research and Testing (SR&T)	**12,614**	**15,310**	**16,966**

Supporting Research and Testing (SR&T) supports the goals of the program through advancement of technologies that have been shown to have the potential to reduce the cost or improve the performance of large utility-scale and distributed wind systems in low wind regimes. The SR&T effort brings specialized technical expertise, comprehensive design and analysis tools, and the unique testing facilities of the National Laboratories to bear on problems that industry is or will encounter in bringing new wind technology to the marketplace. SR&T is composed of four program elements: Design Review and Analysis, Enabling Research, Testing Support, and Resource Assessment. SR&T provides technical support essential to the public/private partnerships and collaboratives 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 products resulting from advances in R&D are developed in a logical and safe manner and in compliance with the applicable international certification standards. This vital step mitigates some market acceptance risk for LWST and DWT technology. Design Review and Analysis activities provide project management, technical oversight and analysis support to industry partners.

Enabling Research focuses on research needed to support wind technology development. Activities include: component reliability studies; site specific design; advanced rotor development; and analysis of drive train, power electronics, blades, systems, and controls to address technology gaps and improve the performance of existing wind technology. Characterization of advanced turbine technologies, design environment, improved computer simulation codes, advanced components, integrated systems and controls are the main product outputs.

Testing Support includes both facility and field tests of newly developed LWST and DWT prototype components and systems to ensure design and performance compliance. Structural testing of blades up to 45 meters in length and dynamometer testing of fully integrated drive train and power systems up to 2.5 MW are accomplished in the controlled environments of the Structural Test Facility (STF) and Dynamometer Test Facility (DTF) at the National Wind Technology Center (NWTC). Field testing of prototypes in actual wind farms and distributed generation applications provides validation of designs before commercialization. The program expects to collaborate with industry-led consortium to establish a large wind turbine blade test facility for turbine blades in excess of 50 meters in length. Six proposals are currently being evaluated by the program. The most promising of these proposals will be advanced to the next stage where a more detailed conceptual design and operations/cost model will be developed.

Resource assessment includes projects to develop more detailed and accurate wind resource assessments for specific areas of the United States, such as state, tribal and Federal lands, and for taller turbine hub heights (up to 100 meters above ground). The focus of this activity is to improve the understanding and analysis of the wind characteristics in areas where wind energy projects are established or are being planned (e.g., Great Plains and offshore) and to develop and validate updated high-resolution wind resource maps in cooperation with the wind industry.

	(dollars in thousands)		
	FY 2006	FY 2007	FY 2008

SR&T also includes funding required for operation and management 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 public-private technology development partnerships, and to support staff, facilities and Technology Application activities. SR&T funding also provides a number of cross-cutting functions for supporting the achievement of the program's goals. These include: systems analysis to track improvements in wind technology in diverse applications; assessment of future improvements in cost performance of wind technology (i.e., technology characterization); investigation of technical, environmental, and institutional issues to address near-term barriers for industry; preparation and updating of Multi-Year Technical Plans; development of inputs and analysis to respond to analytical and reporting requirements involved with GPRA, PART, RDIC and other management tools and processes; and participation in development of domestic and international design standards for wind turbines. Capital equipment expenditures of approximately $2,500,000 are planned by the National Renewable Energy Laboratory for FY 2008 to support testing at NWTC, as well as for the large wind turbine blade test facility collaboration with industry. 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 results of tests at industry and laboratory locations.

SR&T activities in FY 2008 include: developing condition monitoring tools to support condition-based maintenance approaches for wind turbine components and to develop an operations and maintenance database; completing upgrade and integration of Aerodyn aerodynamics code into the design code tool suite; completing analyses of the three primary offshore structural platform options including stability assessment; finalizing an offshore wind resource assessment; and beginning the coupled wind/wave assessment.

SBIR/STTR	**0**	**972**	**541**

In FY 2006, $468,000 and $56,000 was transferred to the SBIR and STTR programs respectively. The FY 2007 and 2008 amounts shown are estimated requirements for the continuation of the SBIR and STTR program.

Total, Technology Viability	**17,829**	**35,905**	**27,200**

Explanation of Funding Changes

	FY 2008 vs. FY 2007 ($000)
Low Wind Speed Technology	
The decrease reflects a shifting of resources to technology acceptance activities, aimed at higher priority efforts to reduce the institutional, political, and environmental barriers to wind energy development and increase the supply of wind energy in the U.S. Because there is reduced need for government-supported cost-shared contracts, the program will also reduce its emphasis on cost-shared public-private partnerships, in favor of Cooperative Research and Development Agreements, for promoting wind energy technology advances and improvements. The program is continuing needed support for laboratory-based technical expertise to address key technical obstacles. Before investing in component or prototype system development for offshore wind technology, the program will complete a series of trade-off and feasibility studies in FY 2008, and determine a technology development strategy for offshore wind. The shift in resources is in accordance with RDIC 1b (Market Barriers to private sector investment in research).	-13,299
Distributed Wind Technology	
Distributed wind systems are seen as a proven but still immature market segment, allowing potential near-term market impact. This increase will support a new round of DWT partnerships for concept, component, and system prototype projects for wind turbines (generally sized 100kW or less for the residential and small business market), initiate an activity to allow testing of distributed turbines in support of state-based incentive programs, and the initiation of a new partnership project for larger turbine systems aimed at the community wind and farm market.	+3,369
Supporting Research and Testing	
The increase supports expanded resource assessment, increased work in the area of turbine component reliability, a large wind turbine blade test facility collaboration with industry, initiation of turbine certification testing activities, and a new round of DWT partnership projects.	+1,656
SBIR/STTR	
Changes in the SBIR/STTR funding are a direct result of changes in the funding of program activities.	-431
Total Funding Change, Technology Viability	**-8,705**

Technology Application

Funding Schedule by Activity

	(dollars in thousands)		
	FY 2006	FY 2007	FY 2008
Technology Application			
Systems Integration	2,466	3,970	5,942
Technology Acceptance	2,646	3,856	6,919
Supporting Engineering and Analysis	2,522	0	0
SBIR/STTR	0	88	8
Total, Technology Application	7,634	7,914	12,869

Description

The Technology Application subprogram addresses opportunities and barriers other than turbine cost of energy concerning use of wind energy systems. The efforts managed in this area of the program help to prepare the market for broad application. The program will collaborate with the utility industry to assure easy and rapid integration of the technology. Concerns with siting, permitting and local effects need to be addressed, studied and resolved so that appropriate decisions about the use of wind technology can be made. Systems Integration presents a major barrier to wind technology, requiring applied technical efforts to predict energy resources, plant productions schedules, turbine and plant electrical characteristics and dealing with electrical grid operations, including the inherent variability of the wind plant output. These will be coordinated with the DOE Office of Electricity Delivery and Energy Reliability. Technology Acceptance will focus on resolving institutional issues, providing state and regional energy sector outreach, and investigating and mitigating social, environmental and wildlife issues associated with wind energy development.

Benefits

Technology Application helps the program achieve its mission by focusing on the cost barriers other than generator technology that enhances or impede wind energy use in the United States. Helping stakeholders and officials within States understand wind energy technologies and how wind can be integrated into their state energy systems will in turn reduce institutional and regulatory barriers, helping wind to compete in a competitive wholesale electric market.

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

(fiscal year)	00	01	02	03	04	05	06	07	08	09	10
Technology Acceptance											
# of States with mature wind markets - Target			--	10	12	16	19	22	25	27	30
# of States with mature wind markets - Actual	4	7	8	10	12	15	16				

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

Detailed Justification

(dollars in thousands)	FY 2006	FY 2007	FY 2008
Systems Integration	**2,466**	**3,970**	**5,942**

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 treatment of wind energy based on the true costs that it imposes on the power system.

System integration includes development of data on wind turbine and wind plant performance from land-based and offshore applications of interest to the power industry; analytical techniques to represent the wind plant in planning and operating tools used by the electric power industry; investigation of transmission tariffs and policies to ensure that wind projects are treated fairly based upon costs imposed on the power system; and transfer of this information and techniques to stakeholders in the power industry, including regional transmission operators, state and Federal regulators, wind plant operators and wind turbine manufacturers. Beginning in FY 2006, improved coordination with the Department's Office of Electricity Delivery and Energy Reliability (OE) was established to assure that the efforts of each office are mutually supportive and coordinated.

The geographical scope of the activity ranges from distributed application, such as a 10 kW turbine interconnected with a rural cooperative farm, to isolated village power systems using wind and diesel power plants, to large wind plants covering several tens of square kilometers. Program staff do not perform electric power research, but rather apply standard power system tools and techniques, along with meteorology and economics, to estimate impacts and develop mitigation strategies where needed. Recent studies have shown that the additional cost to interconnect wind plants at moderate penetrations is on the order of 0.2 cents per kWh, and is thought to increase slowly with increasing wind plant penetration, i.e., as wind supplies a greater fraction of the instantaneous demand. Funding requested will support participation by laboratory researchers and consultants in several studies to examine the implications of penetrations approaching 20 percent.

	(dollars in thousands)		
	FY 2006	FY 2007	FY 2008

Systems Integration also includes consideration of how wind energy competes in the competitive electricity marketplace and wind-hydrogen production to develop operating strategies to create improved economics and benefits for both technologies. In addition, the program will continue to explore emerging applications in the water-energy nexus as a wind energy technology pathway.

In FY 2008, several large scale wind plant operational studies will be undertaken in conjunction with regional transmission system, utility, and wind plant operators. Key inputs include improved resolution of wind plant hourly and sub hourly output for typical years needed to observe the set of wind energy output variations that may challenge power system operators. Mitigation strategies will be developed for periods of adverse impact and guidelines will be developed for use by regional transmission organization (RTO) staff and wind plant operators. In addition, opportunities for improved tariffs such as flexible-firm for low capacity factor and variable output wind projects will be pursued to provide feedback to the wind community on how well this option works. Simulation tools previously developed to represent geographical diversity of several wind plants connected to the same power system will be evaluated in conjunction with industry and verified to provide an analytical basis for integration of larger amounts of wind energy. The geographic diversity and integration of offshore wind plants will also be investigated, subject to data availability. The results of all of these investigations will be coordinated with OE and transferred to power industry regulators and stakeholders. In addition, regional transmission consortia will be encouraged to explore wind energy development and create scenarios for deployment to be used in planning. Feedback on performance of the Grid System Integration activity and potential research focus areas will be sought from regional stakeholder and power system organizations. The program will also solicit co-funding to study the engineering and economics of a wind-water system in the field. Research to date in this area has been on the conceptual design level and the program intends to help support a test application to further determine the viability of this pathway.

Technology Acceptance	**2,646**	**3,856**	**6,919**

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. This program element will inform various stakeholder groups about the opportunities and management approaches applicable to wind energy development for their consideration and application at local, state and regional decision settings.

The Wind Powering America (FY 2006-$2,220,000; FY 2007-$3,100,000; and FY 2008-$3,514,000) 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; and stimulating sustainable tribal and rural-based energy sectors. Activities are conducted in partnership with utility generators, equipment manufacturers, project financiers and developers, public and private officials, regulators, industrial and public sector consumers, other Federal and state agencies, and citizen stakeholder groups to provide technical support, guidance, and information on national, regional, state, and local efforts to explore and develop their wind energy resources, both on land and offshore. Technology Acceptance also supports cooperative activities with utility-based and other key stakeholder organizations to

	FY 2006	FY 2007	FY 2008

(dollars in thousands)

expand access to wind resource data and to provide information on technical and institutional barriers to development.

There will be an increased emphasis beginning in FY 2008 on efforts to assess and mitigate effects of wind turbines on the environment. These efforts include working with all stakeholders to address the following specific barriers: direct and indirect wildlife impacts; lack of government consensus on regulatory requirements that protect wildlife; lack of tools for industry to assess and mitigate wildlife impacts; and public perception that the environmental risks associated with wind power outweigh its environmental and other benefits. Many of these efforts will be applicable to local and regional siting and permitting proceedings.

In FY 2008, activities will focus on launching a new regional wind support effort. This new effort will expand support for existing and emerging state wind working groups; tribal wind technical assistance on wind resources and project planning, in coordination with financial assistance provided through OWIP's Tribal Energy Program; partnership activities with agriculture-sector organizations; collaboration with public power organizations; community and rural schools projects by expanding activity over regions of the country with similar issues. Distributed wind system support activities such as working with state regulators, small wind stakeholders, and the agricultural sector on market acceptance issues specific to distributed wind technologies, will also be expanded. In addition, the program will continue to assess and mitigate effects of wind turbines on the environment. These efforts will address barriers by funding collaborative research activities such as the Grassland and Shrub-Steppe Species Collaborative; working with Department of Interior to develop siting guidelines; supporting mitigation research; and producing technical and outreach materials on ways to develop wind in an environmentally sensitive manner. FY 2008 performance target for this activity: 25 States with over 100 MW.

Supporting Engineering and Analysis	**2,522**	**0**	**0**

The Supporting Engineering and Analysis (SE&A) activity provided a number of cross-cutting functions for supporting the achievement of the program's goals before they were allocated to different activities within the program to allow appropriate tracking of funding with program goals. These include systems analysis to track improvements in wind technology in diverse applications; assessment of future improvements in cost performance of wind technology (i.e., technology characterization); investigation of technical, environmental, and institutional issues to address near-term barriers for industry; participation in development of domestic and international design standards for wind turbine design and testing, and operation and management of the National Wind Technology Center (NWTC) to support staff, facilities and Technology Application activities.

SBIR/STTR	**0**	**88**	**8**

The FY 2006 and FY 2007 amounts shown are estimated requirements for the continuation of the SBIR and STTR program.

Total, Technology Application	**7,634**	**7,914**	**12,869**

Explanation of Funding Changes

	FY 2008 vs. FY 2007 ($000)
Systems Integration	
One of the key barriers to the widespread implementation of wind technologies relates to the acceptance and integration of wind technologies into the national electric system. An expansion of these activities will include further collaboration with the Office of Electricity Delivery Energy Reliability, working together to address the near to mid-term risks of transmission-based limitations being imposed on wind development. Increased funding will be directed to expanding the number of wind plant characterization, integration, and interconnection studies supported by the program; the addition of laboratory staff to provide analytical support; and establishment of regional wind integration teams to allow participation in regional fora as decisions about wind energy are made.	+1,972
Technology Acceptance	
The program is shifting from a focus on longer term research topics to deployment activities which will have impact today and into the mid-term. Siting, permitting, and environmental barriers to the use of LWST technology — both utility-scale and smaller turbines — are expected to expand significantly as the available wind resource that can be captured economically by advanced wind technology moves closer to load/major population centers. Expanding these activities will enable the program to address these concerns that present near term risks from resistance to the expanded use of wind technologies. The increase in funding reflects a new regional wind support effort as well as a more concerted effort to address and mitigate environmental and wildlife issues that could hinder wind energy development if not dealt with immediately and adequately.	+3,063
Supporting Engineering and Analysis	
No change.	0
SBIR/STTR	
Changes in the SBIR/STTR funding are a direct result of changes in the funding of program activities.	-80
Total Funding Change, Technology Application	**+4,955**

Congressionally Directed Activities

Funding Schedule by Activity

(dollars in thousands)	FY 2006	FY 2007	FY 2008
Congressionally Directed Activities	12,870	0	0
Total, Congressionally Directed Activities	12,870	0	0

Description

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

There were a total of 15 Congressionally Directed activities in FY 2006. Due to higher priorities within the program, the program does not plan to request any funding for these activities in future years. The following projects were directed by Congress to be included in this program.

Detailed Justification

(dollars in thousands)	FY 2006	FY 2007	FY 2008
North Dakota Hydrogen Wind Pilot Project	**495**	**0**	**0**

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

Alaska Wind Energy	**1,485**	**0**	**0**

To support competitively selected wind projects in the State of Alaska.

Renewable Energy for Rural Economic Development Program, Utah State University	**495**	**0**	**0**

To support the Rural Economic Development Program at the university.

Mt. Wachusett Community College Wind Project	**990**	**0**	**0**

To conduct tests on the feasibility of using wind power locally in Massachusetts.

Wyandotte Wind Energy on Brownfields Initiative	**990**	**0**	**0**

To demonstrate feasibility of using wind on a brownfields site.

	(dollars in thousands)		
	FY 2006	FY 2007	FY 2008
Illinois State University Wind Energy Resources	**990**	**0**	**0**
To demonstrate the feasibility of wind energy in Illinois and develop related curriculum.			
Texas Tech. University Great Plains Wind Power Facility	**1,485**	**0**	**0**
To demonstrate feasibility of using wind for water resources application and other purposes.			
Brigham City Turbine	**990**	**0**	**0**
To determine and demonstrate feasibility of using wind for municipal applications.			
TowerPower Wind Project	**743**	**0**	**0**
To demonstrate feasibility of using wind for power-related applications.			
White Earth Tribal Nation Wind Project	**990**	**0**	**0**
To develop a wind energy project to help power community buildings on the reservation.			
Coastal Ohio Wind Project	**990**	**0**	**0**
To undertake activities in support of using wind in coastal applications.			
Randall's and Ward's Island Wind Project	**990**	**0**	**0**
To determine feasibility of using wind for island-based application.			
Synchronous Wind Turbines	**495**	**0**	**0**
To determine use of advanced generator in wind turbine.			
Fox Ridge Renewable Energy Education Center	**495**	**0**	**0**
To determine feasibility of wind energy in rural application.			
PowerJet Wind Turbine Project	**247**	**0**	**0**
To determine use of advanced generator in horizontal-axis wind turbine.			
Total, Congressionally Directed Activities	**12,870**	**0**	**0**

Geothermal Technology

Funding Profile by Subprogram

(dollars in thousands)

	FY 2006 Current Appropriation	FY 2007 Request	FY 2008 Request
Geothermal Technology			
Technology Development	14,860	0	0
Technology Application	4,190	0	0
Congressionally Directed Activities	3,712	0	0
Total, Geothermal Technology	22,762	0	0

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"
P.L. 109-190, "Energy Policy Act" (2005)

Mission

The mission of the Geothermal Technology Program ("Geothermal Program") was to work in partnership with U.S. industry to establish geothermal energy as an economically competitive contributor to the U.S. energy supply. The Department is closing out the Geothermal Technology Program in FY 2007 and transferring results of its research and development work related to geothermal technology to industry and the public sector.

Benefits

The Geothermal Technology Program's mission and activities directly supported DOE's mission to promote scientific and technological innovation in support of advancing the national, economic and energy security of the United States. Industry application of technology and resources developed to date will continue to benefit the Nation.

The production tax credit mandated by the Energy Policy Act (EPACT 2005) will accelerate the development of new geothermal power plants. This is evident from the contracts for new geothermal power plants in 2005 which total over 500 megawatts. Two additional States, Idaho and Alaska, are expected to join California, Nevada, Utah, and Hawaii this year with operating geothermal power plants. EPACT 2005 directs the U.S. Forest Service and Bureau of Land Management to develop streamlined leasing and permitting processes for geothermal projects. EPACT 2005 also directs that 25 percent of royalties from geothermal projects go to local jurisdictions, thereby providing incentives for local governments to pursue and facilitate development.

Strategic and GPRA Unit Program Goals

The Department's Strategic Plan identifies five Strategic Themes (one each for nuclear, energy, science, management, and environmental aspects of the mission) plus 16 Strategic Goals that tie to the Strategic Themes. The Geothermal Technology Program directly supported the following goals:

Strategic Theme 1, Energy Security

Strategic Goal 1.1, Energy Diversity: Increase our energy options and reduce dependence on oil, thereby reducing vulnerability to disruptions and increasing the flexibility of the market to meet U.S. needs.

Strategic Theme 3, Scientific Discovery and Innovation

Strategic Goal 3.3, Research Integration: Integrate basic and applied research to accelerate innovation and to create transformational solutions for U.S. energy needs.

And concurrently supports:

Strategic Goal 1.2, Environmental Impacts of Energy: Improve the quality of the environment by reducing greenhouse gas emissions and environmental impacts to land, water, and air from energy production and use.

The Geothermal Technology Program has one GPRA Unit Program goal which contributes to Strategic Goal 1.1 in the "goal cascade:"

GPRA Unit Program Goal 1.1.05.00: Geothermal Technology - With the completion of final reporting on funded projects, the Geothermal Technology Program's goal is to closeout this program and to effectively transition remaining program activities and information (e.g., R&D results, technical data and findings) to private/public sector programs.

Contribution to GPRA Unit Program Goal 1.1.05.00 (Geothermal Technology)

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

Funding by Strategic and GPRA Unit Program Goal

	(dollars in thousands)		
	FY 2006	FY 2007	FY 2008
Strategic Goals 1.1, Energy Diversity; and 3.3 Research Integration			
GPRA Unit Program Goal 1.1.05.00, Geothermal Technology			
Technology Development	14,860	0	0
Technology Application	4,190	0	0
Total, GPRA Unit Program Goal 1.1.05.00, Geothermal Technology	19,050	0	0
All Other			
Congressionally Directed Activities			
Ohio Wesleyan University Geothermal Demonstration Project	742	0	0
Springfield Equestrian Center Energy Efficiency Project	1,485	0	0
Lipscomb University Geothermal System	495	0	0
Geothermal and Renewable Energy Laboratory of Nevada	990	0	0
Total, Congressionally Directed Activities	3,712	0	0
Total, All Other	3,712	0	0
Total, Strategic Goals 1.1 and 3.3 (Geothermal Technology)	22,762	0	0

Annual Performance Results and Targets

FY 2003 Results	FY 2004 Results	FY 2005 Results	FY 2006 Results	FY 2007 Targets	FY 2008 Targets
GPRA Unit Program Goal 1.1.05.00 (Geothermal Technology)					
Technology Development/Systems Development					
Support industry opening and initial operation of a 1 MW small-scale geothermal plant in the State of New Mexico. [MET]	Create an Enhanced Geothermal System (EGS) with an industry partner and test associated technology needed to operate and monitor the system. [NOT MET]	Field test a fully integrated Diagnostics-While-Drilling (DWD) advanced drilling system in a high-temperature geothermal well, verifying control of drilling operations in real time, thereby reducing costs. If successful, DWD will reduce drilling costs by one half of the total cost reduction target for drilling. [MET]	Develop an Electronic Repository which makes digitized copies of all Geothermal Technology Program Research Development and Deployment Technical Reports available via the internet, while demonstrating reduction in cost of power for flash systems to 4.9 cents/kWh from 5.3 cents/kWh in 2005 and reducing cost of binary to 8.2 cents/kWh from 8.5 in 2005 based on modeled analysis. [MET]	Report on completion of program activities and previous year funded projects. Complete closeout of Geothermal Technology Program.	NA
	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. [NOT MET: EERE actively accelerating costing of funds]	Contribute proportionately to EERE's corporate goal of reducing corporate and program adjusted uncosted obligated balances to a range of 20-25 percent by reducing program annual adjusted uncosteds by 10 percent in 2005 relative to the program FY 2004 end of year adjusted uncosted baseline ($21,644K) until the target is met. [MET]	Maintain total administrative overhead costs (defined as program direction and program support excluding earmarks) in relation to total program costs of less than 12 percent. [a] [MET]	Maintain total administrative overhead costs (defined as program direction and program support excluding earmarks) in relation to total program costs of less than 12 percent.	NA

[a] Baseline for administrative overhead rate currently being validated.

Means and Strategies

The Geothermal Technology Program had adopted a two-fold strategy to achieve its goal: (1) provide selected, but aggressive, technology improvements that have the greatest impacts on performance and cost; and (2) mitigate non-technical barriers that can influence or affect performance and costs. Means and strategies in FY 2007 focused on closing out remaining program elements such as completing documentation of technology partnerships and transferring research findings to industry, and archiving legacy documents.

Validation and Verification

To validate and verify program performance, the Geothermal Technology Program conducted internal and external reviews and audits with the assistance of experts from a variety of stakeholder organizations. The table below summarizes validation and verification activities.

Data Sources:	Geothermal Resources Council Bulletin; Geothermal Energy Association Update; Energy Information Administration's Annual Energy Review, Renewable Energy Annual, and Annual Energy Outlook; Geothermal Resources Council Transactions; Stanford Geothermal Program Workshop Proceedings; various system analyses by NREL and other contractors; International Energy Agency's Geothermal Implementing Agreement Annual Report; recent Peer Reviews of the U.S. Department of Energy's Geothermal Technology Program: April 7-8, 2005 and July 18-19, 2006 Enhanced Geothermal Systems; June 6-9, 2005 Systems Development; and July 26-28, 2005 Resource Development. Geothermal Program Briefings: May 23, 2006.
Baselines:	The Geothermal Technology Program's baselines for cost reduction goals are contained in its Strategic Plan, August 2004, and the revised draft Multi-Year Technical Program Plan, September 2005. The cost of geothermal power in 1995 was 4.2 cents/kWh for flash power and 7.7 cents/kWh for binary power.
Evaluation:	Quarterly and annual assessment of program and management results based performance through Joule (the DOE quarterly performance progress review of budget targets); PMA (the President's Management Agenda -- annual departmental and PSO based goals whose milestones are planned, reported and reviewed quarterly); and PART (common government wide program/OMB reviews of management and results).
Frequency:	Annual, through close-out in 2007.
Data Storage:	Corporate Planning System.
Verification:	Trade association and educational association reviews; open bids on electric power purchase agreements; Federal leasing applications; filings with state and Federal regulatory agencies; commercial sales of new technology.

Program Assessment Rating Tool (PART)

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

The 2003 PART generated the following scores: purpose (88 percent) planning (80 percent) and management (88 percent) and results and accountability (58 percent). The PART acknowledged the role of the program in cost reduction and subsequent growth of competitive power production from expanded geothermal resources and implementation of the recommendation to shift resources to Enhanced Geothermal Systems. The PART also found that Congressionally Directed Activities reduced program funding available for competitive solicitations designed to contribute toward program goals.

The Geothermal Technology Program took action to address the PART recommendations. A strategic plan was prepared that specified program goals and the means to achieve them, while a multi-year program plan was drafted that described the technical pathways the program would follow to achieve the performance measures derived from the programmatic goals. In response to one of the 2002 PART recommendations, the Geothermal Technology Program developed a set of annual performance measures dealing with the cost of drilling wells and the cost of building geothermal surface systems. In addition, the program developed performance measures for the number of new geothermal fields expected to be discovered in the United States, and the amount of developable geothermal resources confirmed by resource assessment. These improvements in planning, management and accountability were reflected in the program's improved 2003 PART score in those three areas, resulting in a "moderately effective" rating.

The Department has responded to the PART recommendation of "Develop guidance that specifies a consistent framework for analyzing the costs and benefits of research and development investments, and use this information to guide budget decisions." The Department has specified common scenarios, common methodology, and standardized benefits measures to allow analyzing the costs and benefits of applied R&D investments. While progress has been made, benefits estimates across programs are still not completely comparable. The Department continues to work on implementation of common assumptions and a consistent approach to incorporation of risk.

Expected Program Outcomes

The Geothermal Technology Program is being terminated in FY 2007, benefits to the market are from past research and development, not from research conducted in FY 2007. Therefore, expected program outcomes will not be reported.

Technology Development

Funding Schedule by Activity

	(dollars in thousands)		
	FY 2006	FY 2007	FY 2008
Technology Development			
Resource Development	2,744	0	0
Enhanced Geothermal Systems	5,928	0	0
Systems Development	6,188	0	0
SBIR/STTR	0	0	0
Total, Technology Development	14,860	0	0

Description

This subprogram examined processes affecting the economical production of geothermal systems with the intent of providing technology to increase productivity substantially. The three components of this activity involved: (1) finding resources; (2) creating new techniques for increasing the productivity of geothermal reservoirs; and (3) developing advanced technology in wellfield construction and energy conversion, the two major cost elements of geothermal electric power production and direct use. Consistent with the R&D investment criterion on here to mid-term for incorporating "off-ramps" and the expected commercialization of these technologies, activities under this subprogram are proposed to be completed and transitioned to the public and private sector.

Benefits

Program efforts are focused on closing out field verification activities and the final reporting of outstanding projects. The Geothermal Technology Program has designed, constructed, and tested innovative technologies in close collaboration with industry, such as high temperature borehole televiewers used in geothermal wells and high temperature oil and gas wells; a reservoir analysis code with important applications for geothermal and other hydrothermal systems and applications for nuclear waste isolation and carbon sequestration; and a prototype for innovative air cooled condensers to improve cooling in power generation and reduce consumptive use of water.

Detailed Justification

	(dollars in thousands)		
	FY 2006	FY 2007	FY 2008
Resource Development	**2,744**	**0**	**0**

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

In FY 2007 using prior year funds, the program will close out activities and report on the completion of field tests of technologies for exploration, such as remote sensing, geophysical, and geochemical techniques to locate geothermal resources. The program also will report on its collaboration with the U.S. Geological Survey (USGS) and state agencies on a national resource assessment. The assessment is expected to identify important new resources, resulting in reduced development risk for industry and lower exploration costs. Because DOE associated work was completed in FY 2006, no funds are requested, all remaining activities, such as reporting and transfer of technologies, were completed using prior-year funds. Streamlined leasing and permitting, royalties to local jurisdictions, and the production tax credit mandated by EPACT 2005 should accelerate the exploration for geothermal resources in the western United States, improving exploration technologies through experience and learning.

Enhanced Geothermal Systems	**5,928**	**0**	**0**

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.

During FY 2007, the program prepared final reports on completed cooperative research projects with universities, private companies, and National Laboratories using prior year funds. An analysis of state-of-the-art technology for EGS applications will be completed using prior year funds. Improvements to technologies that support EGS, such as exploration, drilling, and energy conversion, should occur from increased development resulting from the EPACT-mandated activities such as streamlined leasing and permitting, royalties to local jurisdictions, and the production tax credit.

	(dollars in thousands)		
	FY 2006	FY 2007	FY 2008
Systems Development	**6,188**	**0**	**0**

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.

During FY 2007, the program is preparing final reports, using prior year funds, on the completion of FY 2006 projects such as: integrated Diagnostics-While-Drilling data management; verification of the field-worthiness of advanced primary cementing technology such as nitrified, high-temperature, reverse-circulated cements; completion of field demonstrations of hydraulically augmented drag bits and high-strength drill pipe; field-test enhanced air-cooled condensers; development of a laser-based instrument for real-time detection of hydrogen sulfide in cooling towers. Because all research and development work was concluded in FY 2006, no additional funds are requested. Streamlined leasing and permitting, royalties to local jurisdictions, and the production tax credit mandated by EPACT 2005 should accelerate the development of new geothermal power plants and new geothermal wells which will result in reduced cost of key drilling and power plant subsystems through experience and learning.

SBIR/STTR	**0**	**0**	**0**

In FY 2006, $271,000 was transferred to the SBIR program and $33,000 to the STTR program respectively.

Total, Technology Development	**14,860**	**0**	**0**

Technology Application

Funding Schedule by Activity

	(dollars in thousands)		
	FY 2006	FY 2007	FY 2008
Technology Application			
Technology Verification	1,532	0	0
Technology Deployment	2,658	0	0
Total, Technology Application	4,190	0	0

Description

This subprogram has focused on 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.

Benefits

Efforts in FY 2007 are focused on closing out field verification activities and the final reporting of outstanding projects. Partnering with industry, the Geothermal Technology Program established geothermal as an economically competitive contributor to the U.S. energy supply due to the high baseload reliability of geothermal with nearly 2600 MWe of capacity generating over 14.76 GWh/year of electrical energy and 600 MWt of direct use energy. Due to research and application efforts of the program, power generation projects are currently in operation or under development in California, Nevada, Utah, Idaho, Alaska, Hawaii and New Mexico.

Detailed Justification

	(dollars in thousands)		
	FY 2006	FY 2007	FY 2008
Technology Verification	**1,532**	**0**	**0**

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

	(dollars in thousands)		
	FY 2006	FY 2007	FY 2008

technology are done in collaboration with cost-sharing industry partners, who will adopt the technology.

In FY 2006, the program completed collaboration with industry partners to find and evaluate new geothermal resources in the western United States using DOE-sponsored technology improvements and completed design and construction of the electrical power systems field verification projects selected in FY 2005. Shallow hydrothermal systems successfully completed verification and are ready for site application with the potential to expand the development of geothermal resources. These activities were completed using prior year funds. Because work was completed in FY 2006, no funds are requested for FY 2008. Streamlined leasing and permitting, royalties to local jurisdictions, and the production tax credit mandated by EPACT 2005 should accelerate the exploration and evaluation of new geothermal resources in the western United States. EPACT mandates also will accelerate the development of new geothermal electrical power systems.

Technology Deployment	**2,658**	**0**	**0**

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

Most deployment activities were completed in FY 2006; therefore no funds are being requested for FY 2008. Any residual deployment responsibilities will be managed through EERE corporate outreach activities. EPACT 2005 mandates is expected to accelerate deployment of both electrical and direct use geothermal applications.

Total, Technology Application	**4,190**	**0**	**0**

Congressionally Directed Activities

Funding Schedule by Activity

	(dollars in thousands)		
	FY 2006	FY 2007	FY 2008
Congressionally Directed Activities	3,712	0	0
Total, Congressionally Directed Activities	3,712	0	0

Description

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

There were a total of four Congressionally Directed activities in FY 2006. The program does not request further funding for these projects. The following projects were directed by Congress to be included in this program.

Detailed Justification

	(dollars in thousands)		
	FY 2006	FY 2007	FY 2008
Ohio Wesleyan University Geothermal Demonstration Project	**742**	**0**	**0**
Installation of ground source heat pump in Ohio.			
Springfield Equestrian Center Energy Efficiency Project	**1,485**	**0**	**0**
Installation of ground source heat pump in Ohio.			
Lipscomb University Geothermal System	**495**	**0**	**0**
Installation of ground source heat pump in Ohio.			
Geothermal and Renewable Energy Laboratory of Nevada	**990**	**0**	**0**
Geothermal resource assessment and exploration of the Great Basin.			
Total, Congressionally Directed Activities	**3,712**	**0**	**0**

Hydropower

Funding Profile by Subprogram

	(dollars in thousands)		
	FY 2006 Current Appropriation	FY 2007 Request	FY 2008 Request
Hydropower			
Technology Viability	150	0	0
Technology Application	345	0	0
Total, Hydropower	495	0	0

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)
P.L. 109-190, "Energy Policy Act" (2005)

Mission

The mission of the Hydropower Program has been to lead the Nation's efforts to improve the technical, societal, and environmental benefits of hydropower, and develop cost-competitive technologies that enable the development of new and incremental hydropower capacity, adding to the diversity of the Nation's energy supply. The Hydropower Program completed program activities in FY 2006. No funding is requested in FY 2008. Consistent with R&D investment criteria on the necessity of market barriers to justify Federal investment, the Hydropower Program was closed out in FY 2006.

Benefits

The Hydropower Program's mission and activities have contributed directly to EERE's and DOE's mission of improving national, energy, and economic security by increasing supply and diversity. The program met its FY 2006 annual target to complete a final report for operations and maintenance monitoring of large turbine test sites.

Expected Program Outcomes

Consistent with R&D investment criteria on the necessity of market barriers to justify Federal investment, the Hydropower Program was closed out in FY 2006. The industry is expected to continue benefiting from the program as it implements the environmentally-improved advanced turbine designs developed by the program, including from:

- Increased fish survivability and improved dissolved oxygen level, overcoming factors that often lead to reductions in the allowable generation during relicensing;
- Increased generation efficiency due to improved turbine designs; and
- Improved water optimization from models made available by the program.

Technology Viability

Funding Schedule by Activity

	(dollars in thousands)		
	FY 2006	FY 2007	FY 2008
Technology Viability			
Advanced Hydropower Technology	150	0	0
Total, Technology Viability	150	0	0

Description

The Technology Viability key activity focused on development of advanced technologies to enhance environmental performance and greater energy efficiencies. In 2003, the program could not find a partner willing to cost share in the full-scale testing of a new, innovative turbine, indicating a lack of interest and/or need by the industry. The program shifted focus in 2004 and 2005 to R&D on existing commercial designs with potential for efficiency gains and/or increased fish survivability. Market barriers to private sector investment in this R&D are minimal. Consistent with R&D investment criterion on the necessity of market barriers to justify Federal investment, the Hydropower Program was closed out in FY 2006. Therefore, no funding is requested in FY 2008.

To ensure that work completed by the Hydropower Program can be used effectively in the future, the program's FY 2006 closeout activities included making the following available electronically: a basic history of the program areas of inquiry; R&D plans; documented results; and other relevant information to enable the current industry community and potential future interests to make best use of the program efforts to date. The documentation is available on http://hydropower.inel.gov.

Benefits

Efforts in FY 2006 focused on closing out contracts at sites where technology has been implemented. No program activity will take place in FY 2008.

Detailed Justification

	(dollars in thousands)		
	FY 2006	FY 2007	FY 2008
Advanced Hydropower Technology	**150**	**0**	**0**

In FY 2005, the program completed testing of fish-friendly turbines at Wanapum and Osage hydropower plants; completed work with the U.S. Army Corps of Engineers on laboratory scale modeling tests of the Ice Harbor hydropower plant; and completed studies to evaluate the effectiveness of environmental mitigation practice. Outstanding contracts under this key activity were closed out in FY 2006. No funding is requested in FY 2008.

Total, Technology Viability	**150**	**0**	**0**

Technology Application

Funding Schedule by Activity

	(dollars in thousands)		
	FY 2006	FY 2007	FY 2008
Technology Application			
Systems Integration and Technology Acceptance	345	0	0
Total, Technology Application	345	0	0

Description

The Technology Application Subprogram included Systems Integration and Technology Acceptance, and Supporting Engineering and Analysis. In FY 2006, the decision was made to close out the Hydropower Program. Therefore, no funding is requested in FY 2008.

Detailed Justification

	(dollars in thousands)		
	FY 2006	FY 2007	FY 2008
Systems Integration and Technology Acceptance	**345**	**0**	**0**

This activity included the determination of technical, economic, and institutional opportunities to integrate hydropower with wind technology and maintain a dialogue among key stakeholders that will aid in developing and maintaining sustainable hydropower markets. No funding is requested in FY 2008.

Total, Technology Application	**345**	**0**	**0**

Vehicle Technologies

Funding Profile by Subprogram

(dollars in thousands)

	FY 2006 Current Appropriation	FY 2007 Request	FY 2008 Request
Vehicle Technologies			
Hybrid Electric Systems	0	0	80,664
Vehicle Systems	12,720	13,315	0
Hybrid and Electric Propulsion	42,843	50,841	0
Advanced Combustion Engine R&D	40,594	46,706	34,550
Materials Technology	34,373	29,786	33,382
Fuels Technology	13,356	13,845	13,845
Technology Integration	0	0	13,697
Innovative Concepts	495	500	0
Technology Introduction	6,250	11,031	0
Biennial Peer Reviews	990	0	0
Technical/Program Management Support	2,475	0	0
Congressionally Directed Activities	24,255	0	0
Total, Vehicle Technologies	178,351	166,024	176,138

Public Law Authorizations:

P.L. 95-91, "U.S. Department of Energy Organization Act" (1977)
P.L. 102-486, "Energy Policy Act" (1992)
P.L. 109-190, "Energy Policy Act" (2005)

Mission

The mission of the Vehicle Technologies Program is to develop more energy-efficient and environmentally friendly highway transportation technologies (for both cars and trucks) that will enable America to use significantly less petroleum. The long-term aim is to develop "leapfrog" technologies which, through significant improvements in vehicle energy efficiency, will provide Americans with continuing freedom of mobility and greater energy security, at lower costs and with lower impacts on the environment than current vehicles.

Benefits

The Vehicle Technologies (VT) Program mission and activities contribute directly to EERE's and DOE's mission of improving National Energy and Economic Security by addressing the President's Advanced Energy Initiative that supports the National Energy Policy call for reducing dependence on oil imports and modernizing conservation technologies and practices. President Bush observed that "We need to get on a path away from the fossil fuel economy. If we want to be less dependent on foreign sources of energy, we must develop new ways to power automobiles."[a] In fact, highway vehicles alone account for 55 percent of total U.S. oil use ─ more than all U.S. domestic oil production. Cost-competitive, more energy-efficient vehicles will enable U.S. citizens and businesses to accomplish their daily tasks while reducing their consumption of gasoline and diesel fuels, thus reducing demand for petroleum, lowering carbon emissions, and decreasing energy expenditures. As the President noted, "By harnessing the power of technology, we're going to be able to grow our economy, protect our environment, and achieve greater energy independence."[b]

Strategic and GPRA Unit Program Goals

The Department's Strategic Plan identifies five Strategic Themes (one each for nuclear, energy, science, management, and environmental aspects of the mission) plus 16 Strategic Goals that tie to the Strategic Themes. The Vehicle Technologies Program supports the following goals:

Strategic Theme 1, Energy Security

Strategic Goal 1.1, Energy Diversity: Increase our energy options and reduce dependence on oil, thereby reducing vulnerability to disruptions and increasing the flexibility of the market to meet U.S. needs.

And concurrently supports:

Strategic Goal 1.2, Environmental Impacts of Energy: Improve the quality of the environment by reducing greenhouse gas emissions and environmental impacts to land, water, and air from energy production and use.

Strategic Goal 1.4, Energy Productivity: Cost effectively improve the energy efficiency of the U.S. economy.

Program Goal 1.1.02.00: Vehicle Technologies - The Vehicle Technologies Program goal is developing technologies that enable cars and trucks to become highly efficient, through improved power technologies and cleaner domestic fuels, while remaining cost- and performance-competitive. Manufacturers and consumers can then use these technologies to help the Nation reduce both petroleum use and greenhouse gas emissions.

By contributing to Strategic Goal 1.4 through our program goal, the program also will make substantial contributions to achieving Strategic Goal 1.1 of creating energy diversity through increasing the use of biofuels and electricity for highway transportation; and Strategic Goal 1.2 by improving the quality of the environment through substantial reduction in the use of oil through higher efficiencies and oil displacement.

Contribution to GPRA Unit Program Goal 1.1.02.00 (Vehicle Technologies)

The key program contribution to Strategic Theme 1, Energy Security, is the direct reduction of petroleum use. The VT Program supports an R&D portfolio focused on developing technologies that

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[a] Remarks by President George W. Bush on Energy Efficiency, National Small Business Conference, Washington, D.C., April 27, 2005.
[b] IBID

can enable dramatic improvements in the energy efficiency of passenger vehicles (e.g., cars, light trucks, and SUV's) and commercial vehicles (heavy trucks, buses, etc.). In addition, the program R&D will focus on reducing the cost and overcoming technical barriers to volume manufacturing of advanced vehicle technologies.

The program's performance measures presented below demonstrate key technology pathways that contribute to achievement of this goal. Some performance measures have been expanded to provide more comprehensive coverage of program activities.

- Hybrid Electric Systems subprogram: As an intermediate goal, by 2010, develop an integrated electric propulsion system that costs no more than $12/kW peak ($660 per system compared to the cost of $1,900 in 1998) and can deliver at least 55 kW of power for 18 seconds and 30 kW of continuous power with an inlet coolant temperature of 70^{o}C. Additionally, the propulsion system will have an operational lifetime of 15 years. By 2015, meet the same life, performance, and cost requirements but for an inlet coolant temperature of 105^{o}C.

- Hybrid Electric Systems subprogram:

  - Reduce the production cost of a high power 25 kW battery for use in passenger vehicles from $3,000 in 1998 to $500 by 2010, enabling cost competitive market entry of hybrid vehicles; and

  - Reduce the production cost of a high energy and high power battery from $1,000 per kWh in 2006 to $300 per kWh by 2014, enabling cost competitive market entry of plug-in hybrid electric vehicles (PHEVs).

- Advanced Combustion R&D subprogram and Fuels Technology subprogram: Improve the efficiency of internal combustion engines from 30 percent (2002 baseline) to 45 percent by 2010 for passenger vehicles and from 40 percent (2002 baseline) to 55 percent by 2013 for commercial vehicle applications while utilizing an advanced fuel formulation that incorporates a non-petroleum based blending agent to reduce petroleum dependence and enhance combustion efficiency.

- By 2010, develop material and manufacturing technologies which, if implemented in high volume, could cost-effectively reduce the weight of passenger vehicle body and chassis systems by 50 percent with safety, performance, and recyclability comparable to 2002 vehicles.

Funding by Strategic and GPRA Unit Program Goal

(dollars in thousands)

	FY 2006	FY 2007	FY 2008
Strategic Goal 1.1, Energy Diversity			
GPRA Unit Program Goal 1.1.02.00, Vehicle Technologies			
Hybrid Electric Systems	0	0	80,664
Vehicle Systems	12,720	13,315	0
Hybrid and Electric Propulsion	42,843	50,841	0

	(dollars in thousands)		
	FY 2006	FY 2007	FY 2008
Advanced Combustion Engine R&D	40,594	46,706	34,550
Materials Technology	34,373	29,786	33,382
Fuels Technology	13,356	13,845	13,845
Technology Integration	0	0	13,697
Innovative Concepts	495	500	0
Technology Introduction	6,250	11,031	0
Biennial Peer Reviews	990	0	0
Technical/Program Management Support	2,475	0	0
Congressionally Directed Activities			
Phase II Heavy Vehicle Hybrid Propulsion, WI (partially supports goal)	1,485	0	0
Oak Ridge National Lab Highway Transportation Technologies, TN (partially supports goal)	4,950	0	0
Mississippi State University CAVS Center, MS (partially supports goal)	1,980	0	0
Total, Congressionally Directed Activities	8,415	0	0
Total, Strategic Goal 1.1 (Vehicle Technologies)	162,511	166,024	176,138
All Other			
Congressionally Directed Activities			
Phase II Heavy Vehicle Hybrid Propulsion (partially supports goal)	1,485	0	0
National Hybrid Truck Manufacturing Program	1,980	0	0
Turbocharger Diesel Engine R&D	3,960	0	0
Vehicle Test Strip Equipment Demonstration	1,485	0	0
Oak Ridge National Lab Highway Transportation Technologies (partially supports goal)	4,950	0	0
Mississippi State University CAVS Center (partially supports goal)	1,980	0	0
Total, Congressionally Directed Activities	15,840	0	0
Total, All Other	15,840	0	0
Total, Strategic Goal 1.1 (Vehicle Technologies)	178,351	166,024	176,138

Annual Performance Results and Targets

FY 2003 Results	FY 2004 Results	FY 2005 Results	FY 2006 Results	FY 2007 Targets	FY 2008 Targets
GPRA Unit Program Goal 1.1.02.00 (Vehicle Technologies)					
Hybrid Electric Systems (formerly Hybrid and Electric Propulsion)/Advanced Power Electronics and Electric Motors R&D (formerly Advanced Power Electronics)					
				Demonstrate in the laboratory a motor with a specific power of 1.0 kW/kg, power density of 3.0 kW/liter, projected cost of $9/kW peak, and efficiency of 90 percent.	Demonstrate in the laboratory a combined inverter/motor with a specific power of 1.0 kW/kg, power density of 2.0 kW/liter, cost of $14/kW peak at an efficiency of 90 percent for a speed range between 35 percent and 100 percent speed and an inlet coolant temperature of 70^{o} C.
Vehicle Systems/Heavy Vehicle Systems R&D and Materials Technologies/Lightweight Materials Technology					
Reduce parasitic losses of heavy vehicle systems to 30 percent of total engine output and benchmark additional reductions through commercial heavy-duty truck electrification. [EXCEEDED GOAL]	Reduce parasitic loses to 27 percent of total engine output in a laboratory test. [MET GOAL]	Reduce parasitic energy loss to 25 percent of total engine output and reduce unloaded tractor-trailer weight to 22,000 pounds. [MET GOAL]	Reduce parasitic energy loss to 24 percent of total engine output. [MET GOAL]		
Hybrid Electric Systems (formerly Hybrid and Electric Propulsion)/Energy Storage R&D (formerly Energy Storage)					
Reduce high-power 25 kW estimated battery cost to $1,180 per battery system. [EXCEEDED GOAL]	Reduce high-power 25 kW light vehicle estimated lithium ion battery cost to $1,000 per battery system . [MET GOAL]	Reduce high-power, 25 kW, light vehicle, lithium ion battery cost to $900 per battery system . [MET GOAL]	Reduce the projected cost at high volume of a high power, 25 kW, light vehicle, lithium ion battery to $750 per battery system. [MET GOAL]	Reduce high power, 25 kW, passenger vehicle, lithium ion battery cost to $700 per battery system for conventional hybrid vehicles.	Reduce high power, 25 kW, passenger vehicle, lithium ion battery cost to $625 per battery system for conventional hybrid vehicles.
Advanced Combustion R&D (formerly Advanced Combustion Engine R&D)/Combustion and Emission Control and Heavy Truck Engine; Advanced Fuels (formerly Fuels Technology)					
Demonstrate optimized emission control system that achieves 0.07 g/mile NO_x and 0.01 g/mile PM short-term performance in light passenger -vehicles. [MET GOAL]	Complete Light Truck activity with 35 percent fuel efficiency improvement over a gasoline powered light truck and Tier 2 emissions levels (0.07g/mile NO_x). Demonstrate 45 percent thermal efficiency for heavy-duty commercial vehicle diesel engines while meeting EPA	Light vehicle combustion engines will reach 39 percent brake thermal efficiency and commercial heavy-duty vehicle combustion engines will be greater than 45 percent efficient while meeting EPA 2007 emission standards (1.2 g/hp-hr NO_x). [MET GOAL]	Achieve 41 percent brake thermal efficiency for light vehicle combustion engines and 50 percent brake thermal efficiency, while meeting EPA 2010 emission standards (0.2 g/hp-hr NOx), for heavy vehicle combustion engines. [MET GOAL]	In the laboratory, demonstrate passenger vehicle combustion engines with a 42 percent brake thermal efficiency.	In the laboratory, demonstrate passenger vehicle combustion engines with a 43 percent brake thermal efficiency. Complete progress review of heavy-duty engine research and down-select from 4 to 2 the number of cooperative agreements for continued R&D, based on the

FY 2003 Results	FY 2004 Results	FY 2005 Results	FY 2006 Results	FY 2007 Targets	FY 2008 Targets
	2007 emission standards (1.2g/hp-hr NO_x). [MET GOAL]				best prospects of achieving the 2013 goal of 55 percent engine efficiency.
Materials Technology/Lightweight Materials Technology					
Complete R&D on technologies, which, if implemented in high volume, could reduce the price of automotive-grade carbon fiber to less than $7/pound. [EXCEEDED GOAL]	Complete R&D on technologies which, if implemented in high volume, could reduce the price of automotive-grade carbon fiber to less than $5/pound. [MET GOAL]	Complete R&D on technologies, which, if implemented in high volume, could reduce the price of automotive-grade carbon fiber to less than $4.50/pound. [MET GOAL]	Complete R&D on technologies, which, if implemented in high volume, could reduce the projected (i.e., modeled) bulk cost of automotive-grade carbon fiber to less than $3.00/pound. [GOAL NOT MET]	Reduce the modeled weight of a mid-sized passenger vehicle body and chassis components by 10 percent relative to baseline.	Reduce the modeled weight of a mid-sized passenger vehicle body and chassis components by 25 percent relative to baseline.
	Contribute proportionately to EERE's corporate goal of reducing corporate and program adjusted uncosteds to a range of 20-25 percent by reducing program annual uncosteds by 10 percent in 2004 relative to the program uncosted baseline (2005) until the target range is met. [MET GOAL]	Contribute proportionately to EERE's corporate goal of reducing corporate and program adjusted uncosteds to a range of 20-25 percent by reducing program annual uncosteds by 10 percent in 2005 relative to the program uncosted baseline (2006) until the target range is met. [GOAL PARTIALLY MET]	Maintain total administrative overhead costs (defined as program direction and program support excluding earmarks) in relation to total program costs of less than 12 percent. [a] [MET GOAL]	Maintain total administrative overhead costs (defined as program direction and program support excluding earmarks) in relation to total program costs of less than 12 percent.	Maintain total administrative overhead costs in relation to total program costs of less than 12 percent. Baseline for administrative overhead rate currently being validated.

[a] Baseline for administrative overhead rate currently being validated.

Means and Strategies

The Vehicle Technologies Program will use various means and strategies to achieve its GPRA Unit 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 program's ability to achieve its goals. Collaboration with industry partners and other DOE programs will be integral to the planned investments, and the means and strategies used to address external factors.

Means:

Vehicle Technologies uses five basic means of accomplishing the program's goals: support of R&D, deployment efforts, coordination of R&D through government-industry partnerships, market analyses to inform strategic planning, and external and peer reviews of the program's direction and progress.

- The primary barriers and opportunities for improved vehicle efficiency are technological. Therefore the program uses the majority of its funds to support research and development (R&D) of technologies that have the potential to achieve significant improvements in vehicle fuel efficiency or significant displacement of petroleum-based fuels with clean, cost-competitive alternative fuels that can be produced domestically. Research performed by national laboratories and universities is generally not cost-shared, but virtually all R&D performed by private industry is cost-shared, with the private share ranging from 20 percent to more than 50 percent. Most of the program's university and industry R&D is competitively awarded.

- Market deployment and adoption of new technologies face numerous non-technological barriers, and to address those, the program funds and facilitates demonstration and deployment efforts in the Technology Integration subprogram. Those efforts recently have focused on the use of alternative-fuel vehicles, but increasingly the deployment efforts will broaden to include plug-in hybrid electric vehicles (PHEVs) and other advanced technologies. Industry adoption of new technologies is also advanced through the program's university-oriented activities that create graduate education opportunities working with new technologies and encourage undergraduate engineering students to gain experience with hybrid systems technology and advanced combustion engines.

- The program makes extensive use of government/industry consortia to coordinate R&D goals and plans between DOE and our industry partners. Virtually all of the program's R&D is coordinated using technology roadmaps developed in either the FreedomCAR and Fuel Partnership or the 21st Century Truck Partnership. The partnerships not only address what research needs to be performed, but serve as a forum for discussion of which activities industry will undertake on their own and which may be appropriate for DOE funding.

- Both the R&D and deployment activities fund market and economic analyses as needed to properly inform the program's technology strategies and multi-year plans.

- The program's goals, activities, and progress are reviewed and critiqued by our industry partners in the FreedomCAR and Fuel Partnership and the 21st Century Truck Partnership through technical and programmatic reviews, and also through a formal biennial Peer Review process coordinated by the National Academies.

Strategies:

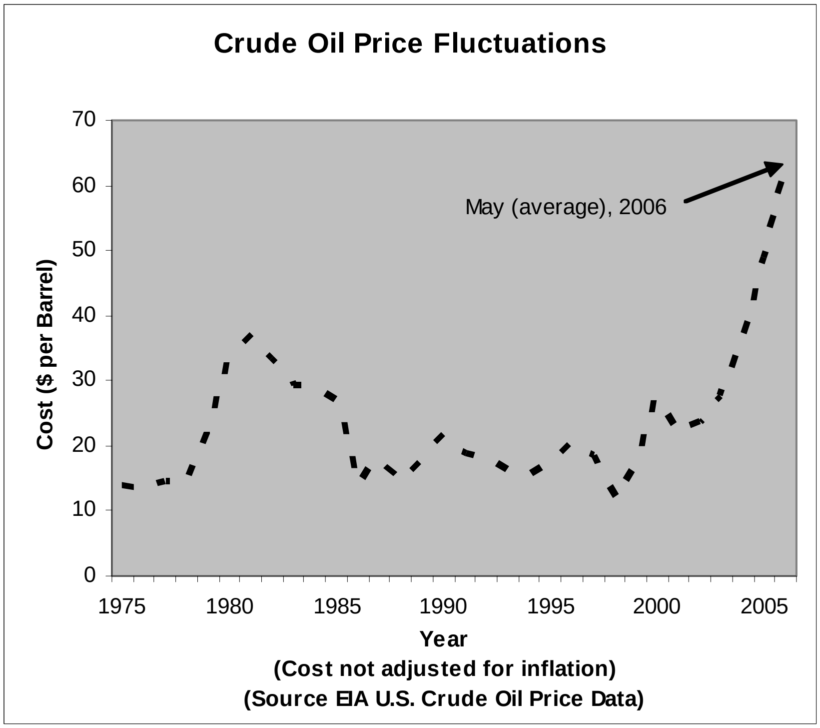
There are four fundamental ways in which vehicle efficiency can be improved and petroleum use can be displaced: more efficient combustion engines, hybrid-electric vehicle systems, reduced vehicle weight, and use of alternative fuels. The Vehicle Technologies program is addressing all four approaches:

- Improved combustion technologies and optimized fuels can provide near- and mid-term fuel-efficiency gains in both passenger and commercial vehicles.
- Improved hybrid-electric systems and components can provide significant improvements in fuel economy even beyond the current generation of hybrids, and technologies optimized for plug-in hybrids will allow displacement of petroleum by electricity in passenger vehicles in the mid- and long-term.
- The efficiency of all vehicles – both passenger and commercial – can be improved by the development of lightweight materials to reduce vehicle weight and improve fuel economy. The VT program supports R&D on both lightweight structural materials and also high-performance materials for energy storage and power-train components.
- Petroleum can be displaced by the use of alternative fuels. The development of alternative fuel production technologies is the responsibility of other DOE programs and Federal agencies (such as DOE's Hydrogen and Biomass programs and the Department of Agriculture), but the Vehicle Technologies program has the lead in facilitating deployment and encouraging adoption of alternative fuels through partnerships with State and local governments, universities, industry, and other organizations. The program's deployment activities will be expanding to promote the adoption of advanced petroleum-displacement technologies such as plug-in hybrid-electric vehicles as well.

If successful, these strategies would result in significant cost savings and a significant reduction in the consumption of gasoline and diesel fuels, cost-effectively reducing America's demand for petroleum, lowering carbon emissions, and decreasing energy expenditures.

The following external factors could affect the ability of the Vehicle Technologies Program to achieve its strategic goal:

- The interest that consumers place on new vehicle fuel economy can be very dependent on the price of gasoline. But because gasoline prices have historically gone up and down, they have not provided a consistent signal. (See "Crude Price Fluctuations" figure.)



Manufacturers and consumers generally have not expected prices to remain high, but this may change. As a result of previous low consumer motivation for high fuel economy vehicles, manufacturers have been reluctant to assume the risk required for the production and distribution of advanced energy-efficient vehicle technologies; and

- Energy savings, oil savings, carbon emission reductions, and energy expenditure savings are estimated using an Energy Information Agency (EIA) reference case that has assumed low future oil prices. The "Annual Energy Outlook 2006" from EIA increased the forecasted price of oil, but it still remains well below CY 2005 prices. The goals and benefits could be affected if changes in energy policy encourage consumers to purchase more efficient vehicles than is currently projected.

Collaboration and Partnerships

Collaboration and partnerships with industry and with other Federal programs have been key features of how the Vehicle Technologies program does business for many years. The principal current collaborations are:

- **FreedomCAR and Fuel Partnership.** The program participates in the FreedomCAR and Fuel Partnership along with the Hydrogen Technology Program (HT), the U.S. Council for Automotive Research (USCAR) and five energy companies to support the FreedomCAR goals. The USCAR member companies are Ford, General Motors and DaimlerChrysler. The energy partners are BP America, Chevron Corporation, ConocoPhillips, Exxon Mobil Corporation, and Shell Hydrogen LLC. The Partnership is focused on precompetitive high-risk research necessary to provide a full range of affordable energy-efficient cars and passenger trucks, and their fueling infrastructure. The primary focus is on hybrid-electric vehicle technologies, supporting R&D on combustion-engine hybrids for the near term and fuel-cell hybrids for the long term. Within this partnership, the Vehicle Technologies Program is responsible for the combustion engine and fuels R&D and for hybrid vehicle systems technologies such as batteries, power electronics, lightweight materials, and system integration models. The Hydrogen Technology Program is responsible for developing fuel-cell technology that could be used in hybrid vehicles along with hydrogen production and fueling infrastructure technologies that would support such vehicles.

FreedomCAR Funding

(dollars in thousands)

	FY 2006	FY 2007 Request	FY 2008 Request
Vehicle Technologies Portion	96,549	109,774	126,619
Hydrogen Portion	74,266	81,804	81,200
Total, FreedomCAR Funding	170,815	191,578	207,819

The FreedomCAR and Fuel partners have identified eight specific technology goals for 2010 and 2015 to guide government and industry R&D efforts and to measure their progress. This request fully supports FreedomCAR goals for both hybrid and internal combustion power-train systems and light-weight materials.

2010 Hydrogen Fuel Initiative and FreedomCAR Coordinated Technology Goals

Vehicle Technologies has sole responsibility for four of the eight goals and joint responsibility, with Hydrogen Technology, for one goal:

- 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 Power train Systems costing $30/kW, having a peak brake engine efficiency of 45 percent, and that meet or exceed emissions standards;
- Electric Drive train Energy Storage with 15-year life at 300 Wh per vehicle and 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; and
- Internal Combustion Engine Power train 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 Hydrogen Technology).*

Hydrogen Technology has sole responsibility for these goals:

- 60 percent peak energy-efficient, durable fuel cell power systems (including hydrogen storage) that achieve a 325 W/kg power density and 220 Wh/l operating on hydrogen. Cost targets are $45/kW by 2010 and $30/kW by 2015;
- Demonstrate hydrogen refueling and develop commercial codes and standards and diverse renewable and non-renewable energy sources. Achieve a cost of energy from hydrogen equivalent to gasoline at market price, assumed to be $2.00-3.00 per gallon gasoline equivalent produced and delivered to the consumer independent of pathway by 2015; and
- On-board Hydrogen Storage Systems demonstrating specific energy of 2.0 kWh/kg (6 weight percent hydrogen), and energy density of 1.5 kWh/l at a cost of $4/kWh by 2010 and specific energy of 3.0 kWh/kg (9 weight percent hydrogen), 2.7 kWh/l, and $2.00/kWh by 2015.

- **21st Century Truck Partnership.** The 21st Century Truck Partnership (21CTP) is a cooperative effort between the commercial vehicle (truck and bus) industry and major Federal agencies to develop technologies that will make our Nation's commercial vehicles more efficient, clean, and safe. Federal agency participants in the Partnership are the Departments of Energy, Defense (represented by the U.S. Army), Transportation, and the Environmental Protection Agency. Industry partners are Allison Transmission, BAE Systems, Caterpillar, Cummins, DaimlerChrysler, Detroit Diesel, Eaton Corporation, Freightliner, Honeywell International, International Truck and Engine, Mack Trucks, NovaBUS, Oshkosh Truck, PACCAR, and Volvo Trucks North America. Primarily due to hydrogen's low energy density when compared to petroleum fuels, hydrogen fuel cells are not seen as a viable option as a prime mover for long-haul heavy highway vehicles in the foreseeable future. Instead, the 21CTP effort centers on research and development to:

  - increase engine efficiency;
  - improve performance of hybrid powertrains;
  - reduce fatalities through advanced safety systems;
  - reduce parasitic and idling losses; and
  - validate and demonstrate these technologies.

21st Century Truck Funding

(dollars in thousands)

	FY 2006	FY 2007 Request	FY 2008 Request
21st Century Truck Funding	45,267	42,021	29,792

- **DOE R&D Pathway Integration.** Vehicle Technologies participates in an effort to integrate and harmonize R&D pathways across DOE's energy research programs. VT's principal counterparts are the Biomass and Biorefinery Systems R&D, Building Technologies, and Hydrogen Technology programs within EERE, and the Basic Energy Sciences program within the Office of Science.
- The program is also collaborating with the Environmental Protection Agency (EPA) to promote deployment of two specific technologies, as discussed in EPA's strategic plan: (1) DOE's

Technology Integration activity will leverage its Clean Cities partnerships to work with EPA's SmartWay Transport Partnership to promote the installation of more biodiesel and E-85 ethanol refueling stations around the country; and (2) the program will also cooperate with EPA to promote the adoption of idling-reduction technologies and practices for trucks and buses.

Validation and Verification

To validate and verify program performance, the Vehicle Technologies Program will conduct internal and external reviews and audits. These programmatic activities are subject to continuing review by, for example, the Congress, the Department's Inspector General, and the National Academy of Sciences. The Vehicle Technologies Program also uses several program performance management methods to validate and verify its performance during the course of the program on an annual and ongoing basis, including: management standards; incorporation of goals; measurement and reporting from program contracts; peer reviewed roadmaps and activities; performance modeling and estimation; prototype testing; site visits; and annual program reviews.

Data Sources:	Program Reviews, Peer Reviews, Laboratory Tests, On-Road Tests, and Peer-Reviewed Model Baselines.
Baseline:	Cost of hybrid batteries in 1998 ($3,000 projected for volume production of a high power 25 kW battery), combustion efficiency in 2002 (30 percent for passenger vehicles and 40 percent for commercial vehicles), 2002 passenger vehicle weight (3450 pounds as the nominal weight for a mid-sized car), cost of plug-in hybrid high energy battery in 2006 ($1,000/kWh), and integrated electric propulsion system cost in 1998 ($1,900). (Note: cost values are not adjusted for inflation.)
Frequency:	Biennial Peer reviews will be conducted in alternate years for the FreedomCAR and Fuel Partnership and for the 21st Century Truck Partnership.
Data Storage:	EE Corporate Planning System
Evaluation:	In carrying out the program's mission, the VT Program uses several forms of evaluation to assess progress and to promote program improvement. These are conducted at both the program and the activity levels. The types of evaluations are:

- Technology validation and operational field measurement, as appropriate;
- Peer review by independent outside experts of both the program and subprogram portfolios;
- Annual internal Technical Program Review of the VT Program;
- Specialized program evaluation studies to examine process, impacts, or market baseline and effects, as appropriate;
- Quarterly and annual assessment of program and management results based on Joule (the DOE quarterly performance progress review of budget targets), PMA (the President's Management Agenda ─ annual departmental and Program

Secretarial Officer (PSO) based goals whose milestones are planned, reported and reviewed quarterly), and PART (common government wide program/OMB reviews of management and results);

- Annual review of methods, and computation of the potential benefits for the Government Performance and Results Act (GPRA); and
- Biennial reviews of both the FreedomCAR and Fuel Partnership and the 21st Century Truck Partnership by an independent third party, such as the National Academy of Sciences/National Academy of Engineering, to evaluate progress and program direction. The reviews include evaluation of progress toward achieving the Partnership's technical goals and direction. Based on this evaluation, resource availability, and other factors, the FreedomCAR and Fuel partners and the 21CT partners will consider new opportunities, make adjustments to technology specific targets, and set goals as appropriate.

Verification: Run and document vehicle simulation tests, conduct bench tests, run laboratory tests on the engine and vehicle dynamometers, run wind tunnel tests, and conduct on-road and track tests to evaluate the technology. Conduct fleet tests and undertake target performance review.

Program Assessment Rating Tool (PART)

PART was developed by OMB to provide a standardized way to assess the effectiveness of the Federal Government's portfolio of programs. The Department has implemented this tool to evaluate selected programs in conjunction with OMB. The structured framework of the PART provides a means through which programs can assess their activities differently than through traditional reviews. The VT Program has incorporated feedback from OMB into the FY 2008 Budget Request and is taking the necessary steps to continue to improve performance.

The Vehicle Technologies Program received its first OMB PART review in 2004. The 2004 PART review included ratings of 80 percent for program purpose, 90 percent for planning, 100 percent for management and 75 percent for program results and accountability with an overall rating of "moderately effective," the second-highest overall rating possible (total weighted score of 83 percent). The PART recommended that the program add a peer review to include the 21st Century Truck Partnership, including an assessment of the appropriateness of Federal support in each program area, which is underway.

The Department has responded to the PART recommendation of "Develop guidance that specifies a consistent framework for analyzing the costs and benefits of research and development investments, and use this information to guide budget decisions." The Department has specified common scenarios, common methodology, and standardized benefits measures to allow analyzing the costs and benefits of applied R&D investments. While progress has been made, benefits estimates across programs are still not completely comparable, primarily because they do not reflect equal levels of technical risk. The Department continues to work on implementation of common assumptions and a consistent approach to incorporation of risk.

Another commitment added in FY 2006, based on a peer review by the National Academies, was to "Set priorities and identify decision points to focus resources on solving the most critical problems to commercialization of technologies that can reduce petroleum consumption." The program has begun to address this recommendation, as reflected in budget shifts between FY 2007 and FY 2008. For example, the National Academies recommended placing greater emphasis on battery R&D. This has been done, particularly in conjunction with the President's Advanced Energy Initiative where funding for high energy battery research (suitable for plug-in hybrid vehicles) has steadily increased.

The Vehicle Technologies (VT) Program is organized into subprograms that are described later in the budget. Nearly all of the subprograms are coordinated with the U.S. auto or trucking industries under either the FreedomCAR and Fuel Partnership or the 21st Century Truck Partnership.

Expected Program Outcomes

The Vehicle Technologies Program pursues its mission through integrated activities designed to improve the energy efficiency of highway vehicles and the productivity of our economy. Achievement of the program's goals is expected to displace 2 million barrels per day (mbpd) of imported oil in 2030 and 6 mbpd in 2050. This displacement will yield energy security, environmental and economic benefits.

Estimates of the security, economic and environmental benefits from 2008 through 2050 that would result from realization of the program's goals are shown in the table below. These benefits are achieved by targeted Federal investments in technology research and development in partnership with auto manufacturers, commercial vehicle manufacturers, equipment suppliers, fuel and energy companies, other Federal agencies, state government agencies, universities, National Laboratories, and other stakeholders. These partnerships facilitate the technical coordination of activities and attract cost sharing to provide leveraged benefits for the American taxpayer.

EERE's Vehicle Technologies Program Goal Case reflects the increasing penetration of the program's technologies over time, as the program's goals are met. Not included are any policy or regulatory mechanisms, or other incentives not already in existence, that might be expected to support or accelerate the achievement of the program goals. The expected benefits reflect solely the achievement of the program's goals.

The goals are modeled in contrast to the "baseline" case, in which no DOE R&D exists. The baseline case is identical to those used for all DOE applied energy R&D programs.[a] Further, across EERE, and across all of DOE's applied energy R&D programs, the expected outcome benefits are being calculated

[a] The starting point for the baseline case is the Energy Information Administration's "reference case," as published in the AEO 2006. Program analysts from across DOE examined the AEO to determine the extent to which their program goals are modeled (explicitly or implicitly). If program goals are modeled in the AEO, they are removed in the GPRA baseline. Further, some programs believe that the AEO's technology representation is too conservative, even in the absence of program goals, and thus in certain cases a modification is made to make the technology representation in the baseline case more optimistic than the AEO.

using the same fundamental methodology. Finally, the metrics by which expected outcome benefits are measured are identical for all of DOE's applied energy R&D programs.[a] This standardization of methods and metrics has been undertaken as part of the Department's efforts to respond to Under Secretary Garman's Strategic Management System initiative and OMB's request to make all programs' outcomes comparable.

The difference between the baseline case and the program goal case results in economic, environmental and security benefits. For example, achievement of program goals results in a reduction in net consumer expenditures of almost $50 billion dollars in 2030 and around $200 billion in 2050. Finally, the program would also result in carbon emissions reductions of 70 million metrics tons in 2030 and 210 million metric tons in 2050. The results are generated by modeling the program goals within two energy-economy models: NEMS-GPRA08 for benefits through 2030, and MARKAL-GPRA08 for benefits through 2050.[b] The full list of modeled benefits appears below.

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[a] The set of expected outcome metrics being used this year differs in substantial ways to that of previous years. In addition to the standardization across DOE's applied energy R&D programs, the list is expanded and more comprehensive than in past years. Further, the list maps to DOE strategic goals. The expected outcome metrics represent inherent societal benefits that stem from achievement of program goals.

[b] Final documentation on the analysis and modeling, including all of the methodologies and underlying assumptions, is expected to be completed and posted on the web by March 31, 2007. Past GPRA modeling and analysis documentation can be found at http://www1.eere.energy.gov/ba/pba/gpra.html .

FY 2008 GPRA Benefits Estimates for the Vehicle Technologies Program[a,b]

	2010	2020	2030	2040	2050
Environmental Benefits (Goal 1.2)					
Avoided carbon emissions, annual (MMTC)	1	22	69	220	210
Avoided carbon emissions, cumulative (MMTC)	3	90	580	2,744	4,932
Reduced cost of criteria pollutant control, NPV[c] (bil. 2004 $)	ns	ns	ns	NC	NC
Economic Benefits (Goal 1.4)					
Consumer savings, annual (bil. 2004 $)	ns	17	46	185	202
Consumer savings, NPV (bil. 2004 $)	ns	49	255	1006	1638
Electric power industry savings, annual (bil. 2004 $)[d]	ns	ns	ns	-2	-10
Electric power industry savings, NPV(bil. 2004 $)	ns	ns	ns	-1	-16
Household energy expenses reduced, annual (bil. 2004 $)	ns	1%	3%	6%	7%
Energy intensity reduced (% change in E/GDP)	0%	1%	3%	9%	10%
Net energy system cost savings, annual (bil. 2004 $)	NC	NC	NC	45	81
Natural gas price change, moving avg. (2004 $ / TCF)[e]	ns	ns	ns	NC	NC
Security and Reliability Benefits (Goal 1.1)					
Total oil reduction, annual (mbpd)	ns	0.85	2.9	5.4	6.3
Avoided oil imports, annual (mbpd)	ns	0.4	2	5	6
Avoided oil imports, cumulative (bil. bbl)	ns	1	5	23	44
Security MPG improvement (%)[f]	ns	6%	16%	77%	129%
Transportation fuel diversity improvement (%)[g]	ns	ns	8%	23%	24%
Oil intensity reduced (% change in bil. bbl/GDP)	0%	2%	7%	24%	28%

[a] Benefits through 2030 are calculated with the NEMS-GPRA 08 model. Benefits from 2035 through 2050 are calculated with the MARKAL-GPRA 08 model. "NC" indicates situations in which no calculation was done because of specific model limitations. "ns" indicates results that were "not significant"—within the noise of the models.
[b] Projected benefits do not include any potential policy changes that might enhance technology deployment. In addition, most technologies show diminishing benefits by 2050, because of the assumption built in to the analysis that baseline industry progress will eventually catch up with the more accelerated progress associated with EERE program success.
[c] Net present value calculations throughout this table are performed for cumulative economic metrics, and are done using a 3% real discount rate, cumulative to 2008.
[d] Negative savings in electric power sector reflect increased electricity demand from plug-in hybrid electric vehicles (PHEVs).
[e] The prices reflected here are average delivered prices to all sectors, and are based on a three year moving average. Thus, the measure of benefit is the change in the three year moving average delivered price, in $ per thousand cubic foot.
[f] Security MPG is the ratio of vehicle miles traveled by light duty vehicles to their usage of oil. It captures oil avoidance by efficiency and fuel alternatives.
[g] Fuel diversity is measured by the Shannon-Weiner Index (SWI) of diversity. The SWI is a measure of "proportional diversity," and hence captures both abundance and richness, i.e., how many different fuels and how much of each fuel both factor into the calculation.

The model used to estimate these benefits increases the market share of advanced-technology vehicles over time as their projected incremental cost relative to conventional vehicles declines and as their efficiency relative to conventional vehicles increases. By 2025, over 1 million barrels per day (mbpd) of oil (relative to base consumption) is projected to be saved as compared with the reference projection without these technologies. This accounts for nearly 6 percent of projected transportation oil use in 2025 (nearly 4 percent of total U.S. oil use). By 2050, the projected oil savings grows to nearly 6.5 mbpd, which is nearly 30 percent of the amount of oil use projected for transportation in that year (nearly 23 percent of total U.S. oil use). The primary non-renewable energy savings are expressed in Quads of energy and they are nearly equal to the oil savings (in normalized units) since oil is a non-renewable energy source. The energy bill savings (in the mid-term benefits) are the savings in fuel costs by vehicle users due to the increased efficiency of their advanced vehicles. The energy savings (in the long-term benefits) are the net savings to the vehicle users, including both the value of fuel saved and the incremental expenditures they made to purchase their advanced vehicles. Carbon emission reductions are based on the amount of carbon that the petroleum products saved would have released if they had been used.

Hybrid Electric Systems

Funding Schedule by Activity

(dollars in thousands)

	FY 2006	FY 2007	FY 2008
Hybrid Electric Systems			
Vehicle and Systems Simulation and Testing	0	0	21,087
Energy Storage R&D	0	0	41,805
Advanced Power Electronics and Electric Motors R&D	0	0	15,626
SBIR/STTR	0	0	2,146
Total, Hybrid Electric Systems	0	0	80,664

Description

This subprogram represents a new budget structure in FY 2008. It incorporates in their entirety two previous subprograms: Vehicle Systems and Hybrid & Electric Propulsion. It also includes the Testing and Evaluation activity formerly included in the Technology Introduction subprogram. This change unites all of the program's efforts directly relating to the planning and modeling, development, and evaluation of advanced hybrid, electric, and plug-in hybrid drive systems.

The Hybrid Electric Systems subprogram funds R&D on advanced vehicle technologies for both passenger and commercial vehicles that could achieve significant improvements in fuel economy without sacrificing safety, the environment, performance, or affordability. Primary emphasis is given to R&D on those technologies that support development of advanced hybrid electric and plug-in hybrid electric vehicles. The subprogram also conducts simulation studies, component evaluations, and testing to establish needs, goals, and component/vehicle performance validation. This subprogram’s funding contributes to the 21st Century Truck Partnership and the FreedomCAR and Fuel Partnership, and the President's Advanced Energy Initiative.

The subprogram focuses its work on the two basic building-blocks of hybrid vehicles, plus a collection of activities that tie the R&D efforts together and evaluate their progress.

- Energy Storage R&D addresses the first building block of a hybrid-electric vehicle: the need for storage of electricity. The needs of “regular” hybrid vehicles and plug-in hybrids are similar, but not identical: plug-in hybrids need to be able to store considerably more total energy in their batteries. Developing batteries that are rugged, long-lasting, affordable, lighter, hold a substantial charge, and work in all climates and seasons is still a major R&D challenge.

- Advanced Power Electronics and Electric Motors R&D addresses the second building block, which is the collection of all the electric and electronic devices that tie the power stored in the battery to the vehicle's drivetrain: power control circuits, charging circuits, electric motors, logic to synchronize the power from the battery and motors with the main vehicle engine, and other related components.

The power electronics for a plug-in hybrid will be considerably more complex than for a regular hybrid to accommodate additional charging modes and more complex driving modes.

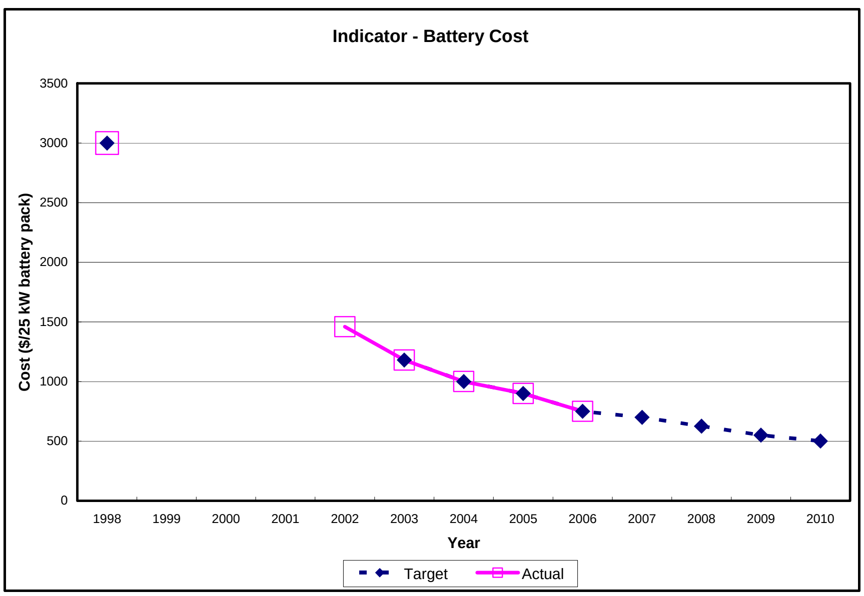
- Vehicle and Systems Simulation and Testing ties all of the hardware R&D together. System-level simulations help specify the necessary performance characteristics of the hardware and predict the overall vehicle performance for a given configuration. Both simulation and testing activities can be used to evaluate the development and progress of individual components, and predict how well they will integrate with other components being developed. Tests and simulations also evaluate how well the program is approaching its whole-vehicle goals, and provide the technical inputs to models of future economic benefits.

Benefits

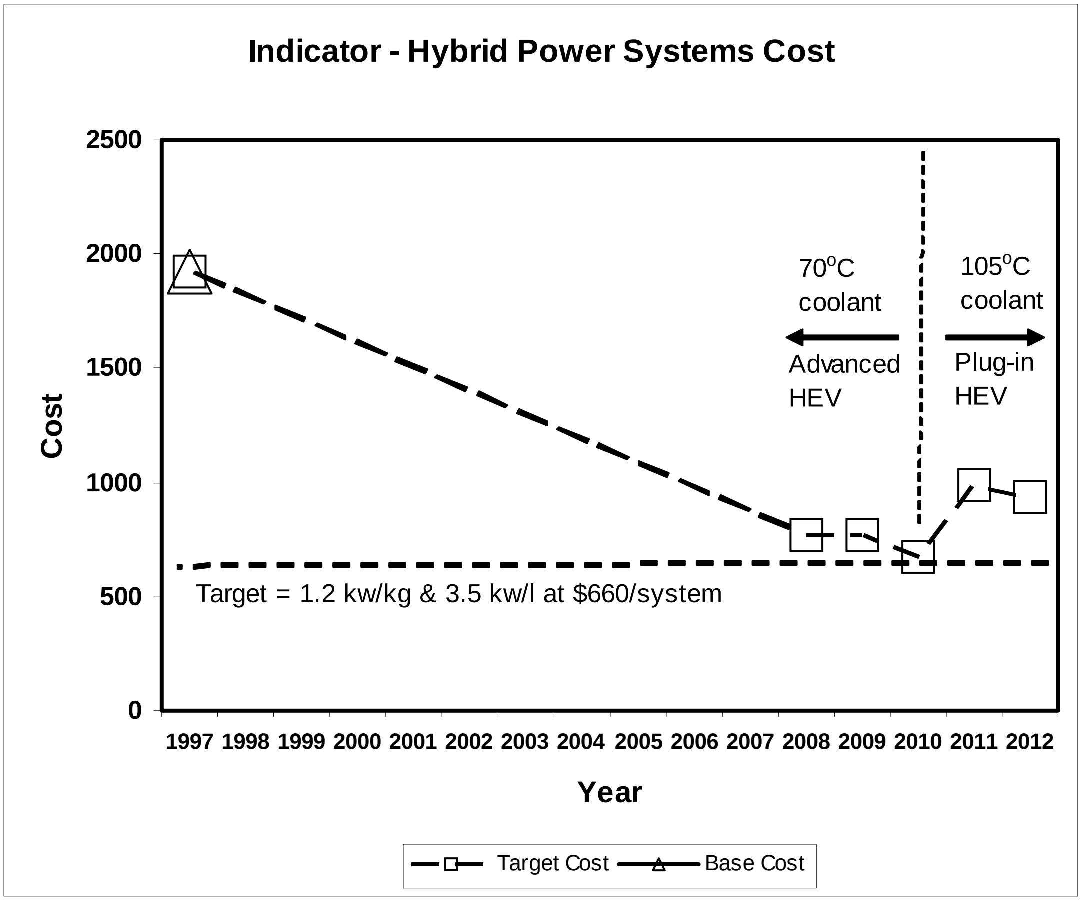
The Hybrid Electric Systems subprogram supports achieving the VT Program goal (04.02.00.00) by addressing those technology elements important to the utilization of electric energy storage, electric drives, and energy recovery in new, more efficient vehicle designs.

A key objective of the Hybrid Electric Systems R&D subprogram is to reduce the production cost of a high-power 25 kW battery for use in passenger vehicles from $3,000 in 1998 to $500 by 2010 (having met an intermediate goal of $750 in 2006), helping to enable cost competitive market entry of hybrid vehicles. Also by 2015, the program will develop an integrated electric propulsion system that costs no more than $12/kW peak and can deliver at least 55 kW of power for 18 seconds and 30 kW of continuous power, with a lifetime of 15 years when operated with an inlet coolant temperature of 105°C.

Progress is indicated by cost per 25 kW battery system estimated for a production level of 100,000 battery systems per year and cost of hybrid power systems. Actual and projected progress for these indicators are shown graphically below:



Note: 1998 value is baseline.



Note: 1997 value is baseline.

Additionally in FY 2008, the subprogram will accelerate the development of low-cost, high-energy batteries and corresponding improvements to the electric drive systems (motors, power electronics, and electric controls) needed for cost-effective plug-in hybrid electric vehicles. Plug-in hybrids (i.e., those that can be plugged into and recharged from an electric outlet) offer the potential to provide significant additional fuel savings benefits, particularly for commuter and local driving, for either combustion or fuel cell powered hybrid passenger vehicles.

Detailed Justification

	(dollars in thousands)		
	FY 2006	FY 2007	FY 2008
Vehicle and Systems Simulation and Testing	**0**	**0**	**21,087**

The Vehicle and Systems Simulation and Testing (VSST) activity integrates the modeling, systems, research, and testing efforts previously located within the Vehicle Systems subprogram, the Subsystems Integration and Development activity (from within Hybrid and Electric Propulsion subprogram), and the Testing and Evaluation activity (from within the Technology Introduction subprogram). The VSST activity uses a systems approach to define technical targets and requirements, guide technology development, and validate performance of DOE-sponsored technologies for passenger and commercial vehicles. The activity develops and validates models and simulation programs to predict the performance, component interaction, fuel economy, and emissions of advanced vehicles. With industry input, these models are used to:

- develop performance targets for the complete range of vehicle platforms and their components; and
- develop advanced control strategies to optimize the interaction between components and the overall performance and efficiency of advanced hybrid electric, plug-in hybrid electric, and fuel cell vehicles.

The models also are used in conjunction with “hardware-in-the-loop” laboratory testing (testing that operates selected pieces of hardware linked to a real-time simulation of the rest of the vehicle) to validate the performance of advanced technology components and systems developed within VT R&D activities without the need to build and test a complete vehicle.

The modeling and validation effort is supported by laboratory and field testing to benchmark and validate the performance of passenger and commercial vehicles that feature one or more advanced technologies. By benchmarking the performance and capabilities of advanced technologies, the effort supports the development of industry and DOE technology targets. The testing results also are used in component, system, and vehicle models, as well as in hardware-in-the-loop testing.

This activity also will research heavy vehicle systems to develop, in collaboration with commercial vehicle manufacturers and their suppliers, advance heavy vehicle systems models, as well as R&D on technologies that will reduce non-engine parasitic energy losses from aerodynamic drag, friction and wear, under-hood thermal conditions, and accessory loads.

In FY 2008, the subprogram will expand simulation studies of advanced control strategies and components for plug-in hybrid electric vehicles (PHEV) as well as the validation of advanced PHEV technology components’ and systems’ performance in the laboratory without building a complete vehicle by utilizing “hardware-in-the-loop” testing techniques. Data collected during laboratory and field tests will be used to enhance vehicle and systems modeling capabilities and to validate the accuracy of the component models. The program also will work to create a series of detailed component models linked to the overall vehicle systems integration model that will ensure the use of the most accurate component data within the systems and vehicle models. This effort, which builds upon an existing CRADA with industry, aims to achieve greater accuracy for model results and to allow the activity to conduct simulations supporting R&D in all other VT subprograms.

The VSST activity will utilize the PHEV Mobile Automotive Technology Testbed (MATT), completed in FY 2007, and hardware-in-the-loop techniques to emulate vehicle systems to determine systems interactions required for vehicle system integration (e.g., energy storage requirements for different cumulative electric range control strategies and power electronics components and configurations). The activity also will enhance engine emission models for analyzing the impact of emissions control on fuel economy and use hardware-in-the-loop testing to determine the impact of expected emission control requirements on fuel economy of advanced hybrid passenger vehicle systems. VSST efforts will validate, in a systems environment, performance targets for deliverables from the power electronics and energy storage technology research and development activities.

The activity also will conduct laboratory and closed track baseline testing and real-world monitored fleet evaluations of advanced plug-in hybrid electric vehicles and conduct in-use testing of vehicles retrofitted with advanced components developed through VT R&D activities. Test results will help identify component and system performance and reliability weaknesses to be addressed through future technology R&D activities. In addition, the funds will allow for a thorough baseline, performance, and reliability testing of plug-in hybrid electric vehicles being prepared by manufacturers and conversion shops. Efforts will be focused on infrastructure/vehicle interface evaluations and the potential impact on the electricity grid.

VSST activities will continue to work with industry partners to enhance the capabilities of the heavy vehicle systems model to incorporate on-road test and proprietary industry data and to complete the integration of turbulence and other computational fluid dynamics (CFD) models. Also to be included are ancillary and under-hood thermal models. The assessment of aerodynamic drag reduction devices and validating CFD techniques which compare wind tunnel results to on-road testing and to theoretical calculations. Data will be collected to enhance the heavy vehicle modeling tools and aerodynamic devices will be evaluated in actual use on over-the-road commercial vehicles. The funds also will support CRADAs (cooperative research and development agreements with industry) and National Laboratory projects to reduce drivetrain friction and wear; to evaluate smaller, lighter, highly efficient cooling systems; and to develop and evaluate under-hood thermal management approaches that will improve vehicle efficiencies while increasing component reliability and life. In addition, these funds may be used to support efforts such as project reviews; data collection and dissemination; and technical, market, economic, and other analyses. (FreedomCAR, $11,344,000; 21CT $5,913,000.)

Energy Storage R&D	**0**	**0**	**41,805**

This activity encompasses all battery research from the Energy Storage activity previously included in the Hybrid and Electric Propulsion subprogram. The Energy Storage activity supports long-term research, applied research, and technology development of advanced batteries for electric, hybrid-electric and plug-in hybrid vehicle (EV, HEV and PHEV) applications. Low-cost, abuse-tolerant batteries with higher energy, higher power, excellent low-temperature operation, and longer lifetimes are needed for the development of the next-generation of hybrid electric vehicles, plug-in hybrid vehicles, and pure electric vehicles. Lithium-based batteries offer the potential to meet all three applications.

The program's long-term, more fundamental research is focused on developing advanced materials for the next generation of energy storage technologies. Applied research is focused on the development and validation of low-cost, abuse-tolerant, and long-life lithium ion batteries for hybrid vehicle applications. Nearer-term technology development is conducted with industry through the United States Advanced Battery Consortium (USABC). All USABC subcontracts to develop advanced batteries for hybrid electric vehicles are awarded under a competitive process and are at least 50 percent cost-shared by developers.

The VT Energy Storage activity coordinates with other DOE programs doing relevant work in advanced battery technologies in order to maximize the return on DOE technology investments in this area. Close cooperation between the VT Energy Storage activity and the Office of Science has resulted in several SBIR/STTR contracts that have provided valuable support to EV and HEV battery development efforts. The activity also coordinates with the Energy Storage Program in the Office of Electricity Delivery and Energy Reliability on the development of batteries and components that might serve both transportation and stationary applications. Interagency coordination on advanced battery development is conducted through the government-sponsored Interagency Advanced Power Group (IAPG) that brings together representatives from the Department of Energy, NASA, the Army, the Navy, and the Air Force.

Lithium-ion batteries offer twice the performance in a lower-cost, lower-weight, and lower-volume package than the nickel metal hydride batteries used in today's hybrid electric vehicles. In FY 2008, the program will continue to develop full-sized lithium-ion modules using low-cost, thermally stable, high-performance anode and cathode materials. The emphasis is on driving down the cost and extending the life of lithium ion batteries (currently at 10 years) to 15 years (the expected life of a vehicle). The program will also continue to support the development of other energy storage devices, such as ultracapacitors, that might be used for micro hybrids (start/stop power only) and some fuel cell hybrid electric vehicles.

Ultracapacitors still have relatively low specific energy (less than 3 Wh/kg) which limits their capacity to serve as the main energy-storage devices in hybrid vehicles, but they offer the possibility of improved vehicle performance in a battery-plus-ultracapacitor hybrid configuration. Ultracapacitor development focuses on the use of low-cost, high-capacity carbon and improved electrolytes which will allow the capacitors to operate at a higher voltage to improve their specific energy. The program will continue to support cost-shared subcontracts through the USABC with multiple battery suppliers to develop batteries meeting the FreedomCAR goal (25 kWh for 18 seconds, 300 Wh available energy, and 15 year life). The program will also continue research at the National Laboratories, focusing on the investigation of cell behavior, developing methodologies to more accurately predict battery life, understanding factors that limit the inherent abuse tolerance, investigating factors that limit low-temperature performance, and identifying approaches to overcome barriers to the introduction of lithium ion batteries.

The dual use of batteries in plug-in hybrid applications for electric drive range during charge depleting mode and for engine power assist during charge sustaining mode, challenges the design of the battery and the methodology to evaluate its performance and life. As a result, materials with higher energy capacity than currently being used are preferred. Also, as the battery becomes larger, abuse-tolerance (susceptibility to damage or failure from vibration or impact, over-charging, fire, etc.) becomes a primary concern requiring higher stability between the electrodes and the electrolyte and adequate/active thermal management at the module and system level. In FY 2008, the program will continue to validate requirements and refine standardized testing procedures to evaluate performance and life of PHEV batteries, and will continue to identify areas for additional R&D and address the specific needs of plug-in hybrid vehicles. The program will also solicit proposals and award additional subcontracts to battery suppliers for development of batteries for plug-in hybrid application. These subcontracts will be awarded competitively through the USABC. The goal is to reduce the cost of the PHEV battery to $300/kWh by 2014.

In FY 2008, the Energy Storage long-term activity will examine innovative materials and electrochemical couples that offer the potential for significant improvements over existing technologies for use in both hybrid and plug-in hybrid electric vehicles. These efforts are being coordinated with the Office of Science to assure best utilization of the research efforts.

The activity also will continue to support the research and development aimed at reducing volume change during cycling of metallic alloys (1000 mAh/g) as a replacement for carbon/graphite material (372 mAh/g) used in present-day lithium batteries. Efforts are underway to accelerate the development of solid polymer electrolytes with significantly higher stiffness and improved high ionic conductivity at room temperature that show promise in retarding dendrite formation in cells with lithium metal anodes (3,000 mAh/g). Block copolymers are also being investigated, with one block providing conduction and other block offering stiffness, providing another alternative for use of metallic lithium electrode.

Cathode capacities of presently-available lithium batteries are in the range of 150 to 200 mAh/g. New materials in the research stage (e.g., lithium-rich layered materials) show promise in achieving capacities approaching 300 mAh/g, but this capacity can only be accessed at voltages where presently-available electrolytes are not stable, necessitating the development of new liquid electrolytes that are stable in the range of 4.5 – 5.0 Volts. Another approach to increasing the capacity is to investigate materials that can accommodate more than one Li atom per molecule of the active material such as lithium vanadium oxide, where capacities in excess of 400 mAh/g have been reported.

	(dollars in thousands)		
	FY 2006	FY 2007	FY 2008

The activity will continue to develop advanced diagnostic techniques to investigate and better understand life- and performance-limiting processes in lithium-based batteries. The program will develop and apply electrochemical models to understand failure mechanisms, mechanisms of thermal runaway in lithium batteries, and to design new functional materials.

In a joint initiative with the Office of Science the activity also will investigate the performance of nano-structures for application in high-energy batteries for plug-in hybrid vehicles, building on Office of Science research on the electrical properties of nanomaterials. Nanomaterials can exhibit superior performance over conventional lithium-ion battery materials in terms of high pulse discharge and recharge power and improved performance at low temperatures. However, the behavior of these materials is not well understood. New diagnostic tools and techniques could be required to investigate these materials. In addition, these funds may be used to support efforts such as project reviews; data collection and dissemination; and technical, market, economic, and other analyses. (FreedomCAR, $41,805,000).

Advanced Power Electronics and Electric Motors R&D	**0**	**0**	**15,626**

This activity encompasses the Advanced Power Electronics activity previously included in the Hybrid and Electric Propulsion subprogram. The Advanced Power Electronics and Electric Motors R&D activity supports long-term R&D on power electronics, electric motors and other electric propulsion components, and thermal control subsystems that are necessary for the development and ultimate adoption of fuel cell and advanced, high-efficiency hybrid electric vehicles. Supporting R&D on capacitors, magnets and wide bandgap materials (such as silicon carbide [SiC]) for advanced power electronics technologies also is included to enable the higher operating temperatures that are anticipated to occur with increased coolant temperatures.

In FY 2008, R&D efforts will continue on inverters, advanced permanent magnet motors, DC-to-DC converters, SiC components, low-cost permanent magnet materials, high temperature capacitors, advanced thermal systems, and motor control systems to meet future passenger vehicle hybrid systems requirements. Existing work in these areas will be expanded to address the more stringent performance requirements for plug-in hybrid systems. The synergies of technologies for advanced vehicles, including plug-in and fuel cell hybrid vehicles, will be evaluated by maintaining close collaboration among researchers, device manufacturers, and users of the technologies. The developed technologies will be tested at National Laboratories for validation of performance and conformance to specifications. Crosscutting technologies also will be evaluated for potential application for advanced vehicle applications. In addition, these funds may be used to support efforts such as peer reviews; data collection and dissemination; and technical, market, economic, and other analyses. (FreedomCAR, $15,626,000).

	FY 2006	FY 2007	FY 2008
SBIR/STTR	**0**	**0**	**2,146**

The FY 2008 amount shown is an estimated requirement for the continuation of the SBIR and STTR program. (FreedomCAR, $1,967,000; 21CT, $179,000).

(dollars in thousands)

	FY 2006	FY 2007	FY 2008
Total, Hybrid Electric Systems	**0**	**0**	**80,664**

Explanation of Funding Changes

	FY 2008 vs. FY 2007 ($000)
Vehicle and Systems Simulation and Testing The additional funding will expand the simulation, testing, and analysis activities aimed at supporting the development of plug-in hybrid electric vehicles. (Relative to the comparable request in FY 2007, the change is +$103,000.)	+21,087
Energy Storage R&D The additional funding will accelerate the development of plug-in (high energy) batteries in support of the President's Advanced Energy Initiative. The increase will support research on advanced materials (e.g., anodes, cathodes, and electrolytes) for the next generation of energy-storage devices, and will also support more aggressive near-term development of long-life, abuse-tolerant lithium batteries. (Relative to the comparable request in FY 2007, the change is +$10,666,000.)	+41,805
Advanced Power Electronics and Electric Motors R&D The additional funding will support increased R&D to address the barriers, technical gaps and unique requirements for power electronics and electrical machines for plug-in hybrid components. Research and development efforts will focus on component and system analysis to meet the additional technical requirements for plug-in hybrid vehicles. (Relative to the comparable request in FY 2007, the change is +$1,946,000.)	+15,626
SBIR/STTR Changes in the SBIR/STTR funding are a direct result of changes in the funding of program activities and projected allocation among activities.	+2,146
Total Funding Change, Hybrid Electric Systems	**+80,664**

Vehicle Systems

Funding Schedule by Activity

	(dollars in thousands)		
	FY 2006	FY 2007	FY 2008
Vehicle Systems			
Heavy Vehicle Systems R&D			
Vehicle Systems Optimization	8,456	5,922	0
Truck Safety Systems	99	0	0
Total, Heavy Vehicle Systems R&D	8,555	5,922	0
Ancillary Systems	965	292	0
Simulation and Validation	3,200	6,729	0
SBIR/STTR	0	372	0
Total, Vehicle Systems	12,720	13,315	0

Description

In FY 2008, this subprogram is entirely incorporated within the Vehicle and Systems Simulation and Testing activity of the Hybrid Electric Systems subprogram. The material presented here applies to FY 2006-2007 and is included for reference.

The Vehicle Systems subprogram funds R&D on advanced vehicle technologies and ancillary equipment that could achieve significant improvements in fuel economy for passenger and commercial vehicles without sacrificing safety, the environment, performance, or affordability. This subprogram's funding contributes to both the FreedomCAR and 21st Century Truck budgets.

Detailed Justification

	(dollars in thousands)		
	FY 2006	FY 2007	FY 2008
Heavy Vehicle Systems R&D	**8,555**	**5,922**	**0**

The Heavy Vehicle Systems R&D activity has been moved to the Vehicle Systems, Simulations, and Testing activity within the Hybrid Electric Systems subprogram in FY 2008. Heavy Vehicle Systems research develops, in collaboration with heavy-duty commercial vehicle manufacturers and their suppliers, technologies that will reduce non-engine parasitic energy losses from aerodynamic drag, tire rolling resistance, friction and wear, under-hood thermal conditions, and accessory loads. The goals and technology barriers in this activity were identified and established through workshops involving government, industry and academic expert participants. These activities are undertaken through a variety of mechanisms, including in-house work at the National Laboratories, competitively-awarded contracts or cooperative agreements with industry, and university consortia. Throughout, powertrain and truck system integration issues are considered in order to optimize overall system energy efficiency and to ensure proper accounting of system energy. In addition, these funds may be used to support efforts such as peer reviews; data collection and dissemination; and technical, market, economic, and other analyses.

(dollars in thousands)

	FY 2006	FY 2007	FY 2008
▪ **Vehicle Systems Optimization**	**8,456**	**5,922**	**0**

FY 2007 activities continue the viability assessment of various aerodynamic drag reduction devices, including, but not restricted to, flat boat tails, circulation control, wedges, splitters, and cab extenders. Compare wind tunnel results to on-road testing and to theoretical calculations for increased vehicle energy efficiency using various computational fluid dynamics (CFD) techniques, employing appropriate turbulence models. Incorporate data from on-road tests being conducted by a truck industry consortium (Truck Manufacturers Association). Determine the effect of tire treads on “splash and spray” and compare to CFD models for both increased efficiency and safety. Enhance capabilities of the heavy vehicle systems modeling tool by incorporating on-road test data and by integrating turbulence and other computational fluid dynamics models. Surface texturing and coating techniques to reduce friction in the drive train, axle, and various engine components will be developed and these effects will be related to interactions with selected lubricants, which will allow determination of potential durability improvement of sensitive parts by this approach.

The program will continue a new project on the electrification of medium-duty trucks, building on lessons learned from the very successful More Electric Truck (Class 8). Thermal control approaches will focus on nanofluids, higher temperature coolants, evaporative cooling, heat pipes, re-design of the cooling system and integration of internal heat flow to external aerodynamics with the aim of aerodynamic drag reduction. To increase overall vehicular energy efficiency, researchers will determine and use the fractal dimensions of particulate matter at various locations from the engine of spark ignition and diesel engines in order to optimize filters and reduce concurrent fuel penalties. Commence design of a high-thermal-conductivity exhaust gas recirculation (EGR) cooler utilizing nanofluids and carbon foams and conduct aerodynamic drag computational fluid dynamics activities. (21CT, $5,922,000)

	FY 2006	FY 2007	FY 2008
▪ **Truck Safety Systems**	**99**	**0**	**0**

This Truck Safety Systems activity was terminated for FY 2007 because it is not directly related to fuel efficiency improvements. Previously this activity funded simulation studies of the ways in which the stability and braking of heavy trucks could be improved by activity manipulating vehicle aerodynamics.

	FY 2006	FY 2007	FY 2008
	(dollars in thousands)		
Ancillary Systems	**965**	**292**	**0**

The Ancillary Systems activity has been moved to the Vehicle and Systems Simulation and Testing activity within the Hybrid Electric Systems subprogram. The activity seeks to reduce direct and indirect fuel-consuming loads imposed on internal combustion engines or fuel cell powered vehicles. These loads include those that negatively impact the fuel efficiency of a vehicle but do not propel the vehicle directly; the primary load in this category is the air-conditioning system.

Simulation and Validation	**3,200**	**6,729**	**0**

The Simulation and Validation activity has been moved to the Vehicle Systems, Simulations, and Testing activity within the Hybrid Electric Systems subprogram. The activity develops and validates models and simulation programs to predict the performance, component interaction, fuel economy, and emissions of advanced vehicles. With industry input, these models are used to develop performance targets for the complete range of vehicle platforms and their components to facilitate prioritization of technology R&D activities that could significantly reduce petroleum usage for transportation. In coordination with industry partners, the simulation and modeling tools are used to develop advanced control strategies to optimize the interaction between components and the overall performance and efficiency of advanced hybrid electric and fuel cell vehicles. The models are also used, in conjunction with “hardware-in-the-loop” (HIL) laboratory testing, to validate the performance of advanced technology components and systems developed within VT R&D activities without the need to build and test a complete vehicle.

SBIR/STTR	**0**	**372**	**0**

In FY 2006, $300,000 and $96,000 were transferred to the SBIR and STTR programs respectively. The FY 2007 amount shown is the estimated requirement for the continuation of the SBIR and STTR program in that year. The change in budget structure means that no activities – and no SBIR or STTR – are funded from this budget line in FY 2008.

Total, Vehicle Systems	**12,720**	**13,315**	**0**

Explanation of Funding Changes

	FY 2008 vs. FY 2007 ($000)
Heavy Vehicle Systems R&D	
▪ **Vehicle Systems Optimization**	
Activities in this area will be reduced in order to enable accelerated R&D efforts offering greater potential for reducing oil consumption. Part of the reduction also reflects completion of major railroad and transit bus demonstration projects. The work that continues is funded in the Vehicle and Systems Simulation and Testing activity within the Hybrid Electric Systems subprogram beginning in FY 2008.	-5,922
Ancillary Systems	
Most of the efforts in this area will be phased out because they have reached a point in their development where their commercial potential should be evident to the private sector. Remaining efforts will focus on the research opportunities with the greatest potential for petroleum reduction, and are funded in the Vehicle Systems, Simulations, and Testing activity within the Hybrid Electric Systems subprogram beginning in FY 2008.	-292
Simulation and Validation	
In FY 2008, these efforts are funded in the Vehicle Systems, Simulations, and Testing activity within the Hybrid Electric Systems subprogram.	-6,729
SBIR/STTR	
SBIR/STTR funding related to these activities is now included in the Hybrid Electric Systems subprogram.	-372
Total Funding Change, Vehicle Systems	**-13,315**

Hybrid and Electric Propulsion

Funding Schedule by Activity

	(dollars in thousands)		
	FY 2006	FY 2007	FY 2008
Hybrid and Electric Propulsion			
Energy Storage			
High Power Energy Storage	16,807	17,181	0
Advanced Battery Development	1,448	7,615	0
Exploratory Technology Research	6,279	6,343	0
Total, Energy Storage	24,534	31,139	0
Advanced Power Electronics	12,894	13,680	0
Subsystem Integration and Development			0
Light Vehicle Propulsion and Ancillary Subsystems	3,595	4,603	0
Heavy Vehicle Propulsion and Ancillary Subsystems	1,820	0	0
Total, Subsystem Integration and Development	5,415	4,603	0
SBIR/STTR	0	1,419	0
Total, Hybrid and Electric Propulsion	42,843	50,841	0

Description

In FY 2008, the Hybrid Electric Propulsion subprogram activities (Energy Storage, Advanced Power Electronics, and Subsystem Integration and Development) are incorporated within the Hybrid Electric Systems subprogram, with Subsystem Integration and Development incorporated within the Vehicle and Systems Simulation and Testing activity. The material presented here applies to FY 2006 - 2007 and is included for reference.

The Hybrid and Electric Propulsion subprogram funds research and development for both passenger and commercial vehicles. R&D efforts include research in energy storage systems, advanced power-electronics and electric motors, and hybrid system development and integration, including new activities in FY 2007 on plug-in hybrids. In FY 2007 there are three activities: Energy Storage, Advanced Power Electronics, and Subsystem Integration and Development.

Detailed Justification

	(dollars in thousands)		
	FY 2006	FY 2007	FY 2008
Energy Storage	**24,534**	**31,139**	**0**

The Energy Storage activity supports long-term research, applied research, and technology development for both passenger and commercial vehicles. Long-term research is focused on developing advanced energy storage technologies for electric and hybrid-electric vehicle (EV and HEV) applications. Applied research is focused on the development and validation of low-cost, abuse-tolerant, and long-life batteries for hybrid vehicle applications. Technology development for all passenger vehicle energy storage is conducted with industry through the United States Advanced Battery Consortium (USABC). All USABC subcontracts to develop advanced vehicle batteries for hybrid and electric passenger vehicles are awarded under a competitive process and are cost-shared by the developers.

	FY 2006	FY 2007	FY 2008
▪ **High Power Energy Storage**	**16,807**	**17,181**	**0**

Beginning in FY 2008, these activities are funded in the Energy Storage R&D activity within the Hybrid Electric Systems subprogram. Lithium-ion batteries offer twice the performance in a lower-cost, lower weight, lower volume package than the nickel metal hydride batteries developed by DOE and used in today's hybrid electric vehicles. The FY 2007 effort continues to develop full-sized lithium-ion cells using low-cost, stable, high-performance cathode materials such as manganese oxide. Novel approaches to enhance the tolerance of batteries to overcharge and/or exposure to high temperatures are being evaluated. Also continuing are early-stage development of an advanced battery for use in fuel cell hybrid vehicles. The effort develops battery requirements and assessed battery technology for plug-in hybrid vehicles. Benchmark testing and assessments of non-battery energy storage devices, such as ultracapacitors, that might be applicable in hybrid vehicle systems also continue. This activity also supports cost-shared contracts with multiple battery suppliers through the USABC to develop batteries meeting the FreedomCAR requirements.

	FY 2006	FY 2007	FY 2008
(dollars in thousands)			
▪ **Advanced Battery Development**	**1,448**	**7,615**	**0**

Beginning in FY 2008, these activities are funded in the Energy Storage R&D activity within the Hybrid Electric Systems subprogram. In FY 2007 the effort accelerates the benchmarking of candidate technologies for electric vehicle and plug-in hybrid applications. Possible candidates include advanced high-energy lithium-ion systems with gel and/or polymer electrolytes. Data from these studies will be combined with similar data from other development contracts to identify areas for additional R&D, particularly addressing the needs of plug-in hybrid vehicles. Based on positive assessment results, one or more manufacturers or teams of manufacturers and researchers to develop and begin production of cost-effective batteries suitable for either electric vehicle or plug-in hybrid application will be competitively selected for funding in the Hybrid Electric Systems subprogram in FY 2008.

▪ **Exploratory Technology Research**	**6,279**	**6,343**	**0**

Beginning in FY 2008, these activities are funded in the Energy Storage R&D activity within the Hybrid Electric Systems subprogram. In FY 2007 this research examines innovative energy storage systems that offer the potential for significant improvements over existing technologies for use in both electric and hybrid electric vehicles. These efforts are coordinated with the Office of Science to assure best utilization of DOE's research assets. Novel materials offering the possibility for improved cell performance, life, or cost are being synthesized. Novel anode and cathode materials and electrolytes that have higher energy capability, longer and more stable cycling characteristics, and are lower in cost are being developed and characterized. Multivalent and alloy based electrodes (such as Sn-based intermetallic alloys of Cu, Sb, and Mg), and electrodes fabricated from higher purity metals, including pure Li are being investigated.

The development of advanced diagnostic techniques to investigate and better understand life- and performance-limiting processes in lithium-based batteries continues. Electrochemical models to understand failure mechanisms and the mechanisms of thermal runaway in lithium batteries are being developed and used. In particular, the program will measure thermal characteristics of batteries and create and use computer-aided design tools to develop configurations with improved thermal performance. Solid polymer electrolytes with high room temperature conductivity and good mechanical strength and improved safety are being re-evaluated, investigated, and developed.

	FY 2006	FY 2007	FY 2008
	(dollars in thousands)		
Advanced Power Electronics	**12,894**	**13,680**	**0**

Beginning in FY 2008, these activities are funded in the Advanced Power Electronics and Electric Motors R&D activity within the Hybrid Electric Systems subprogram. The Advanced Power Electronics activity include R&D on power electronics, electric motors and other components, and thermal-management systems that are necessary for the development and ultimate adoption of fuel cell and advanced high-efficiency combustion-engine hybrid vehicles. The efforts also include supporting R&D on capacitors, magnets and wide-bandgap (SiC) components for advanced power electronics technologies.

Subsystem Integration and Development	**5,415**	**4,603**	**0**

Beginning in FY 2008, these activities are funded in the Vehicle and Systems Simulation and Testing activity within the Hybrid Electric Systems subprogram. Subsystem Integration and Development has supported work to validate achievement of technical targets for components and subsystems by emulating a vehicle operating environment for passenger and commercial vehicles using hardware-in-the-loop testing. This activity also benchmarks and characterizes advanced commercial vehicles and components to determine commercial progress against research performance goals. Data are gathered to validate simulation models used to predict fuel economy and emissions using advanced controls and configurations for hybrid vehicles. Commercial hybrid efforts support research and development of advanced, cost-effective components and systems to improve fuel economy by up to 100 percent while meeting 2007 emission standards. In addition, these funds may be used to support efforts such as peer reviews; data collection and dissemination; and technical, market, economic, and other analyses.

▪ **Light Vehicle Propulsion and Ancillary Subsystems**	**3,595**	**4,603**	**0**

In FY 2007, use hardware-in-the-loop techniques to emulate fuel cell propulsion systems to determine systems interactions required for vehicle system integration (e.g., energy storage requirements for different fuel cell subsystem technologies and configurations). Enhance engine emission models to analyze the impact of emissions control on fuel economy. Conduct hardware studies using HIL to determine the impact of expected emission control requirements on fuel economy of advanced hybrid passenger vehicle systems. Validate, in a systems environment, performance targets for deliverables from the power electronics and energy storage technology research and development activities. Utilize advanced vehicle data from the Testing and Evaluation activity to enhance and validate the PSAT model and determine progress toward meeting FreedomCAR goals.

	FY 2006	FY 2007	FY 2008
▪ **Heavy Vehicle Propulsion and Ancillary Subsystems**	**1,820**	**0**	**0**

In FY 2006, the program closed out development of advanced heavy hybrid components and systems that supported the 21CT Partnership. The R&D progress is being documented and transferred to industry for commercialization. The close out of these activities will allow funds to be applied in areas with larger market, environmental, and energy security benefits.

SBIR/STTR	**0**	**1,419**	**0**

In FY 2006, $1,012,000 and $122,000 were transferred to the SBIR/STTR programs respectively. The FY 2007 amount shown is the estimated requirement for the continuation of the SBIR and STTR program in that year. The change in budget structure means that no activities – and no SBIR or STTR – are funded from this budget line in FY 2008.

Total, Hybrid and Electric Propulsion	**42,843**	**50,841**	**0**

(dollars in thousands)

Explanation of Funding Changes

	FY 2008 vs. FY 2007 ($000)
Energy Storage	
In FY 2008, all subactivities were transferred to the Energy Storage R&D activity within the Hybrid Electric Systems subprogram in FY 2008.	
▪ **High Power Energy Storage**	-17,181
▪ **Advanced Battery Development**	-7,615
▪ **Exploratory Technology Research**	-6,343
Total, Energy Storage	**-31,139**
Advanced Power Electronics	
In FY 2008, this activity was transferred to the Advanced Power Electronics and Electric Motors R&D activity within the Hybrid Electric Systems subprogram.	-13,680

	FY 2008 vs. FY 2007 ($000)
Subsystem Integration and Development	
▪ **Light Vehicle Propulsion and Ancillary Subsystems**	
In FY 2008, this activity is funded within the Vehicle Systems, Simulations, and Testing activity within the Hybrid Electric Systems subprogram.	-4,603
SBIR/STTR	
Changes in the SBIR/STTR funding are a direct result of changes in the funding of program activities and projected allocation among activities.	-1,419
Total Funding Change, Hybrid and Electric Propulsion	**-50,841**

Advanced Combustion Engine R&D

Funding Schedule by Activity

	(dollars in thousands)		
	FY 2006	FY 2007	FY 2008
Advanced Combustion Engine R&D			
Combustion and Emission Control	24,041	23,864	29,701
Heavy Truck Engine	9,271	14,490	0
Solid State Energy Conversion	1,500	4,569	3,882
Off-Highway Engine R&D	3,369	0	0
Health Impacts	2,413	2,479	0
SBIR/STTR	0	1,304	967
Total, Advanced Combustion Engine R&D	40,594	46,706	34,550

Description

The Advanced Combustion Engine R&D subprogram focuses on removing critical technical barriers to commercialization of higher efficiency, advanced internal combustion engines in passenger and commercial vehicles. The goals are to improve the efficiency of internal combustion engines for passenger vehicle applications from 30 percent in 2002 to 45 percent by 2010, and for commercial vehicles from 40 percent in 2002 to 55 percent by 2013, while meeting cost, durability, and emissions constraints. Research will be conducted in collaboration with industry and industry partnerships, National Laboratories, and universities. The Advanced Combustion Engine R&D subprogram includes Combustion and Emission Control R&D and Solid State Energy Conversion.

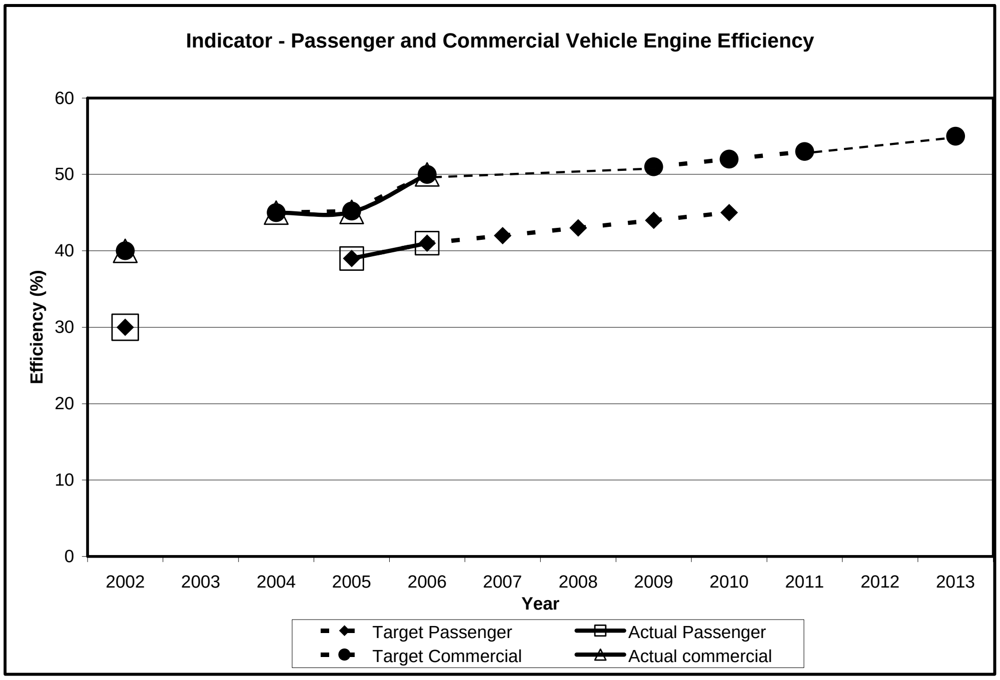
Benefits

The most promising method to reduce petroleum consumption through efficiency improvements in the mid-term (10-20 years) – or until fuel cell hybrid vehicles dominate the market – is to develop high-efficiency combustion engines and enable their introduction in conventional and hybrid electric vehicles. Improvements in engine efficiency alone have the potential of increasing fuel economy by 40 to 50 percent. Accelerated research on advanced combustion regimes, including homogeneous charge compression ignition (HCCI) and other modes of low-temperature combustion, is aimed at realizing this potential and making a major contribution to improving the U.S. energy security, environment, and economy. This research will benefit from the synergies of the program's cooperative efforts (e.g., sharing of data and some joint funding) with the Distributed Energy activity within the Office of Electricity Delivery and Energy Reliability, which focuses on natural-gas-fueled HCCI research.

The Advanced Combustion Engine R&D subprogram and Fuel Technology subprogram will contribute to the Vehicle Technologies Program goals by dramatically improving the efficiency of internal combustion engines and will identify fuel properties that improve the system efficiency or can displace petroleum based fuels. Improved efficiency and petroleum displacement both can directly reduce petroleum consumption.

The key objective is to meet the FreedomCAR and 21st Century Truck goals to improve the efficiency of internal combustion engines from 30 percent (2002 baseline) to 45 percent by 2010 for passenger vehicles and from 40 percent (2002 baseline) to 55 percent by 2013 for commercial vehicles. An advanced fuel formulation will be utilized that incorporates a non-petroleum based blending agent to reduce petroleum dependence while enhancing combustion efficiency.

Progress is indicated by efficiency of passenger and commercial vehicle internal combustion engines.



Note: 2002 value is baseline.

Detailed Justification

	(dollars in thousands)		
	FY 2006	FY 2007	FY 2008
Combustion and Emission Control	**24,041**	**23,864**	**29,701**

The Combustion and Emission Control R&D activity has been expanded to include the Heavy Truck Engine Activity and the Health Impacts activities. This integrates all engine research into one activity. Combustion and Emission Control research supports the Vehicle Technologies Program goal to enable energy-efficient, clean vehicles powered by advanced internal combustion engines using clean, petroleum- and non-petroleum-based fuels and hydrogen**.** Although advanced diesel engine technology has demonstrated short-term Tier 2 emissions performance, energy consumption, cost and durability of the emission control system will limit the rate of market penetration. The research in this activity focuses on developing technologies for passenger and commercial vehicle engines operating in advanced combustion regimes, including Homogeneous Charge Compression Ignition (HCCI) and other modes of low-temperature combustion (LTC), which will increase efficiency beyond current advanced diesel levels and reduce engine emissions of NO_x and particulate matter (PM) to near-zero levels, greatly reducing the need for exhaust after-treatment. This will allow the use of lower-cost emission control systems with little or no energy consumption and greater durability. By overcoming these challenges, more efficient combustion engines can be cost-competitive with gasoline engines in passenger vehicles, and further improve the efficiency and reduce the cost of engines used in commercial vehicles. The purpose of this activity is to develop technologies for advanced engines with the goal of improving thermal efficiency by optimizing combustion, fuel injection, emission control, and waste heat recovery systems, along with reducing friction and pumping losses while ensuring that no new air toxic compounds are generated. The activity will be closely coordinated with the Fuels Technology subprogram since different fuel characteristics and reduced property variability may be needed to meet the goals.

In FY 2008, the Combustion and Emission Control activity will continue emphasis on research and development of advanced combustion regimes that can achieve FreedomCAR and 21st Century Truck efficiency goals for passenger and commercial vehicles while maintaining current cost and durability levels and achieving near-zero regulated emissions. The program will also continue its cooperative agreement with General Motors to develop high-efficiency gasoline and diesel fueled engines for passenger vehicle applications that operate in advanced combustion regimes. The program will down-select, from four to two, the number of competitively awarded cooperative agreements for improving heavy-duty engine efficiency through the utilization of advanced combustion regimes (HCCI, LTC and mixed-mode). The selected participants will develop technologies for heavy-duty diesel engines, such as optimized combustion, fuel injection, emissions control, and waste heat recovery systems, along with reduced friction and pumping losses, to meet the 2013 thermal efficiency goal of 55 percent.

Examples of specific activities to be conducted for passenger and commercial vehicles include the development of multi-mode combustion processes which combine the various forms of HCCI, partial HCCI and traditional diffusion combustion. Develop a combustion system capable of transitioning from one mode to another seamlessly allowing for the optimization of combustion for a given operating speed and load. This system will also require advanced precision controls which will also be developed as part of this effort. Components needed to enable the advanced combustion system described above will include advanced ultra high pressure injectors and charge air and exhaust gas recirculation handling systems. Advanced injectors must be capable of tightly packed multiple injection events within a given engine cycle. Advanced charger air systems will allow for precision control of flow and charger temperature. Similarly the EGR system will be able to precisely mix with the charge air producing the correct air to fuel ratio. Efforts will also be undertaken to develop and integrate NO_x adsorbers, sulfur traps and PM filters to meet the durability requirement of 435,000 miles for commercial vehicles and 120,000 for passenger vehicles while meeting emission standards.

The activity also will develop and integrate NO_x adsorbers, sulfur traps and PM filters to meet the durability requirement of 435,000 miles for commercial vehicles while meeting emission standards.

Combustion and Emission Control's cost-shared cooperative agreements awarded in FY 2005 and FY 2006 to automotive suppliers and universities will continue to develop innovative component technologies such as variable valve timing, variable compression ratio, and NO_x and PM sensors that enable cost-effective implementation of advanced combustion regimes with high efficiency and near-zero emissions of NO_x and PM.

The activity will conduct optical laser diagnostics of in-cylinder combustion process for advanced combustion regimes such as, HCCI, other modes of LTC and mixed-mode regimes. Through simulation and experimentation, R&D on advanced thermodynamic strategies that will enable engines to approach 60 percent thermal efficiency will be conducted. The activity also will utilize laser-based, optical diagnostics to conduct in-cylinder engine research focused on overcoming barriers to the development of high-efficiency, hydrogen-fueled IC engine technology in coordination with the HFCIT Program. Development of detailed chemical kinetic models of advanced combustion regimes and emissions processes, including fuel composition effects, to aid the development of advanced, high-efficiency combustion engines using LTC and mixed-mode combustion regimes will continue. The activity will utilize x-rays from the Advanced Photon Source to study fuel-injection spray characteristics near the injection nozzle.

The health impacts research will continue to evaluate the relative toxicity and consequent human health implications of emissions from new combustion technologies, new fuels derived from unconventional feedstocks, and new blending agents such as biodiesel and hydroisomerized vegetable oils. In FY 2008, emissions from the low temperature combustion of a variety of fuels derived from these unconventional feedstocks will begin to be screened for toxic compounds along with screening of the fuels themselves for toxic compounds. In addition, efforts will begin to determine potential health impacts from aldehydes and organic acids generated by combustion of ethanol fuels. Other emissions such as lubricant-derived particulate matter as well as from permeation of alcohol and gasoline hydrocarbons through fuel lines due to the polar nature of alcohols will be quantitatively characterized and screened for toxic compounds.

Also in FY 2008, the third full year of the Advanced Collaborative Emissions Study (ACES), the activity will begin focusing on emissions sample generation from 2010 emissions compliant commercial vehicle diesel engines and from Selective Catalytic Reduction (SCR) Urea after-treatment devices. DOE is responsible for the generation and collection of samples. Any acute screening test (bacteria - Ames Test, and mammalian lung cells) responses will be noted in preparation for the longer term chronic bioassays of exposures of animals (rats and mice).

	(dollars in thousands)		
	FY 2006	FY 2007	FY 2008

In order to improve our understanding of "real world" emissions and their effects, an effort to identify and characterize emissions, especially air toxics, via "on the fly" remote sensing techniques will be continued at the heavily traveled Watt Road Truck Stop intersection in Knoxville, TN, and large-scale eddy modeling will be completed to determine "mixing" parameters occurring in dynamic roadside locations.

In addition, these funds may be used to support efforts such as peer reviews; data collection and dissemination; and technical, market, economic, and other analyses. (FreedomCAR, $20,703,000; 21CT, $8,998,000).

	FY 2006	FY 2007	FY 2008
Heavy Truck Engine	**9,271**	**14,490**	**0**

The Heavy Truck Engine activity has been incorporated within the Combustion and Emission Control R&D activity in FY 2008. Heavy Truck Engine efforts are developing technologies for diesel engines, such as optimized combustion, fuel injection, emissions control, and waste heat recovery systems, along with reduced friction and pumping losses.

	FY 2006	FY 2007	FY 2008
Solid State Energy Conversion (formerly Waste Heat Recovery)	**1,500**	**4,569**	**3,882**

The Solid State Energy Conversion activity develops technologies to convert waste heat from engines and other sources to electrical energy or work to improve overall thermal efficiency and reduce emissions. In FY 2007, this activity also included R&D on mechanical systems to recover waste energy from engines. This included the development of Rankine and Brayton thermodynamic cycles that, when incorporated with the diesel engine, improved the energy efficiency of the engine by up to 10 percent by utilizing the waste heat from the engine. Since this work has matured, any further R&D on mechanical methods of recovering waste energy will be conducted in the Combustion and Emissions Control activity as part of an overall engine systems approach. This activity will focus exclusively on the R&D of thermoelectrics and other solid state systems that recover energy from waste heat. The name of this activity has been changed to reflect this new R&D focus.

In FY 2008, the program will eliminate the three 2005 cooperative agreements for research to develop and integrate turbo-compound units with engine and control systems, for commercial vehicle application. These systems have the potential to produce up to 20kW from engine waste heat, but are already becoming commercially available. If any additional R&D is required it will be funded within the Combustion and Emissions Control activity as part of an overall engine systems approach. Ending the three agreements will allow expansion of research on solid-state thermoelectric technologies that have wide-ranging applications and a great potential for energy savings.

In FY 2008, the activity will continue cost-shared cooperative agreements awarded in FY 2004 to develop and fabricate high efficiency thermoelectric devices that will recover from 1 to 3kW of electric power from engine waste heat for passenger vehicle and up to 5kW for commercial vehicle application. These improvements could increase vehicle fuel economy by up to 10 percent. For these waste heat

	(dollars in thousands)		
	FY 2006	FY 2007	FY 2008

applications, the research will demonstrate conversion efficiencies greater than 15 percent using direct energy conversion methods, such as nano-scale high-efficiency thermoelectrics, thermionics, or other innovative concepts. The activity will collaborate with the Office of Solar Energy Technologies for commercially viable manufacturing technologies for nano-scale thermoelectrics. In addition, these funds may be used to support efforts such as peer reviews; data collection and dissemination; and technical, market, economic, and other analyses. (FreedomCAR, $1,361,000; 21CT, $2,521,000).

Off-Highway Engine R&D	**3,369**	**0**	**0**

The Off-Highway Engine R&D activity has been terminated. Research activities were concluded in FY 2006 in order to focus on other research opportunities having significantly higher potential for energy savings. Off-highway vehicle manufacturers were among recipients for the cooperative agreements awarded in 2005 to improve engine efficiency through the utilization of advanced combustion regimes.

Health Impacts	**2,413**	**2,479**	**0**

The Health Impacts activity has been incorporated within the Combustion and Emission Control activity.

SBIR/STTR	**0**	**1,304**	**967**

In FY 2006, $923,000 and $111,000 were transferred to the SBIR and STTR programs respectively. The FY 2007 and 2008 amounts shown are estimated requirements for the continuation of the SBIR and STTR program. (FreedomCAR, $631,000; 21CT, $336,000).

Total, Advanced Combustion Engine R&D	**40,594**	**46,706**	**34,550**

Explanation of Funding Changes

	FY 2008 vs. FY 2007 ($000)
Combustion and Emission Control	
Based on FY 2007 research performance, FY 2008 efforts will be focused on the most promising research agreements. (The Heavy Truck Engine and Health impacts activities have been integrated with Combustion and Emission Control in FY 2008 request. These additions result in a net funding increase for Combustion and Emission Control in FY 2008. Relative to the comparable funding in FY 2007, the FY 2008 request represents a reduction of $11,132,000.)	+5,837
Heavy Truck Engine	
The Heavy Truck Engine research activity has been incorporated within the Combustion and Emission Control R&D activity.	-14,490
Solid-State Energy Conversion (formerly Waste Heat Recovery)	
The change to the Solid State Energy Conversion activity represents an increased emphasis on direct energy conversion research with deletion of mechanical waste heat recovery, a mature technology.	-687
Off-Highway Engine R&D	
No change.	0
Health Impacts	
Health impact research is funded within the Combustion and Emission Control activity beginning in FY 2008.	-2,479
SBIR/STTR	
Changes in the SBIR/STTR funding are a direct result of changes in the funding of program activities and projected allocation among activities.	-337
Total Funding Change, Advanced Combustion Engine R&D	**-12,156**

Materials Technology

Funding Schedule by Activity

	(dollars in thousands)		
	FY 2006	FY 2007	FY 2008
Materials Technology			
Propulsion Materials Technology	6,093	5,844	9,420
Lightweight Materials Technology	21,063	18,737	18,652
High Temperature Materials Laboratory	7,217	4,374	4,375
SBIR/STTR	0	831	935
Total, Materials Technology	34,373	29,786	33,382

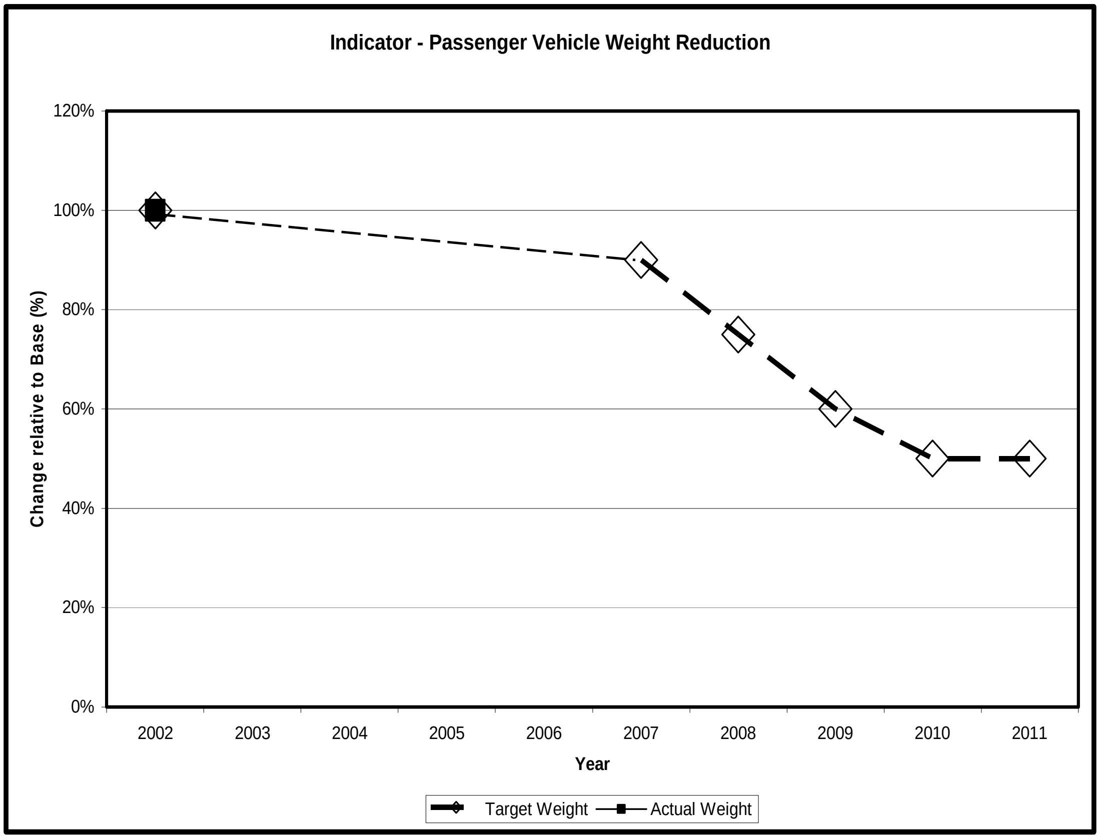
Description

The Materials Technologies subprogram supports the development of cost-effective materials and materials manufacturing processes that can contribute to fuel-efficient passenger and commercial vehicles. This subprogram is a critical enabler for concepts developed elsewhere in the FreedomCAR and 21st Century Truck budgets. The subprogram consists of three activities: Propulsion Materials Technology, Lightweight Materials Technology, and the High Temperature Materials Laboratory (HTML).

Benefits

The Materials Technology subprogram contributes to the VT Program goal by developing higher performing, more cost effective materials that will make lighter vehicle structures and more efficient power systems possible. Lighter vehicles require less energy to operate and thus reduce fuel consumption. Likewise, better propulsion materials can enable more efficient power systems that will contribute to a vehicle's reduced energy consumption.

A key goal for the Materials Technology subprogram is to develop material and manufacturing technologies by 2010 that, if implemented in high volume, could cost-effectively reduce the weight of passenger vehicle body and chassis systems by 50 percent with safety, performance, and recyclability comparable to that of 2002 vehicles. This is a broader goal than the previous goal of reducing the projected mass-production price of carbon-fiber materials to $3 per pound. The broader goal encompasses both further progress in carbon-fiber composites and advances in a variety of other lightweight automotive materials.



Note: 2002 value is baseline

Detailed Justification

	(dollars in thousands)		
	FY 2006	FY 2007	FY 2008
Propulsion Materials Technology	**6,093**	**5,844**	**9,420**

The Automotive Propulsion Materials and Heavy Vehicle Propulsion Materials subactivities have been merged into the Propulsion Materials Technology key activity. The combined effort will conduct research and development of improved materials for engines, chassis components, thermal management systems, and electric drive systems that can contribute to greater passenger car and commercial vehicle efficiency by way of improved material properties and design.

In FY 2008, specialized materials developed for hydrogen-fueled engines and advanced engines operating in an advanced combustion regime will be tested in research engines. The subprogram will expand support to the advanced combustion engine research by addressing the implications of changes to fuel formulations and combustion regimes on engine materials. Emission sensors will be evaluated in stationary engines and results shared with potential licensees. Integrated surface

	(dollars in thousands)		
	FY 2006	FY 2007	FY 2008

modification of materials for reduced friction and new applications for magnesium will be explored. The subprogram will provide expanded support for hybrid-drive systems materials requirements associated with the development of new high-efficiency electric drives and control systems for plug-in hybrids. As part of the new thrust to develop atomic-scale theoretical computational modeling tools, the program will explore concepts for improved catalysts, electrical energy storage, and thermoelectric materials. In addition, these funds may be used to support efforts such as peer reviews; data collection and dissemination; and technical, market, economic, and other analyses. (FreedomCAR, $4,565,000; 21CT, $4,855,000).

	FY 2006	FY 2007	FY 2008
▪ **Automotive Propulsion Materials** (Integrated into the Propulsion Materials Technology activity in FY 2008)	**1,834**	**1,944**	**0**
▪ **Heavy Vehicle Propulsion Materials** (Integrated into the Propulsion Materials Technology activity in FY 2008)	**4,259**	**3,900**	**0**
Lightweight Materials Technology	**21,063**	**18,737**	**18,652**

This activity supports R&D on advanced concepts to reduce the weight (i.e., lightweighting) of passenger vehicles. Activities to reduce the weight of commercial vehicles previously included here were dropped in FY 2007. Lightweighting is accomplished primarily by substitution of lower density or stronger materials for current materials. Materials include carbon-fiber-reinforced polymer matrix composites (carbon-FRPMCs), magnesium, advanced high-strength steels (AHSSs), titanium, and metal-matrix composites. Since cost-effectiveness is one of the major materials challenges, this element supports research, development and validation on designing and manufacturing components and structures from these materials. Emphasis is on exploration and development of materials needed to meet the FreedomCAR goal of 50 percent weight reduction. Activities also will be directed at developing improved machining, joining, and forming processes as well as design data and modeling tools. The objective is to lower the potential costs and cost uncertainties of advanced materials to approach the FY 2010 goal of cost neutrality.

The National Academies, in their 2005 peer review of FreedomCAR activities, emphasized the value of continuing to work on reducing the cost of carbon-FRPMCs for automotive applications. In FY 2008, most of the R&D on advanced technologies for producing low cost automotive-grade carbon-fibers will reach the technical feasibility stage of development. Integration and validation of carbon fiber conversion technologies conducted on the integration line at ORNL will continue toward a planned transfer to industry in FY 2009. Research, development and validation on design and manufacture of cost-effective automotive components and structures from carbon-FRPMCs, magnesium, low-cost titanium and AHSSs will continue. The activity will continue development and validation of predictive modeling tools for tailored polymer composite structures. Efforts on stamping and joining of AHSS and magnesium sheet, on-line/real-time nondestructive evaluations/inspections, and recycling will continue. New efforts will begin on cost-effective repair of automotive structures made from these new materials. These are aimed at minimizing consumer costs. In addition, these funds may be used to support efforts such as peer reviews; data collection and dissemination; and technical, market, economic, and other analyses. (FreedomCAR, $18,652,000)

High Temperature Materials Laboratory	**7,217**	**4,374**	**4,375**

The FY 2008 funding will provide continued support of the HTML. The HTML facility is an advanced materials R&D industrial user center located at the Oak Ridge National Laboratory. The HTML strives to maintain world-class, state-of-the-art advanced materials characterization (i.e., the determination of the composition and structure of materials which determine their properties and functionality) capabilities not available elsewhere and makes them available to U.S. industries for use in solving complex materials problems. It develops cutting-edge analytical techniques to identify innovative materials for use in transportation applications. Activities include the investigation and determination of the composition, structure, physical and chemical properties and performance characteristics of metals, alloys, ceramics, composites, and even novel nano-phase materials under development for vehicle applications. New analytical capabilities being added to the HTML inventory of instrumental tools include thermal measurement instrumentation for determining high efficiency thermoelectric material properties (e.g., Seebeck Coefficient) and an intense neutron flux diffractometer, VULCAN, enabling research on chemical reactions occurring in the solid state and rapidly occurring changes in materials subjected to stresses.

In FY 2008, the VULCAN diffractometer, which will occupy one of the beam lines at the newly operational Spallation Neutron Source, will undergo its initial on line testing. The same Lean NOx Catalytic formulations previously characterized by the Aberration Corrected Electron Microscope (ACEM) as indicated below will be subjected to analysis by VULCAN. Previously, the new sub-angstrom level clear imaging and chemical analysis capabilities of the ACEM were applied to characterize various formulations of lean NO_x and NO_x adsorber emissions-control catalytic materials identified as promising candidates by the FreedomCAR and 21st Century Truck partnerships. Such catalysts will enable higher efficiency diesel engines to meet emissions regulations and thereby be capable of replacing lower efficiency spark ignition engines in automobiles, light trucks and commercial vehicles. Selected members of the most completely characterized catalysts will be submitted for computational modeling in FY 2008 in order to understand, predict, and simulate improvements to their mechanisms of catalytic action. In addition, these funds may be used to support efforts such as peer reviews; data collection and dissemination; and technical, market, economic, and other analyses. (HTML $4,375,000)

	(dollars in thousands)		
	FY 2006	FY 2007	FY 2008
SBIR/STTR	**0**	**831**	**935**

In FY 2006, $805,000 and $91,000 were transferred to the SBIR and STTR programs respectively. The FY 2007 and 2008 amounts shown are estimated requirements for the continuation of the SBIR and STTR program. (FreedomCAR, $664,000; 21CT, $146,000).

Total, Materials Technology	**34,373**	**29,786**	**33,382**

Explanation of Funding Changes

	FY 2008 vs. FY 2007 ($000)
Propulsion Materials Technology	
The request will expand support for the Advanced Combustion Engine effort by addressing the implications of changes to fuel formulations and combustion regimes on engine materials and to expanded support for hybrid-drive systems materials requirements for plug-in hybrids. The funding also will accelerate the development and validation of modeling tools for improved catalysts, electrical energy storage, and thermoelectric materials.	+3,576
Lightweight Materials Technology	
The reduction reflects completion of the funding in FY 2007 of the Computational Materials Engineering study by the National Materials Advisory Board (NMAB) as well as the Lightweight Materials peer review.	-85
High Temperature Materials Technology	
No significant change.	+1
SBIR/STTR	
Changes in the SBIR/STTR funding are a direct result of changes in the funding of program activities and projected allocation among activities.	+104
Total Funding Change, Materials Technology	**+3,596**

Fuels Technology

Funding Schedule by Activity

	(dollars in thousands)		
	FY 2006	FY 2007	FY 2008
Fuels Technology			
Advanced Petroleum Based Fuels (APBF)	6,268	6,511	6,512
Non-Petroleum Based Fuels and Lubricants (NPBFL)	7,088	6,948	6,948
SBIR/STTR	0	386	385
Total, Fuels Technology	13,356	13,845	13,845

Description

The Fuels Technology subprogram supports R&D that will provide vehicle users with cost competitive fuel options that enable high fuel economy, deliver low emissions, and contribute to petroleum displacement. Future refinery feedstocks may increasingly be from non-conventional sources including, but not limited to, oil sands, shale oil, and tar sands. The focus is to assess mid- to long-term changes in the make-up of refinery feedstocks and identify the best use of these to produce a refining product that matches the needs of extremely-efficient internal combustion engines that are envisioned for the post-2010 time frame. In the nearer term this subprogram will address technology barriers associated with the introduction of biomass based fuels used as blend-stocks with conventional fuels. This subprogram supports the mission of the Vehicle Technologies Program (VT) to develop more energy-efficient and environmentally-friendly highway transportation vehicles that enable America to use less petroleum. It consists of two activities: Advanced Petroleum-Based Fuels (APBF) and Non-Petroleum-Based Fuels and Lubricants (NPBFL). These activities have been coordinated with and are supportive of EPA’s fuels and emissions related activities, as mentioned in their strategic plan.

Benefits

The APBF and NPBFL activities are undertaken: (1) to enable post-2010 advanced combustion regime engines and emission control systems to be more efficient while meeting future emission standards; and (2) to reduce reliance on petroleum-based fuels. To differentiate these two activities, an advanced petroleum-based fuel is envisioned as consisting of highly-refined petroleum-base fuel derived from what are considered to be future refinery feedstocks, possibly blended with performance-enhancing non-petroleum additives derived from renewable resources such as biomass or from non-petroleum fossil resources such as natural gas or coal. In contrast, a non-petroleum-based fuel consists of a fuel or fuel-blending component derived primarily from non-crude-oil sources such as agricultural products, biomass, natural gas, bitumen, shale, or coal. The benefit of the APBF activity is that it will enable fuel providers to work cooperatively with engine manufacturers to match future refinery products with future engine needs. The benefit of NPBFL is that it will provide non-petroleum based blending agents that enable both high fuel economy and direct displacement of petroleum fuels.

Detailed Justification

	(dollars in thousands)		
	FY 2006	FY 2007	FY 2008
Advanced Petroleum Based Fuels (APBF)	**6,268**	**6,511**	**6,512**

The APBF activity develops petroleum-based fuels and lubricants that will enable extremely high efficiency engines for passenger and commercial vehicle applications. This effort employs the expertise and shared funding of the Government, energy companies, and emission control and engine manufacturers. The main goal is to identify and exploit fuel properties that can enable engines to operate in the highest efficiency mode while meeting future emissions standards. These activities are undertaken in close coordination with the Advanced Combustion Engine R&D subprogram.

In FY 2008, awards made under the two High Efficiency Clean Combustion solicitations (in FY 2005 and FY 2006) will continue to account for a significant portion of APBF activities. These activities are undertaken by industry, generally organized in vertically-integrated teams which include passenger vehicle manufacturers or heavy-duty engine manufacturers, energy companies, suppliers, and National Labs. The on-going work under these awards is intended to identify fuel-property requirements of post-2010 passenger-vehicle and heavy-vehicle advanced internal combustion engines. These awards are co-funded by the Advanced Combustion Engine R&D subprogram. Precompetitive work on the relationship between fuel properties and combustion is generally undertaken by the National Labs and their partners and fall under the aegis of the Fuels for Advanced Combustion Engines (FACE) working group of the Coordinating Research Council. Utilizing the in-house National Laboratory expertise through cooperative research and development agreements (CRADA) or in-house laboratory work, continue development of predictive tools that relate molecular structure to ignition behavior and heat release of fuels in commercial vehicle advanced internal combustion engines. This effort is conducted through experimentation and modeling, utilizing Government-provided specialized equipment and scientists. Through the combined industry/Government effort, kinetic modeling of base fuel properties that effect advanced combustion regime engine operation will be expanded. In addition, these funds may be used to support efforts such as peer reviews; data collection and dissemination; and technical, market, economic, and other analyses. (FreedomCAR, $3,889,000; 21CT, $2,623,000).

Non-Petroleum Based Fuels and Lubricants (NPBFL)	**7,088**	**6,948**	**6,948**

The NPBFL activity formulates and evaluates non-petroleum-based fuels and lubricants that can be used as neat (pure) alternative fuels or blending agents and lubricants in transportation engines. With a primary focus on biomass-based renewable and synthetic fuels, specific areas being investigated include fuel quality and stability; molecular make-up and other fuel properties; the effect of these properties on engine performance and emissions; and storage, handling, toxicity, volatility, and other critical issues associated with the safe and proper use of these fuels. In addition, these funds may be used to support efforts such as peer reviews; data collection and dissemination; and technical, market, economic, and other analyses.

	FY 2006	FY 2007	FY 2008
	(dollars in thousands)		

In FY 2008, the activity will continue development of baseline data on the relationships between molecular structure and bulk fuel properties, ignition behavior, and heat release for renewable and synthetic fuels in advanced combustion regime engines and will continue development of a predictive model based on this data. The activity also will develop and optimize vehicle engines that take advantage of the fuel properties of high ethanol blends or other non-petroleum-based fuels in order to improve fuel economy or other performance issues associated with their use. Working with industry partners, this effort will further refine fuel quality, safety, and use specifications for bio-diesel and other non-petroleum-based-fuels to adequately address problems associated with regular and widespread use of these fuels. Research will develop testing and blending best practices to enable seamless introduction of alternative fuels and fuel blends at terminals. (FreedomCAR, $2,917,000; 21CT, $4,031,000).

	FY 2006	FY 2007	FY 2008
SBIR/STTR	**0**	**386**	**385**

In FY 2006, $315,000 and $38,000 were transferred to the SBIR and STTR programs respectively. The FY 2007 and 2008 amounts shown are estimated requirements for the continuation of the SBIR and STTR program. (FreedomCAR, $195,000; 21CT, $190,000)

	FY 2006	FY 2007	FY 2008
Total, Fuels Technology	**13,356**	**13,845**	**13,845**

Explanation of Funding Changes

	FY 2008 vs. FY 2007 ($000)
Advanced Petroleum Based Fuels (APBF)	
No significant change.	+1
SBIR/STTR	
Changes in the SBIR/STTR funding are a direct result of changes in the funding of program activities and projected allocation among activities.	-1
Total Funding Change, Fuels Technology	**0**

Technology Integration

Funding Schedule by Activity

	(dollars in thousands)		
	FY 2006	FY 2007	FY 2008
Technology Integration			
Graduate Automotive Technology Education (GATE)	0	0	500
Advanced Vehicle Competitions	0	0	1,300
Legislative and Rulemaking	0	0	1,804
Vehicle Technologies Deployment[a]	0	0	9,593
Biennial Peer Reviews[b]	0	0	500
Total, Technology Integration	0	0	13,697

Description

Technology Integration is a new (restructured) subprogram in FY 2008. It is based on the former Technology Introduction subprogram, but expanded with one activity moved out and two moved in, to consolidate the program's non-R&D activities. The Testing and Evaluation activity previously funded in Technology Introduction has been integrated into the Vehicle Systems subprogram, while the GATE (Innovative Concepts) and Biennial Peer Reviews activities are now included here.

The Technology Integration subprogram accelerates the adoption and use of alternative fuel and advanced technology vehicles to help meet national energy and environmental goals and accelerate dissemination of advanced vehicle technologies through demonstrations and education. This subprogram's efforts logically follow successful research by industry and government and help to accelerate the commercialization and/or widespread adoption of technologies that are developed in other VT program areas. Deployment activities linked to R&D also provide early market feedback to emerging R&D. Subprogram functions include both regulatory and voluntary components. The regulatory elements include legislative, rulemaking, and compliance activities associated with alternative fuel requirements identified within the Energy Policy Acts of 1992 and 2005 (EPACT 1992 and EPACT 2005). Voluntary efforts include demonstration of advanced technology vehicles to verify market readiness and public information, education, outreach and technical assistance efforts. VT technology deployment efforts include public/private partnerships between DOE and local coalitions of key stakeholders around the Nation (such as Clean Cities), to implement strategies and projects that displace petroleum. The Advanced Vehicle Competitions and GATE activities contribute to both the Vehicle Technologies and Hydrogen Technology Program missions by supporting the development of students with technical skill in the same areas of technology where the program is engaged in advanced

[a] This activity reorganizes the efforts previously funded as "Clean Cities". Comparable funding in FY 2007 is $4.393 million. In FY 2006, Clean Cities activities were funded in the Weatherization and Intergovernmental Activities Program, under the heading of Gateway Deployment. Comparable Funding for FY 2006 was $6.510 million.
[b] Biennial Peer Reviews were funded as a separate subprogram in FY 2006-2007. Comparable funding was $990,000 (to fund two reviews) in FY 2006 and $0 in FY 2007.

R&D. In addition, the annual DOE/EPA Fuel Economy Guide publication and related data dissemination efforts (required by law) are produced as part of this activity along with the website at www.fueleconomy.gov.

Benefits

The Technology Integration subprogram contributes to the VT Program goal by accelerating the adoption and use of alternative fuels, hybrid and fuel efficient vehicles, and idle reduction technologies in commercial highway vehicles. These fuels and vehicles will reduce the consumption of petroleum-based fuels thus contributing to achieving the program goal. Activities such as the Advanced Vehicle Competitions and GATE encourage the interest of university student engineers and engage their participation in advanced technology development. This helps address the need for more highly trained engineers in hybrid technologies to overcome barriers in the market place. Also, the GATE effort supports a pipeline into the auto industry of new engineers familiar with the most advanced technologies.

Detailed Justification

	(dollars in thousands)		
	FY 2006	FY 2007	FY 2008
Graduate Automotive Technology Education (GATE)	**0**	**0**	**500**

The GATE activity was moved from the Innovative Concepts subprogram. In FY 2008, this activity will fund GATE Centers of Excellence (competitively selected) to develop new curricula and provide research fellowships for approximately 25 students for research in advanced automotive technologies. (Comparable funding in both FY 2006 and FY 2007 was $500,000 each year.) (FreedomCAR, $500,000)

Advanced Vehicle Competitions	**0**	**0**	**1,300**

The Advanced Vehicle Competitions activity was moved from the Technology Introduction subprogram. In FY 2008, DOE will conduct the fourth year of the Challenge X competition in partnership with General Motors. Selected teams will be challenged to integrate advanced vehicle technologies and appropriate fuels to develop an approach that minimizes use of petroleum fuel. Initiate planning for a follow-on advanced vehicle competition. Many students who graduate from these vehicle competitions and from the GATE program go on to take jobs in the auto industry where they bring with them an unprecedented appreciation and understanding of advanced automotive efficiency technologies. (FreedomCAR, $1,300,000) (Comparable funding in FY 2006 was $1.3 million and the same in FY 2007.)

Legislative and Rulemaking	**0**	**0**	**1,804**

The Legislative and Rulemaking activity was moved from the Technology Introduction subprogram. The Legislative and Rulemaking activity consists of implementation of the State and Alternative Fuel

	(dollars in thousands)		
	FY 2006	FY 2007	FY 2008

Provider Regulatory Program 10CFR Part 490, alternative fuel designations, the Private and Local Government Fleet Regulatory Program, and the normal implementation of other EPACT 2005 requirements including reports and rulemaking, analyses of the impacts from other regulatory and pending legislative activities, and the implementation of legislative changes to the EPACT fleet activities as they occur. The fleet programs require selected covered fleets to procure alternative fuel passenger vehicles annually. The Department also reviews and processes petitions to designate new alternative fuels under EPACT. In addition, these funds may be used to support efforts such as peer reviews; data collection and dissemination; and technical, market, economic, and other analyses. (Comparable funding in FY 2006 was $2.489 million and in FY 2007 was $1.804 million.)

	FY 2006	FY 2007	FY 2008
Vehicle Technologies Deployment (formerly Clean Cities)	**0**	**0**	**9,593**

The Clean Cities activity was moved from the Technology Introduction subprogram and renamed as Vehicle Technology Deployment. The Vehicle Technology Deployment activity restructures efforts formerly supported under the Clean Cities heading. It will continue to promote the adoption and use of petroleum reduction technologies and practices by working with local Clean Cities coalitions and their stakeholders, industry partners, fuel providers, and end-users. Technology focus areas include: alternative fuel vehicles, alternative fuel infrastructure development, idling reduction for commercial trucks and buses, expanded use of non-petroleum and renewable fuel blends, hybrid vehicles, driving practices for improved efficiency, and engine/vehicle technologies that maximize fuel economy. Working in conjunction with technology experts at the National Laboratories, activities include outreach, education, training, and technical assistance related to each technology focus area. Critical tools and information will be provided via internet, telephone hotline, publications, and direct interaction with experts. The program also will continue efforts to provide technical assistance for early adopters of technologies and provide education, training, and workshops to coalitions, public safety officials, and stakeholders related to infrastructure development and targeted niche market opportunities (like transit, refuse trucks, school bus, delivery trucks, municipal fleets, etc.).

In support of the National Energy Policy, Section 405 of EPACT 1992, and Sections 721, 1001, and 1004 of EPACT 2005 directing the Department to expand consumer education, to promote technology transfer, and to address implementation barriers, the program will identify and support opportunities to showcase the technology focus areas and continue to build national and regional alliances to promote petroleum reduction strategies and will support further expansion of ethanol infrastructure deployment. Up to $1 million of the request will be used to support demonstration and deployment of other alternative-fuel and advanced combustion and emission control technologies developed by DOE, so that the technologies are not left “sitting on the shelf.” In addition, these funds may be used to support efforts such as technology transfer/technology exchange meetings and forums with industry stakeholders, peer reviews, data collection and dissemination, and technical, market feasibility, economic, and other analyses. Efforts to support the development and promote the use of the (legislatively mandated) Fuel Economy Guide and associated www.fueleconomy.gov website also will continue.

	(dollars in thousands)		
	FY 2006	FY 2007	FY 2008

(Comparable funding under "Clean Cities" in FY 2007 is $4.393 million. In FY 2006, Clean Cities was funded in the Weatherization and Intergovernmental Program, under Gateway Deployment, and comparable funding was $6.510 million.)

Biennial Peer Reviews	**0**	**0**	**500**

Funding will be used to conduct biennial reviews of the FreedomCAR and Fuel Partnership and the 21st Century Truck Partnership by an independent third party, such as the National Academy of Sciences/National Academy of Engineering, to evaluate progress and program direction. Reviews will include evaluation of progress toward achieving the technical and program goals supporting each partnership, as well as an assessment of the appropriateness of Federal investment in each of the activities. The FreedomCAR review to be held in FY 2008 will address relevant elements of both the Vehicle Technologies Program and the Hydrogen Technology Program. Based on the evaluations, resource availability, and other factors, the partners will consider new opportunities, make adjustments to technology specific targets, and set goals as appropriate. Because reviews of both partnerships were held in FY 2006, there was no review in FY 2007, in preparation for shifting to an alternate-year schedule. This shift not only simplifies the budgeting but also simplifies the management of these important activities by having only one review in a given year. (FreedomCAR, $500; 21st Century Truck, $0.)

Total, Technology Integration	**0**	**0**	**13,697**

Explanation of Funding Changes

	FY 2008 vs. FY 2007 ($000)
Graduate Automotive Technology Education	
Includes the GATE activities previously funded within the Innovative Concepts subprogram. There is no change relative to the comparable previous request.	+500
Advanced Vehicle Competitions	
Includes Advanced Vehicle Competitions activities previously funded within the Technology Introduction subprogram. There is no change relative to the comparable previous request.	+1,300

	FY 2008 vs. FY 2007 ($000)
Legislative and Rulemaking	
Includes the Legislative Rulemaking activities previously funded within the Technology Introduction subprogram. There is no change relative to the FY 2007 request for comparable activities even with the moving the funding for tracking of Federal Fleet Alternative-fuel vehicle acquisitions to FEMP in FY 2008.	+1,804
Vehicle Technologies Deployment	
Includes a restructuring of activities previously funded within the Technology Introduction subprogram, plus an increase to allow for additional support to further expand the use of alternative fuels. The additional funds will be used to extend current efforts to other regions of the country and to expand the spectrum of technologies deployed to include a broader range of technologies being developed by Vehicle Technologies. The change relative to the comparable previous request is +$5,200,000.	+9,593
Biennial Peer Reviews	
Includes funding for Biennial Peer Review activities previously funded as a separate subprogram. Funding will be used to conduct biennial reviews of the FreedomCAR and Fuel Partnership by an independent third party, such as the National Academy of Sciences/National Academy of Engineering, to evaluate progress and program scope and emphasis.	+500
Total Funding Change, Technology Integration	**+13,697**

Innovative Concepts

Funding Schedule by Activity

	(dollars in thousands)		
	FY 2006	FY 2007	FY 2008
Innovative Concepts			
Graduate Automotive Technology Education (GATE)	495	500	0
Total, Innovative Concepts	495	500	0

Description

In the new budget structure, the Innovative Concepts subprogram has been dropped and its one activity, Graduate Automotive Technology Education (GATE), has been moved to the Technology Integration subprogram. GATE contributes to activities of both the Vehicle Technologies and Hydrogen Technology Program missions by supporting the development of students with technical skill in the same areas of technology where the program is engaged in advanced R&D.

Detailed Justification

	(dollars in thousands)		
	FY 2006	FY 2007	FY 2008
Graduate Automotive Technology Education	**495**	**500**	**0**

In FY 2008, GATE is funded within the Technology Integration activity.

The GATE activity aids in the development of interdisciplinary curricula to train the future workforce of automotive engineers. This is accomplished by setting up GATE Centers of Excellence at universities that have been competitively selected, establishing focused curricula, and providing funds for research fellowships.

Total, Innovative Concepts	**495**	**500**	**0**

Explanation of Funding Changes

	FY 2008 vs. FY 2007 ($000)
Graduate Automotive Technology Education	
In FY 2008, GATE is funded within the Technology Integration activity.	-500
Total Funding Change, Innovative Concepts	**-500**

Technology Introduction

Funding Schedule by Activity

	(dollars in thousands)		
	FY 2006	FY 2007	FY 2008
Technology Introduction			
Legislative and Rulemaking			
State and Fuel Provider Fleet	990	990	0
Private and Local Fleet	297	0	0
Fuel Petitions	311	0	0
Federal Fleets	693	700	0
Regulatory Support	198	114	0
Total, Legislative and Rulemaking	2,489	1,804	0
Clean Cities[a]	0	4,393	0
Testing and Evaluation			
Vehicle Evaluation	2,425	3,484	0
Infrastructure Testing	49	50	0
Total, Testing and Evaluation	2,474	3,534	0
Advanced Vehicle Competitions	1,287	1,300	0
Total, Technology Introduction	6,250	11,031	0

Description

In FY 2008, all of the activities in Technology Introduction (except Testing and Evaluation) are funded in the Technology Integration subprogram. The Testing and Evaluation activity is included in the vehicle systems subprogram in FY 2008. Funding for some Federal Fleets activities under the Legislative and Rulemaking activity is requested within the Federal Energy Management Program in FY 2008 and the remainder ─ activities to support E-85 ethanol fuel deployment and additional regulatory support ─ have been included within the Legislative and Rulemaking activity within the Technology Integration subprogram.

[a] Clean Cities was funded in Weatherization and Intergovernmental Activities in FY 2006 under the heading of Gateway Deployment. Comparable funding for FY 2005 and 2006 was $10.626 million and $6.510 million respectively.

Detailed Justification

	(dollars in thousands)		
	FY 2006	FY 2007	FY 2008
Legislative and Rulemaking	**2,489**	**1,804**	**0**

The Legislative and Rulemaking has been shifted to the Technology Integration subprogram in FY 2008. The activity consists of the State and Alternative Fuel Provider Regulatory Program, Fuel Petitions, Private and Local Government Fleet Regulatory Program, Federal Fleet requirements and the normal implementation of other EPACT 2005 requirements including reports and rulemaking, the analysis of the impact of other regulatory and pending legislative activities, and the implementation of legislative changes to EPACT as they occur. The fleet programs require selected covered fleets to procure alternative fuel passenger vehicles annually as well as the Department's compliance with the Federal fleet requirements. The Department also reviews and processes petitions to designate new alternative fuels under EPACT. In addition, these funds may be used to support efforts such as peer reviews; data collection and dissemination; and technical, market, economic, and other analyses.

▪ **State and Fuel Provider Fleet**	**990**	**990**	**0**

The State and Fuel Provider Fleet subactivity has been included within the Legislative and Rulemaking activity within the Technology Integration subprogram. In FY 2007, this activity promotes the use of alternative fuel in the state fleets through outreach and partnership building between the state and alternative fuel providers (EPACT Sec 507 (1992)).

▪ **Private and Local Fleet**	**297**	**0**	**0**

Beginning in FY 2007, activities in support of this area are conducted by in-house DOE staff.

▪ **Fuel Petitions**	**311**	**0**	**0**

Beginning in FY 2007, activities in support of this area are conducted by in-house DOE staff.

▪ **Federal Fleets**	**693**	**700**	**0**

In FY 2008, part of the Federal Fleet activity (tracking of Federal fleet AFV acquisitions) is moved to FEMP. Remaining activities to support E85 deployment and additional regulatory support have been included within the Legislative and Rulemaking activity within the Technology Integration subprogram.

▪ **Regulatory Support**	**198**	**114**	**0**

The Regulatory Support subactivity has been included within the Legislative and Rulemaking activity within the Technology Integration subprogram. In FY 2007, the program continues tracking and analysis of energy legislation and revised EPACT 2005 Renewable Fuel goal.

	(dollars in thousands)		
	FY 2006	FY 2007	FY 2008
Clean Cities	**0**	**4,393**	**0**

In FY 2008, the Clean Cities activity is reorganized as Vehicle Technology Deployment within the Technology Integration subprogram. In FY 2007, Clean Cities continues to promote petroleum displacement strategies by working with local Clean Cities coalitions and their partners. Technologies included: alternative fuel vehicles, idling reduction devices in commercial trucks and buses, expanded use of non-petroleum fuel blends, and hybrid technologies. Through regional collaboration and small grants to local coalitions, the program will facilitate local coalition market development, education, and training; conduct peer review opportunities; and continue providing limited technical assistance teams to help address technical niche market issues raised by local Clean Cities coalitions. The program also is continuing efforts to provide targeted niche market assistance, analyze market trends, and provide education and training to Clean Cities coalitions about market opportunities in airport, school bus, transit, and municipal fleets.

In support of the National Energy Policy and EPACT 1992 Section 405 direction to expand consumer education and to address implementation barriers, the program: identifies and supports opportunities to showcase commercially available AFVs, hybrids, idle-reduction technologies, fuel blends and highlight fuel economy and other petroleum reduction activities; publishes case studies of successful niche markets for various petroleum reduction technologies; and continues to build national and regional alliances to promote petroleum reduction strategies. Efforts to support development of the legislatively mandated Fuel Economy Guide and associated www.fueleconomy.gov website also continue.

In FY 2005 and 2006, Clean Cities was funded in the Weatherization and Intergovernmental Program, under Gateway Deployment.

Testing and Evaluation	**2,474**	**3,534**	**0**

The Testing and Evaluation activity has been integrated into the Vehicle Systems subprogram. The primary goal of the Advanced Vehicle Testing Activity (AVTA) is to benchmark and validate the performance of passenger and commercial vehicles that feature one or more advanced technologies. These include: internal combustion engines burning advanced fuels, such as 100 percent hydrogen and hydrogen/compressed natural gas-blended fuels; hybrid electric, pure electric, and hydraulic drive systems; advanced batteries and engines; and advanced climate control, power electronic, and other ancillary systems.

By benchmarking the performance and capabilities of advanced technologies, the AVTA supports the development of industry and DOE technology targets. The testing results are also input to component, system, and vehicle models, as well as hardware-in-the-loop testing.

In FY 2007, the AVTA developed vehicle test procedures with input from industry and other stakeholders to accurately measure real-world vehicle performance. These test procedures were then applied to production and preproduction advanced technology vehicles on dynamometers and closed test tracks as well as in government, commercial, and industry fleets. The AVTA tests produced unbiased information about vehicles with advanced transportation technologies, which reduces the U.S.

	(dollars in thousands)		
	FY 2006	FY 2007	FY 2008

dependence on foreign oil, while improving the Nation's air quality. In addition, these funds are used to support efforts such as peer reviews; data collection and dissemination; and technical, market, economic, and other analyses.

	FY 2006	FY 2007	FY 2008
▪ **Vehicle Evaluation**	**2,425**	**3,484**	**0**

In FY 2007, expand the controlled, closed track baseline testing and real-world monitored fleet evaluations of advanced plug-in hybrid electric vehicles in cooperation with industry partners. Identify component and system performance and reliability weaknesses to be addressed through future technology R&D activities. Continue testing of first generation hydrogen-fueled internal combustion engine hybrid electric vehicles and initiate testing of second generation advanced hybrid electric vehicles, including hydraulic and ultra-capacitor equipped hybrids. Complete evaluation of first generation hydrogen-fueled internal combustion engine passenger vehicles and electric airport ground support equipment. Expand baseline performance and accelerated reliability testing of new hybrid electric vehicles. Expand data collection on fuel cell and advanced hybrid electric transit buses. Complete initial evaluations of advanced commercial truck idle-reduction devices. Initiate fleet evaluation of passenger fuel cell vehicles.

	FY 2006	FY 2007	FY 2008
▪ **Infrastructure Testing**	**49**	**50**	**0**

In FY 2007, continue evaluation of vehicle refueling and recharging systems required for advanced plug-in hybrid electric vehicles and hydrogen-fueled vehicles.

	FY 2006	FY 2007	FY 2008
Advanced Vehicle Competitions	**1,287**	**1,300**	**0**

Advanced Vehicle Competitions provide educational opportunities for university students to learn and use real-world engineering skills while demonstrating the performance of critical vehicle technologies identified by the Department of Energy and industry. In FY 2007, we will conduct the third year of the Challenge X competition in partnership with General Motors. Selected teams will be challenged to integrate advanced vehicle technologies and appropriate fuels to develop an approach that minimizes use of petroleum fuel. Many students who graduate from these vehicle competitions go on to take jobs in the auto industry where they bring with them an unprecedented appreciation and understanding of advanced automotive technologies. Initiate planning for a follow-on advanced vehicle competition. (FreedomCAR, $1,300,000)

	FY 2006	FY 2007	FY 2008
Total, Technology Introduction	**6,250**	**11,031**	**0**

Explanation of Funding Changes

	FY 2008 vs. FY 2007 ($000)
Legislative and Rulemaking	
Funding is shifted to the Technology Integration subprogram in FY 2008.	-1,804
Clean Cities	
In FY 2008, the Clean Cities activity is reorganized as Vehicle Technology Deployment within the Technology Integration subprogram.	-4,393
Testing and Evaluation	
In FY 2008, Testing and Evaluation is integrated into the Vehicle Systems subprogram.	-3,534
Advanced Vehicle Competitions	
Advanced Vehicle Competitions are supported in the Technology Integration subprogram in FY 2008.	-1,300
Total Funding Change, Technology Introduction	**-11,031**

Biennial Peer Reviews

Funding Schedule by Activity

	(dollars in thousands)		
	FY 2006	FY 2007	FY 2008
Biennial Peer Reviews	990	0	0
Total, Biennial Peer Reviews	990	0	0

Description

In FY 2007 there was no request corresponding to no scheduled peer review. In FY 2008 the activity has been moved to the Technology Integration subprogram.

Detailed Justification

	(dollars in thousands)		
	FY 2006	FY 2007	FY 2008
Biennial Peer Reviews	**990**	**0**	**0**
In FY 2008 the activity has been moved to the Technology Integration subprogram.			
Total, Biennial Peer Reviews	**990**	**0**	**0**

Technical/Program Management Support

Funding Schedule by Activity

	(dollars in thousands)		
	FY 2006	FY 2007	FY 2008
Technical/Program Management Support	2,475	0	0
Total, Technical/Program Management Support	2,475	0	0

Description

In the past, consistent with other DOE programs under the jurisdiction of the Interior and Related Agencies Appropriations Committees, the Energy Conservation programs provided funding for Technical/Program Management Support. This included activities such as R&D feasibility studies; R&D option development and trade-off analyses; and technical, economic, and market evaluations of research. These activities provide important benefits directly to the VT Program described above and are therefore an integral part of the R&D program. Consistent with Energy and Water subcommittee standard practice, those functions are funded in the individual program budgets starting in FY 2007.

Benefits

The analysis and technology assessment and planning necessary for good management of the R&D programs will be funded within the programs themselves, since it is an integral part of the Federal role of oversight of the R&D activities.

Detailed Justification

	(dollars in thousands)		
	FY 2006	FY 2007	FY 2008
Technical/Program Management Support	**2,475**	**0**	**0**

Technical management activities, including strategic and technical planning; project and performance tracking; program reviews and evaluations, including R&D feasibility studies and trade-off analyses; peer reviews; data collection and publication; and market, economic, and other analyses are all part of the sound management of any R&D or technology deployment program. Consistent with Energy and Water subcommittee standard practice, funding for those activities will be taken from within the requested budgets for the individual technology and deployment programs starting in FY 2007.

Total, Technical/Program Management Support	**2,475**	**0**	**0**

Congressionally Directed Activities

Funding Schedule by Activity

	FY 2006	FY 2007	FY 2008
	(dollars in thousands)		
Congressionally Directed Activities	24,255	0	0
Total, Congressionally Directed Activities	24,255	0	0

Description

In general, Congressionally Directed activities do not support program goals because such activities were not a result of the program's planning effort which is focused on overcoming technical barriers. In FY 2006, there were six Congressionally directed activities funded in the Vehicles Technologies Program. The program does not request any funds to continue these projects as they do not further the achievement of DOE's goals. The Detailed Justification section lists the projects directed by Congress to be included in this program.

Detailed Justification

	FY 2006	FY 2007	FY 2008
	(dollars in thousands)		

In FY 2007, continuation of Congressionally Directed activities was not requested by the Vehicle Technologies Program. In FY 2008, the program does not request any funds for activities in this area. Previous activities generally do not further the achievement of DOE's goals; those that may be characterized as partially contributing represent less-than-optimal ways to support the program's goals. The following projects were previously directed by Congress to be included in the program:

Phase II Heavy Vehicle Hybrid Propulsion	**2,970**	**0**	**0**

In FY 2006, this project continued previous Oshkosh – VT cost-shared technology development of a heavy hybrid (Class 8) refuse hauler.

National Hybrid Truck Manufacturing Program	**1,980**	**0**	**0**

In FY 2006, this project proposed: 1) technology development of an International Truck/Eaton Corporation hybrid electric lift truck, and 2) technology development of a hydraulic hybrid refuse hauler.

	FY 2006	FY 2007	FY 2008
	(dollars in thousands)		
Vehicle Test Strip Equipment Demonstration	**1,485**	**0**	**0**

This FY 2006 project was designed to contribute to the development of more effective data for the evaluation of technology performance.

Oak Ridge National Lab Highway Transportation Technologies	**9,900**	**0**	**0**

The Oak Ridge National Laboratory conducted research and development in FY 2006 on materials development and computational modeling. Materials development efforts focused on energy-critical body, chassis, and engine systems on cars and heavy trucks. Computational modeling activities addressed vehicle systems such as engines, electric drive systems, and body systems.

Mississippi State University CAVS Center	**3,960**	**0**	**0**

In FY 2006, the Center for Advanced Vehicular Systems (CAVS) at the University of Mississippi performed cradle-to-grave modeling of automotive and truck components to reduce weight and cost while improving performance and safety. In addition, the university conducted multidisciplinary research on automotive design using the multi scale virtual manufacturing suite of tools.

Turbocharger Diesel Engine R&D	**3,960**	**0**	**0**

The Honeywell Corporation conducted research and development on turbocharger technology in FY 2006 to improve diesel engine efficiency and reduce emissions. Funding is not requested for turbocharger work in the Advanced Combustion Engine R&D subprogram because it is a mature, commercialized technology.

Total, Congressionally Directed Activities	**24,255**	**0**	**0**

Building Technologies

Funding Profile by Subprogram

(dollars in thousands)

	FY 2006 Current Appropriation	FY 2007 Request	FY 2008 Request
Building Technologies			
Residential Buildings Integration	14,858	19,700	19,700
Commercial Buildings Integration	3,069	4,699	7,000
Emerging Technologies	32,289	32,756	32,756
Technology Validation and Market Introduction	0	8,249	13,361
Equipment Standards and Analysis	10,153	11,925	13,639
Oil Heat Research for Residential Buildings	990	0	0
Technical/Program Management Support	1,485	0	0
Congressionally Directed Activities	5,346	0	0
Total, Building Technologies	68,190	77,329	86,456

Public Law Authorizations:

P.L. 94-163, "Energy Policy and Conservation Act" (EPCA) (1975)
P.L. 94-385, "Energy Supply 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 Supply Policy Act" (NECPA) (1978)
P.L. 95-620, "Power Plant and Industrial Fuel Use Act" (1978)
P.L. 96-294, "Energy Security Act" (1980)
P.L. 100-12, "National Appliance Energy Supply Act" (1987)
P.L. 100-357, "National Appliance Energy Supply Amendments" (1988)
P.L. 100-615, "Federal Energy Management Improvement Act" (1988)
P.L. 102-486, "Energy Policy Act" (1992)
P.L. 109-190, "Energy Policy Act" (2005)

Mission

The mission of the Building Technologies Program (BT) is to develop technologies, techniques and tools for making residential and commercial buildings more energy efficient, productive, and affordable. The portfolio of activities includes efforts to improve the energy efficiency of building components and equipment and their effective integration using whole-building-system-design techniques, the development of building codes and equipment standards, the integration of renewable energy systems into building design and operation, and the acceleration of adoption of these technologies and practices.

Benefits

Buildings account for over two thirds of the electric energy consumption in the Nation. The Building Technologies Program supports DOE's goal to improve energy security by developing reliable, affordable and environmentally sound technologies that significantly reduce the energy consumption and peak electrical demands of residential and commercial buildings. By combining state-of-the art, energy efficient construction and appliances with commercially available renewable energy systems, BT strives to make net zero energy homes and buildings a reality.

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 GPRA Unit Program Goals

The Department's Strategic Plan identifies five Strategic Themes (one each for nuclear, energy, science, management, and environmental aspects of the mission) plus 16 Strategic Goals that tie to the Strategic Themes. The Building Technologies Program supports the following goals:

Strategic Theme 1, Energy Security

Strategic Goal 1.4, Energy Productivity: Cost-effectively improve the energy efficiency of the U.S. economy.

And concurrently supports:

Strategic Goal 1.2, Environmental Impacts of Energy: Improve the quality of the environment by reducing greenhouse gas emissions and environmental impacts to land, water, and air from energy production and use.

Strategic Theme 3, Scientific Discovery and Innovation

Strategic Goal 3.3, Research Integration: Integrate basic and applied research to accelerate innovation and to create transformational solutions for U.S. energy needs.

The Building Technologies Program has one GPRA Unit Program goal which contributes to Strategic Goals 1.4 in the "goal cascade:"

GPRA Unit Program Goal 1.4.20.00: Building Technologies - The Building Technologies Program goal is to develop cost effective tools, techniques and integrated technologies, systems and designs for buildings that generate and use energy so efficiently that buildings are capable of generating as much energy as they consume.

Contribution to GPRA Unit Program Goal 1.4.20.00 (Building Technologies)

The principal Building Technologies Program contributions to Strategic Theme 1 (Energy Security) and Strategic Theme 3 (Scientific Discovery and Innovation), are improving energy efficiency, and incorporating productive power technologies into the whole building infrastructure. Key technology pathways that contribute to achievement of the goal include:

- Residential Buildings Integration R&D Activities: Provide the energy technologies and solutions that will catalyze 70 percent reduction in energy use of new prototype residential buildings that when combined with onsite energy technologies result in zero energy homes (ZEH)[a] by 2020 and, when adapted to existing homes result in a significant reduction in their energy use. By 2010, develop, document and disseminate five cost effective technology packages that achieve an average of 40 percent reduction in whole house energy use. Performance indicators include the number of: subsystem technological solutions developed, researched, and evaluated; technology package research reports developed, researched, and evaluated against the Building America benchmark[b] for homes; builder best practices manuals developed; existing homes retrofitted to achieve 20 percent or more improvement in energy efficiency, and project and demonstration homes developed in the Building America (BA) Program.

- Commercial Buildings Integration R&D Activities: By 2010, collaborate with industry to develop, document and disseminate a complete set of 14 technology packages that provide builders energy efficient options to meet their complex performance demands that can achieve 30 percent reduction in the purchased energy use in new, small to medium-sized commercial buildings relative to American Society of Heating, Refrigerating and Air Conditioning Engineers (ASHRAE) 90.1-2004. Complete an initial technology option set that establishes a basis for achieving 50 percent energy use reductions. Performance indicators include the number of: technology packages and option sets developed, researched, and evaluated for their demonstrated potential to contribute to the target reduction of energy use in new buildings.

- Emerging Technologies (ET) Activities: Accelerate the introduction of highly-efficient technologies and practices for both residential and commercial buildings. The emerging technologies activities support the BT goal through research and development of advanced lighting, building envelope, windows, space conditioning, water heating and appliance technologies. In the area of solid state lighting (SSL) our goal is to achieve lighting technologies with double the efficiency of today's most efficient lighting sources. Without advanced components and subsystems developed in the Emerging Technologies activities, the goal of zero energy buildings (ZEB) will not be met. The performance indicators include the number of potentially market viable technologies demonstrated each of which is expected to contribute to the ZEB based upon individual builder objectives.

- Equipment Standards and Analysis: Increase minimum efficiency levels of buildings and equipment through codes, standards, and guidelines that are technologically feasible, economically justified, and save significant energy. By 2010, issue 13 formal proposals, consistent with enacted law, for enhanced product standards and test procedures. Performance indicators include: product standards and test procedures proposed/issued that will result in more efficient buildings energy use.

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[a] The zero energy building (ZEB) (referred to as zero energy homes (ZEH) in the residential sector) research initiative is bringing a new concept to homebuilders across the United States. A zero energy home combines state-of-the-art, energy efficient construction and appliances with commercially available renewable energy systems such as solar water heating and solar electricity. This combination can result in a net zero energy consumption. A ZEH, like most houses, is connected to the utility grid, but can be designed and constructed to produce as much energy as it consumes on an annual basis. With its reduced energy needs and renewable energy systems, a ZEH can, over the course of a year, give back as much energy to the utility as it takes.

[b] Building America Benchmark, Version 3.1, November 2003, National Renewable Energy Laboratory

- Technology Validation and Market Introduction: Accelerates the adoption of clean and efficient domestic energy technologies through such activities as Rebuild America, ENERGY STAR,® and Building Energy Codes. By 2010, increase the market penetration of ENERGY STAR® labeled windows to 54 percent (40 percent, 2003 baseline), and maintain 28 percent market share for ENERGY STAR® appliances. ENERGY STAR® activities will work to remove technical, financial and institutional barriers to the widespread awareness, availability, and purchase of highly efficient appliances, compact fluorescent lighting products, windows and other products. Rebuild America activities will work to remove technical, financial and institutional barriers to the widespread awareness, availability and application of highly efficient buildings including building design, construction, retrofit and operations practices. The Building Energy Code activities will support the development and implementation of energy efficient building codes which increases the construction of more energy efficient buildings.

Funding by Strategic and GPRA Unit Program Goal

(dollars in thousands)

	FY 2006	FY 2007	FY 2008
Strategic Goals 1.4, Energy Productivity; and 3.3, Research Integration			
GPRA Unit Program Goal 1.4.20.00, Building Technologies			
Residential Buildings Integration	14,858	19,700	19,700
Commercial Buildings Integration	3,069	4,699	7,000
Emerging Technologies	32,289	32,756	32,756
Technology Validation and Market Introduction	0	8,249	13,361
Equipment Standards and Analysis	10,153	11,925	13,639
Oil Heat Research for Residential Buildings	990	0	0
Technical/Program Management Support	1,485	0	0
Total, GPRA Unit Program Goal 1.4.20.00, Building Technologies	62,844	77,329	86,456
All Other			
Congressionally Directed Activities			
National Center on Energy Management and Building Technologies	3,960	0	0
University of Louisville Sustainable Buildings Project	396	0	0
Carnegie Mellon University Advanced Building Testbed	990	0	0
Total, All Other	5,346	0	0
Total, Strategic Goals 1.4 and 3.3 (Building Technologies)	68,190	77,329	86,456

Annual Performance Results and Targets

FY 2003 Results	FY 2004 Results	FY 2005 Results	FY 2006 Results	FY 2007 Targets	FY 2008 Targets
GPRA Unit Program Goal 1.4.20.00 (Building Technologies)					
Residential Buildings Integration					
Pursue six promising technical solutions considering regional and housing type differences targeting 40 percent reductions in residential space conditioning, hot water, and lighting loads. Based on Building America systems research results develop regional Building System Performance Packages for five climate zones describing "best practice" systems that reduce space conditioning energy use by 30 percent. [MET GOAL]	Initiate 5 design packages that provide promising technological solutions considering regional and housing type differences targeting 40 - 50 percent reductions in residential space conditioning loads, compared to IECC 2003, through Building America Consortia. Strategies to reduce the major loads, including energy used for hot water, lighting and clothes dryers were also investigated. [MET GOAL]	Complete the research for production-ready new residential buildings that are 30 percent more efficient than the whole-house Building America benchmark in 2 climate zones and document the results in Technology Package Research Reports. [MET]	Complete system research with lead builders in two climate zones demonstrating production-ready new residential buildings that are 30 percent more efficient than the whole-house Building America benchmark and document the results in Technology Package Research Reports. [MET]	Document in Technology Package Research Reports research results for production ready new residential buildings that are 30 percent more efficient in 1 climate zone and 40 percent more efficient in 1 climate zone than the whole-house Building America benchmark.	Complete research for production ready new residential buildings in one climate zone that are 40 percent more efficient than the whole-house Building America benchmark and document in one technology package research report.
		Analyze and develop code change proposals that are expected to result in a cost-effective improvement in energy efficiency in residential buildings of approximately 1-2 percent. [MET]			
Commercial Buildings Integration					
Facilitate a 10 percent increase in commercial building designs that have meaningful consideration of energy efficiency by developing improved design tools, including code compliance tools, and completing six researches assisted design case studies in cooperation with industry. [MET GOAL]		Complete assessments of controls technology, optimization methods and market opportunities, with substantial input from designers and building owners, to establish a framework for development of programmatic pathways to achieve 50 percent or better energy performance in significant numbers of buildings enabling development of design and/or technology packages for new commercial buildings. [MET]	Complete the development of one design technology package to achieve 30 percent or better energy savings, focusing on a single, high priority building type, such as small commercial retail or office buildings, based on the technical and market assessments completed in 2005. [MET]	Complete the development of two new design technology packages for a second small to medium sized commercial building type to achieve 30 percent energy savings over ASHRAE 90.1-2004.	Complete the development of four additional design technology packages for small to medium sized commercial building types to achieve 30 percent energy savings over ASHRAE 90.1-2004.

FY 2003 Results	FY 2004 Results	FY 2005 Results	FY 2006 Results	FY 2007 Targets	FY 2008 Targets
		Analyze and develop code change proposals that are expected to result in a cost-effective improvement in energy efficiency in commercial buildings of approximately 1-2 percent. [MET]			
Emerging Technologies					
	Complete a solicitation and award five or more competitively based research awards for cost-shared research on technology (such as materials and light extraction) to contribute to the goal of 160 lumens/Watt (lm/W) and $11/Klm of white light from solid state devices with industry, National Laboratories, and universities. [MET GOAL]	Select five new competitively based research awards for cost-shared research on technology (such as optical materials and device structures) to achieve ≥65 lm/W white light from solid state devices with industry, National Laboratories, and universities. [MET]	Conduct cost-shared, competitively selected research on technology to achieve = 65 1m/W (in a laboratory device) of white light from solid state devices with industry, National Laboratories, and universities. [MET]	Achieve at least 86 lumens per Watt (in a laboratory device) of white light from solid state devices based on cost-shared research which is competitively selected.	Achieve ≥ 93 1m/W (in a laboratory device) of white light from solid state devices.
		Complete a prototype dynamic window that will have a Solar Heat Gain Coefficient (SHGC) in the range of 0.05 to 0.60 , while meeting American Society for Testing and Materials (ASTM) durability standards for cycling in a high temperature, high ultraviolet light environment. [MET]			
Complete investigation of 5 methods to increase the optimum selection of equipment components for air conditioning and heat pumps. [MET GOAL]		Complete a thermodynamic study of emerging refrigerants. Based on study results, make go/no-go decision on initiation of first stage development of a laboratory prototype, high efficiency residential 1-ton air-conditioning and heat pump unit that uses a novel approach to the vapor compression refrigeration cycle and has the potential for a Seasonal Energy			

FY 2003 Results	FY 2004 Results	FY 2005 Results	FY 2006 Results	FY 2007 Targets	FY 2008 Targets
		Efficiency Ratio (SEER) of over 20. [MET]			
Equipment Standards and Analysis					
Conduct 4 rulemakings to amend appliance standards and test procedures. [MET LESS THAN 80 percent OF GOAL]	Prepare for issuance up to four rules to amend appliance standards and test procedures for some of the following products: Residential Furnaces, Boilers, and Mobile Home Furnaces; Electrical Distribution Transformers; Commercial Unitary Air-Conditioners and Heat Pumps; and Residential Niche Product Air-Conditioners and Heat Pumps. [MET]	Complete analytical and regulatory steps necessary for DOE issuance of 3-4 rules, consistent with enacted law, to amend appliance standards and test procedures that are economically justified and will result in significant energy savings. [MET]	Complete analytical and regulatory steps necessary for DOE issuance of 4 rules, consistent with enacted law, to amend appliance standards and test procedures that are economically justified and will result in significant energy savings. Develop for DOE issuance notices of proposed rulemaking (NOPRs) regarding energy conservation standards for electric distribution transformers, commercial unitary air conditioners and heat pumps, and residential furnaces and boilers. [MET]	Final rules will be issued for 3-5 product categories, consistent with enacted law, to amend appliance standards and test procedures that are economically justified and will result in significant energy savings. This includes final rules for distribution transformers and residential furnaces and boilers.	Complete analytical and regulatory steps necessary for rulemaking activities for 13-15 product categories. Final rules will be issued for 1-2 of these product categories, consistent with enacted law, to amend appliance standards and test procedures that are economically justified and will result in significant energy savings.
Technology Validation and Market Introduction/Rebuild America					
Assist 450 Rebuild America community partnerships to upgrade 80 million square feet of floor space in K-12 schools, college, public housing, and State/local governments. [MET]	Assist over 500 new and existing Rebuild America community partnerships to upgrade 70 million square feet of floor space in K-12 schools, colleges, public housing, and State/local governments, reducing the average energy used in these buildings by 18 percent. [MET]	Help Rebuild America community partnerships to upgrade 60 million square feet of floor space in K-12 schools, colleges, public housing, and State/local governments, reducing the average energy used in these buildings by 18 percent. [MET]			

FY 2003 Results	FY 2004 Results	FY 2005 Results	FY 2006 Results	FY 2007 Targets	FY 2008 Targets
Technology Validation and Market Introduction/ENERGY STAR®					
Recruited 375 additional ENERGY STAR® partners including retail stores, utilities and manufacturers. [MET]	Recruit 500 additional retail stores, 5 additional utilities and 10 additional manufacturers. Add domestic hot water heaters to the program. Begin work on a Commercial Window Specification. Expand room air-conditioner program to include heating cycle. Continue outreach to non-English speaking communities and Weatherization activities. [NOT MET]	Recruit 500 additional retail stores, 5 additional utilities and 10 additional manufacturers. Complete draft Commercial Window specification. Begin update of Residential Window specification. Expand coordination with all gateway activities. [MET]	Increase market penetration of appliances (clothes washers, dishwashers, room air conditioners and refrigerators) to 38 to 42 percent (baseline 30 percent calendar year 2003), to 2 to 3 percent for Compact Fluorescent Lamps (baseline 2 percent calendar year 2003) and 40 to 45 percent for windows (baseline 40 percent calendar year 2004). Estimated energy savings will be 0.030 Quads and $657 million in consumer utility bill savings. [MET]	Increase market penetration of appliances to 30 to 32 percent (baseline 30 percent calendar year 2003), to 2.5 to 4 percent for CFL's (baseline 2 percent calendar year 2003) and 45 to 50 percent for windows (baseline 40 percent for calendar year 2003). Estimated energy savings will be 0.032 Quads and $671 million in consumer utility bill savings.	Achieve market penetration for Energy Star appliances of 33 percent (baseline 30 percent in 2003), 6 percent for CFLs (baseline 2 percent, in 2003), and 48 percent for windows (baseline 40 percent in 2003).
	Contributed proportionately to EERE's corporate goal of reducing corporate and program uncosted 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. [Not MET: EERE actively accelerating costing 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 2005 relative to the program uncosted baseline in 2004 ($33,417k) until the target range is met. [NOT MET]	Maintain total administrative overhead costs (defined as program direction and program support excluding earmarks) in relation to total program costs of less than 12 percent. [a] [MET]	Maintain total administrative overhead costs (defined as program direction and program support excluding earmarks) in relation to total program costs of less than 12 percent.	Maintain total administrative overhead costs in relation to total program costs of less than 12 percent. Baseline for administrative overhead rate currently being validated.

[a] Baseline for administrative overhead rate currently being validated.

Means and Strategies

The Building Technologies Program will use various means and strategies, as described below, to achieve its GPRA Unit Program goal. "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 Department will implement the following means:

- The Residential Buildings Integration subprogram focuses on improving the efficiency of the approximately 1.5 to 2.0 million new homes built each year and the 100+ million existing homes, including multifamily units. These improvements are accomplished through research, development, demonstrations, and technology transfer strategies. This includes efforts to improve the energy efficiency of residential energy uses such as space heating and cooling, ventilation, water heating, lighting, and home appliances. These activities support efforts to develop strategies to integrate solar energy technologies and practices and other renewable technologies into buildings and the concept for zero energy buildings. Outputs include technology package research reports, which represent research results achieving a target level of performance. Builder Best Practices Manuals, tailored for specific climate regions, are derived from these reports;

- The Commercial Buildings Integration subprogram addresses energy savings opportunities in new and existing commercial buildings ($270 billion spent annually for new capital construction and over $160 billion for renovation in 2004, according to 2006 Buildings Energy Data Book (US Department of Energy, September 2006)). This includes research, development and demonstration of whole building technologies, design methods and operational practices. Technology development efforts focus on cross-cutting, whole building technologies such as sensors and controls. These efforts support the net zero energy buildings goal not only by reducing building energy needs, but also by developing design methods and operating strategies which seamlessly incorporate solar and other renewable technologies into commercial buildings;

- The Emerging Technologies subprogram conducts R&D and technology transfer associated with energy-efficient products and technologies, for both residential and commercial buildings. These efforts address high-impact opportunities within building components such as lighting, building envelope technologies (including advanced windows) and analysis tools and design strategies. Efficiency advances for these building components will support the BT goal;

- The Equipment Standards and Analysis subprogram leads to improved efficiency of appliances and equipment by conducting analyses and developing standards that are technologically feasible and economically justified, under the Energy Policy and Conservation Act, as amended (EPCA). Analysis performed under this program will support related program activities such as ENERGY STAR,® to ensure a consistent methodology is used in setting efficiency levels for each related program; and

- Technology Validation and Market Introduction: Activities will be developed to accelerate the adoption of clean, efficient, and domestic energy technologies. The three major activities are: ENERGY STAR,® Rebuild America, and Building Energy Codes. ENERGY STAR® is a joint

Department of Energy/Environmental Protection Agency activity designed to identify and promote energy efficient products. The Rebuild America Program element is aligned with the Commercial Building Integration research and development activity to accelerate the adoption of advances in commercial building integrated design, software tools, practices and advanced controls, equipment and lighting. The activity will target decision-makers with national and regional market scope, such as multi-brand corporations in the retail, lodging, and restaurant market segments, as well as commercial property developers, owners and operators. Building Energy Codes provides technical and financial assistance to States to update and implement their energy codes in support of Energy Conservation and Production Act, Section 304. It will also include the current building energy code activities previously conducted under Residential and Commercial Building Integration.

BT's challenge is to address the opportunities with appropriate strategies, and design programs that give appropriate consideration to the marketplace and barriers to energy efficiency. To accomplish this, the Building Technologies Program will implement the following strategies:

- Focus the R&D portfolios to ensure that the most promising, revolutionary technologies and techniques are being explored, align the Residential and Commercial Integration subprograms to a vision of zero net energy buildings, and appropriately exit those areas of technology research that are sufficiently mature or proven to the marketplace, and close efforts where investigations prove to be technically or economically infeasible ("off ramps");
- Use a "whole buildings" approach to energy efficiency that takes into account the complex and dynamic interactions between a building and its environment, among a building's energy systems, and between a building and its occupants. Our analysis suggests that this approach has achieved energy savings of 30 percent beyond those obtainable by focusing solely on individual building components, such as energy-efficient windows, lighting, and water heaters;[a]
- Investing in collaborative research with the Solar Energy Program to reduce barriers to the installation and operation of photovoltaic technology on zero energy homes and buildings;
- Develop technologies and strategies to enable effective integration of energy efficiency and renewable energy technologies and practices;
- Increase minimum efficiency levels of buildings and equipment through codes, standards, and guidelines that are technologically feasible and economically justified. BT develops standards through a public process and submits codes proposals to International Energy Conservation Code (IECC) and American Society of Heating, Refrigeration and Air conditioning Engineers (ASHRAE);
- The management strategy for developing affordable net zero energy buildings requires a high level of coordination with other programs in the Office of Energy Efficiency and Renewable Energy. These include the Solar Energy Technology Program, Biomass Program, Wind Energy Program, and Hydrogen Technology Program (fuel cells) that may have important technologies to contribute. The Building Technologies Program also invests in technical program and market analysis and performance assessment in order to direct effective strategic planning; and

[a] Building Science Corporation, Final Report: Lessons Learned from Building America Participation, February 1995 – December 2002, February 2003, NREL/SR-550-33100

- Provide technical information to customers through deployment of cost-effective energy technologies, forming partnerships with private and public sector organizations. Rebuild America accelerates energy efficient improvements by targeting key decision-makers and influence leaders in the supporting financial, design-build, architectural, and engineering networks related to commercial buildings. ENERGY STAR® utilizes partnerships with more than 7,000 private and public sector organizations, delivering the technical information and tools that organizations and consumers need to choose energy-efficient solutions and best management practices. The Building Energy Code activities provide technical and financial assistance to the States to update and implement their energy codes in support of Energy Conservation and Production Act, Section 304.

These strategies will result in significant cost savings and a significant reduction in the consumption of energy, increase the substitution of clean and renewable fuels, and cost effectively reduce America's demand for energy, thus lowering carbon emissions and decreasing energy expenditures.

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

- There are several factors that interfere with the private sector making R&D investments in energy efficient building technologies. These include a highly diversified industry comprised of thousands of builders and manufacturers, none of which has the capacity to sustain research and development activities over multi-year periods.

- Another factor is the compartmentalization of the building professions, in which architects and designers, developers, construction companies, engineering firms, and energy services providers do not typically apply integrated strategies for siting, construction, operations and maintenance.[a]

- The high initial cost of energy efficient building appliances can keep consumers from purchasing them even if they are cost effective in the long run.

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

Partnerships and cost share arrangements with industry and other Federal agencies become critical management tools that can build a critical mass to address these barriers. ENERGY STAR® is a joint DOE and Environmental Protection Agency Program (EPACT 2005) with more than 4,000 retailers to label ENERGY STAR® qualified appliances and energy efficient products, while Rebuild America will partner with decision-makers with national and regional market scope, such as multi-brand corporations in the retail, lodging and restaurant market segments, as well as commercial property developers, owners and operators. DOE coordinates its research and development, regulatory activities, and technology demonstrations with EPA's marketplace activities (http://www.energystar.gov/). Through these activities with EPA, BT contributes to EPA's objective of reducing greenhouse gas emissions.

The Building Energy Code activities include technical and financial assistance to the States to update and implement their energy codes in support of Energy Conservation and Production Act, Section 304. BT works with national, regional, and state building code officials and stakeholders to help building owners, builders and the design community understand the science, benefits, and techniques for going significantly beyond code with added value strategies. BT trains approximately 2,000 code officials,

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[a] Scott Hassell, Anny Wong, Ari Houser, Debra Knopman, Mark Bernstein, RAND Corporation: *Building Better Homes: Government Strategies for Promoting Innovation in Housing, 2003.*

designers, and builders to implement these codes and updates and improves the core materials and code compliance software to reflect recent changes in the model energy codes and emerging energy efficiency technologies.

- Partners with the Solar Energy Program to work toward the goal of zero energy homes.
- Coordinates with the Office of Science in basic research on solid state lighting technology.
- The program's management strategy involves four key elements: a customer-focused, team-based organization for greater accountability and improved results; systematic multi-year planning including collaboratively developed technology roadmaps to provide for a more integrated, customer driven R&D portfolio; utilization of stage-gate management processes to ensure progress and market relevance; greater competition in project solicitations to increase innovation and broaden research participation; and increased peer review to assure scientifically sound approaches.
- The program interacts regularly with industry to ensure relevance of research, including research and development workshops (e.g., biennial reviews in solid state lighting and windows research) and peer reviews.

Validation and Verification

To validate and verify program performance, the Building Technologies Program will conduct various internal and external reviews and audits. These programmatic activities are subject to continuing review by, for example, the Congress, the General Accountability 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:	EIA Annual Energy Review (AER); Commercial Building Energy Consumption Survey (CBECS); Residential Energy Consumption Survey (RECS); and Annual Energy Outlook (AEO) ISTAR (ENERGY STAR® database). U.S. Department of Commerce (DOC) Current Industrial Reports (CIR). Various trade publications. Information collected directly from Building Technologies performers or partners.
Baselines:	The following are key baselines used in the Building Technologies Program: ▪ New Residential Buildings: Energy use varies by climate region, based on the Building America Benchmark. The program will focus on creating design technology packages to reduce energy consumption from the Building America Benchmark. In 2003, 0 technology package research reports at 30/50/70 percent energy savings. ▪ New Commercial Buildings Energy Use Intensity: Varies by climate region and building type (ASHRAE 90.1-2004). The program will focus on creating design technology packages to reduce energy consumption by 30 and 50 percent for small commercial buildings (baseline 1 technology packages for 30 percent and 0 technology packages for 50 percent in 2005). ▪ Solid State Lighting (2002): 25 lumens/Watt efficacy (solid state lighting whitelight).

- Windows (2003): 0.33 to 0.75 U-values (varies by region).
- Residential Heating and Cooling (2003): Average total heating and cooling system energy use, defined by reported consumption in EIA for residential buildings and all existing buildings, and the Building America benchmark for new residential buildings, by climate region.
- New Residential Building Codes: 2003 International Energy Conservation Code (IECC), International Code Council.
- New Commercial Building Codes: ASHRAE 90.1-2004.

ENERGY STAR®: Federal appliance minimum standards and applicable national building codes (windows). ENERGY STAR® baseline is market share for ENERGY STAR® appliances of 30 percent in 2003, compact fluorescent light bulb market share of 2 percent in 2003, windows market share of 40 percent in 2003.

Frequency: Complete revalidation of assumptions and results can only take place every three to four years, due to the reporting cycle of two crucial publications: CBECS and RECS. However, updates of most of the baseline forecast and BT Program outputs will be undertaken annually.

Evaluation: In carrying out the program's mission, the Building Technologies Program uses several forms of evaluation to assess progress and to promote program improvement:

- Technology validation and operational field measurement, as appropriate;
- Peer review by independent outside experts of both the program and subprogram portfolios;
- Annual internal technical and management reviews of program and subprogram portfolios;
- Specialized program evaluation studies to examine process, impacts, or market baseline and effects, as appropriate;
- Quarterly and annual assessment of program and management results based performance through Joule, R&D Investment Criteria, President's Management Agenda and Program Assessment and Rating Tool (PART) reviews;
- Peer reviews as needed when evaluating go/no go decision points in each research area; and
- Annual review of methods, and recomputation of potential benefits for the Government Performance and Results Act (GPRA).

Data Storage: EIA and DOC data sources are publicly available. Trade publications are available on a subscription basis. BT Program output information is contained in various reports and memoranda.

Verification: Calculations are based on assumptions of future market status, equipment or technology performance, and market penetration rates. These assumptions can be verified against actual performance through technical reports, market survey and product shipments.

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. BT has incorporated feedback from OMB into its results based management strategy reflected in the FY 2007 Budget Request, and continues to improve performance along the lines suggested by the PART.

The Building Technologies Program was rated as Adequate in its PART for 2003 receiving the following scores: Purpose (80), Planning (50), Management (88), and Results (42). The program has addressed many of the original PART recommendations through activities including: a multi-year planning effort that focuses on the development of technical pathways and the integration of the systems and component research to achieve Zero Energy Buildings; increasing funding for solid state lighting and reducing support for other technologies near commercialization; and continued development of adequate long-term and annual performance measures with OMB assistance which have been reflected in a multi-year program plan and annual operating plan. The program continues to work with OMB to define meaningful annual performance measures. A more recent PART recommendation to improve management processes that will accelerate analyses to reduce the backlog of statutorily mandated energy efficiency regulations is reflected in the program's detailed timeline and report to Congress on this topic.

The Department has responded to the PART recommendation of "Develop guidance that specifies a consistent framework for analyzing the costs and benefits of research and development investments, and use this information to guide budget decisions." The Department has specified common scenarios, common methodology, and standardized benefits measures to allow analyzing the costs and benefits of applied R&D investments. While progress has been made, benefits estimates across programs are still not completely comparable. The Department continues to work on implementation of common assumptions and a consistent approach to incorporation of risk.

Expected Program Outcomes

The Building Technologies Program pursues its mission through integrated activities designed to improve the energy efficiency and productivity of our economy. Achievement of the program's goals is expected to yield energy security, economic and environmental benefits. Additionally, building energy efficiency technologies provide less easily quantifiable benefits, such as improved lighting quality and building occupant productivity. The benefits estimates reported exclude any expected acceleration in the deployment of the technologies that may result from the unique field partnerships that provide the basis for the Residential Building Integration R&D, or synergies with the ENERGY STAR® Home Program.

Estimates of the security, economic and environmental benefits from 2008 through 2050 that would result from realization of the program's goals are shown in the table below.

EERE's Building Technology Program Goal Case reflects the increasing penetration of building technologies over time, as the program's goals are met. Not included are any policy or regulatory mechanisms, or other incentives not already in existence, that might be expected to support or accelerate the achievement of the program goals. The expected benefits reflect solely the achievement of the program's goals.

The goals are modeled in contrast to the "baseline" case, in which no DOE R&D exists. The baseline case is identical to those used for all DOE applied energy R&D programs.[a] Further, across EERE, and across all of DOE's applied energy R&D programs, the expected outcome benefits are being calculated using the same fundamental methodology. Finally, the metrics by which expected outcome benefits are measured are identical for all of DOE's applied energy R&D programs.[b] This standardization of methods and metrics has been undertaken as part of the Department's efforts to respond to Under Secretary Garman's Strategic Management System initiative and OMB's request to make all programs' outcomes comparable.

The difference between the baseline case and the program goal case results in economic, environmental and security benefits. For example, achievement of program goals results in a reduction in net consumer expenditures of 27 billion dollars in 2030 and 71 billion in 2050. Savings to the electric power industry are expected to be 18 billion dollars in 2030 and 17 billion dollars in 2050. Finally, the program would also result in carbon emissions reductions of 57 million metrics tons in 2030 and 77 million metric tons in 2050. The results are generated by modeling the program goals within two energy-economy models: NEMS-GPRA08 for benefits through 2030, and MARKAL-GPRA08 for benefits through 2050.[c] The full list of modeled benefits appears on the next page.

[a] The starting point for the baseline case is the Energy Information Administration's "reference case," as published in the AEO 2006. Program analysts from across DOE examined the AEO to determine the extent to which their program goals are modeled (explicitly or implicitly). If program goals are modeled in the AEO, they are removed in the GPRA baseline. Further, some programs believe that the AEO's technology representation is too conservative, even in the absence of program goals, and thus in certain cases a modification is made to make the technology representation in the baseline case more optimistic than the AEO.

[b] The set of expected outcome metrics being used this year differs in substantial ways to that of previous years. In addition to the standardization across DOE's applied energy R&D programs, the list is expanded and more comprehensive than in past years. Further, the list maps to DOE strategic goals. The expected outcome metrics represent inherent societal benefits that stem from achievement of program goals.

[c] Final documentation on the analysis and modeling, including all of the methodologies and underlying assumptions, is expected to be completed and posted on the web by March 31, 2007. Past GPRA modeling and analysis documentation can be found at http://www.eere.energy.gov/ba/pba/gpra.html.

FY 2008 GPRA Benefits Estimates for Building Technologies Program[a,b]

	2010	2020	2030	2040	2050
Environmental Benefits (Goal 1.2)					
Avoided carbon emissions, annual (MMTC)	3	32	57	79	77
Avoided carbon emissions, cumulative (MMTC)	7	150	621	1,404	2,181
Reduced cost of criteria pollutant control, NPV[c] (bil. 2004 $)	ns	2	5	NC	NC
Economic Benefits (Goal 1.4)					
Consumer savings, annual (bil. 2004 $)	2	8	27	72	71
Consumer savings, NPV (bil. 2004 $)	2	36	121	648	899
Electric power industry savings, ann. (bil. 2004 $)	1	7	18	19	17
Electric power industry savings, NPV(bil. 2004 $)	1	30	101	169	232
Household energy expenses reduced, annual (bil. 2004 $)	0.1%	0.3%	0.8%	1.5%	1.4%
Energy intensity reduced (% change in E/GDP)	0.1%	1.2%	2.1%	2.6%	2.8%
Net energy system cost savings, annual (bil. 2004 $)	NC	NC	NC	88	107
Natural gas price change, moving avg. (2004$ / TCF)[d]	0.03	0.06	0.14	NC	NC
Security and Reliability Benefits (Goal 1.1 or 1.3)					
Avoided oil imports, annual (mbpd)	ns	ns	0.1	0.1	0.1
Avoided oil imports, cumulative (bil. bbl)	ns	ns	0.3	0.7	0.9

[a] Benefits through 2030 are calculated with the NEMS-GPRA08 model. Benefits from 2035 through 2050 are calculated with the MARKAL-GPRA08 model. "NC" indicates situations in which no calculation was done because of specific model limitations. "ns" indicates results that were "not significant"—within the noise of the models.
[b] Projected benefits do not include any potential policy changes that might enhance technology deployment. In addition, most technologies show diminishing benefits by 2050, because of the assumption built in to the analysis that baseline industry progress will eventually catch up with the more accelerated progress associated with EERE program success.
[c] Net present value calculations throughout this table are performed for cumulative economic metrics, and are done using a 3% real discount rate, cumulative to 2008.
[d] The prices reflected here are average delivered prices to all sectors, and are based on a three year moving average. Thus the measure of benefit is the change in the three year moving average delivered price, in $ per thousand cubic foot.

	2010	2020	2030	2040	2050
Security MPG improvement (%)[a]	ns	ns	ns	ns	ns
Transportation fuel diversity improvement (%)[b]	ns	ns	ns	ns	ns
Oil intensity reduced (% change in bil. bbl/GDP)	ns	ns	0.6%	0.5%	0.4%

[a] Security MPG is the ratio of vehicle miles traveled by light duty vehicles to their usage of oil. It captures oil avoidance by efficiency and fuel alternatives.

[b] Fuel diversity is measured by the Shannon-Weiner Index (SWI) of diversity. The SWI is a measure of "proportional diversity," and hence captures both abundance and richness, i.e., how many different fuels and how much of each fuel both factor into the calculation.

Residential Buildings Integration

Funding Schedule by Activity

	(dollars in thousands)		
	FY 2006	FY 2007	FY 2008
Residential Buildings Integration			
Research and Development: Building America	14,759	18,775	19,268
Residential Building Energy Codes	99	495	0
SBIR/STTR	0	430	432
Total, Residential Buildings Integration	14,858	19,700	19,700

Description

The long-term goal of the Residential Buildings Integration subprogram is to develop cost effective, production ready systems in five major climate zones that result in houses that produce as much energy as they use on an annual basis.

Benefits

In order to achieve the technical capability for zero energy homes by 2020, integrated cost-effective whole-building strategies will be developed to enable residential buildings to use up to 70 percent less total energy than the Building America Benchmark and provide energy for the remaining 30 percent of energy requirements through the use of integrated onsite power systems.[a] Building America is a private/public partnership that conducts research on energy solutions for new and existing homes on a cost shared basis with major stakeholders in the homebuilding industry. The Building America Program combines the knowledge and resources of industry leaders with the U.S. Department of Energy's technical capabilities. Together, they act as a catalyst for energy efficient change in the home-building industry. Industry partners provide all costs for equipment, construction materials and construction labor used in research projects.

Building America is also integrating energy efficiency and onsite/renewable power solutions, demonstrated on a production basis by building community subdivisions which will reduce whole-house energy use in new homes by an average of 50 percent by 2015 and 70 percent by 2020 compared to the Building America Benchmark[b] at zero or less net cash flow.[a]

[a] Whole house energy savings for all residential end uses are measured relative to the BA Research Benchmark Definition (Building America, Building America Research Benchmark Definition, Version 3.1, November 11, 2003, National Renewable Energy Laboratory). (www.buildingamerica.gov)

[b] Whole house energy savings are measured relative to the BA Research Benchmark Definition (Building America, Building America Research Benchmark Definition, December 29, 2004, National Renewable Energy Laboratory) which consists of the 2000 IECC requirements plus lighting, appliances and plug load energy levels (www.buildingamerica.gov).

To ensure meeting the performance goals, Building America has specified the following interim performance targets for completion of technology package research reports for each climate region, shown below. The annual performance goals will be evaluated and adjusted due to market conditions and the degree of technical complexity involved in developing solutions for each climate.

The Energy Policy Act of 2005 (EPACT) and the consumer tax incentives it provides for residential energy efficiency could accelerate the current target dates. Increased demand from consumers for energy efficient products may improve participation by manufacturers and builders, thus improving the cost-effectiveness of advanced energy efficient technology.

Residential Integration Performance Targets by Climate Zone

Target (Energy Savings)	Marine	Hot Humid	Hot/Mixed Dry	Mixed Humid	Cold
30%	2006	2007	2005	2006	2005
40%	2008	2010	2007	2008	2009
50%	2011	2015	2012	2013	2014
70%[b]	2020	2020	2020	2020	2020

Detailed Justification

(dollars in thousands)

	FY 2006	FY 2007	FY 2008
Research and Development: Building America	**14,759**	**18,775**	**19,268**

The residential systems research, driven by the performance targets by climate zone and the financial constraint of zero or less net cash flow, is applied in three phases for each climate zone.[c] During the three phases, Building America acts as a national residential energy systems test bed where homes with different system options are designed, built and tested at three levels of system integration, including research houses, production prototype houses, and community scale housing. A summary of the three phases follows.

Phase 1 – System Evaluations: The Building America Consortia design, construct and test subsystems for whole house designs in research houses to evaluate how components perform. The focus of Phase

[a] Net cash flow is the monthly mortgage payment for energy options minus the monthly utility bill cost savings. "Zero or less net cash flow" means that monthly utility bill cost savings are greater than the monthly mortgage payment for energy options. In other words, the increase in mortgage payment is offset by the energy savings.
[b] The current Building America target year for completion is 2020. Climate zone target dates for the 70 percent level are dependent upon progress at lower target (energy savings) levels, and will be determined in a future planning cycle; some climate zones may be completed before 2020.
[c] Building America deals with five climate zones in the U.S. — Marine, Hot Humid, Hot/Mixed Dry, Mixed Humid, and Cold. These climate zones require unique approaches to reach the 30-40-50 percent energy target savings.

1 is to evaluate and field test prototype subsystems to determine the most reliable and cost effective solution for a given performance level and climate.

Phase 2 – Homes incorporating the successful subsystems from Phase 1 are designed and constructed by production builders working with the Building America Consortia to evaluate the ability to implement the systems on a production basis. The focus of Phase 2 research is to move the research prototype house and building practices to the point that they are production-ready, capable of being integrated with production construction techniques practiced by today's builders.

Phase 3 – The Building America Consortia provide technical support to builder partners to advance from the production prototypes to full production in a subdivision. The results are documented in a case study report. Several of these reports are distilled into a final research report that describes the design and construction practices needed to achieve a particular level of energy savings within each climate zone targeted by the program.

From the technology package research reports developed from Phase 3, "Best Practices" manuals are designed for builders, manufacturers, homeowners, realtors, educators, insurance companies, and mortgage providers. The Best Practices manuals present the research results in illustrated text that is targeted to a specific audience to make it easily assimilated, and then synthesize research findings into energy-efficient processes for the building industry.

The three system research stages currently take approximately three years. For more advanced energy efficiency levels at and above 50 percent whole house savings, the system research process is expected to take additional iterations of whole house testing before implementation in production ready homes.

In FY 2008, BT will continue research at the 40 percent efficiency level for four climate zones (hot humid, cold, marine and mixed humid) and will complete the research in one of these climate zones (marine and mixed humid). The specific climate zone targets may be adjusted due to market conditions and the degree of technical complexity involved in developing solutions for each climate.

During 2008, BT will also be testing strategies to achieve a 50 percent reduction in the energy used in a home. The focus of the 50 percent systems research will continue work to reduce the energy used to heat and distribute hot water, field test lower cost efficient windows and methods of space heating and cooling in a very efficient home. A major effort will be made to find innovative ways to reduce electric energy used by the miscellaneous appliances in the home.

Additionally, BT will invest in collaborative research with the Solar Energy Program Office to reduce barriers to the installation and operation of solar systems on homes and buildings. The focus of the BT funded efforts will be on the building/solar system interface and maximizing the amount of energy from the solar system that is actually delivered to meet electricity needs in the home. For example, there are inherent losses in the inverters that convert the DC power from the solar system to AC

	(dollars in thousands)		
	FY 2006	FY 2007	FY 2008

power needed by the home systems. Efficient fluorescent lighting and many of the appliances in the home use DC power which is produced by power supplies at the device. These power supplies use energy even when the devise is not in use (standby losses). Research will be conducted to determine the feasibility of directly connecting the home lighting and appliances to the solar system to eliminate the losses in the inverter and power supplies.

In addition, these funds may be used to support efforts such as peer reviews; data collection and dissemination; and technical, market, economic, and other analyses.

Residential Building Energy Codes	**99**	**495**	**0**

These activities will be carried out within Technology Validation and Market Introduction/Building Energy Codes to more effectively coordinate with the market transformation activities.

SBIR/STTR	**0**	**430**	**432**

In FY 2006, $275,000 and $35,000 were transferred to the SBIR and STTR programs respectively. The FY 2007 and 2008 amounts shown are estimated requirements for the continuation of the SBIR and STTR program.

Total, Residential Buildings Integration	**14,858**	**19,700**	**19,700**

Explanation of Funding Changes

	FY 2008 vs. FY 2007 ($000)
Research and Development: Building America	
The increased funding will be used to characterize the energy use of appliances; investigate alternative, more efficient equipment; and investigate strategies for redesign of major energy consuming products – to reduce their energy use and/or examine additional means by which they could be powered (e.g., PV solar panels).	+493

	FY 2008 vs. FY 2007 ($000)
Residential Building Energy Codes	
These activities will be carried out within Technology Validation and Market Introduction/Building Energy Codes to more effectively coordinate with the market transformation activities.	-495
SBIR/STTR	
Changes in the SBIR/STTR funding are a direct result of changes in the funding of program activities.	+2
Total Funding Change, Residential Buildings Integration	**0**

Commercial Buildings Integration

Funding Schedule by Activity

	(dollars in thousands)		
	FY 2006	FY 2007	FY 2008
Commercial Buildings Integration			
Research and Development	2,970	4,204	7,000
Commercial Building Energy Codes	99	495	0
Total, Commercial Buildings Integration	3,069	4,699	7,000

Description

In order to reach net zero energy buildings (ZEB) by 2025, DOE will develop integrated whole-building strategies to enable commercial buildings to be designed, constructed, and operated to use 60 to 70 percent less energy relative to ASHRAE Standard 90.1-2004. By 2010, the BT goal is to develop five or more cost-effective design technology packages using highly efficient component technologies, integrated controls, improved construction practices, streamlined commissioning, maintenance and operating procedures that will make new and existing commercial buildings durable, healthy and safe for occupants. These design technology packages aim to reduce energy use for new small commercial buildings by 30 percent, relative to conventional practice.

The long-term goal of the Commercial Buildings Integration subprogram is to develop cost-effective technologies, integrated design strategies and operating procedures for commercial buildings such that they produce as much energy as they use on an annual basis. Research will focus on integrating energy efficient technologies to reduce the total energy use in commercial buildings by 60 to 70 percent by 2025. These improvements in energy efficiency coupled with renewable energy supply could result in marketable net zero energy commercial buildings.

The subprogram's initial focus is on whole-building design packages for specific building types to achieve modest (30 percent) efficiency improvements beyond current energy codes. However, a different approach is needed to achieve higher levels of performance, particularly in medium to larger-size buildings. The commercial buildings sector is characterized by: tremendous diversity of building types, sizes and uses; significant variability in design, construction and operational approaches; a one-building-at-a-time, customized design process; and a variety of institutional arrangements that influences design decisions. Thus the program's information products must be highly flexible so designers can adapt the embedded knowledge in various ways to meet the requirements and constraints of each individual design job. The prescriptive and monolithic nature of whole-building design packages is not flexible enough to meet designers' needs at performance levels well beyond 30 percent, particularly for mid- to large-size buildings. In addition, despite the wide variety of building types and uses, some technologies could be deployed in several building types with a common strategy.

Therefore, the BT strategy beyond the 30 percent improvement level is to develop "technology option sets." A technology option set is an integrated group of envelope, equipment and control system technologies that interact in a primary way and which can be combined in various ways to reach the 50 percent to 70 percent energy savings level. Validation of these option sets in real buildings will begin in FY 2011, through partnerships with national account firms that own or operate large numbers of buildings and associated design firms. Validation could involve the building life cycle from design through construction and far enough into operation to determine that a particular technology option set will achieve design energy performance and maintain or improve building function.

Benefits

The challenges inherent in designing and operating high performance and net zero energy buildings demand a number of breakthroughs, both in technology and in the fundamental knowledge of how to integrate and operate technology so as to optimize whole building performance. Systems integration and improved component technology (HVAC, lighting, windows, etc.) are required in order to achieve progressively higher levels of energy performance. Also required is a much richer understanding of the market itself, given the heterogeneity of the buildings sub sector, which varies widely across the dimensions of size, surface-to-volume ratio, vintage of construction, complexity of function, and energy use. This understanding is necessary to target the R&D to realize the largest opportunities to save energy in commercial buildings.

The commercial buildings integration activities are focused on small to medium-sized repeatable building designs such as strip malls, retail stores, office buildings, and schools. BT is focused on these buildings because these building types consume the largest share of commercial sector energy use. There are greater opportunities for energy savings (developers of smaller commercial buildings do not usually have engineering budgets sufficient to perform comprehensive energy analysis) and these buildings are replicated more times. To increase leverage, BT will form partnerships with commercial companies that build numerous similar buildings and are favorably disposed to investments that yield 50 percent or more energy savings.

DOE's principal technical approach will be development of whole-building technologies, integrated design strategies and operating procedures, which can be used by architects, engineers and others to design, build and operate commercial buildings in an integrated manner. The prescriptive design technology packages for modest efficiency gains will be enhanced with the development of "technology option sets" for achieving efficiency gains of 50 percent or higher. The BT method validates the process with architects and engineers on actual buildings, encompassing numerous requirements for cost-effective technology, marketability, maintenance of real estate value, building durability and grid connection reliability. Such an approach is clearly targeted at new construction, because the opportunities for aggressive performance improvement are so much greater than in existing buildings, where many building parameters (orientation, envelope, etc.) are set in steel and concrete. However, this does not exclude the renovation and existing building market, as many of the strategies can be adapted and deployed in this sector. Research results will be transferred through close cooperation with the Rebuild America activity that is transferred to BT in FY 2007. The design technology packages will be developed in collaboration with industry and technical societies to ensure rapid dissemination across the design community.

The new building tax incentives for commercial energy efficiency in EPACT 2005 could accelerate the current target dates. Increased acceptance among commercial building owners of energy efficient products may improve participation by manufacturers and builders, thus improving the cost-effectiveness of advanced energy efficient technology.

Commercial Building Design Technology Packages Performance Targets

Characteristics	Units	2004	2005	2006	2007	2008	2009	2010	2011	2012
Small and Medium Sized Commercial Building Design Technology Packages	30% Energy Savings	0	1	1	2	4	4	2		
Technology Option Sets	50% Energy Savings	0						0	1	1

Detailed Justification

(dollars in thousands)

	FY 2006	FY 2007	FY 2008
Research and Development	**2,970**	**4,204**	**7,000**

In FY 2008, BT will continue and accelerate the development of design guides for cost-effectively achieving 30 percent energy savings over ASHRAE 90.1-2004 in small to medium sized (less than 25,000 square feet) commercial buildings. Each design guide will describe a package of energy efficient technologies tailored to each major climate region in the U.S., on the basis of energy and economic analysis and a feasibility consensus among private sector practitioners. BT will continue its focus on developing and evaluating technologies and design strategies for achieving 50 percent savings based on analysis and optimization methodologies developed in FY 2006 and 2007. In FY 2008, BT will also substantially accelerate testing and validating the technologies and integration strategies in collaboration with private sector building owners and operators. Validation in actual buildings is essential to create the confidence and reduce the risk of applying the suite of technology advancements required for routinely creating zero energy buildings within 20 years.

In addition, these funds may be used to support efforts such as peer reviews; data collection and dissemination; and technical, market, economic, and other analyses.

	FY 2006	FY 2007	FY 2008
Commercial Building Energy Codes	**99**	**495**	**0**

These activities will be carried out within Technology Validation and Market Introduction/Building Energy Codes to more effectively coordinate with the market transformation activities.

	FY 2006	FY 2007	FY 2008
Total, Commercial Buildings Integration	**3,069**	**4,699**	**7,000**

Explanation of Funding Changes

	FY 2008 vs. FY 2007 ($000)
Research and Development	
Additional Commercial Building Integration funding will be used to double the number of design guides produced (from 2 to 4) for small and medium size buildings at the 30 percent savings level and will accelerate development of technology option sets to achieve 50 percent savings. The additional funding will also allow BT to begin to validate the design guides and technology option sets in real buildings with commercial companies that build numerous similar buildings (for example, national retail chains) and thereby increase their market relevance and impact.	+2,796
Commercial Building Energy Codes	
These activities will be carried out within Technology Validation and Market Introduction/Building Energy Codes to more effectively coordinate with the market transformation activities.	-495
Total Funding Change, Commercial Buildings Integration	**+2,301**

Emerging Technologies

Funding Schedule by Activity

	(dollars in thousands)		
	FY 2006	FY 2007	FY 2008
Emerging Technologies			
Lighting R&D	19,034	19,283	19,283
Space Conditioning and Refrigeration R&D	2,890	2,845	2,845
Appliances and Emerging Technologies R&D	1,047	0	0
Building Envelope R&D	6,860	7,119	7,119
Analysis Tools and Design Strategies	2,458	2,684	2,684
SBIR/STTR	0	825	825
Total, Emerging Technologies	32,289	32,756	32,756

Description

The long-term goal of the Emerging Technologies subprogram is to develop cost effective advanced technologies, (e.g., lighting, windows, and space heating and cooling) for residential and commercial buildings. Research will focus on developing technologies to support the residential and commercial building goal to reduce the total energy use in buildings up to 70 percent. BT is actively analyzing technology advancement in areas that will be required to reach the zero energy buildings goals and using this analysis to inform which technology pathways to fund. The improvement in component and system energy efficiency when coupled with research to integrate onsite renewable energy supply systems into the commercial and residential buildings will establish the technologies from which to package marketable net zero energy designs.

Specifically, we will focus on:

- Solid State Lighting (SSL), which has long term efficiencies that have the technical potential to approach 200 lm/W, compared to most conventional technologies maximum efficiencies in the 85 to 115 lm/W range.
- Heating and cooling systems with the technical potential to reduce annual HVAC, dehumidification and water heating energy consumption by 50 percent aligned with advanced technology performance requirements of the Residential Integration activities.
- Advanced windows that incorporate advanced insulation materials and dynamic solar control have the potential to become net energy producers in many climates by harvesting passive heating, while dramatically reducing peak cooling loads.

Benefits

The Emerging Technologies subprogram improves energy security by supporting the technology development needs of the Residential Integration and Commercial Integration subprograms and the need for energy efficient replacement technologies in the existing building stock. The advancement of these technologies supports the appliance standards rulemakings by creating more efficient, cost-effective technology advancements that have the potential to be incorporated into future rulemakings.

Lighting Research and Development

The Lighting Research and Development (R&D) goal is to achieve lighting technologies with double the efficacy of today's most efficient lighting sources, linear and compact fluorescents.[a] Our primary targets are solid state lighting devices and technologies that can produce white light with efficacies[b] in excess of 160 lumens per Watt in commercial products, with an interim target of 107 lumens per Watt projected for laboratory devices by 2012.

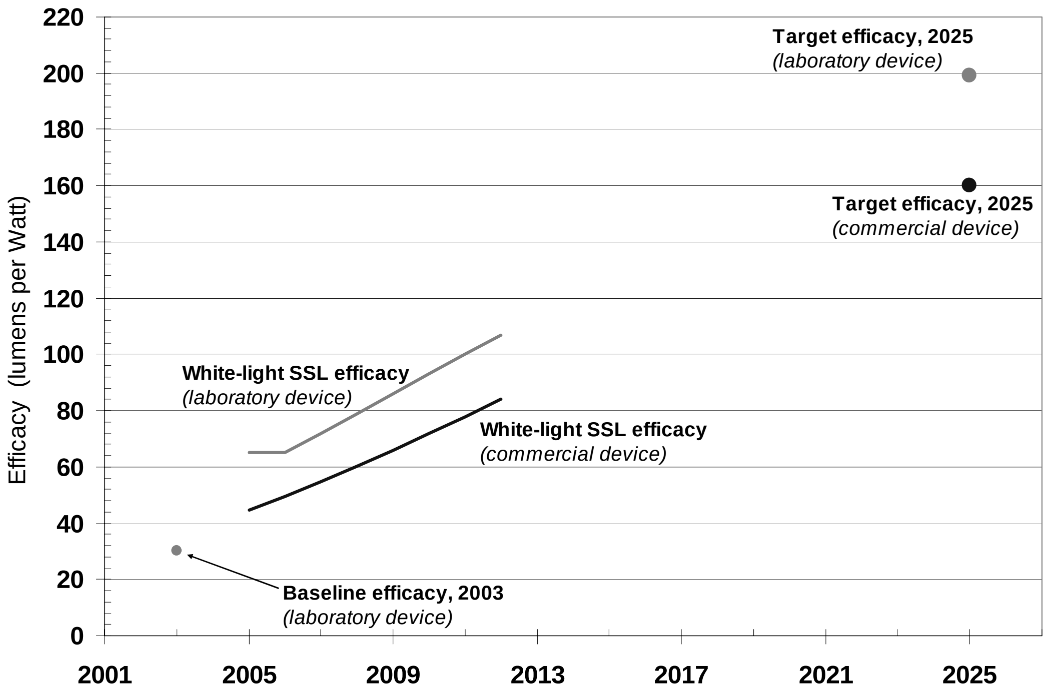
The solid state lighting (SSL) activity is evaluating both inorganic light emitting diodes (LEDs) and organic light emitting diodes (OLEDs). LEDs have a focused point of light and monochromatic LEDs are used in many of the newly installed traffic signals and brake lights on cars. OLEDs have a distributed light and are used in display technologies on cell phones and digital cameras, but ultimately could be used in innovative and unique lighting designs such as painted on and full wall surface lighting. To prepare these SSL technologies for the highly competitive general illumination market, research, development, demonstration, and commercial application activities will be performed. The anticipated rate of performance improvement for LEDs is shown in the following diagram.

[a] Linear fluorescent lamps offer efficacies as high as 80 lumens per Watt. Compact fluorescent lamps, a derivative of this technology, are less efficient (approximately 60 lumens per Watt); however they still offer a four-fold improvement over traditional incandescent bulbs.

[b] For solid-state lighting technologies, the performance target is focused on the energy efficiency rating of the device. The unit of performance commonly used when discussing light sources and systems is lumens of light produced per Watt of energy consumed. The technical term for this metric is 'efficacy' measured in lumens per Watt. Several lighting products, including fluorescent lamps and incandescent reflector lamps, are regulated using an efficacy target. The efficacy projections for solid-state lighting are generated for laboratory devices because the Lighting R&D portfolio does not have direct influence over commercially offered products.

Efficacy Projection for White-Light SSL Laboratory Devices (Projections 2005 to 2012)

White-Light LED Efficacy Targets



This projection is translated into point values in the following table, with the five-year target milestones.

Point Values of Efficacy Projections for White-Light SSL Laboratory Devices

Characteristics	Units	2003 (baseline)	2005	2006	2007	2008	2009	2010	2011	2012
Solid State Lighting Performance	Lumens / Watt	30	65	65	86	93	100	107	114	121

The SSL activity provides a focus on increased efficacy while the state of SSL development in industrial labs and the marketplace is formative and can be influenced. Manufacturers would likely not focus on efficacy but on the unique attributes of solid state lighting (e.g., durability, reliability, etc.) This emphasis on efficacy contributes to the Department's strategic goal to cost-effectively improve the energy efficiency of the U.S. economy.

DOE conducts its SSL R&D through strong industry partnerships that are already producing results such as improvements of 50 percent in efficiency in blue organic light emitting diodes. Industry enthusiasm and cost share on projects is high (>35 percent).

Space Conditioning and Refrigeration Research and Development

Space conditioning systems, which have transformed the 20th century by enabling us to become more productive and comfortable, will play a critical role in achieving BT's goal of zero energy buildings. Space conditioning equipment for residential and commercial buildings consumes approximately 38 percent of the total energy used in buildings and is the most important contributor to summer peak electricity demand.[a]

In the past, R&D and efficiency standards have focused on increasing the efficiency of the various individual units. Raising the minimum efficiency standard for residential unitary equipment from 10 to 13 SEER is one key example. New approaches, beyond focusing on individual units, can help to further advance HVAC system efficiency.

In order to assist Building America in its purchased energy reduction goal of 60 – 70 percent, the HVAC, dehumidification and water heating contribution to that reduction is a 25 percent reduction in the energy consumption of that equipment from baseline levels at no additional cost. The measurement protocol will be simulated and compared to chamber test measurements of electric power consumption and demand.

Although the energy efficiency of HVAC equipment has increased substantially in recent years, new approaches, including radically new ideas, are needed to continue this trend. The dramatic reductions in HVAC energy consumption necessary to support the ZEB goals require a systems-oriented approach that characterizes each element of energy consumption, identifies alternatives, and determines the most cost-effective combination of options. Therefore, the first task in this effort will involve system characterizations, identification of necessary upgrades to analysis tools, and an assessment of cost and performance of alternative solutions.

Space Conditioning System Performance Goals

Characteristics	Units	2004 Status	2007 Target	2010 Target
Annual HVAC, Water Heating and Dehumidification Energy Consumption Reduction vs. Building America benchmark (demonstrated product)	%	Baseline	25	50

Building Envelope Research and Development

Thermal Insulation and Building Materials

The Building Envelope program element will contribute to Zero Energy Buildings by advancing a portfolio of new insulation and membrane materials, including improved exterior insulation finishes, with both residential and commercial wall application. The next generation of attic/roof systems integrating thermal mass, ventilation and advanced insulated roof structures will be applied to the residential new construction market.

The table below lists the performance goals for the Thermal Insulation activities. All performance measurements are relative to historical baselines that have been set as the Building America regional

[a] US DOE Energy Efficiency and Renewable Energy, *2004 Buildings Energy Databook*, August 2004.

baseline new construction. Achieving cost-effectiveness and durability are critical aspects of these targets.

Thermal Insulation and Materials Performance Goals

Characteristics	Units	2004 Status	2007 Target	2010 Target
Advanced attic/roof system	R-Value	30	35	Dynamic annual performance equal to conventional R-45
Wall insulation	R-Value	10	Dynamic annual performance equal to conventional R-20[a]	Dynamic annual performance equal to conventional R-20[b]

Windows Technologies

Window performance will also be vital to reaching the residential and commercial buildings goals. Development of cost effective, highly efficient glazing and fenestration systems for all building types and all parts of the country will require a portfolio of technologies matched to those types and climatic conditions. The table below lists the performance measurement targets for the Windows element. All performance measurements are relative to historical baselines that have been set as the baseline new construction in 2003. The next generation of highly insulated and dynamic windows can become net energy producers in climates with heating loads and can dramatically reduce cooling loads and peak electricity demand.

Windows Performance Goals

Characteristics	Units	2003 Status	2007 Target	2010 Target	2015 Target	2020 Target
Energy Consumption Improvement	Reduction in window energy use, * (Percentage)	Base-ENERGY STAR (Low E)	20-30	30-40	40-50	40-60

* These percentage reductions will only be considered complete after meeting technical performance requirements such as incremental price/sq. ft., size (sq. ft.), visual transmittance, solar heat gain coefficient, durability (American Society for Testing and Materials Tests), U-value, and incremental cost $/sq. ft.

Analysis Tools and Design Strategies

BT has established aggressive goals to create a new generation of residential and commercial building technologies by 2025 that will enable zero energy buildings. Similar technologies and design approaches will also be applied to improve the performance of existing buildings. These ZEB goals cannot be met alone through research to significantly improve the performance of components (e.g., windows, appliances, heating and cooling equipment, lighting). It also requires a revolutionary approach to building design and operation that can achieve up to 70 percent reductions in load coupled

[a] Interim target NOT subject to cost constraints and may not be in commercial production
[b] Subject to no additional operating cost, within the traditional 3.5-in. wall dimension, with acceptable durability characteristics

with careful integration with onsite renewable energy supplies as well as thermal and electrical storage.[a] This in turn requires new design strategies and powerful simulation tools that support evaluation of new ZEB demand-reduction and energy-supply technologies.

Detailed Justification

	(dollars in thousands)		
	FY 2006	FY 2007	FY 2008
Lighting R&D	**19,034**	**19,283**	**19,283**

The R&D agenda of the solid state lighting (SSL) activities are established through an annual consultative process with general lighting industry, compound semi-conductor industry, universities, research institutions, National Laboratories, trade organizations, other industry consortia, and the Next Generation Lighting Industry Alliance (DOE's competitively selected Solid State Lighting Partnership). The high priority tasks are competitively bid and awarded to entities whose proposals meet these priorities and the SSL portfolio's stated objectives. The solid state lighting activity classifies its projects into four R&D classes: LED Core Technology, LED Product Development, OLED Core Technology and OLED Product Development. Tasks in Core Technology are truly innovative and groundbreaking, fill technology gaps, provide enabling knowledge or data, and represent a significant advancement in the SSL knowledge base. These Core Technology tasks are focused on gaining pre-competitive knowledge for future application to products, for use by other organizations. Product Development tasks are the systematic use of knowledge gained from basic and applied research to develop or improve commercially viable materials, devices, or systems. Technical activities are focused on a targeted market application with fully defined price, efficacy, and other performance parameters necessary for success of the proposed product. Product development encompasses the technical activities of product concept modeling through to the development of test models and field ready prototypes. Within each R&D class, there are active, detailed R&D agendas which contribute to the larger programmatic objective.

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[a] Building energy performance, particularly in ZEB, is the result of interactions among many elements including climate (outdoor temperature, humidity, solar radiation and illumination), envelope heat and moisture transfer, internal heat gains, lighting power, HVAC equipment, controls, thermal and visual comfort, and energy cost—and these complex interactions cannot be understood and quantified without simulation tools. For example the effect of daylighting dimming controls on the electric lights with daylighting has several effects: lighting electricity use goes down as does the heat gain from lights. Lower heat from lights reduces cooling use (amount depends on cooling equipment efficiency) but in the winter it can significantly increase the heating energy. Thus the annual impact of daylighting on energy use requires detailed calculations that consider these interactions. In a series of field evaluation case study reports, NREL found that simulation tools were one of the essential elements for tuning the building design as well as the operating building performance [Paul A. Torcellini, Ron Judkoff, and Drury B. Crawley, "Lessons Learned: High-Performance Buildings," ASHRAE Journal, September. 2004].

The SSL portfolio is presently funding eleven core priority R&D topics and seven product development priority R&D topics (based on FY 2005 Solid State Lighting Workshop prioritized R&D topics). Each year, the R&D topics are reviewed for progress on currently funded projects, completion of topical areas, new topics to start, and advice from the Alliance and the research community. The agenda is reprioritized for upcoming solicitations.

Solid State Lighting Research Topics

Topic	LEDs		OLEDs	
	Current R&D	Future R&D	Current R&D	Future R&D
CORE:	● UV emissions ● Power conversion efficiency ● Phosphors ● Semiconductor materials ● Device approaches, structures, and systems ● Defect Physics ● Light extraction	● Substrates, buffers and wafers	● Materials ● Light extraction ● Novel device structures ● Structures for quantum efficiency	● Encapsulants and packaging ● Transparent electrodes ● Fabrication and patterning techniques
PROD. DEVEL.:	● Luminaire design and materials ● Electronics ● Packaging ● Chip architecture	● Optical coupling and modeling ● Manufactured materials ● Electronic development ● Thermal design	● Luminaire design and materials ● Packaging ● Light extraction from devices	● Materials – incorporating emerging materials into devices ● Devices – increase quantum efficiency ● Substrates

In FY 2008, the program will continue the Solid-State Lighting (SSL) research projects that have demonstrated progress. These projects resulted from the competitive solicitations in 2004 and 2005 to develop and deploy SSL products for general illumination. These project topical areas are identified in the table under current R&D and include LED core topics (UV emissions, power conversion efficiency, phosphors, materials, device structures, defect physics, and light extraction), LED product development topics (luminaire design and materials, electronics, packaging, and chip architecture), OLED core topics (materials, light extraction, novel device structures, and structures for quantum efficiency), and OLED product development (luminaire design and materials, packaging, and light extraction from devices). For LEDs, the additional research topic will be on substrates, buffers, and wafer research to lower defect density (improve light generation efficiency) and affect the cost of these widely used materials. For OLEDs, the additional research topic will be on encapsulants and

	(dollars in thousands)		
	FY 2006	FY 2007	FY 2008

packaging to invent new, low-cost methods to protect the organic system from the environment (mostly oxygen and water). For further information on the SSL R&D Agenda, as formulated by and rank-prioritized by the research community see the SSL website (www.netl.gov/ssl/PDFs/DOE_SSL_Workshop_Report_Feb2005.pdf).

New awards will focus on the “future R&D” core and product development topic areas for LEDs and OLEDs. The new projects will continue advancements in device efficacy, durability, manufacturing, and cost needed to reach a commercially viable white light with efficacies meeting the 160 lumens per Watt goal.

Activities will also be initiated to analyze and address barriers to enable market introduction and commercialization of technologies resulting from these research projects.

In addition, these funds may be used to support efforts such as peer reviews; data collection and dissemination; and technical, market, economic, and other analyses.

Space Conditioning and Refrigeration R&D	**2,890**	**2,845**	**2,845**

Three projects, selected in FY 2005, will continue into FY 2008 through various developmental stages, after appropriate evaluation, to demonstrate through laboratory or field testing whether they have the long term potential to reduce annual HVAC, dehumidification and water heating energy consumption by 50 percent in new residential buildings, relative to Building America Benchmarks. The three projects include: the application of solid water sorbent (SWS) materials to enhance coupling to the ground, or to combinations of ground and outdoor air for hybrid applications; the development of an air-to-air integrated heat pump (IHP) system that can meet the air heating, cooling, dehumidifying, ventilating, and water heating requirements of a tight-envelope mechanically ventilated near-zero-energy house; and the development of a ground-source integrated heat pump (GSIHP). The design concepts must also address other critical Building America needs such as humidity control, uniform comfort, and indoor air quality. The R&D projects will emphasize modest cost premiums, since very high efficiency equipment already exists, but has low market penetration due to high first cost. The potential for multi-function appliances to contribute to achieving the energy consumption reduction goals will also be evaluated. In addition, these funds may be used to support efforts such as peer reviews; data collection and dissemination; and technical, market, economic, and other analyses.

Appliances and Emerging Technologies R&D	**1,047**	**0**	**0**

The Emerging technologies activity is eliminated as a stand alone effort in FY 2007 in order to better align technology transfer and market transition with core research activities in the Building Technologies Program.

	(dollars in thousands)		
	FY 2006	FY 2007	FY 2008
Building Envelope R&D	**6,860**	**7,119**	**7,119**
▪ **Thermal Insulation and Building Materials**	**2,970**	**2,411**	**2,411**

An assessment of the advanced state of thermal insulation and building materials technologies, which are being demonstrated in the Residential Buildings Integration subprogram, was undertaken in November 2004. The assessment revealed that more energy efficient, cost effective, and durable building materials and insulation are required to achieve the Building Technology Program's long range goal of developing zero energy buildings (ZEB) by 2025. Reducing energy losses through the building enclosure will contribute significantly to DOE's attainment of a practical ZEB.

DOE is developing the next generation of new envelope materials in response to needs identified in the Residential and Commercial Integration activities. In FY 2008, research will include the regional optimization of the next generation of attic systems in terms of the insulation and its placement, ventilation strategies, thermal mass, radiant barrier and location of ducts. BT will also conduct research relating to the durability problems associated with tighter and more energy-efficient building envelopes.

In addition, these funds may be used to support efforts such as peer reviews; data collection and dissemination; and technical, market, economic, and other analyses.

▪ **Windows Technologies**	**3,890**	**4,708**	**4,708**

In FY 2008, DOE will continue competitive fundamental science research to develop the second generation of materials, chemical engineering applications, and advanced manufacturing processes that can offer "leap frog" reductions in cost for dynamic windows while maintaining a high level of reliability and durability with a broad range of optical properties. In FY 2007, second generation dynamic prototypes, with significant potential to reduce cost were developed. The key FY 2008 goal will be to conduct research on the prototype(s) that have passed prior FY 2006 and FY 2007 stage gate criteria to further improve durability and scale up to larger sizes. The second generation of dynamic windows is targeted to enter the market in the 2010 to 2015 timeframe with substantially lower consumer prices. In FY 2006, the first generation prototype of a dynamic, highly insulating full scale functional window was developed and tested achieving 30–40 percent energy savings compared to the ENERGY STAR® baseline. Work will continue on the commercialization of affordable highly insulating windows that approach U values of 0.20. Also, DOE will continue work on one vacuum glazing project with the potential to achieve U values of 0.10.

In addition, these funds may be used to support efforts such as peer reviews; data collection and dissemination; and technical, market, economic, and other analyses.

	(dollars in thousands)		
	FY 2006	FY 2007	FY 2008
Analysis Tools and Design Strategies	**2,458**	**2,684**	**2,684**

In FY 2008, BT will continue to develop, improve, verify, and maintain software packages for researchers, engineers, architects, and builders who design or retrofit buildings to be energy efficient and comfortable. BT will conduct research on and incorporate additions to EnergyPlus analysis and design tool to create new-generation whole-building energy simulation software that allows building designers, operators, owners, and researchers to evaluate technologies for substantially improving the energy efficiency of buildings and reducing energy costs while maintaining comfort. BT will focus on technologies, systems, and controls which are needed in low-energy buildings, incorporating new modules in EnergyPlus versions which will support research, design, and retrofit of low-energy buildings. EnergyPlus module development research will focus on the top 20-30 features, completing new capabilities for recent state-of-the-art fenestration, daylighting, insulation, controls, HVAC equipment and systems, and renewable energy technologies such as air and water solar collector systems, material properties as a function of temperature and moisture, shading as a function of glare/illumination/sun position/heat gain, concentrating fiber optic solar lighting, under-floor air distribution, evaporative cooling, and thermal storage.

In addition, these funds may be used to support efforts such as peer reviews; data collection and dissemination; and technical, market, economic, and other analyses.

SBIR/STTR	**0**	**825**	**825**

In FY 2006, $686,000 and $80,000 were transferred to the SBIR and STTR programs respectively. The FY 2007 and 2008 amounts shown are estimated requirements for the continuation of the SBIR and STTR program.

Total, Emerging Technologies	**32,289**	**32,756**	**32,756**

Explanation of Funding Changes

	FY 2008 vs. FY 2007 ($000)
No change.	0
Total Funding Change, Emerging Technologies	**0**

Technology Validation and Market Introduction

Funding Schedule by Activity

	(dollars in thousands)		
	FY 2006	FY 2007	FY 2008
Technology Validation and Market Introduction			
Rebuild America[a]	0	2,473	2,834
ENERGY STAR® [b]	0	5,776	6,776
Building Energy Codes[c]	0	0	3,751
Total, Technology Validation and Market Introduction	0	8,249	13,361

Description

The Technology Validation and Market Introduction element funds activities that accelerate the adoption of clean, efficient, and domestic energy technologies. The three major activities, transferred to BT in 2007 from Weatherization and Intergovernmental Activities, are: ENERGY STAR®, Rebuild America and Building Codes Training and Assistance. ENERGY STAR® is a joint Department of Energy/ Environmental Protection Agency activity designed to identify and promote energy efficient products. Through its partnership with more than 7,000 private and public sector organizations, ENERGY STAR® delivers the technical information and tools that organizations and consumers need to choose energy-efficient solutions and best management practices and Home Performance with ENERGY STAR®, an innovative whole house approach to improving energy-efficiency in existing homes aimed at the over 100 million existing homes market. The Rebuild America Program element has been aligned with the Building Technologies Program's research and development activities to accelerate the adoption of advances in building integrated design, software tools, practices and advanced controls, equipment and lighting. The existing residential and commercial building code activities described below have been transferred and combined with the Building Energy Codes activities. These activities support upgraded State model energy codes and their adoption, implementation and enforcement, in response to the Department's determinations (described below). Implementation of energy codes incrementally raise the baseline of building energy efficiency and provide a baseline for the Department's building programs. It is a critical part of BT market transformation activities. Core code information, training, tools, and materials are upgraded to the improved model codes and made available to States to customize and use. Competitive, targeted, cost shared incentive funding is provided to States to upgrade, implement and enforce advanced building energy codes.

[a] Rebuild America was funded in Weatherization and Intergovernmental Activities in FY 2006 under the heading of Gateway Deployment. Comparable funding for FY 2006 was $3,769,000,.
[b] ENERGY STAR® was funded in Weatherization and Intergovernmental Activities in FY 2006 under the heading of Gateway Deployment. Comparable funding for 2006 was $5,940,000.
[c] Building Energy Code was funded in Weatherization and Intergovernmental Activities in FY2006 under the heading of Gateway Deployment. Comparable funding for 2006 was $4,455,000.

Building Energy Codes (Residential and Commercial)

The activities of the Building Codes and Standards element are established by legislation and the 3-year cycle for upgrading the model building energy codes and standards. Title III of the Energy Conservation and Production Act, as amended (ECPA) (42 USC 6831 et seq.), requires the Department of Energy to:

1. Support the upgrading of model building energy codes (American Society of Heating Refrigerating and Air-Conditioning Engineers' (ASHRAE) Standard 90.1, for commercial buildings, and the International Code Council's (ICC) International Energy Conservation Code (IECC), for residential buildings). Review and assist in improving the technical basis, determining cost effectiveness, and technical feasibility of code measures and, based on ongoing research activities, recommend and seek adoption of feasible, cost effective measures.
2. Review and upgrade the Federal building energy codes (10 CFR 434 and 435) based on the upgrades to ASHRAE 90.1 and the IECC that are cost-effective. DOE maintains Federal building energy codes as distinct from the voluntary sector building energy codes to reflect the unique financial perspective of the Federal sector and to address the role of the Federal sector in leading the private sector towards greater energy efficiency.
3. Publish a determination in the Federal Register as to whether each new edition of the model codes will improve the energy efficiency of buildings.
4. Provide incentive funding and technical assistance to States to update, implement and enforce their code to meet or exceed the upgraded model codes that the Department of Energy has determined will improve the energy efficiency of buildings.

The model code organizations have established a three-year upgrade cycle, receiving and deliberating on proposed amendments to the model codes and republishing a new edition of each model code every three years.

The Building Technologies Program is responsible for requirements 1, 3 and 4, above, and for coordinating the overall codes effort. The Federal Energy Management Program is responsible for requirement two.

Benefits

Technology Validation and Market Introduction contributes to BT goals by developing and implementing cross-cutting, strategically focused approaches to technology deployment through partnerships with state energy offices, building professionals, manufacturers, retailers, associations, non-profit organizations and other critical stakeholders. As of the end of 2003, with a cumulative Federal investment of $72 million, Rebuild America partnerships have renovated more than 609 million square feet of floor space, saving building owners more than $141 million each year with a cumulative saving of $1.6 billion through private investment for energy-efficiency improvements in excess of $700 million.[a] Another 590 million square feet of projects have progressed beyond the planning stage.

[a] As reported by Rebuild Partnerships. Information available on website: http://rebuild.org.

Detailed Justification

	(dollars in thousands)		
	FY 2006	FY 2007	FY 2008
Rebuild America	**0**	**2,473**	**2,834**

The Rebuild America Program element is aligned with the Building Technology Program's research and development activities to accelerate the adoption of advances in building integrated design, software tools, practices and advanced controls, equipment and lighting. The program will continually expand and update its technical assistance and delivery mechanisms and partners to effectively transfer the technological advances in R&D.

In addition, these funds may be used to support efforts such as peer reviews; data collection and dissemination; and technical, market, economic, and other analyses.

ENERGY STAR®	**0**	**5,776**	**6,776**

In accordance with EPACT 2005, ENERGY STAR® will continue to update criteria on selected products. In FY 2008, DOE will focus on raising efficiency targets to increase energy efficiency of the current appliance portfolio (e.g., clothes washers, dishwashers, room air conditioners and CFLs) to ensure the label connotes top-level performance of managed products, and introduce new ENERGY STAR® products, as appropriate (e.g., photovoltaics, solid state lighting, and water heaters.) These activities, while increasing energy savings, may temporarily reduce market penetration. The Home Performance Program is creating a contractor base to perform whole house assessments which not only save energy but provide the added benefits of improved indoor air quality, health and safety. Also, DOE will work through regional and national organizations to disseminate information about ENERGY STAR® throughout the U.S., create inter- and intra-state partnerships to promote ENERGY STAR® best practices and increase the number of ENERGY STAR® State Partners, as well as funding for Energy Efficiency Partnerships. DOE will work closely with national retailers to increase product sales, at home services and develop joint programs to increase consumer awareness of the importance of buying energy efficient products and technologies.

In addition, these funds may be used to support efforts such as peer reviews; data collection and dissemination; and technical, market, economic, and other analyses.

Building Energy Codes	**0**	**0**	**3,751**

In FY 2008, DOE will provide analyses and support for the upgrading by 2-3 percent of the residential model building energy code to produce the 2009 International Energy Conservation Code. It will also initiate the analysis of the changes adopted in 2007 in support of the determination required on the 2009 edition. DOE will provide analyses and propose new code changes to ASHRAE 90.1 that will have code stringency effects of approximately 2-3 percent in the upgraded 2010 edition. It will also complete its analysis of the changes incorporated in the 2007 edition, and make the required determination regarding whether the changes would improve the energy efficiency of commercial

	(dollars in thousands)		
	FY 2006	FY 2007	FY 2008

buildings. A positive determination triggers required actions by the State to upgrade their codes.

Technical and financial assistance will be provided to States to update and implement their energy codes.

In addition, these funds may be used to support efforts such as peer reviews; data collection and dissemination; and technical, market, economic, and other analyses.

Total, Technology Validation and Market Introduction	**0**	**8,249**	**13,361**

Explanation of Funding Changes

	FY 2008 vs. FY 2007 ($000)
Rebuild America	
The increase will be used to expand the commercial lighting initiative started in FY 2007 to include new advances in technology and practices resulting from the R&D work in Commercial Buildings Integration and Lighting.	+361
ENERGY STAR®	
The increase will be used to continue the expansion of the Home Performance with ENERGY STAR® Program beyond the pilots, and to develop appropriate tools, such as a national audit protocol, to deliver the information to consumers more effectively.	+1,000
Building Codes Training and Assistance	
In addition to the building code activities described above, technical and financial assistance will be provided to States to update and implement their energy codes.	+3,751
Total Funding Change, Technology Validation and Market Introduction	**+5,112**

Equipment Standards and Analysis

Funding Schedule by Activity

	(dollars in thousands)		
	FY 2006	FY 2007	FY 2008
Equipment Standards and Analysis	10,153	11,925	13,639
Total, Equipment Standards and Analysis	10,153	11,925	13,639

Description

The goal of the Equipment Standards and Analysis subprogram is to develop minimum energy efficiency standards that are technologically feasible and economically justified. During FY 2005 and FY 2006, the Department has identified and implemented significant enhancements to implementation of rulemaking activities. The Department has made a commitment to clear the backlog of delayed actions that accumulated during prior years, while simultaneously implementing all new requirements of the Energy Policy Act of 2005. In FY 2008, the Department will continue to implement productivity enhancements that will allow multiple rulemaking activities to proceed simultaneously while maintaining the rigorous technical and economic analysis required by statute.

Detailed Justification

	(dollars in thousands)		
	FY 2006	FY 2007	FY 2008
Equipment Standards and Analysis	**10,153**	**11,925**	**13,639**

The Equipment Standards and Analysis subprogram will continue ongoing rule-makings and add new rule-making activities for the following product categories that will continue in FY 2008:

- Residential Water Heaters
- Direct Heating Equipment
- Pool Heaters
- Ceiling Fan Light Kits [EPACT 2005]
- Battery Chargers and External Power Supplies [EPACT 2005]
- Incandescent Reflector Lamps
- Fluorescent Lamps
- Incandescent General Service Lamps
- Residential Dishwashers
- Ranges and Ovens and Microwave Ovens (Electric and Gas)

	(dollars in thousands)		
	FY 2006	FY 2007	FY 2008

- Dehumidifiers (Residential) [EPACT 2005]
- Commercial Clothes Washers [EPACT 2005]
- Refrigerated Bottle or Canned Beverage Vending Machines [EPACT 2005]
- Packaged Terminal Air-Conditioners
- Ice-Cream Freezers, Self-Contained Commercial Refrigerators, Freezers, and Refrigerator-Freezers without doors, and remote-condensing commercial refrigerators, freezers and refrigerator-freezers [EPACT 2005]

The specific standards and test procedure activities listed above have been identified considering existing obligations, new legislative directives and input from a broad range of external stakeholders. In FY 2008, DOE will complete analytical and regulatory steps necessary for rulemaking activities for 13-15 product categories. Final rules will be issued for 1-2 of these product categories, consistent with enacted law, to amend appliance standards and test procedures that are economically justified and will result in significant energy savings.

Activities in FY 2008 will also include responses to waiver requests from manufacturers and requests for input and recommendations to the Office of Hearings and Appeals. Resource planning becomes critical to minimize delays and availability conflicts of DOE staff and contractor support. Some resources may also be utilized to prepare for challenges such as new technologies utilized in appliances including compound use appliances, networked or interconnected appliances and even test procedure sensing devices that can give false readings of efficiency levels.

In addition, these funds may be used to support efforts such as peer reviews; data collection and dissemination; and technical, market, economic, and other analyses.

Total, Equipment Standards and Analysis	**10,153**	**11,925**	**13,639**

Explanation of Funding Changes

	FY 2008 vs. FY 2007 ($000)
The increased funding request addresses the new requirements of EPACT 2005 and will also allow the Department to clear the backlog of rulemaking activities, as outlined in "Energy Conservation Standards Activities" at http://www.eere.energy.gov/buildings/appliance_standards/2006_schedule_setting.html.	+1,714
Total Funding Change, Equipment Standards and Analysis	**+1,714**

Oil Heat Research for Residential Buildings

Funding Schedule by Activity

	FY 2006	FY 2007	FY 2008
	(dollars in thousands)		
Oil Heat Research for Residential Buildings	990	0	0
Total, Oil Heat Research for Residential Buildings	990	0	0

Description

The goal of the Oil Heat Research for Residential Buildings Integration subprogram has been to develop ultra-low emissions combustion technologies for oil-based fuels that could be used in residential building applications.

Benefits

Based on the completion of research to improve the environmental performance of oil combustion systems in FY 2006, no further activities will be performed in the Oil Heat Research for Residential Buildings Integration subprogram.

Detailed Justification

	FY 2006	FY 2007	FY 2008
	(dollars in thousands)		
Oil Heat Research for Residential Buildings	**990**	**0**	**0**

Oil Heat Research is complete and results are transferred to private industry. No further Federal role is justified due to market forces driving down the number of oil heated homes by 35 percent from 1980 to 2000 (See Data from Census Bureau below) and limited remaining technical potential for improvement (NAECA Standard 78 AFUE, GAMA highest available 86 AFUE). DOE sees greater opportunity to assist oil heat consumers through commercially available high efficiency oil furnaces and ENERGY STAR® windows, lighting and appliances; duct sealing, adding recommended insulation and general weatherization.

	(dollars in thousands)		
	FY 2006	FY 2007	FY 2008

Data from Census – Total Household; Households Heating w/ Fuel Oil

Year	Total Households	Households Heated by Fuel Oil	Percent Households Heated by Fuel Oil
1980	88,410,627	14,768,118	16.7%
1990	91,947,410	11,243,727	12.2%
2000	105,480,101	9,457,850	9.0%

	FY 2006	FY 2007	FY 2008
Total, Oil Heat Research for Residential Buildings	**990**	**0**	**0**

Technical/Program Management Support

Funding Schedule by Activity

	(dollars in thousands)		
	FY 2006	FY 2007	FY 2008
Technical/Program Management Support	1,485	0	0
Total, Technical/Program Management Support	1,485	0	0

Description

The Technical/Program Management Support subprogram provided analytic support to aid the program to achieve its net zero energy building goals.

Benefits

This was accomplished by identifying research priorities through R&D feasibility studies and trade-off analyses. The Technical/Program Management Support subprogram focused on implementing a research and development evaluation process for integrating component research with building system research.

Detailed Justification

	(dollars in thousands)		
	FY 2006	FY 2007	FY 2008
Technical/Program Management Support	**1,485**	**0**	**0**
In FY 2008, technical program management support activities are funded as needed within the preceding programmatic budget lines, consistent with Energy and Water standard practice.			
Total, Technical/Program Management Support	**1,485**	**0**	**0**

Congressionally Directed Activities

Funding Schedule by Activity

	(dollars in thousands)		
	FY 2006	FY 2007	FY 2008
Congressionally Directed Activities	5,346	0	0
Total, Congressionally Directed Activities	5,346	0	0

Description

In general, Congressionally directed activities do not support program goals because such activities were not a result of the program's planning effort which is focused on overcoming technical barriers. In FY 2006, there were three Congressionally directed activities funded out of the Building Technologies Program. The program does not request any funds to continue these projects as they do not further the achievement of DOE's goals. The following projects were directed by Congress to be included in this program.

Detailed Justification

	(dollars in thousands)		
	FY 2006	FY 2007	FY 2008
National Center on Energy Management and Building Technologies	**3,960**	**0**	**0**

The National Center for Energy Management and Building Technologies conducts activities to improve the efficiency, productivity, and security of the U.S. building stock by developing and disseminating synergistic and complementary solutions to energy management, indoor environmental quality, and security concerns in new and existing buildings. These activities include research, participating in standard setting, advancing technical training and professional education, and serving as a repository of information on economic, technical, and policy issues.

University of Louisville Sustainable Buildings Project	**396**	**0**	**0**

Project to improve the sustainability of local buildings and essential community applications through the use of solar heating, lighting, and photovoltaics.

Carnegie Mellon University Advanced Building Testbed	**990**	**0**	**0**

Supports a research facility to test the performance and interaction of advanced window, insulation, lighting and other building technologies.

Total, Congressionally Directed Activities	**5,346**	**0**	**0**

Industrial Technologies

Funding Profile by Subprogram

(dollars in thousands)

	FY 2006 Current Appropriation	FY 2007 Request	FY 2008 Request
Industrial Technologies			
Industries of the Future (Specific)	20,708	17,001	9,254
Industries of the Future (Crosscutting)	27,928	28,562	36,744
Technical/Program Management Support	3,755	0	0
Congressionally Directed Activities	3,465	0	0
Total, Industrial Technologies	55,856	45,563	45,998

Public Law Authorizations:

P.L. 94-163, "Energy Policy and Conservation Act" (EPCA) (1975)
P.L. 94-385, "Energy Supply and Production Act" (ECPA) (1976)
P.L. 95-91, "Department of Energy Organization Act" (1977)
P.L. 95-619, "National Energy Supply Policy Act" (NECPA) (1978)
P.L. 95-620, "Powerplants and Industrial Fuel Use Act" (1978)
P.L. 96-294, "Energy Security Act" (1980)
P.L. 101-218, "Renewable Energy and Energy Efficiency Technology Competitiveness Act" (1989)
P.L. 102-486, "Energy Policy Act" (1992)
P.L. 109-190, "Energy Policy Act" (2005)

Mission

The mission of the Industrial Technologies Program (ITP) is to reduce the energy intensity of the U.S. industrial sector through a coordinated program of research and development, validation, and dissemination of information on energy-efficiency technologies and operating practices.

Benefits

ITP develops, manages, and implements a balanced portfolio of technology investments to address industry requirements throughout the technology development cycle. Research and development, particularly high-risk, high-return R&D, is conducted to target efficiency opportunities in manufacturing processes and crosscutting energy systems unlikely to be addressed by industry alone.

Dissemination of energy-efficiency technologies and practices is accomplished through a variety of technology delivery mechanisms that will be the near-term focus of program efforts. These activities will help accelerate industry understanding, acceptance, and implementation of efficiency advances as industry starts reaping the benefits of proven technologies, system management decision tools, training, and strategic partnerships. These technology successes are the result of the "industry pull" designed into the Industrial Technologies Program by the involvement of industry in identifying potential energy-saving R&D areas and cost-sharing the R&D.

With reduced energy intensity comes improved productivity through yield improvement and resource conservation. Reducing industrial energy intensity also contributes to environmental quality by promoting technologies and practices that minimize adverse environmental impacts. These industrial, economic viability and international competitiveness benefits contribute to energy security by promoting technologies that increase independence from foreign energy sources. 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 GPRA Unit Program Goals

The Department's Strategic Plan identifies five Strategic Themes (one each for nuclear, energy, science, management, and environmental aspects of the mission plus 16 Strategic Goals that tie to the Strategic Themes. The Industrial Technologies Program principally supports the following goal:

Strategic Theme 1, Energy Security

Strategic Goal 1.4, Energy Productivity: Cost-effectively improve the energy efficiency of the U.S. economy;

And concurrently supports:

Strategic Theme 3, Scientific Discovery and Innovation: Strengthening U.S. scientific discovery, economic competitiveness, and improving quality of life through innovations in science and technology.

Strategic Goal 3.3 (Research Integration: Integrate basic and applied research to accelerate innovation and to create transformational solutions for energy and other U.S. needs).

Strategic Goal 1.2 (Environmental Impacts of Energy: Improve the quality of the environment by reducing greenhouse gas emissions and environmental impacts to land, water, and air from energy production and use.)

The Industrial Technologies Program has one GPRA Unit Program goal which contributes to Strategic Goal 1.4 in the "goal cascade":

GPRA Unit Program Goal 1.3.19.00: Industrial Technologies - The Industrial Technology Program goal is to partner with our most energy-intensive industries in strategic planning and specific RD&D to develop the technologies needed to use energy efficiently in their industrial processes and cost-effectively generate much of the energy they consume. The result of these activities will save feedstock and process energy, improve the environmental performance of industry, and help America's economic competitiveness.

Contribution to GPRA Unit Program Goal 1.3.19.00 (Industrial Technologies)

The Industry Technologies Program's key contribution to energy security is through improving energy efficiency and directly reducing the demand for oil, natural gas, and electricity. Between 2003 and 2010, industrial technologies will contribute to an 9.4 percent reduction in energy intensity (Btu per unit of industrial output as compared to 2002) in the energy-intensive Industries of the Future (a potential savings of 2.4 Quads, an additional 0.9 Quads above projected baseline efficiency improvements); between 2004 and 2012, target industries and RD&D partners will commercialize over 20 energy-efficiency technologies developed through the ITP partnerships.

The production improvements and direct reduction in both total industrial energy use and the use of fossil fuels will contribute to the Administration goal of an 18 percent reduction between 2003 and 2012 in the greenhouse gas intensity, or total greenhouse gas emissions per unit of Gross Domestic Product, of the U.S. economy. According to an EIA report[a], carbon dioxide emissions from the industrial end-use sector, including fuel burning emissions as well as process emissions, were 2.7 percent lower in 2004 than in 1996, a savings of 49 million metric tons comparing those two years. Over the life of the program, ITP estimates that technologies it developed and activities it undertook since 1977 cumulatively saved almost 95 million metric tons of carbon. Program savings from 1996 to 2004 amounted to 52 million metric tons of carbon. Due to changes in production levels and the mix of goods produced, total carbon levels estimated by EIA for the whole industrial sector during that period both increased and decreased, with a net decrease of 14 million tons of carbon.

Funding by Strategic and GPRA Unit Program Goal

(dollars in thousands)

	FY 2006	FY 2007	FY 2008
Strategic Goal 1.4, Energy Productivity			
GPRA Unit Program Goal 1.3.19.00, Industrial Technologies			
Industries of the Future (Specific)	20,708	17,001	9,254
Industries of the Future (Crosscutting)	27,928	28,562	36,744
Technical/Program Management Support	3,755	0	0
Congressionally Directed Activities	3,465	0	0
Total, Strategic Goal 1.4 (Industrial Technologies)	55,856	45,563	45,998

[a] See EIA Report Emissions of Greenhouse Gasses in the United States 2004 at ftp://ftp.eia.doe.gov/pub/oiaf/1605/cdrom/pdf/ggrpt/057304.pdf.

Annual Performance Results and Targets

FY 2003 Results	FY 2004 Results	FY 2005 Results	FY 2006 Results	FY 2007 Targets	FY 2008 Targets
GPRA Unit Program Goal 1.3.19.00 (Industrial Technologies)					
Industries of the Future (Specific)					
Commercialize 4 new technologies in partnership with the most energy-intensive industries. [MET: Exceeded, 5 technologies] Turn over 25 percent of projects in the RD&D portfolio. [MET]	Commercialize 4 new technologies in partnership with the most energy-intensive industries. [MET: Exceeded, 6 technologies]	Commercialize 3 new technologies in partnership with the most energy-intensive industries. [MET]	Commercialize 3 new technologies in partnership with the most energy-intensive industries. [MET]	Commercialize 3 new technologies in partnership with the most energy-intensive industries that improve energy efficiency of an industrial process or product by at least 10 percent.	Commercialize 3 new technologies in partnership with the most energy-intensive industries that improve energy efficiency of an industrial process or product by at least 10 percent.
Industries of the Future (Specific and Crosscutting)					
Help industry save more than 180 trillion Btu of energy worth at least $720 million (assumes average energy prices of $4.00 a million Btu). [MET]					
Industries of the Future (Crosscutting)					
6,200 energy-intensive U.S. plants that will apply EERE technologies and services averaging up to a 15 percent improvement in energy productivity per plant. [MET: Exceeded, 6400 plants]	An additional 600 (leading to a cumulative 6,800) energy intensive U.S. plants will apply EERE technologies and services averaging a 5 percent improvement in energy productivity per plant. [MET: Exceeded, 9,987 cumulative plants]	An additional 200 (leading to a cumulative 7,000) energy intensive U.S. plants will apply EERE technologies and services. [MET]	An additional 200 (leading to a cumulative 8,600) energy intensive U.S. plants will apply EERE technologies and services contributing to the goal of a 20 percent reduction in energy intensity from 2002 levels by 2020. [MET]	An estimated 100 trillion Btus saved by an additional 800 energy intensive U.S. plants applying EERE technologies and services	An estimated 100 trillion Btus saved by an additional 800 energy intensive U.S. plants applying EERE technologies and services
	Contribute proportionately to EERE's corporate goal of reducing corporate and program uncosteds to a range of 20-25 percent by reducing program annual uncosteds by 10 percent in 2004 relative to the program uncosted baseline (2003) until the target range is met. [MET]	Contribute proportionately to EERE's corporate goal of reducing corporate and program adjusted uncosted obligated balances to a range of 20-25 percent by reducing program annual adjusted uncosteds by 10 percent in 2005 relative to the program FY 2004 end of year adjusted uncosted baseline ($40,741K) until the target range is met. [MET]	Maintain total administrative overhead costs (defined as program direction and program support excluding earmarks) in relation to total program costs of less than 12 percent. [a] [MET]	Maintain total administrative overhead costs (defined as program direction and program support excluding earmarks) in relation to total program costs of less than 12 percent.	Maintain total administrative overhead costs in relation to total program costs of less than 12 percent. Baseline for administrative overhead rate currently being validated.

[a] Baseline for administrative overhead rate currently being validated.

Means and Strategies

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

The Industrial Technologies Program implements the following means:

- ITP invests in pre-competitive and high-risk RD&D that individual companies are unable to undertake without Government support. These industry and departmental investments in applied research and pre-commercialization technology represent the greatest opportunities to save energy and improve environmental performance in a cost-effective manner.
- ITP cost-shares the funding of projects with multiple industrial and academic partners. Sharing project costs (industrial partners typically contribute 50 percent) leverages public investment with private resources, increases access to scientific capabilities, increases industry commitment to achieving R&D success, shortens the technology development and commercialization cycle, and facilitates technology delivery. ITP activities have focused on industry-specific R&D and are moving toward technology development applicable to multiple industries.

The Industrial Technologies Program implements the following strategies:

- Identify industrial energy "bandwidths," or categorized energy savings potentials per type of improvement, to focus on greatest opportunities;
- Address energy losses that when remedied will reduce the energy requirements of industry while stimulating economic productivity and growth and reduce emissions.
- Invest in next-generation manufacturing concepts that cut across industry lines and produce dramatic energy and environmental benefits providing large public benefits. The development of these transformational technologies typically requires high-risk, high-return R&D which one industry cannot typically undertake, such as an entirely new processing route to achieve much lower energy use than current processes. An example of such transformational technologies is the nano-manufacturing applications research to be begun in FY 2007 to support national manufacturing priorities. These efforts are expected to yield substantial energy, environmental, and economic benefits.
- In FY 2008 ITP will begin a transition to more multi-industry application and transformational R&D activities in the Energy-Intensive Process R&D key activity.

The following external factors could affect ITP's ability to achieve its goals:

- Rates of market growth/technology adoption;
- Industry profit margins;
- Capital investment requirements;
- Foreign competition;
- Energy supply markets and prices;
- Safety and environmental regulations;

- Costs and adoption rates of technologies;
- Labor and material costs; and
- Environmental policies at the national and state level, including Federal efforts to reduce carbon and criteria emissions that might affect the choice of energy sources.

In carrying out the program's mission, Industrial Technologies Program (ITP) performs the following collaborative activities:

- The *National Energy Policy*[a] encourages energy efficiency programs that are modeled as public-private partnerships. The Industrial Technologies Program has used this partnership model for the past ten years to bring together the strengths of business and Government to improve energy efficiency. These partnerships also help to disseminate and share best energy management practices in factories throughout the United States.
- ITP works with DOE's Basic Energy Sciences and Fossil Energy Programs to coordinate research in such areas as nanotechnology and mining, respectively.
- On manufacturing technology issues, ITP collaborates through the National Science and Technology Council interagency working group on manufacturing (IWG) with many of the participating agencies, and this budget request includes funding to contribute to the collaborative R&D developed through that group.
- ITP coordinates with other Federal agencies, including the National Aeronautics and Space Administration, the National Science Foundation, the National Institute of Standards and Technology, Environmental Protection Agency, and the Departments of Defense, Commerce, Agriculture, and Interior to organize research efforts in common areas.

Validation and Verification

To validate and verify program performance, the Industrial Technologies Program will report and manage its performance plan and conduct internal and external reviews and audits. These programmatic activities are subject to continuing review by, for example, the Congress, the General Accountability Office, the Department's Inspector General, the U.S. Environmental Protection Agency, and state environmental agencies. ITP will also undertake analyses to address Government Performance and Results Act (GPRA) and the President's Management Agenda (PMA) requirements, including the Performance Assessment Rating Tool (PART) and the R&D Investment Criteria (RDIC).

The table below summarizes validation and verification activities. Progress toward annual performance targets and results are also tracked on a quarterly basis through the DOE management system, Joule.

Data Sources:	Energy intensity is calculated from the Energy Information Administration's (EIA's) Annual Energy Outlook, Manufacturing Energy Consumption Survey (MECS) and Department of Commerce data. The number of technologies and their energy savings are ascertained through interviews with technology developers and suppliers. Energy savings for the technical assistance programs are estimated based upon past reported participant data. Project financial data is tracked through the EERE Corporate Planning System.

[a] See National Energy Policy report of the National Energy Policy Development Group (May 2001), P. 4-12.

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

- Technology validation and operational field measurement, as appropriate;
- Peer review by independent outside experts of both the program and subprogram portfolios;
- Annual internal Technical Program Review of the Industrial Technologies Program;
- Specialized program evaluation studies to examine process, impacts, or market baseline and effects, as appropriate;
- Quarterly and annual assessment of program and management results based performance through Joule (the DOE quarterly performance progress review of budget targets); PMA (the President's Management Agenda annual departmental and Program Secretarial Officer (PSO) based goals whose milestones are planned, reported and reviewed quarterly); and PART (common government wide program/OMB reviews of management and results); and
- Annual review of methods, and recomputation of benefits for the Government Performance and Results Act (GPRA).

Baselines: The following are the key baselines used in ITP for contributions to its program goal:

- Industrial energy intensity (2002) 14,000 Btu/$1996 value of shipments of energy intensive industry output.
- The baseline for the cumulative count of new commercialized technologies that achieve 10 percent improvement in energy efficiency is zero in 2003.

Frequency: EIA/MECS collects energy intensity data once every 4 years, and ITP makes annual estimates based upon data from annual Department of Commerce surveys. ITP collects data on energy savings and technologies commercialized annually. The EERE Corporate Planning System tracks project awards and expenditures continually.

Data Storage: Energy intensity information is contained in EIA's computer database. Data on energy savings and technologies commercialized are stored in ITP's Impacts Database and are available on the internet at: http://www.pnl.gov/impacts/. Data on the counts and impacts of plants contacted is collected by Lawrence Berkeley National Laboratory and Oak Ridge National Laboratory.

Verification: ITP uses prospective and retrospective peer reviews to evaluate project performance and to adjust support. To verify program performance and results, ITP tracks all technologies commercialized (and the extent of their use) by industry through an analysis of program impacts conducted by Pacific Northwest National Laboratory. ITP also provides EIA quality control and outside peer review of the Manufacturing Energy Consumption Survey. Industry representatives review data on energy savings and technologies commercialized. ITP has conducted reviews of the impacts of several technical programs and assistance programs have also been reviewed several times.

Program Assessment Rating Tool (PART)

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

The Industrial Technologies Program received its first OMB PART review in 2005. The PART review included ratings of 80 percent for program purpose, 90 percent for planning, 91 percent for management and 50 percent for program results and accountability with an overall rating of Adequate. The program will address the findings and recommendations in the PART, including an independent assessment of ITP's contribution to the long-term goal of improving industrial energy efficiency, and expects to improve its score in the next assessment. These ratings reflect the commitment of EERE program management at all levels to the basic management and planning principles of the President's Management Agenda including the criteria scored in the PART and the implementation of the EERE reorganization employing those principles**.**

The Department has responded to the PART recommendation of "Develop guidance that specifies a consistent framework for analyzing the costs and benefits of research and development investments, and uses this information to guide budget decisions." The Department has specified common scenarios, common methodology, and standardized benefits measures to allow analyzing the costs and benefits of applied R&D investments. While progress has been made, benefits estimates across programs are still not completely comparable. The Department continues to work on implementation of common assumptions and a consistent approach to incorporation of risk.

Expected Program Outcomes

Over the past 30 years, industry has shown a remarkable ability to improve energy efficiency, greatly increasing economic output without a corresponding increase in energy use. The Industrial Technologies Program estimates that, in 2004, it directly contributed to industrial energy savings of over 366 trillion Btu[a] in energy savings worth over $3.1 billion.[b] From the ITP activity's inception in 1977 through 2004, ITP helped develop more than 180 commercialized industrial technologies. Cumulative tracked energy savings over that period are estimated to be over 4.7 Quads.

Yet an expanding economy will increase industrial energy demand. In its Annual Energy Outlook 2006, the Energy Information Administration projects industrial energy use will grow by almost 22 percent from 2004 to 2030, even with assumed efficiency gains and an economic shift to less energy-intensive industries. Reducing energy intensity – the amount of energy used to produce a given amount of industrial product is the key to increasing energy efficiency in industry without impeding economic growth. Because there are significant gaps between current energy use and the practical minimum energy use for most industrial processes, the industrial sector will continue to offer excellent opportunities to improve energy efficiency in the United States over the next 25 years.

If energy use per unit of output in the ITP partner industries continued at 2002 levels, these industries would be using over 20 Quads by 2012. However, by that time, partner industries are expected to

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[a] See 2006 Impacts report at http://www.pnl.gov/impacts/

[b] Constant 2004 dollar values for energy savings shown in this budget are based upon Energy Information Administration data from the Annual Energy Outlook 2006 (AEO 2006). Average industrial energy prices per million Btu were $8.03 in 2003 and $8.67 for 2004. Source: based on AEO 2006, Table A3, available at www.eia.doe.gov/oiaf/aeo/pdf/aeo_base.pdf.

reduce their energy use by 1.5 Quads through business-as-usual efficiency improvements (EIA projection of 0.75 percent annually) and, concurrently, activities originally sponsored by the Industrial Technologies Program are projected to help these industries lower energy use by another 0.9 Quads.

	Historic					Planned		
	2002	2003	2004	2005	2006	2007	2008	2009
Performance Indicators								
Annual number of technologies commercialized (after 2006, that achieve 10 percent improvement in energy efficiency)								
Target	---[a]	---	4	3	3	3	3	3
Actual	---	---	6	3				
Annual energy savings from Industrial Program activities in partnership with industry (trillion Btu)								
Target		290	220	220	180	180	180	180
Actual	293	352	366					
Annual number of energy-intensive plants impacted by the program[b]								
Target	600	600	600	200	200	1000	400	400
Actual	738	1647	2089	2634	2153			
Percentage change in energy intensity from 2002								
Target		-1.2	-2.4	-3.7	-4.8	-6.0	-7.2	-8.3
Actual		-1.6	-3.7	-4.3 Est.				

Estimates of the security, economic and environmental benefits from 2008 through 2050 that would result from realization of the program's goals are shown in the table below.

EERE's Industrial Technology Program Goal Case reflects the increasing adoption of the technologies in the program's research, development and deployment portfolio over time, as the program's goals are met. Not included are any other policies or regulatory mechanisms, or other incentives not already in existence, which might be expected to support or accelerate the achievement of the program goals. The expected benefits reflect solely the achievement of the program's goals.

[a] For the purpose of establishing PART goals, the cumulative count of commercialized technologies from ITP R&D efforts was restarted, beginning with 2004 efforts. There were actually 10 commercialized technologies in 2002 and 5 in 2003.
[b] "Impacted" refers to the number of unique plants receiving EERE energy efficiency information or applying EERE energy technologies and practices.

The goals are modeled in contrast to the "baseline" case, in which no DOE R&D exists. The baseline case is identical to those used for all DOE applied energy R&D programs.[a] Further, across EERE, and across all of DOE's applied energy R&D programs, the expected outcome benefits are being calculated using the same fundamental methodology. Finally, the metrics by which expected outcome benefits are measured are identical for all of DOE's applied energy R&D programs.[b] This standardization of methods and metrics has been undertaken as part of the Department's efforts to respond to Under Secretary Garman's Strategic Management System initiative and OMB's request to make all programs' outcomes comparable.

The difference between the baseline case and the program goal case results in economic, environmental, and security benefits. For example, achievement of program goals results in a reduction in net consumer expenditures of 11 billion dollars in 2030. Savings to the electric power industry are expected to be 3 billion dollars in 2030 and 2 billion dollars in 2050. Finally, the program would also result in carbon emissions reductions of 40 million metrics tons in 2030 and 18 in 2050. The results are generated by modeling the program goals within two energy-economy models: NEMS-GPRA08 for benefits through 2030, and MARKAL-GPRA08 for benefits through 2050.[c] The full list of modeled benefits appears on the next page.[d]

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[a] The starting point for the baseline case is the Energy Information Administration's "reference case," as published in the AEO 2006. Program analysts from across DOE examined the AEO to determine the extent to which their program goals are modeled (explicitly or implicitly). If program goals are modeled in the AEO, they are removed in the GPRA baseline. Further, some programs believe that the AEO's technology representation is too conservative, even in the absence of program goals, and thus in certain cases a modification is made to make the technology representation in the baseline case more optimistic than the AEO.

[b] The set of expected outcome metrics being used this year differs in substantial ways to that of previous years. In addition to the standardization across DOE's applied energy R&D programs, the list is expanded and more comprehensive than in past years. Further, the list maps to DOE strategic goals. The expected outcome metrics represent inherent societal benefits that stem from achievement of program goals.

[c] Final documentation on the analysis and modeling, including all of the methodologies and underlying assumptions, is expected to be completed and posted on the web by March 31, 2007. Past GPRA modeling and analysis documentation can be found at http://www.eere.energy.gov/ba/pba/gpra.html.

[d] The results from the integrated energy models show slightly less energy savings than the results from the program's offline analyses. The macroeconomic feedbacks, as well as the interactions among the various ITP programs, are accounted for in the integrated modeling.

FY 2008 GPRA Benefits Estimates for Industrial Technologies Program[a b]

	2010	2020	2030	2040	2050
Environmental Benefits (Goal 1.2)					
Avoided carbon emissions, annual (MMTC)	4	31	40	20	18
Avoided carbon emissions, cumulative (MMTC)	8	174	567	614	791
Reduced cost of criteria pollutant control, NPV[c] (bil. 2004$)	ns	ns	ns	NC	NC
Economic Benefits (Goal 1.4)					
Consumer savings, annual (bil. 2004$)	1	9	11	16	-12
Consumer savings, NPV (bil. 2004$)	2	37	97	242	268
Electric power industry savings, annual (bil. 2004$)	0.4	2	3	2	2
Electric power industry savings, NPV(bil. 2004$)	0.2	9	22	57	62
Household energy expenses reduced, annual (bil. 2004$)	ns	ns	ns	0.2%	0.0%
Energy intensity reduced (% change in E/GDP)[d]	0.2%	1.3%	1.6%	0.8%	0.5%
Net energy system cost savings, annual (bil. 2004$)	NC	NC	NC	10	6
Natural gas price change, moving avg. (2004$ / TCF)[e]	ns	0.08	0.01	NC	NC
Security and Reliability Benefits (Goal 1.1 or 1.3)					
Avoided oil imports, annual (mbpd)	ns	ns	ns	0.0	0.0
Avoided oil imports, cumulative (bil. bbl)	ns	ns	0.3	0.1	0.1
Security MPG improvement (%)[f]	ns	ns	ns	0.0	0.0
Transportation fuel diversity improvement (%)[g]	ns	ns	ns	ns	ns
Oil intensity reduced (% change in bil. bbl/GDP)	ns	ns	0.3%	0.1%	0.1%

[a] Benefits through 2030 are calculated with the NEMS-GPRA08 model. Benefits from 2035 through 2050 are calculated with the MARKAL-GPRA08 model. "NC" indicates situations in which no calculation was done because of specific model limitations. "ns" indicates results that were "not significant"—within the noise of the models.
[b] Projected benefits do not include any potential policy changes that might enhance technology deployment. In addition, most technologies show diminishing benefits by 2050, because of the assumption built in to the analysis that baseline industry progress will eventually catch up with the more accelerated progress associated with EERE program success.
[c] Net present value calculations throughout this table are performed for cumulative economic metrics, and are done using a 3% real discount rate, cumulative to 2008.
[d] Impacts of the program on energy intensity are greater within the industrial sector, but the overall impact as measured by the energy intensity of the overall economy is less pronounced.
[e] The prices reflected here are average delivered prices to all sectors, and are based on a three year moving average. Thus the measure of benefit is the change in the three year moving average delivered price, in $ per thousand cubic foot.
[f] Security MPG is the ratio of vehicle miles traveled by light duty vehicles to their usage of oil. It captures oil avoidance by efficiency and fuel alternatives.
[g] Fuel diversity is measured by the Shannon-Weiner Index (SWI) of diversity. The SWI is a measure of "proportional diversity," and hence captures both abundance and richness, i.e., how many different fuels and how much of each fuel both factor into the calculation.

Industries of the Future (Specific)

Funding Schedule by Activity

	(dollars in thousands)		
	FY 2006	FY 2007	FY 2008
Industries of the Future (Specific)			
Forest and Paper Products Industry	3,466	2,878	1,752
Steel Industry	3,383	3,613	1,605
Aluminum Industry	3,069	2,265	1,750
Metal Casting Industry	2,393	982	194
Glass Industry	1,631	0	0
Chemicals Industry	5,060	6,787	3,694
Mining Industry	1,017	0	0
Supporting Industries	689	0	0
SBIR/STTR	0	476	259
Total, Industries of the Future (Specific)	20,708	17,001	9,254

Description

The Industries of the Future (Specific) subprogram supports cost-shared research, development, and demonstration (RD&D) of advanced technologies to reduce the energy intensity while improving the environmental performance of America's energy-intensive and waste-intensive industries. ITP will begin a three-year process in FY 2008 to transition from industry-specific research and development to more crosscutting research as funding and investigation for existing multi-year projects are completed. The future broader initiatives in Energy-Intensive Process R&D (see below) will enable ITP to shift toward higher impact R&D activities to dramatically improve the energy efficiency and environmental performance of the energy-intensive industries. Through this process, ITP will improve its ability to prioritize activities to meet key programmatic objectives in support of the Department's strategic goals. These funds may also be used to support efforts such as peer reviews; data collection and dissemination; and technical, market, economic, and other analyses.

Benefits

Key domestic industries will conclude industry-specific R&D on industrial efficiency technologies that reduce their energy consumption and improve their competitive position, preserving domestic economic benefits while reducing cost, saving energy and improving environmental performance. This partnership has achieved notable successes. For example, the Steel industry announced in 2005 that they have reduced their average energy consumption per ton of steel by 7 percent and have attributed this milestone to collaborative R&D activities with DOE.

Detailed Justification

	(dollars in thousands)		
	FY 2006	FY 2007	FY 2008
Forest and Paper Products Industry	**3,466**	**2,878**	**1,752**

In FY 2008, efforts within this activity are focused on completing research to investigate avenues for the reduction of natural gas use through transformational technologies. The program will continue development of a dewatering technology, achieving 40 percent energy saving for paper drying process. Beginning in FY 2008, any new R&D activities relevant to this industry will be conducted through the crosscutting Energy-Intensive Process R&D activity.

Continue to support the American Forest & Paper Association and other industry organizations to improve their member companies' energy efficiency and environmental performance through the industry's Agenda 2020. The collaborative activities will include the continuation of cost-shared R&D on as well as the utilization of new improved energy technologies, industrial energy efficiency tools, and energy management best practices such as high efficiency pulping.

Steel Industry	**3,383**	**3,613**	**1,605**

In FY 2008, the focus will be on processes that both reduce the use of natural gas and improve energy efficiency in iron and steelmaking, as industry-specific activities begin to be phased out to be replaced by cross-industry R&D. Continue work initiated in FY 2005 for cokeless ironmaking and for developing transformational technology for next generation steelmaking. Funding will be used to continue research initiated in previous years. Beginning in FY 2008, any new R&D activities relevant to this industry will be conducted through the crosscutting Energy-Intensive Process R&D activity.

Continue to support the American Iron and Steel Institute, the Steel Manufacturers' Association, and other industry organizations to improve their member companies' energy efficiency and environmental performance. The collaborative activities will include the continuation of cost-shared R&D on as well as the utilization of new improved energy technologies, industrial energy efficiency tools, and energy management best practices.

Aluminum Industry	**3,069**	**2,265**	**1,750**

In FY 2008, key activities will be in the area of isothermal melting of aluminum, a revolutionary new technology using conduction rather than gas heat for melting and offering many benefits to industry, including energy savings, improved product quality, less noise in the plant, and less pollution. The energy savings are estimated at 70 percent, and industry-wide, the technology could save an estimated 63 trillion Btus in energy and 340 billion dollars per year.

Beginning in FY 2008, any new R&D activities relevant to this industry will be conducted through the crosscutting Energy-Intensive Process R&D activity.

(dollars in thousands)

	FY 2006	FY 2007	FY 2008
Metal Casting Industry	**2,393**	**982**	**194**
In FY 2008, the program will conclude activities in advanced melting and efficient net shape manufacturing processes and transfer of research and development results and technologies to industry.			
Glass Industry	**1,631**	**0**	**0**
Close out of this activity in FY 2006 included the transfer of research and development results and findings to the industry and the public sector.			
Chemicals Industry	**5,060**	**6,787**	**3,694**
In FY 2008, this key activity will be scaled down to bring existing projects addressing Oxidation Reactions, Hybrid Distillations and Micro Reactors to conclusion. Beginning in FY 2008, any new R&D activities relevant to this industry will be conducted through the crosscutting Energy-Intensive Process R&D activity.			
Mining Industry	**1,017**	**0**	**0**
Close out of this activity in FY 2006 included the transfer of the remainder of the research and development results and findings to the industry and the public sector.			
Supporting Industries	**689**	**0**	**0**
Close out of this activity in FY 2006 included the transfer of research and development results and findings to the industry and the public sector.			
SBIR/STTR	**0**	**476**	**259**
In FY 2006, $558,616 and $67,882 were transferred to the SBIR and STTR programs. The FY 2007 and FY 2008 amounts shown are estimated requirements for the continuation of the SBIR and STTR program.			
Total, Industries of the Future (Specific)	**20,708**	**17,001**	**9,254**

Explanation of Funding Changes

	FY 2008 vs. FY 2007 ($000)
Forest and Paper Products Industry New R&D for advanced water removal technologies for pulp and paper processing will transition to crosscutting Energy Intensive Process R&D. ITP will shift toward more crosscutting and higher impact energy-intensive process R&D activities to dramatically improve the energy efficiency and environmental performance of the energy-intensive industries, consistent with R&D Investment Criteria on incorporating “off-ramps”.	-1,126
Steel Industry R&D for alternative ironmaking and new steelmaking technologies will transition to crosscutting Energy Intensive Process R&D. ITP will shift toward more crosscutting and higher impact energy-intensive process R&D activities to dramatically improve the energy efficiency and environmental performance of the energy-intensive industries, consistent with R&D Investment Criteria on incorporating “off-ramps”.	-2,008
Aluminum Industry Beginning in FY 2008, any new R&D activities relevant to this industry will be conducted through the crosscutting Energy-Intensive Process R&D activity. ITP will shift toward more crosscutting and higher impact energy-intensive process R&D activities to dramatically improve the energy efficiency and environmental performance of the energy-intensive industries, consistent with R&D Investment Criteria on incorporating “off-ramps”.	-515
Metal Casting Industry The request will conclude ongoing activities. ITP will shift toward more crosscutting and higher impact energy-intensive process R&D activities to dramatically improve the energy efficiency and environmental performance of the energy-intensive industries, consistent with R&D Investment Criteria on incorporating “off-ramps”.	-788
Chemicals Industry Beginning in FY 2008, any new R&D activities relevant to this industry will be conducted through the crosscutting Energy-Intensive Process R&D activity. The funding requested with provided for the completion of existing projects. ITP will shift toward more crosscutting and higher impact energy-intensive process R&D activities to dramatically improve the energy efficiency and environmental performance of the energy-intensive industries, consistent with R&D Investment Criteria on incorporating “off-ramps”.	-3,093

	FY 2008 vs. FY 2007 ($000)
SBIR/STTR	
Changes in the SBIR/STTR funding are a direct result of changes in the funding of program activities.	-217
Total Funding Change, Industries of the Future (Specific)	**-7,747**

Industries of the Future (Crosscutting)

Funding Schedule by Activity

	(dollars in thousands)		
	FY 2006	FY 2007	FY 2008
Industries of the Future (Crosscutting)			
Industrial Materials of the Future	11,059	9,847	4,753
Combustion	0	2,357	646
Sensors and Automation	3,068	3,051	1,819
Industrial Technical Assistance			
Industrial Assessment Centers	6,411	4,035	4,035
Best Practices	7,390	8,833	8,833
Total, Industrial Technical Assistance	13,801	12,868	12,868
Energy-Intensive Process R&D	0	0	7,241
Fuel and Feedstock Flexibility	0	0	3,888
Interagency Manufacturing R&D	0	0	4,860
SBIR/STTR	0	439	669
Total, Industries of the Future (Crosscutting)	27,928	28,562	36,744

Description

The Industries of the Future (Crosscutting) activities work with industrial partners and suppliers to conduct cost-shared RD&D on technologies that have potential applications across many partner industries. In FY 2008 ITP will begin a transition to more multi-industry application and transformational R&D activities in the Energy-Intensive Process R&D key activity. Investments in the key activity areas of Industrial Materials of the Future, Combustion, Robotics, and Sensors and Automation will be completed and merged into this activity.

In addition, Fuel and Feedstock Flexibility activities will lead to the development and deployment of alternative fuel and feedstock technologies to replace natural gas and oil. Several new activities will be undertaken in FY 2008. With funding of the Interagency Manufacturing R&D activity, ITP will be able to contribute to multi-agency funding of manufacturing R&D thus participating in a larger pool of matching funds. Deployment activities such as Industrial Assessment Centers and the Best Practices activities will continue to deliver the results of energy-efficiency R&D and energy-saving practices to industrial plants nationwide.

Benefits

Crosscutting IOF technologies have provided the means for development of broad benefit and enabling technologies that were not within practical developmental reach of an individual industry. These technologies continue to be developed across industries providing economic, energy and environmental benefits nationally, and the deployment activities bring the results of the R&D to the plant floor.

Detailed Justification

	(dollars in thousands)		
	FY 2006	FY 2007	FY 2008
Industrial Materials of the Future	**11,059**	**9,847**	**4,753**

In FY 2008, work will continue on the development of transformational advanced materials solutions such as membranes for waste energy recovery; refractories for industrial systems; and materials solutions for corrosion and wear. Beginning in FY 2008, any new Materials projects will be undertaken under the crosscutting Energy-Intensive Process R&D which will enable ITP to shift toward broader research areas with higher impacts to improve the energy efficiency and environmental performance of energy-intensive industries. It is anticipated that some selected work in nano-scale materials will be undertaken under the Interagency Manufacturing R&D activity.

Combustion	**0**	**2,357**	**646**

Continue work initiated in FY 2005 for a transformational superboiler, with a demonstration of a high efficiency industrial boiler at over 94 percent fuel-to-steam efficiency at 2 ppm NO_x and CO_2 emissions by FY 2009. This key activity will be scaled down to complete existing projects in FY 2009. Beginning in FY 2008, any future combustion-related projects will be undertaken under the crosscutting Energy-Intensive Process R&D activity which will enable ITP to shift toward broader research areas with higher impacts to improve the energy efficiency and environmental performance of energy-intensive industries.

Sensors and Automation	**3,068**	**3,051**	**1,819**

In FY 2008, this key activity will be scaled down to complete existing projects. Beginning in FY 2008, future sensors and automation projects will be undertaken under the crosscutting Energy-Intensive Process R&D activity which will enable ITP to shift toward broader research areas with higher impacts to improve the energy efficiency and environmental performance of energy-intensive industries. Activities in this area such as wireless real-time sensors systems will also be conducted through the Interagency Manufacturing R&D activity.

Industrial Technical Assistance	**13,801**	**12,868**	**12,868**
▪ **Industrial Assessment Centers**	**6,411**	**4,035**	**4,035**

The ITP Industrial Assessment Centers (IAC) activity funds a network of universities which send graduate engineering students out to small and medium sized manufacturers, conducting free energy audits that identify a range of efficiency improvements, including no-cost and low-cost recommendations, providing assistance to U.S. manufacturers struggling to cope with high energy prices. This activity also supports the Administration's goal of training more engineers and scientists in the energy field. IAC alumni are very much in demand by top firms as energy managers with real-world knowledge and experience, ready to work on projects immediately and improve the bottom line.[a]

(dollars in thousands)

Through the end of 2004, almost 14,000 audits have been completed, training over 2,300 students, with an estimated cumulative energy savings of over 1.1 quadrillion Btus for actions actually implemented by the audited companies. An average of about 350 audits is expected to be conducted annually beginning in FY 2007.

	FY 2006	FY 2007	FY 2008
▪ **Best Practices**	**7,390**	**8,833**	**8,833**

The Best Practices key activity will continue to provide technical assistance to plant sites, enabling their use of industrial process application tools relevant to energy feedstock selection and switching, motor, pump, process heating, steam and compressed air systems emphasizing system-level improvements. ITP also launched an Energy Savings Assessments (ESA) effort to support the Secretarial "Easy Ways to Save Energy" initiative. Secretary Bodman kicked this off on October 3, 2005 as part of a comprehensive national campaign to highlight how American families; businesses and the Federal Government can save energy in response to rising winter energy costs. As part of the ESA campaign, ITP will continue sending energy experts to the Nation's most energy-intensive manufacturing facilities to identify immediate opportunities for saving energy and money.

	FY 2006	FY 2007	FY 2008
Energy-Intensive Process R&D	**0**	**0**	**7,241**

ITP will begin to transition from industry-specific R&D to more crosscutting research. Using the convening power of government to form working groups for future industrial cooperation, this key activity will support multi-industry R&D in the four platform areas of: Advanced Energy Systems (including high efficiency steam generation and combustion technologies and improved energy recovery technologies), Industrial Reaction and Separation (including oxidation processes and advanced water removal), High-Temperature Processing (including high efficiency calcining and next-generation steelmaking), and Fabrication and Infrastructure Technologies (including near net shape casting and forming). This shift toward larger targets of energy savings opportunities will lead to the development of advanced, energy-efficient technologies to serve a broad set of industries in the near- to mid-term time horizon (3-10 years).

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[a] For more information about the education benefits of this activity, see http://www1.eere.energy.gov/industry/bestpractices/about_iac.html#About_the_Students

	(dollars in thousands)		
	FY 2006	FY 2007	FY 2008
Fuel and Feedstock Flexibility	**0**	**0**	**3,888**

Fuel and Feedstock Flexibility activities will seek to displace industrial natural gas use through a targeted, deployment-focused technology development initiative that links industrial users with advanced fuel development activities taking place throughout DOE (e.g., EERE's Biomass Program, the Fossil Energy office, etc.) and the National Laboratories. This activity will assist industry to integrate alternative fuels into manufacturing processes, improving fuel flexibility to reduce the damaging effects of fossil fuel price hikes. Initial efforts will focus on technical analysis of advanced fuel and feedstock flexibility technology platforms and industrial process integration issues. Targeted technology deployment efforts will enhance knowledge among industrial decision makers, catalyze stakeholder collaboration, and generate reliable data and analyses in support of fuel and feedstock flexibility implementation in the industrial sector.

Interagency Manufacturing R&D	**0**	**0**	**4,860**

The Interagency Manufacturing R&D activity will support the development of next-generation manufacturing processes to reduce the energy intensity of the U.S. manufacturing sector dramatically. A technology roadmap workshop will be conducted with industry and in coordination with the Federal agencies participating in the White House Office of Science and Technology Policy's Interagency Working Group on Manufacturing R&D. Initial research focus will include development of technologies such as integrated process predictive tools and wireless real-time sensors systems that are synergetic and adaptable to the confluence of manufacturing processes and products that may reside in dissimilar industries today. The activity will also explore techniques and processes needed for nanomanufacturing, enabling the mass production and application of nano-scale materials, structures, devices and systems to transform industrial processes that could provide energy savings and improve economic productivity.

SBIR/STTR	**0**	**439**	**669**

In FY 2006, $406,000 was transferred to the SBIR and STTR programs. The FY 2007 and FY 2008 amounts shown are estimated requirements for the continuation of the SBIR and STTR program.

Total, Industries of the Future (Crosscutting)	**27,928**	**28,562**	**36,744**

Explanation of Funding Changes

	FY 2008 vs. FY 2007 ($000)
Industrial Materials of the Future	
ITP will shift toward more crosscutting and higher impact R&D activities to improve the energy efficiency and environmental performance of the energy-intensive industries, consistent with R&D Investment Criteria on incorporating "off-ramps".	-5,094
Combustion	
This decrease reflects the completion of the development and demonstration for a transformational super boiler. Beginning in FY 2008, any future combustion-related projects will be undertaken under the crosscutting Energy-Intensive Process R&D activity.	-1,711
Sensors and Automation	
ITP will shift toward more crosscutting and higher impact R&D activities to dramatically improve the energy efficiency and environmental performance of the energy-intensive industries.	-1,232
Energy-Intensive Process R&D	
The Industrial Technologies Program (ITP) will begin a three-year process in FY 2008 to transition from industry-specific research and development (R&D) to more crosscutting research as funding and investigation for existing multi-year projects are completed. This focus on potentially higher pay-off activities is consistent with RDIC guidance.	+7,241
Fuel and Feedstock Flexibility	
This focus on potentially higher pay-off activities is consistent with RDIC guidance.	+3,888
Interagency Manufacturing R&D	
With funding of the Interagency Manufacturing R&D activity, ITP will be able to build upon multi-agency funding of manufacturing R&D science such as industrial nano-manufacturing and integrated and intelligent manufacturing to accelerate industry adoption of new manufacturing technologies.	+4,860
SBIR/STTR	
Changes in the SBIR/STTR funding are a direct result of changes in the funding of program activities.	+230
Total Funding Change, Industries of the Future (Crosscutting)	**+8,182**

Technical/Program Management Support

Funding Schedule by Activity

	(dollars in thousands)		
	FY 2006	FY 2007	FY 2008
Technical/Program Management Support	3,755	0	0
Total, Technical/Program Management Support	3,755	0	0

Description

In the past, consistent with other DOE programs under the jurisdiction of the Interior and Related Agencies Appropriations Committees, the Energy Conservation programs provided funding for Technical/Program Management Support. This included activities such as strategic and operating plans; evaluation of the impact of new legislation on R&D programs; identification and application of performance methodologies (including GPRA); data collection to assess program and project performance, efficiency and impacts on accomplishing the mission; and technical, economic, and market evaluations of research. Those functions are built into the individual program budgets starting in FY 2007.

Benefits

The analysis and technology assessment and planning necessary for good management of the R&D programs will be funded within the programs themselves, since they are an integral part of the Federal role of oversight of the R&D activities.

Detailed Justification

	(dollars in thousands)		
	FY 2006	FY 2007	FY 2008
Technical/Program Management Support	**3,755**	**0**	**0**

Technical management activities, including strategic and technical planning; project and performance tracking; program reviews and evaluations, including R&D feasibility studies and trade-off analyses; peer reviews; data collection and publication; and market, economic, and other analyses are all part of the sound management of any R&D or technology deployment program. Consistent with Energy and Water committee standard practice, funding for those activities will be provided from within the requested budgets for the Industrial Technologies starting in FY 2007.

Total, Technical/Program Management Support	**3,755**	**0**	**0**

Congressionally Directed Activities

Funding Schedule by Activity

	(dollar in thousands)		
	FY 2006	FY 2007	FY 2008
Congressionally Directed Activities	3,465	0	0
Total, Congressionally Directed Activities	3,465	0	0

Description

In FY 2006, ITP provided funding for two earmarked projects managed by the Biomass and Biorefinery systems R&D Program.

Detailed Justification

	(dollars in thousands)		
	FY 2006	FY 2007	FY 2008
Anaerobic Digestion – Ohio Agricultural Research Development Center	**1,485**	**0**	**0**
Anaerobic digestion technology for converting organic food wastes to syngas and hydrogen useful products.			
National Biofuel Energy Laboratory	**1,980**	**0**	**0**
Research on biodiesel/petroleum diesel with carefully controlled compositions to determine impacts on emissions, exhaust system life and vehicle operation.			
Total, Congressionally Directed Activities	**3,465**	**0**	**0**

Federal Energy Management Program

Funding Profile by Subprogram

	(dollars in thousands)		
	FY 2006 Current Appropriation	FY 2007 Request	FY 2008 Request
Federal Energy Management Program			
Project Financing	6,759	5,935	7,935
Technical Guidance and Assistance	7,642	6,519	6,519
Planning, Reporting and Evaluation	2,574	2,473	2,337
Departmental Energy Management	1,999	1,979	0
Total, Federal Energy Management Program	18,974	16,906	16,791

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)
P.L. 109-190, "Energy Policy Act" (2005)

Mission

The Federal Energy Management Program (FEMP) strives to enhance energy security, environmental stewardship and cost reduction within the Federal Government by advancing energy efficiency and water conservation; promoting the use of renewable energy, alternative fuels in Federal vehicle fleets, sustainable building design, and distributed energy resources; and improving utility management decisions at Federal facilities.

Benefits

FEMP supports DOE's goal of improving energy security by improving the energy efficiency and productivity of Federal Government buildings and by promoting a diverse supply and delivery of reliable, affordable, and environmentally sound energy to Federal facilities. These activities fulfill several national energy and environmental priorities as outlined in the President's National Energy Policy (NEP) as well as the statutory requirements of the National Energy Conservation Policy Act (NECPA); Energy Policy Act of 1992 (EPACT); Energy Policy Act of 2005; and provisions of Executive Order 13123 (Efficient Energy Management) and Executive 13149 (Federal Fleet). These policy measures call upon Federal agencies to reduce the energy intensity of their operations, accelerate the protection and improvement of the environment, and increase our Nation's energy security.

As of 2005 (the year with the latest available data), FEMP has assisted Federal agencies in reducing energy intensity in Federal buildings by 29.6 percent using 1985 as a baseline. While there is a trend in reducing energy intensity over time, a great many factors combine to affect Federal agency energy consumption in any one year. Throughout its program history, FEMP has had a significant effect on reducing Federal energy intensity, as do other factors such as new Federal building construction; military base closures and greater use of the existing building stock have contributed to this reduction as well. The Federal fleet program helps the Federal Government reduce on-road petroleum consumption in Federal vehicles.

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

Strategic and GPRA Unit Program Goals

The Department's Strategic Plan identifies five Strategic Themes (one each for nuclear, energy, science, management, and environmental aspects of the mission) plus 16 Strategic Goals that tie to the Strategic Themes. The Federal Energy Management Program directly supports the following goal:

Strategic Theme 1, Energy Security

Strategic Goal 1.4, Energy Productivity: Cost-effectively improve the energy efficiency of the U.S. economy.

And concurrently supports:

Strategic Goal 1.1, Energy Diversity: Increase our energy options and reduce dependence on oil, thereby reducing vulnerability to disruptions and increasing the flexibility of the market to meet U.S. needs; and Strategic Goal 1.2, Environmental Impacts of Energy: Improve the quality of the environment by reducing greenhouse gas emissions and environmental impacts to land, water, and air from energy production and use.

DEMP/FEMP has one GPRA Unit Program goal which contributes to Strategic Goals 1.1, 1.2 and 1.4 in the "goal cascade:"

GPRA Unit Program Goal 1.4.07.00: Federal Energy Management Program - The Federal Energy Management Program goal is to provide assistance with project financing and technical assistance to Federal agencies to further the use of cost-effective energy efficiency and renewable energy. FEMP's activities enhance energy security, environmental stewardship and cost reduction within the Federal Government.

FEMP's assistance will help agencies reach the goals set by Executive Order and legislation. In addition to these FEMP-assisted efforts, agencies make additional energy savings investments without direct FEMP assistance and are expected to continue to do so. Federal agencies will need to make significant investments beyond the projects assisted by FEMP to meet the goals set forth by Executive Order 13123 and the Energy Policy Act of 2005 as summarized below:

- Executive Order 13123 establishes that the goal for all Federal agencies is to reduce energy intensity in Federal buildings by 35 percent by 2010 (relative to the 1985 baseline level of 139,480 Btu per gross square foot).

- The Energy Policy Act of 2005 sets forth the following goals for Federal agencies (including the Department of Energy):
    - Reduce energy consumption per square foot by 20 percent by 2015 compared to the baseline year of FY 2003 at a rate of 2 percent per year.
    - Ensure that at least 3 percent of Federal electricity consumption be generated by renewable in the years FY 2007 through FY 2009; 5 percent in the years FY 2010 through FY 2012; and 7.5 percent in FY 2013 and each fiscal year thereafter.

DOE has already achieved the Executive Order 13123 goal for 2010 to reduce the energy intensity in its standard buildings. The baseline (1985) energy intensity in standard buildings was 473,126 Btu per square foot, whereas the energy intensity in 2005 was 224,043 Btu per square foot, showing a 53 percent reduction in energy intensity in that time period. Contributing factors to this reduction in intensity include actions that were related to FEMP program activities such as retrofit projects receiving technical assistance from FEMP or projects financed through Energy Savings Performance Contracts. Other factors independent of FEMP which have contributed to this reduction include decommissioning of old buildings, changes in mission at facilities and construction of new facilities (which are generally more energy efficient than older building stock).

Executive Order 13123 set a goal for all Federal agencies to use renewable energy for 2.5 percent of electricity consumption in FY 2005. In FY 2005, renewable energy (including purchased renewable energy credits) accounted for 6.9 percent of Federal facility electricity consumption. The Federal government as a whole exceeded the FEMP goal, although some individual agencies did not.

Contribution to GPRA Unit Program Goal 1.4.07.00 (DEMP/FEMP)

FEMP contributes to the Program Goal by assisting Federal agencies through alternative financing contract support, technical assistance, guidance on Federal fleet activities and reporting and evaluating agency progress each year. The program facilitates the award of alternative financing contracts between Federal agencies and the private sector to fund energy efficiency improvements through the use of dollar savings on Federal energy bills. FEMP provides technical assistance to Federal energy managers so they can identify, design, and implement energy efficient and renewable energy technologies and practices. In addition, FEMP reports to Congress on Federal energy efficiency, renewable electric power and agency compliance with relevant Executive order requirements.

Success occurs when FEMP and its agency and private sector partners enable Federal energy managers to make better energy management choices that result in a more efficient, effective and energy secure government. In FY 2008, FEMP's goal is to complete Energy Savings Performance Contract (ESPC) and Utility Energy Service Contract (UESC) awards and provide technical assistance that will result in lifecycle Btu savings of 20.2 trillion. These savings should result in about a 0.4 percent annual reduction in energy intensity.

DOE government-owned contractor operated (GOCO sites) spend a significant amount of indirect funds for energy efficiency and renewable energy projects and will continue to do so. Therefore, in FY 2008, the Department plans to close out project funding under the Departmental Energy Management Program (DEMP), but policy, oversight, coordination and reporting will continue. As with other Federal agencies, FEMP will assist DOE sites with third party financing and technical assistance.

In FY 2008, FEMP will be taking over the reporting, analysis and coordination responsibilities of the Federal Fleet Activity from the Office of FreedomCAR and Vehicle Technologies. Also, in FY 2008, FEMP will be taking over responsibility of Federal building performance standards from the Office of Building Technologies.

Funding by Strategic and GPRA Unit Program Goal

	(dollars in thousands)		
	FY 2006	FY 2007	FY 2008
Strategic Goal 1.4, Energy Productivity			
GPRA Unit Program Goal 1.4.07.00, DEMP/FEMP			
Project Financing	6,759	5,935	7,935
Technical Guidance and Assistance	7,642	6,519	6,519
Planning Reporting and Evaluation	2,574	2,473	2,337
Departmental Energy Management	1,999	1,979	0
Total, GPRA Unit Program Goal 1.4.07.00, DEMP/FEMP	18,974	16,906	16,791
Total, Strategic Goal 1.4 (Federal Energy Management Program)	18,974	16,906	16,791

Annual Performance Results and Targets

FY 2003 Results	FY 2004 Results	FY 2005 Results	FY 2006 Results	FY 2007 Targets	FY 2008 Targets
GPRA Unit Program Goal 1.4.07.00 (DEMP/FEMP)					
Project Financing/Technical Guidance and Assistance/Departmental Energy Management					
				Complete ESPC and UESC contract awards, fund DOE retrofit projects and provide technical assistance that will result in lifecycle Btu savings of 17.1 trillion.	Complete ESPC and UESC contract awards and provide technical assistance that will result in lifecycle Btu savings of 20.2 trillion. These savings should result in about a 0.4 percent annual reduction in energy intensity.
Project Financing					
Achieve between $80 and $120 million in private sector Energy Savings Performance Contract (ESPC) investment. [MET: $252 million in private sector investment]	Achieve between $35 and $55 million in private sector investment through Super ESPCs, contributing to National energy security. [NOT MET: Program not authorized]	Will achieve between $80 and $120 million in private sector investment through Super ESPCs which will result in about a 0.2 percent annual reduction in energy intensity. These projects are cost-effective resulting in a positive net present value gain for the tax payer. [NOT MET. MET reduced goal of $60 million -- $73 million in private sector investment].	Will achieve between $80 and $120 million in private sector investment through Super ESPCs and/or UESCs which we expect to result in about a 0.2 percent annual reduction in energy intensity. These projects are cost-effective resulting in a positive net present value gain for the tax payer. [MET]		

FY 2003 Results	FY 2004 Results	FY 2005 Results	FY 2006 Results	FY 2007 Targets	FY 2008 Targets
Technical Guidance and Assistance					
Provide technical and design assistance for 40 energy efficiency, renewable energy, and water conservation projects; 10 will be large-scale distributed energy resources and combined heat and power projects. Report results achieved through the end of FY 2001. [MET: 53 energy efficiency and renewable projects]	Provide technical and design assistance for 60 energy efficiency, renewable energy, Operations and Management (O&M), distributed Energy Resource (DER)/Combined Heat and Power (CHP), and water conservation projects. [MET: 66 energy efficiency and renewable projects]	Will provide technical and design assistance for 60 Federal projects which include energy efficiency, renewable energy, O&M, Distributed Energy Resources, Combined Heat and Power, SAVEnergy Audits, ALERTS and water conservation projects. These projects are cost-effective, because the technologies applied have been shown to be cost-effective by the supporting EERE programs. [MET: 73 energy efficiency and renewable projects]	Provide technical and design assistance for 27 Federal projects (e.g., energy efficiency, renewable energy, Operations and Maintenance, Distributed Energy Resources, Combined Heat and Power, Assessment of Load and Energy Reduction Techniques (ALERTS) and water conservation projects) which are expected to result in energy savings of about 60 billion Btus. [MET]		
Complete at least 35 energy assessments including SAVEnergy Audits, industrial facility assessments and operation and maintenance assessments to identify energy and cost saving opportunities. [MET: 50 energy assessments]					
Train 4,000 Federal energy personnel in best practices supporting National Energy Policy education goals. [MET: 6700 personnel trained]	Train 4,000 Federal energy attendees in energy management best practices supporting National Energy Policy education goals. [MET: 4,450 personnel trained]	Train 4,000 Federal energy attendees in energy management best practices supporting National Energy Policy education goals. [MET: 4844 personnel trained]			
Integrate information on standby power into Defense Logistics Agency and General Services Administration's product schedules in accordance with E.O. 13221. [MET]					

FY 2003 Results	FY 2004 Results	FY 2005 Results	FY 2006 Results	FY 2007 Targets	FY 2008 Targets
Departmental Energy Management					
Complete the selection process for between 4 and 12 energy projects that will reduce the annual energy use in DOE facilities by 15 billion Btus. [MET: 14 projects selected for a reduction of 29 billion Btus.]	Complete the selection for funding of 4 to13 energy efficiency projects through a competitive selection process that chooses those projects with the greatest return on investment. [MET: 11 projects selected for a reduction of 35 billion Btus.]	Complete the selection for funding of 4 to 13 energy efficiency projects through a competitive selection process that chooses those projects with the greatest return on investment. [MET: 13 projects selected.]	Complete the selection for funding of 3 energy retrofit projects that will provide the required dollar savings to achieve a 20 percent return on the investment of the DEMP funding. These projects will save over 12 billion Btus per year. [MET]		
	Contribute proportionately to EERE's corporate goal of reducing corporate and program uncosteds to a range of 20-25 percent by reducing annual program uncosteds by 10 percent in 2004 relative to the program uncosted baseline (in 2003) until the target range is met. [NOT MET: EERE actively accelerating costing of funds.]	Contribute proportionately to EERE's corporate goal of reducing corporate and program adjusted uncosted obligated balances to a range of 20-25 percent by reducing program annual adjusted uncosteds by 10 percent in 2005 relative to the FEMP/DEMP Program FY 2004 end of year adjusted uncosted baseline ($11,266K) until the target range is met. [NOT MET]	Maintain total administrative overhead costs (defined as Program Direction and Program Support excluding earmarks) in relation to total program costs of less than 12 percent. [MET]	Maintain total administrative overhead costs (defined as Program Direction and Program Support excluding earmarks) in relation to total program costs of less than 12 percent.	Maintain total administrative overhead costs in relation to total program costs of less than 12 percent. Baseline for administrative overhead rate currently being validated.

Means and Strategies

FEMP will use various means and strategies to achieve its GPRA Unit Program goals as described below. "Means" include operational processes, resources and information, and "strategies" include program, policy, management and legislative initiatives. 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.

FEMP helps Federal agencies take advantage of energy management opportunities in building construction, renovation, retrofit, operations and maintenance; energy consuming product and equipment procurement; and utility service acquisition and utility load management.

FEMP will implement the following means:

- Developing policy and guidance to achieve Executive Order and legislative requirements;
- Directing project analysis and engineering services at Federal sites;
- Providing energy savings performance contracting mechanisms and oversight for the Federal sites;
- Evaluating the potential of new, innovative technologies for use in the Federal sector;
- Reporting progress with respect to energy conservation at the Federal agencies;
- Providing oversight and approval of DOE utility contracts and support utility rate interventions; and
- Providing analysis and reporting on Federal Fleet Activity to identify issues and problem areas that present challenges. FEMP will work with agencies to develop strategies for addressing those issues and shares the lessons learned with other fleets.

FEMP will implement the following strategies:

- Identify high impact opportunities across Federal agencies for energy efficiency improvements and to increase the use of renewable energy;
- Identify opportunities for widespread use of energy efficient and renewable energy technologies in the Federal sector and deploy these technologies through coordinated procurement, alternative financing, or other means; and
- Recommend strategies for improved security for critical energy needs at Federal facilities.

These strategies will result in significant cost and energy savings and improved energy security at Federal facilities.

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

- Mission changes at Federal sites that would change building usage;
- Availability of energy management personnel at Federal sites; and
- Energy price increases that could help focus attention on energy conservation.

The following collaborations help FEMP achieve its goals:

- FEMP collaborates with agency leadership, energy and facility managers from other Federal agencies and State and industry partners to identify key opportunities for enhancing energy efficiency and the use of renewable energy at Federal facilities; and
- FEMP helps DOE program offices develop energy performance plans with their respective "landlord" sites in order to achieve energy management goals and measure progress.

Validation and Verification

To validate and verify programs, FEMP conducts ongoing internal reviews of its program activities each year. In addition, external peer reviews are conducted. FEMP provides a report to Congress every year on the progress of Federal agencies on reaching their energy efficiency and renewable energy goals.

Data Sources:	Agencies submit annual reports to the Department of Energy documenting energy use in buildings, cost, gross square footage and exempt facilities and FEMP compiles this information in a report to Congress each year. For the Federal Fleet activity, agencies enter fleet and fuel use data into the Federal Automotive Statistical Tool (FAST) database.
Baselines:	The baseline for the energy efficiency goal for Federal facilities of the Energy Policy Act of 2005 is the FY 2003 energy intensity of standard and energy intensive Federal buildings – approximately 115,000 Btu per square foot. The baseline for Executive Order 13123 for standard buildings is the 1985 energy intensity of 139,480 Btu/square foot. As established by Executive Order 13149, the baseline for the Federal Fleet was the amount of Federal petroleum usage in 1999 – 281 million gallons of gasoline equivalent.
Frequency:	Annual.
Evaluation:	In carrying out the program's mission, the Federal Energy Management Program uses several forms of evaluation to assess progress and to promote program improvement: ▪ Peer review by independent outside experts of both the program and subprogram portfolios; ▪ Annual internal program reviews; ▪ Specialized program evaluation studies to examine process, impacts, or market baseline and effects, as appropriate; ▪ Quarterly and annual assessment of program and management results based performance through Joule (the DOE quarterly performance progress review of budget targets); PMA (the President's Management Agenda – annual departmental and Program Secretarial Officer (PSO) based goals whose milestones are planned, reported and reviewed

quarterly); and PART (common government wide program/OMB reviews of management and results); and

- Annual review of methods, and recomputation of potential benefits for the Government Performance and Results Act (GPRA).

Data Storage:	FEMP maintains a database of reported information. Agencies maintain their own, more detailed data.
Verification:	External audits are conducted each year. Reporting anomalies are identified and resolved during the annual reporting cycle.

Program Assessment Rating Tool (PART)

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

The Federal Energy Management Program participated in its first PART review in 2005. This PART review included ratings of 100 percent for program purpose, 100 percent for planning, 86 percent for management and 50 percent for program results and accountability with an overall rating of Moderately Effective. These ratings reflect the commitment of EERE program management to the basic management and planning principles of the President's Management Agenda, including the criteria scored in the PART and the Implementation of the EERE reorganization employing those principles. In response to the PART findings and recommendations, FEMP has taken action to ensure that responsibility for planning and strategy development is assigned to program staff with a reduced dependence on contractors for these activities. In addition, action has been taken to make sure that measures that the program uses internally to assess performance of its various activities are consistent with program's long-term and annual measures.

The Department has responded to the PART recommendation of "Develop guidance that specifies a consistent framework for analyzing the costs and benefits of research and development investments, and uses this information to guide budget decisions." The Department has specified common scenarios, common methodology, and standardized benefits measures to allow analyzing the costs and benefits of applied R&D investments. While progress has been made, benefits estimates across programs are still not completely comparable. The Department continues to work on implementation of common assumptions and a consistent approach to incorporation of risk.

Expected Program Outcomes

FEMP pursues its mission through integrated activities to improve the energy efficiency of, and renewable energy usage by, the Federal Government. We expect these improvements to reduce the energy intensity at Federal facilities, lower their energy bills and provide environmental benefits. Additionally, building energy efficiency technologies provide less easily quantifiable benefits, such as improved lighting quality and building occupant productivity. The benefits estimates reported exclude any expected acceleration in the deployment of the technologies that may result from "spillover" to state or local office buildings.

Estimates of the security, economic and environmental benefits from 2008 through 2050 that would result from realization of the program's goals are shown in the table below.

EERE's FEMP Program Goal Case reflects the program's continuance over time, and the gradual penetration of efficiency measures throughout Federal buildings.

The goals are modeled in contrast to the "baseline" case, in which no DOE R&D or deployment programs exist. The baseline case is identical to those used for all DOE applied energy R&D programs.[a] Further, across EERE, and across all of DOE's applied energy R&D programs, the expected outcome benefits are being calculated using the same fundamental methodology. Finally, the metrics by which expected outcome benefits are measured are identical for all of DOE's applied energy R&D programs.[b] This standardization of methods and metrics has been undertaken as part of the Department's efforts to respond to Under Secretary Garman's Strategic Management System initiative and OMB's request to make all programs' outcomes comparable.

The difference between the baseline case and the program goal case results in economic, environmental and security benefits. For example, achievement of program goals results in a reduction in net consumer expenditures of 1 billion dollars in both 2030 and 2050. Finally, the program would also result in carbon emissions reductions of 1 million metrics tons in both 2030 and 2050. The results are generated by modeling the program goals within two energy-economy models: NEMS-GPRA08 for benefits through 2030, and MARKAL-GPRA08 for benefits through 2050.[c] The full list of modeled benefits appears on the next page.

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[a] The starting point for the baseline case is the Energy Information Administration's "reference case," as published in the AEO 2006. Program analysts from across DOE examined the AEO to determine the extent to which their program goals are modeled (explicitly or implicitly). If program goals are modeled in the AEO, they are removed in the GPRA baseline. Further, some programs believe that the AEO's technology representation is too conservative, even in the absence of program goals, and thus in certain cases a modification is made to make the technology representation in the baseline case more optimistic than the AEO.

[b] The set of expected outcome metrics being used this year differs in substantial ways to that of previous years. In addition to the standardization across DOE's applied energy R&D programs, the list is expanded and more comprehensive than in past years. Further, the list maps to DOE strategic goals. The expected outcome metrics represent inherent societal benefits that stem from achievement of program goals.

[c] Final documentation on the analysis and modeling, including all of the methodologies and underlying assumptions, is expected to be completed and posted on the web by March 31, 2007. Past GPRA modeling and analysis documentation can be found at http://www.eere.energy.gov/ba/pba/gpra.html.

FY 2008 GPRA Benefits Estimates for Federal Energy Management Program[a,b]

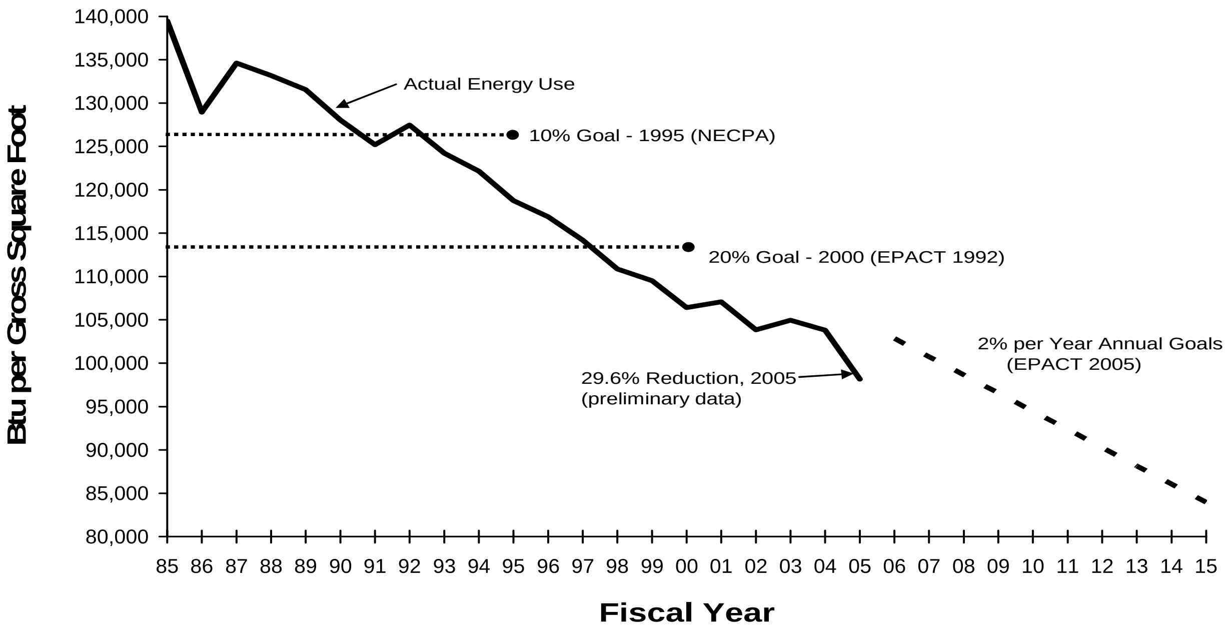
	2010	2020	2030	2040	2050
Environmental Benefits (Goal 1.2)					
Avoided carbon emissions, annual (MMTC)	0	1	1	2	1
Avoided carbon emissions cumulative (MMTC)	0	3	11	23	35
Reduced cost of criteria pollutant control, NPV[c] (bil. 2004$)	ns	ns	ns	NC	NC
Economic Benefits (Goal 1.4)					
Consumer savings, annual (bil. 2004$)	0	1	1	1	1
Consumer savings, NPV (bil. 2004$)	0	3	7	15	19
Electric power industry savings, annual (bil. 2004$)	ns	ns	0.3	ns	ns
Electric power industry savings, NPV(bil. 2004$)	0.1	0.7	2	4	5
Household energy expenses reduced, annual (bil. 2004$)	ns	ns	ns	ns	ns
Energy intensity reduced (% change in E/GDP)	ns	0.1%	0.1%	ns	ns
Net energy system cost savings, annual (bil. 2004$)	NC	NC	NC	2	2
Natural gas price change, moving avg. (2004$ / TCF)[d]	ns	ns	ns	NC	NC
Security and Reliability Benefits (Goal 1.1. or 1.3)					
Avoided oil imports, annual (mbpd)	ns	ns	ns	ns	ns
Avoided oil imports, cumulative (bil. bbl)	ns	ns	ns	ns	ns
Security MPG improvement (%)[e]	ns	ns	ns	ns	ns
Transportation fuel diversity improvement (%)[f]	ns	ns	ns	ns	ns
Oil intensity reduced (% change in bil bbl/GDP)	ns	ns	ns	ns	ns

[a] Benefits through 2030 are calculated with the NEMS-GPRA08 model. Benefits from 2035 through 2050 are calculated with the MARKAL-GPRA08 model. "NC" indicates situations in which no calculation was done because of specific model limitations. "ns" indicates results that were "not significant"—within the noise of the models.
[b] Projected benefits do not include any potential policy changes that might enhance technology deployment. In addition, most technologies show diminishing benefits by 2050, because of the assumption built in to the analysis that baseline industry progress will eventually catch up with the more accelerated progress associated with EERE program success.
[c] Net present value calculations throughout this table are performed for cumulative economic metrics, and are done using a 3% real discount rate, cumulative to 2008.
[d] The prices reflected here are average delivered prices to all sectors, and are based on a three year moving average. Thus the measure of benefit is the change in the three year moving average delivered price, in $ per thousand cubic foot.
[e] Security MPG is the ratio of vehicle miles traveled by light duty vehicles to their usage of oil. It captures oil avoidance by efficiency and fuel alternatives.
[f] Fuel diversity is measured by the Shannon-Weiner Index (SWI) of diversity. The SWI is a measure of "proportional diversity," and hence captures both abundance and richness, i.e., how many different fuels and how much of each fuel both factor into the calculation.

In addition to the benefits quantified, 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.

The EPACT 2005 goal calls for a 2 percent reduction in Federal building energy intensity each year between 2006 through 2015 measured against a 2003 baseline. The following figure shows the goals from three pieces of legislation along with the actual energy intensity over time for Federal agencies for standard buildings. Although the figure illustrates energy intensity objectives for standard buildings, the annual goals from the Energy Policy Act of 2005 include both standard and energy intensive buildings. Previous goals established in NECPA and the EPACT 1992 were measured against a 1985 baseline. More information regarding these goals can be found on FEMP's website: www.eere.energy.gov/femp.

Standard Building Energy Intensity[a]



[a] Figure uses data compiled from FEMP's Annual Report to Congress. Goals from the following are shown: National Energy Conservation Policy Act (NECPA) (1978), Energy Policy Act (1992) and Energy Policy Act (2005).

Project Financing

Funding Schedule by Activity

	(dollars in thousands)		
	FY 2006	FY 2007	FY 2008
Project Financing	6,759	5,935	7,935
Total, Project Financing	6,759	5,935	7,935

Description

FEMP developed its alternative financing effort to help Federal agencies access private sector financing to fund needed energy improvements. It provides guidance, documentation and individual project assistance to Federal agencies which utilize Energy Savings Performance Contracts (ESPCs), public benefit funds, and Utility Energy Service Contracts (UESCs) to finance energy saving improvements. This financing pays for energy improvements at Federal facilities that are in need of significant energy system retrofits. Projects include energy improvements of all types, such as lighting upgrades, new heating and ventilation systems, and improved control systems. The Energy Policy Act of 2005 extended the authority for implementing ESPCs through 2016.

Benefits

These third party funding mechanisms for energy efficiency and renewable energy projects have and will continue to improve the energy efficiency of Federal facilities. These projects reduce the energy bills of Federal facilities and are implemented with little or no upfront cost to the government. By providing a means for Federal agencies to utilize renewable energy and energy efficiency technologies, these financing mechanisms help reduce the emissions associated with power usage at Federal facilities and promotes the use of clean alternatives to conventional technologies.

FEMP has set a target to facilitate energy investments through project financing that will result in lifecycle Btu savings of 14.9 trillion from FEMP project financing activities in FY 2008. This savings is equivalent to displacing the energy use of about 10,800 households over the lifetime of the investment.

Detailed Justification

	(dollars in thousands)		
	FY 2006	FY 2007	FY 2008
Project Financing	**6,759**	**5,935**	**7,935**

Federal agency use of ESPCs was authorized by Congress to provide an alternative to direct appropriations for the funding of energy-efficient improvements in Federal facilities. Under the ESPC legislation, agencies can take advantage of private sector financing and expertise with little or no upfront cost to the Government. The Government pays back the industry — including interest at private sector rates — through energy cost savings over the life of the projects. ESPC and UESC projects will continue in the areas of energy-efficient improvements, renewable energy technologies, alternative fuel (biomass/landfill), combined heat and power, and reduced water consumption technologies.

The Department of Energy is responsible for ESPC oversight and reporting. FEMP will continue to make improvements in the areas of project facilitation, financing, reporting and competition. Competitively awarded project facilitators will continue to provide ESPC and UESC assistance including identifying and screening projects, preparing delivery orders and evaluating proposals. They will provide technical, contracting and information expertise for issues such as interest rates, competitive financing, and utility rates to support the negotiation process and National Laboratory expertise will continue to be utilized in FY 2008.

Reporting and monitoring of contract performance will continue to ensure data integrity and provide the Federal Government with improved means of quantifying benefits. This will include activities in measurement and verification methodologies and practices related to quantifying ESPCs and UESCs benefits.

Analytical activities will continue in support of reporting requirements for project metrics, milestones and program plans to implement improvements in the ESPC and UESC activities.

Activities supporting the use of state-provided public benefit funds for Federal facilities will continue. Specifically, a website will be supported to identify the public benefits funds available for Federal sites. Technical experts at the project management center will assist Federal agencies applying for public benefit funds.

Technical and financial analysis assistance provided for the ESPC and UESC projects is expected to result in Federal agency reimbursements of about $800,000 in FY 2008. Reimbursements were $330,000 in FY 2006 and projected to be $750,000 in FY 2007. In FY 2008, these funds will be used for technical and financial analyses by project facilitators, the marketing of ESPC projects through alternative financing representatives, Federal employee travel, contractor support, funding a contingency account to reimburse Federal agencies for fees collected on projects that were terminated, and other third party financing activities.

Total, Project Financing	**6,759**	**5,935**	**7,935**

Explanation of Funding Changes

	FY 2008 vs. FY 2007 ($000)
The increase in funding will be used to expand program outreach, measurement and verification activities, project facilitation and technical assistance for ESPCs.	+2,000
Total Funding Change, Project Financing	**+2,000**

Technical Guidance and Assistance

Funding Schedule by Activity

(dollars in thousands)

	FY 2006	FY 2007	FY 2008
Technical Guidance and Assistance			
Direct Technical Assistance	5,722	6,519	6,519
Training and Information	1,920	0	0
Total, Technical Guidance and Assistance	7,642	6,519	6,519

Description

Technical Guidance and Assistance helps Federal agencies take advantage of innovative technologies, tools, and best practices. FEMP assists Federal energy managers in their efforts to identify, design, and implement new construction and facility improvement projects. FEMP provides unbiased, expert technical assistance in areas such as audits for buildings and new technology deployment, including combined heat and power and distributed energy technologies. FEMP also provides analytic software tools to help agencies choose the most effective energy and water project investments. In addition, FEMP helps agencies acquire the most energy efficient and water conserving products by continuing to update its specifications for highly energy efficient products and providing them to the General Services Administration and Defense Logistics Agency as required by the "federal purchase requirement" set forth in the Energy Policy Act of 2005.

Benefits

Technical Guidance and Assistance supports FEMP's mission by helping agencies implement projects and practices that reduce energy bills, improve air quality, and promote the use of water conservation, energy efficiency and renewable energy. FEMP's direct project assistance provides the information and means that agencies need to determine cost-saving and energy-saving practices appropriate to their needs as they design new buildings and renovate existing ones. FEMP's technical assistance on energy efficiency and renewable technologies results in accelerated acceptance of these technologies in the Federal sector.

FEMP's goal is to provide technical assistance that will result in lifecycle Btu savings of 5.3 trillion from FEMP technical assistance activities in the areas of energy efficiency, renewable energy, Operations and Maintenance (O&M), Distributed Energy Resources, Combined Heat and Power, Energy Savings Expert Teams and water conservation projects. This savings is equivalent to displacing the energy use of about 3,900 households over the lifetime of the investment.

Detailed Justification

	(dollars in thousands)		
	FY 2006	FY 2007	FY 2008
Direct Technical Assistance	**5,722**	**6,519**	**6,519**

FEMP's technical assistance activities will continue to support cost-effective investments in energy efficiency and renewable energy technologies. Direct technical assistance will continue to provide analytical support and expert assistance to Federal agencies. National Laboratory technical assistance will be utilized in areas where competitively selected private sector experts are not available and to provide unbiased technical review.

Current areas of activity include lighting and renewable energy and Combined Heat and Power (CHP) technologies for energy security. In-depth technology installation reviews will be completed at each site. Analytical review of new technologies will assess the technical potential for replication in the Federal sector, energy savings potential and cost. Federal Technology Alerts, and web-based technical case studies and guidance documents, which provide summary information on candidate energy-saving technologies, will continue to be developed. The Energy Policy Act of 2005 establishes that FEMP is responsible for carrying out a number of activities, including developing product specifications and issuing guidance on metering, new construction, and other energy-related building topics. FEMP will continue to update its specifications for highly energy efficient products and provide them to the General Services Administration and Defense Logistics Agency as required by the Federal purchase requirement set forth in the Energy Policy Act of 2005. Program-specific technical training and information will continue on a limited basis and will rely primarily on web-based training where appropriate. FEMP will continue to employ Energy Savings Expert Teams.

Guidance documents and analytical assistance will continue to be provided in the area of renewable energy credit purchases and bulk procurements. Additional analysis and guidance documents will be developed to educate decision makers on regulatory, market, economic and environmental benefits or impacts to the Federal sector.

Tools will continue to be developed that support the Federal sector including energy management programs that analyze energy/water consumption and provide analysis on energy efficient products.

Information and technical assistance will be provided to agencies to implement new Federal Building Performance Standards. EPACT 2005 also requires that DOE revisit, and possibly revise, these Performance Standards after the American Society of Heating, Refrigeration and Air-Conditioning Engineers updates it's American Society of Heating, Refrigerating and Air Conditioning Engineers (ASHRAE) 90.1 Standard in 2007. In this effort, FEMP will undertake cost-effectiveness analysis and environmental impact modeling.

	(dollars in thousands)		
	FY 2006	FY 2007	FY 2008
Training and Information	**1,920**	**0**	**0**

General energy efficiency and renewable energy training and information activities were transferred to Technology Advancement and Outreach in FY 2007.

Prior to FY 2007, this subprogram included the provision of technical information, tools and technical information.

	FY 2006	FY 2007	FY 2008
Total, Technical Guidance and Assistance	**7,642**	**6,519**	**6,519**

Planning, Reporting and Evaluation

Funding Schedule by Activity

	(dollars in thousands)		
	FY 2006	FY 2007	FY 2008
Planning, Reporting and Evaluation	2,574	2,473	2,337
Total, Planning, Reporting and Evaluation	2,574	2,473	2,337

Description

The Energy Policy Act of 2005 and Executive Order 13123 require the Department to collect, verify and report on progress by the Federal agencies (including the Department of Energy) toward the goals that address energy efficiency in facilities that includes standard buildings, industrial and commercial space, petroleum reduction and water conservation. FEMP will collect and publish data for the Annual Report to Congress and respond to inquiries to help ensure accuracy in reporting and analysis of trends.

In FY 2008, FEMP will be taking over the responsibilities for reporting and analysis for the Federal Fleet subprogram from the Office of FreedomCAR and Vehicle Technologies. The Federal fleet activity provides guidance and support to each agency toward compliance with legislative and Executive order requirements to reduce dependence on foreign sources of oil. To streamline the compliance process, the program works with the agencies to develop strategies for addressing those issues and shares the lessons learned with other fleets. The role of the Federal fleet activity is to implement compliance measures in each agency's fleet activity in support of the Energy Policy Acts of 1992 and 2005, and Executive Order 13149.

Benefits

Through reporting and evaluation, FEMP meets the reporting requirements set forth by Congress and Executive Order for Federal facilities and the Federal Fleet. In this way the program's investments lead to the greatest possible reductions in energy costs, improvements in air quality, and promotion of water conservation, energy efficiency and renewable energy technologies.

Detailed Justification

	(dollars in thousands)		
	FY 2006	FY 2007	FY 2008
Planning, Reporting and Evaluation	**2,574**	**2,473**	**2,337**

The Energy Policy Act of 2005, Executive Order 13123 and the National Energy Conservation Policy Act require the Department of Energy (DOE) to collect, verify and report to Congress on the progress by the Federal agencies, including DOE, toward the Federal facility energy management goals of reducing energy intensity in buildings, reducing petroleum usage and conservation of water. Data collection, verification and reporting continue to be centralized for the Federal agencies at FEMP with the assistance of technical experts for preparing analysis and verification of data. This also includes maintaining the Department of Energy's facilities information and developing annual plans and reports. Information will be made available on Federal progress toward the legislative and Executive Order goals on the FEMP website and technical updates to web-based materials will continue for the Federal sector.

Technical analysis will continue as required to respond to analytical reporting requirements involved with the Government Performance and Results Act (GPRA), the Program Assessment and Rating Tool (PART), multi-year planning and peer reviews. Program assistance will continue in preparing and updating the Federal sector plans for meeting the legislative and Executive Order goals as well as recognizing progress through Presidential and Federal awards program. Support will also be provided for the Federal Energy Management Advisory Committee and other interagency committees.

In its outreach efforts, FEMP's activities will be streamlined with increased utilization of electronic media to offset printing and mailing costs. Certain activities under FEMP's "You Have the Power Campaign" will be discontinued.

In FY 2008, the FEMP Program is taking over responsibility for the Federal Fleet activity from the Office of FreedomCAR and Vehicle Technologies with funding kept at the level of the FY 2007 request ($700,000). Activities will include tracking and reporting each agency's EPACT 1992/2005 and E.O. 13149 compliance and in-depth analysis of the successes and challenges in agency compliance. Interagency partnerships will be facilitated in support of energy conservation and petroleum displacement activities. The Federal Automotive Statistical Tool (FAST) will be expanded for greater analysis capabilities.

In support of EPACT 1992, Section 303, assistance will be provided for Federal agencies increasing alternative fuel vehicle (AFV) acquisitions, beyond the minimum 75 percent requirement, and increasing the amount of alternative fuel consumed in Federal fleets. FEMP will provide assistance and work with industry partners to increase alternative refueling infrastructure projects to be used by Federal fleets, and employ fleet efficiency measures to reduce petroleum consumption in fleet vehicles.

	(dollars in thousands)		
	FY 2006	FY 2007	FY 2008

FEMP will provide management and organizational support to the Federal INTERFUEL committee which DOE chairs and sponsors. INTERFUEL, with more than 100 members from over 20 agencies, supports DOE's efforts to implement EPACT and Executive Order Federal fleet requirements. Activities include coordinating information among agencies, promoting common understanding of policies, legislation, and regulations; identifying common issues and providing a forum for assisting in analysis and subsequent resolution; and encouraging the efficient use of resources in implementing fleet requirements through partnership activities.

	FY 2006	FY 2007	FY 2008
Total, Planning, Reporting and Evaluation	**2,574**	**2,473**	**2,337**

Explanation of Funding Changes

	FY 2008 vs. FY 2007 ($000)
To take advantage of the benefits of consolidation of reporting on Federal activities, FEMP is taking on the additional reporting responsibilities for the Federal Fleet activity from the Office of FreedomCAR and Vehicle Technologies. By streamlining outreach activities, FEMP is still able to achieve a net decrease in funding for Planning, Reporting and Evaluation. Ongoing communication needs will be met through increased utilization of electronic media to offset printing and mailing costs.	-136
Total Funding Change, Planning, Reporting and Evaluation	**-136**

Departmental Energy Management

Funding Schedule by Activity

	(dollars in thousands)		
	FY 2006	FY 2007	FY 2008
Departmental Energy Management			
Energy Management Project Support	1,768	1,979	0
Energy Management Model Program Development	231	0	0
Total, Departmental Energy Management	1,999	1,979	0

Description

The Departmental Energy Management Program currently provides direct funding and leveraged cost sharing for energy retrofit projects and new energy technologies at DOE facilities to increase the energy efficiency of DOE facilities and reduce future utility and maintenance costs. However, DOE government-owned contractor operated (GOCO sites) spend a significant amount of indirect funds for energy efficiency and renewable energy projects and will continue to do so. Therefore, in FY 2008, this activity will be closed out, but policy, oversight, coordination and reporting will continue within other activities of FEMP. As with all Federal agencies, FEMP will be available to assist DOE sites with alternative financing tools and technical assistance.

Benefits

DOE has already achieved the Executive Order 12123 goal for 2010 to reduce the energy intensity in its standard buildings. The baseline (1985) energy intensity in standard buildings was 473,126 Btu per square foot, whereas the energy intensity in 2005 was 224,043 Btu per square foot, showing a 53 percent reduction in energy intensity in that time period.

FEMP will collect information on the funding spent on all energy efficiency projects and activities at DOE facilities and laboratories. FEMP will provide guidelines on what investments or the parts thereof can be classified and reported as energy efficiency investments.

Detailed Justification

	(dollars in thousands)		
	FY 2006	FY 2007	FY 2008
Energy Management Project Support	**1,768**	**1,979**	**0**

Prior to FY 2008, DEMP provided support through direct funding and leveraged cost-sharing at various DOE facilities for energy projects to increase the energy efficiency of DOE facilities and reduce future utility and maintenance costs. DOE government-owned contractor operated (GOCO sites) spend a significant amount of indirect funds for energy efficiency and renewable energy projects and will continue to do so.

Energy Management Model Program Development	**231**	**0**	**0**

Prior to FY 2007, the program ran a solicitation for projects which was sent to DOE facilities with set criteria for ranking projects.

Total, Departmental Energy Management	**1,999**	**1,979**	**0**

Explanation of Funding Changes

	FY 2008 vs. FY 2007 ($000)
Energy Management Project Support The Federal Energy Management Program will provide policy, guidance and reporting for DOE facilities, but no direct funding for projects. The management of energy efficiency and renewable investments at its facilities can be effectively conducted using alternative financing and operation and maintenance funds under the stewardship and oversight of the cognizant Program Secretarial Office. DOE government-owned contractor operated (GOCO sites) will also continue to use indirect funds for energy efficiency and renewable energy projects. As with all Federal agencies, FEMP will be available to assist DOE sites with alternative financing tools and technical assistance.	-1,979
Total Funding Change, Departmental Energy Management	**-1,979**

Facilities and Infrastructure

Funding Profile by Subprogram

	(dollars in thousands)		
	FY 2006 Current Appropriation	FY 2007 Request	FY 2008 Request
Facilities and Infrastructure			
National Renewable Energy Laboratory	26,052	5,935	6,982
Total, Facilities and Infrastructure	26,052	5,935	6,982

Public Law Authorizations:

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

Mission

NREL is a single-purpose National Laboratory dedicated to the research and development of energy efficiency, renewable energy, and related technologies. NREL is EERE's primary National Laboratory and EERE sponsors NREL as a Federally Funded Research and Development Center (FFRDC). NREL provides EERE, as well as the Office of Science and the Office of Electricity Delivery and Energy Reliability, with world-class research and development, expert advice, and objective programmatic counsel.

Benefits

This Facilities and Infrastructure budget funds capital investments to support a vibrant world-class research and development program at major participant DOE laboratory sites. Included are funding requests for projects and equipment that are of general benefit to all research activities at NREL.

Maintaining EERE's state-of-the-art research facilities at NREL is important to EERE's research and development mission. EERE's proposed investment meets DOE's annual reinvestment goal and provides funding to ensure the availability of these capabilities in the future.

National Renewable Energy Laboratory

Funding Schedule by Activity

(dollars in thousands)

	FY 2006	FY 2007	FY 2008
National Renewable Energy Laboratory			
Operation and Maintenance	5,742	5,935	6,982
Construction			
Research Support Facilities, Phase I	9,900	0	0
Science and Technology Facility	10,410	0	0
Total, Construction	20,310	0	0
Total, National Renewable Energy Laboratory	26,052	5,935	6,982

Description

NREL is home to 1,100 researchers, engineers, analysts, and administrative staff, plus visiting professionals, graduate students, and interns on a 632-acre campus located at three major sites near Golden, Colorado. The NREL complex occupies 360,000 square feet in 5 large research buildings, approximately a dozen smaller research and testing facilities totaling about 80,000 square feet, and 296,000 square feet of research and administrative leased space in neighboring office buildings.

Operational and Maintenance funding supports general scientific work and supports real property and equipment infrastructure throughout NREL. The funding request reflects DOE's commitment to infrastructure reinvestments to ensure the viability of EERE's capabilities at NREL. Funds are used to complete basic maintenance and repairs of the real property and equipment infrastructure, to achieve improvements that yield operational efficiencies, to provide safety enhancements, and to provide for general site improvements.

Detailed Justification

(dollars in thousands)

	FY 2006	FY 2007	FY 2008
Operation and Maintenance	**5,742**	**5,935**	**6,982**

The maintenance and repair request represents funding to maintain EERE's real property and equipment infrastructure in fully operable condition consistent with corporate reinvestment and management standards, to achieve operational efficiencies, and to ensure a safe and healthful working environment. These funds do not include technology-specific capital equipment requested by EERE programs.

(dollars in thousands)

	FY 2006	FY 2007	FY 2008
▪ **Plant and Capital Equipment**	**5,742**	**5,935**	**6,982**
• **Plant Projects**	**3,790**	**3,957**	**3,362**

The Plant Projects request supports a portion of the annual investment used to maintain the capabilities of EERE's existing real property and related infrastructure at NREL. These projects apply to both the South Table Mountain (STM) and National Wind Technology Center (20 miles away) locations in Golden, CO. Projects may include safety and security improvements; replacements of roofs and other building components; upgrades to utilities and heating ventilation and air conditioning systems; energy efficiency improvements; reconfigurations of existing buildings to accommodate changes or growth in R&D programs or research support needs; upgrades of site-wide utility systems, telecommunications and computer networks; road and parking improvements; and walkways, landscaping, water management, water treatment, and other site improvements to enhance the sustainability, cohesiveness, and pedestrian nature of the site.

	FY 2006	FY 2007	FY 2008
• **Capital Equipment**	**1,952**	**1,978**	**3,620**

The Capital Equipment request maintains EERE's general scientific and administrative equipment to a corporate standard of 50 percent (average) remaining portfolio value through maintenance, repair, or replacement. This portfolio includes general scientific equipment with multiple users across NREL, information technology, safety and security equipment, communications equipment, etc.

	FY 2006	FY 2007	FY 2008
Construction	**20,310**	**0**	**0**
▪ **Research Support Facility**	**9,900**	**0**	**0**

The RSF will provide 22,080 square feet of office space for 120 employees that are currently occupying leased space off-site. (The project will not immediately reduce leased building space due to configuration limitations of current leased buildings and security requirements. Blocks of leased space cannot be terminated until completely emptied.) The RSF will use an integrated design approach to achieve its goal producing a high-performance building that will serve as a showcase for the Nation's commercial building sector. The RSF will be designed to achieve a "Platinum" rating using the U.S. Green Buildings Council's Leadership in Energy and Environmental Design (LEED) system.

	FY 2006	FY 2007	FY 2008
▪ **Science and Technology Facility**	**10,410**	**0**	**0**

The Science and Technology Facility (STF), initially funded in FY 2004 with final funding in FY 2006, has been completed ahead of schedule, within scope, and at cost. The STF provides EERE's Solar Technologies Program, as well as other programs that rely on materials and thin-film science, 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

	FY 2006	FY 2007	FY 2008
of the industry to solve. The STF allows EERE to pursue transformational research approaches to lower manufacturing costs and reduce time-to-market of next-generation thin-film and nano-structure technologies.			
The STF provides nine advanced material synthesis and general support laboratories, a unique process development and integration laboratory, and office space for 55 research staff. The STF is a showcase facility for energy savings and sustainability in a research and development laboratory and is seeking a "Gold" rating using the U.S. Green Buildings Council's Leadership in Energy and Environmental Design (LEED) system.			
Total, National Renewable Energy Laboratory	**26,052**	**5,935**	**6,982**

(dollars in thousands)

Explanation of Funding Changes

	FY 2008 vs. FY 2007 ($000)
Operation and Maintenance	
▪ **Plant and Capital Equipment**	
• **Plant Projects** Category decreases with the FY 2007 completion of the $2.5M South Table Mountain infrastructure project (which supported the RSF) and the reallocation of Plant Project funds to meet the 2 percent corporate reinvestment goal for real property and related assets.	-595
• **Capital Equipment** Activity increases to maintain EERE's general scientific and administrative equipment to a corporate standard of 50 percent (average) remaining portfolio value through maintenance, repair, or replacement.	+1,642
Total, Plant and Capital Equipment	**+1,047**
Total, Operation and Maintenance	**+1,047**
Total Funding Change, National Renewable Energy Laboratory	**+1,047**

Capital Operating Expenses and Construction Summary

Capital Operating Expenses

(dollars in thousands)

	FY 2006	FY 2007	FY 2008
General Plant Projects	3,790	3,957	3,362
Research Support Facilities	9,900	0	0
Capital Equipment	1,952	1,978	3,620
Total, Capital Operating Expenses	15,642	5,935	6,982

Construction Projects

(dollars in thousands)

	Total Estimated Cost (TEC)	Prior-Year Appropriations	FY 2006	FY 2007	FY 2008	Unappropriated Balance
NREL Science and Tech Facility	22,585	12,175	10,410	0	0	0
Research Support Facility	0	0	9,900	0	0	0
Total, Construction Projects			20,310	0	0	

Major Items of Equipment

(dollars in thousands)

	Total Project Cost (TPC)	Total Estimated Cost (TEC)	Prior-Year Appropriations	FY 2006	FY 2007	FY 2008	Completion Date
Process Development and Integration Lab, NREL	6,480	6,480[a]	1,872	1,800	2,808	0	FY 2007
Total, Major Items of Equipment				1,800	2,808	0	

[a]

Item	Cost ($K)	Item	Cost ($K)
CIS PVD Workstation (3 chambers - Se, S based PVD, CdS or other)	$1,200	Thin-film Analyzer (Auger Electron Spectrometer)	$460
Thin-Si iodine transport or other high temperature process	$550	Stationary Universal Sample Transfer Interface Platform	$230
X-ray and Ultraviolet Photoelectron Spectrometer	$800	CBD CdS-controlled ambient glove box (CdTe/CIS)	$185
Multi-target Sputtering system (TCO/metallization)	$550	Real Time Spectroscopic Ellipsometer	$370
A-Si CVD Workstation (Low T processing, 3 chambers p, i, n, all combi)	$1,200	Optical Probe Workstation, phase II, (FTIR, ATR)	$235
Optical Probe Workstation, phase I, (PL, TRPL, Raman, rf-PCD)	$700	Total	$6,480

08-EE-01, Research Support Facility (RSF), National Renewable Energy Laboratory, Golden, Colorado

1. Significant Changes

This is the project data sheet for the Research Support Facility.

2. Design, Construction, and D&D Schedule

(fiscal quarter)

	Preliminary Design start	Final Design Complete	Physical Construction Start	Physical Construction Complete	D&D Offsetting Facilities Start	D&D Offsetting Facilities Complete
FY 2006	--	--	--	--	4Q 2006	--
FY 2007	2Q 2007	3Q 2007	3Q 2007	--	--	--
FY 2008	--	--	--	4Q 2008	--	4Q 2008

3. Baseline and Validation Status

(dollars in thousands)

	TEC	OPC, except D&D Costs	Offsetting D&D Costs	Total Project Costs	Validated Performance Baseline	Preliminary Estimate
FY 2006	9,900	2,532	0	12,432	TBD	12,432

Project Description, Justification, and Scope

The project provides for the design, engineering, construction, and commissioning of the Research Support Facility at the National Renewable Energy Laboratory (NREL) in Golden, Colorado.

The National Renewable Energy Laboratory, located in Golden, Colorado, is EERE's primary National Laboratory for energy efficiency, renewable energy, and related technology research and development. EERE sponsors NREL's designation as a Federally Funded Research and Development Center. As such, NREL is a strategic partner to EERE, and is a critical component of EERE's program and project management supply chain. NREL hosts a contingent of approximately 1,100+ scientists, engineers, and support personnel. EERE's Golden Field Office (GO) oversees the management and operating contract at NREL, and manages a substantial portion of EERE's research, development, and deployment portfolio through the Project Management Center.

The Mission Need Statement (Critical Decision-0) has been reviewed by DOE's Office of Program Analysis and Evaluation's integrated review team, which includes the Office of Engineering and Construction Management and the Office of the Chief Financial Officer, and was approved by DOE's Acquisition Executive.

The Research Support Facility provides for all design, construction, and commissioning activities to replace a portion of EERE's current leased space located adjacent to NREL's South Table Mountain site.

The project will be a showcase of sustainable, high-performance design and will incorporate the best in energy efficiency, environmental performance, and advanced controls using a "whole-building" integrated design process. The project will be designed to achieve the Leadership in Energy and Environmental Design (LEED) "Platinum" standard, the highest third-party certification building standard currently defined. Certification of the project's LEED attainment level will be provided by an independent expert entity. The project will comply with all applicable Energy Star standards and will achieve at least a 50 percent energy reduction over the American Society of Heating, Refrigerating and Air-Conditioning Engineers (ASHRAE) standard for commercial buildings, with the potential to achieve 60 percent to 70 percent energy reduction. The project will maximize its use of energy generated from renewable sources consistent with life-cycle cost considerations

The integrated design process, led by a Design/Build (Construction Contractor/ Architect/Engineer) firm or joint venture selected through a national competition, will be highly collaborative and will use design charettes, independent reviews, and external experts in advanced controls, renewable design, and operations to ensure the project's high-performance, sustainable, and cost competitive goals can be achieved.

This project will be managed to the principles of project management outlined in DOE Order 413.3A, PROGRAM AND PROJECT MANAGEMENT FOR THE ACQUISITION OF CAPITAL ASSETS.

Facility operating costs are included in Item 7, Related Annual Funding Requirements, shown below.

Compliance with Project Management Order[a]

- Critical Decision – 0: Approve Mission Need – 12/24/2004
- Critical Decision – 1: Approve Preliminary Baseline Range – 2nd Qtr FY07
- Independent Cost Review – 2nd Qtr FY07
- Critical Decision – 2: Approve Performance Baseline[b] – 3rd Qtr FY07
- Critical Decision – 3: Approve Start of Construction – 3rd Qtr FY07
- Critical Decision – 4: Approve Start of Operations – 4th Qtr FY08

[a] The requirements of DOE Order 413.3A do not apply to this project given its small dollar value. However, EERE will use the principles as set forth in DOE Order 413.3A Program and Project Management for the Acquisition of Capital Assets for management of this project. Critical Decisions will be approved by the EERE ESAAB.
[b] This project will be accomplished using a Design/Build approach. Design/Build allows for a combined CD-2/3.

5. Financial Schedule

(dollars in thousands)

	Appropriations	Obligations	Costs
Design/Construction by Fiscal Year			
Design, including Independent Cost Estimates And Review			
2006	1,837	1,837	290
2007	0	0	1,547
Total, Design	1,837	1,837	1,837
Construction			
2006	8,063	8,063	0
2007	0	0	3,100
2008	0	0	4,963
Total, Construction	8,063	8,063	8,063
Total, TEC	9,900	9,900	9,900

6. Details of Project Cost Estimate

Total Estimated Costs

(dollars in thousands)

	Current Estimate ($000)	Previous Estimate ($000)
Preliminary and Final Design, including Independent Cost Review	1,837	0
Construction Phase		
Site Preparation	220	0
Equipment	0	0
All other construction	0	0
Contingency/Management Reserve	440	0
Construction	7,403	0
Total, Construction	8,063	0
Total, TEC	9,900	0

Other Project Costs

Cost Element	(dollars in thousands) Current Estimate ($000)	Previous Estimate ($000)
Conceptual Planning	440	0
NEPA documentation costs	50	0
ES&H costs	35	0
Experimental equipment (Process Development and Integration Lab)	--	--
Other Project-Related costs	2,007	0
Start-up	--	--
Offsetting D&D Phase[a]	0	0
D&D for removal of the offsetting facility	0	0
Other D&D to comply with "one-for-one" requirements	0	0
D&D contingency	0	0
Total D&D	0	0
Contingency for OPC other than D&D	--	--
Total, OPC	2,532	0

7. Schedule of Project Costs

(dollars in thousands)

	Prior Years	FY 2007	FY 2008	FY 2009	FY 2010	FY 2011	Outyears	Total
TEC (Design)	0	1,837	0	0	0	0	0	1,837
TEC (Construction)	0	3,540	4,523	0	0	0	0	8,063
OPC Other than D&D	897	88	1,547	0	0	0	0	2,532
Offsetting D&D Costs	0	0	0	0	0	0	0	0
Total Project Costs	897	5,465	6,070	0	0	0	0	12,432

[a] Note: The DOE Golden Field Office is working with the HQ Program Office (EERE) and other DOE sites to identify square footage offsets that NREL can use to comply with the "one-for-one" requirement.

8. Related Operations and Maintenance Funding Requirements

Start of Operation or Beneficial Occupancy (fiscal quarter)	3Q 2008
Expected Useful Life (number of years)	50
Expected Future start of D&D for new construction (fiscal quarter)	N/A

(Related Funding Requirements)

(dollars in thousands)

	Annual Costs		Life cycle costs[a]	
	Current estimate	Prior Estimate	Current estimate	Prior Estimate
Operations	109	0	5,450	0
Maintenance	325	0	16,250	0
Total Related Funding	434	0	21,700	0

9. Required D&D Information

The DOE Golden Field Office is working with the HQ Program Office (EERE) and other DOE sites to identify square footage offsets that NREL can use to comply with the "one-for-one" requirement.

Name(s) and site location(s) of existing facility(s) to be replaced: Lease space will be released as soon as feasible in accordance with lease terms and operational requirements.

D&D Information Being Requested	Square Feet
Area of new construction[b]	22,080
Area of existing facility(ies) being replaced (Space currently leased from private parties)[c]	0
Area of any additional space that will require D&D to meet the "one-for-one" requirement	0

10. Acquisition Approach (formerly Method of Performance)

Design, construction, and inspection are being performed under a negotiated design/build contract with a Guaranteed Maximum Price. All subcontracts will be managed by the Design/Build Contractor with oversight by the National Renewable Energy Laboratory and the Department of Energy.

[a] Undiscounted costs based on 50-year asset life.
[b] Estimated. Adequate offset space for the first two modules.
[c] The project will not reduce immediately leased building space due to configuration limitations of current leased buildings and security requirements. Blocks of leased space cannot be terminated until completely emptied.

Weatherization and Intergovernmental Activities

Funding Profile by Subprogram

	(dollars in thousands)		
	FY 2006 Current Appropriation	FY 2007 Request	FY 2008 Request
Weatherization and Intergovernmental Activities			
Weatherization Assistance Program	242,550	164,198	144,000
State Energy Program	35,640	49,457	45,501
State Energy Activities	495	0	0
Gateway Deployment	25,400	0	0
International Renewable Energy Program	3,871	2,473	0
Tribal Energy Activities	3,960	3,957	2,957
Renewable Energy Production Incentive	4,950	4,946	4,946
Asia Pacific Partnership	0	0	7,500
Total, Weatherization and Intergovernmental Activities	316,866	225,031	204,904

Public Law Authorizations:

P.L. 94-163, "Energy Policy and Conservation Act" (EPCA) (1975)
P.L. 94-385, "Energy Supply 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 Supply Policy Act" (NECPA) (1978)
P.L. 95-620, "Power Plant and Industrial Fuel Use Act" (1978)
P.L. 96-294, "Energy Security Act" (1980)
P.L. 100-12, "National Appliance Energy Supply Act" (1987)
P.L. 100-615, "Federal Energy Management Improvement Act" (1988)
P.L. 102-486, "Energy Policy Act of 1992"
P.L. 109-190, "Energy Policy Act" (2005)

Mission

The mission of the Weatherization and Intergovernmental Program (WIP) is to develop, promote, and accelerate the adoption of energy efficiency, renewable energy, and oil displacement technologies and practices by a wide range of stakeholders. These include state and local governments, weatherization agencies, communities, companies, foreign and Native American Governments.

Benefits

The Weatherization and Intergovernmental Program contributes to DOE's Energy Productivity Strategic Goal. The program also addresses the demand for fuels and energy and modernizing the deployment and public use of conservation technologies and practices. Weatherization Assistance Program grants provide services that can make energy affordable for low-income households by reducing their energy demand. The State Energy Program assists States in developing emergency energy plans and in fostering clean, reliable, and diverse energy supplies. Sections 123 and 140 of the Energy Policy Act of 2005 encourage greater state energy efficiency. The Tribal Energy Program helps foster diverse supplies of reliable, affordable and environmentally-sound energy through the market transfer of clean energy technologies. The Asia Pacific Partnership strives to improve environmental quality through the development and deployment of technologies that reduce greenhouse gas emissions and air pollution in key market sectors, including residential and commercial buildings, power systems, and industries.

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

Strategic and GPRA Unit Program Goals

The Department's Strategic Plan identifies five Strategic Themes (one each for nuclear, energy, science, management, and environmental aspects of the mission) plus 16 Strategic Goals that tie to the Strategic Themes. The Weatherization and Intergovernmental Activities Program supports the following goal:

Strategic Theme 1, Energy Security

Strategic Goal 1.4, Energy Productivity: Cost-effectively improve the energy efficiency of the U.S. economy.

And concurrently supports:

Strategic Goal 1.2, Environmental Impacts of Energy: Improve the quality of the environment by reducing greenhouse gas emissions and environmental impacts to land, water, and air from energy production and use.

The Weatherization and Intergovernmental Program has two program goals which contribute to Strategic Goal 1.4 in the "goal cascade":

Contribution to GPRA Unit Program Goal 1.4.21.00 (Weatherization)

The goal of Weatherization Assistance Program grants is to increase the energy efficiency of dwellings occupied by low-income Americans, thereby reducing their energy costs. DOE works directly with States and certain Native American Tribes that contract with local governmental or non-profit agencies to deliver weatherization services.

Weatherization Assistance Program grants contribute to Strategic Goal 1.4 by providing cost-effective energy efficiency improvements to low-income households through the weatherization of 54,599 low-income homes with DOE funds in FY 2008. Priority is given to the elderly, persons with disabilities, families with children, and households that spend a disproportionate amount of their income on energy bills (utility bills consume an average of about 13 percent of household income for low income families, compared to 3.5 percent or less for all other Americans).[a]

[a] Data source: DOE EIA Residential Energy Consumption Survey (RECS).

Contribution to GPRA Unit Program Goal 1.4.22.00 (State Energy Programs)

The State Energy Program (SEP) goal is to strengthen and support the capabilities of States to promote energy efficiency and adopt renewable energy technologies, helping the Nation achieve a stronger economy, a cleaner environment and greater energy security.

SEP contributes to Strategic Goal 1.4 by supporting States' promotion of energy efficiency and renewable energy technologies. The SEP, among other activities, funds the development and maintenance of energy emergency planning at the state and local levels, a critical security benefit. SEP also assists States in developing strategic planning and logic modeling to target individual state energy priorities and increase energy security through diversification.

Contribution from additional Intergovernmental Activities

The goal of the remaining intergovernmental activities is to facilitate the movement of energy efficiency and renewable energy products into the marketplace through incentives and technical assistance and cooperation.

The other intergovernmental activities managed by the WIP contribute to Strategic Goal 1.4 by providing highly leveraged technical and financial assistance in targeted communities that accelerates the adoption of clean cost-effective EERE technologies. These activities benefit the public by improving energy productivity, reducing demand, deploying clean energy technologies and lessening the burden of energy costs on the economically disadvantaged, those least able to afford energy efficiency improvements and investment. The program aims to facilitate the installation of 100 MW of renewable energy generation by Native American tribes by 2010. It is estimated that the Renewable Energy Production Incentive will reimburse public utilities for approximately 16 billion kWh of renewable energy by 2010. The Asia Pacific Partnership is an opportunity to encourage clean energy technology deployment -- the partners include Australia, China, India, Japan and South Korea.

Funding by Strategic and GPRA Unit Program Goal

(dollars in thousands)

	FY 2006	FY 2007	FY 2008
Strategic Goal 1.4, Energy Productivity			
GPRA Unit Program Goal 1.4.21.00, Weatherization			
Weatherization Assistance Program	242,550	164,198	144,000
Total, GPRA Unit Program Goal 1.4.21.00, Weatherization	242,550	164,198	144,000
GPRA Unit Program Goal 1.4.22.00, State Energy Programs			
State Energy Program	35,640	49,457	45,501
State Energy Activities	495	0	0
Total, GPRA Unit Program Goal 1.4.22.00, State Energy Programs	36,135	49,457	45,501

	(dollars in thousands)		
	FY 2006	FY 2007	FY 2008
All Other			
Gateway Deployment	25,400	0	0
International Renewable Energy Program	406	2,473	0
Tribal Energy Activities	2,970	3,957	2,957
Renewable Energy Production Incentive	4,950	4,946	4,946
Asia Pacific Partnership	0	0	7,500
Congressionally Directed, International Renewable Energy Program, International Utility Electricity Partnership, (IUEP)	3,465	0	0
Congressionally Directed, Tribal Energy Activities, Council of Renewable Energy Resource Tribes, (CERT)	990	0	0
Total, All Other	38,181	11,376	15,403
Total, Strategic Goal 1.4 (Weatherization and Intergovernmental Activities)	316,866	225,031	204,904

Annual Performance Results and Targets

FY 2003 Results	FY 2004 Results	FY 2005 Results	FY 2006 Results	FY 2007 Targets	FY 2008 Targets
GPRA Unit Program Goal 1.4.21.00 (Weatherization)					
International Renewable Energy Program					
	International Renewable Energy will strengthen and broaden activities supporting priority agreements, e.g., expanded the harmonization of standards to additional countries, ramped up implementation of the Energy Efficiency and Village Energy initiatives. Continue to work with APEC and NAEWG. [MET]	Provide technical analysis and reviews, data access, training and project support for 7 international clean energy projects which includes: developing 2 components for GIS tools to analyze U.S. EERE technology export markets; provide phase 1 technical assistance to secure access for EERE technologies to build 1,000 MW of generation globally over 10 years. [MET]			Close out program
Tribal Energy Activities					
	Tribal Energy will conduct 6 technical and policy development workshops. [MET]	Tribal Energy will provide direct technical assistance to Tribal nations including: 4 development workshops, 2-3 economic development projects, 8-10 “first steps” efforts, and 6-10 feasibility studies, working toward the goal of 100 MW of generation in Indian country by 2010. [PARTIALLY MET]			
GPRA Unit Program Goal 1.4.21.00 (Weatherization)					
Weatherization Assistance Program					
Award $223 million in FY 2003 funds through 53 Weatherization Program grants, including all 50 States, to enable the direct Weatherization of 93,000 homes. This will bring the cumulative number of homes weatherized to over 52 million. [MET: 93,750 homes weatherized]	Weatherize 94,450 homes, with DOE funds. [MET]	Weatherize 92,500 homes, with DOE funds, and support the weatherization of approximately 100,000 additional homes with leveraged funds. [MET]	Weatherize 97,300 homes, with DOE funds. [MET]	Weatherize 64,084 homes with DOE funds.	Weatherize 54,599 homes, with DOE funds, and support the weatherization of approximately 50,000 additional homes with leveraged funds.

FY 2003 Results	FY 2004 Results	FY 2005 Results	FY 2006 Results	FY 2007 Targets	FY 2008 Targets
	Cumulative total of 2.8 million homes will be weatherized with DOE funds. [MET] Cumulative total of 5.4 million homes will be weatherized with DOE and leveraged funds. [MET]	Program will update the energy savings benefit-cost ratio and savings per DOE dollar invested as part of a national evaluation of the program. This will allow the program to track an annual performance efficiency of Btus per Federal dollar invested. [MET]	The program will complete planning for and initiate implementation of the new comprehensive national evaluation of the Weatherization Assistance Program. The evaluation is a multi-year task that will provide new, accurate baselines for average energy savings, benefit cost ratios, and Btu energy savings per Federal dollar expended. [PARTIALLY MET]		
GPRA Unit Program Goal 1.4.22.00 (State Energy Programs)					
State Energy Program					
	Achieve an annual energy savings of 52,406,930 source Btu and $317,772,960 in annual energy cost savings by awarding $43,952,000 in grants to States and Territories. [MET]	Achieve an annual energy savings of 10,250,000 source Btus and $64,780.000 in annual energy cost savings with DOE funds. Achieve an annual energy savings 36,695,000 source Btus and $231,912.400 in annual energy cost savings with leveraged funds. [MET] Program will update Btu to dollar calculation derived from 2003 metrics study to establish new baseline. [MET]	Achieve an average annual energy savings of 8-10 trillion source Btus (an estimated $50-60 million in annual energy cost savings) with DOE funds. Achieve an additional average energy savings of 26-30 trillion source Btus (an estimated $190-$200 million in annual energy cost savings) from leveraged funds. [MET]	Achieve an average annual energy savings of 8-10 trillion source Btus (an estimated $50-60 million in annual energy cost savings) with DOE funds.	Achieve an average annual energy savings of 10-12 trillion source Btus (an estimated $60-70 million in annual energy cost savings) with DOE funds. [a]

[a] The program estimates energy savings from its activities using factors that were developed by Oak Ridge National Laboratory (ORNL), which is not considered an independent source. While the ORNL study was reviewed in 2005 by an external group of professionals and found to provide a "good start" to documenting program impacts, the DOE Inspector General in 2006 found that the program “had not established or collected meaningful performance metrics” and “did not validate or compare actual results to those planned” (DOE IG OAD-M-06-05).The program is implementing under the following improvements: undertaking an independent analysis of program benefits and effectiveness; developing metrics that directly measure the current amount of energy saved by the program, and; implementing a strategic plan which sets ambitious targets for the future.

FY 2003 Results	FY 2004 Results	FY 2005 Results	FY 2006 Results	FY 2007 Targets	FY 2008 Targets
Other Program Goals					
WIP Financial Efficiency Measure					
	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. [NOT MET: EERE actively accelerating costing of funding]	Contribute proportionately to EERE's corporate goal of reducing corporate and program adjusted uncosted obligated balances to a range of 20-25 percent by reducing program annual adjusted uncosteds by 10 percent in 2005 relative to the program FY 2004 end of year adjusted uncosted baseline ($21,257K) until the target range is met. [MET]	Maintain total administrative overhead costs (defined as program direction and program support excluding earmarks) in relation to total program costs of less than 12 percent. [a] [MET]	Maintain total administrative overhead costs (defined as program direction and program support excluding earmarks) in relation to total program costs of less than 12 percent.	Maintain total administrative overhead costs in relation to total program costs of less than 12 percent. Baseline for administrative overhead rate currently being validated.
Gateway Deployment /Rebuild America					
Assist 450 *Rebuild America* community partnerships to upgrade 80 million square feet of floor space in K-12 schools, college, public housing, and state/local governments. [MET]	Assist over 500 new and existing *Rebuild America* community partnerships to upgrade 70 million square feet of floor space in K-12 schools, colleges, public housing, and state/local governments, reducing the average energy used in these buildings by 18 percent. [MET]	Help *Rebuild America* community partnerships to upgrade 60 million square feet of floor space in K-12 schools, colleges, public housing, and state/local governments, reducing the average energy used in these buildings by 18 percent. [MET]		Activity transferred to Building Technology Program.	
Gateway Deployment/Building Codes Training and Assistance					
	Provide technical assistance to States resulting in 4 States adopting upgraded 2001 and 2003 model commercial or residential building energy codes. [MET]	Provide technical assistance to States resulting in 4 States adopting upgraded 2001 and 2003 model commercial or residential building energy codes. [MET]		Activity transferred to Building Technology Program.	
	Train 2,000 architects, engineers, builders and code officials to implement the above codes and upgraded 2004 model commercial code. [MET]				

[a] Baseline for administrative overhead rate currently being validated.

FY 2003 Results	FY 2004 Results	FY 2005 Results	FY 2006 Results	FY 2007 Targets	FY 2008 Targets
Gateway Deployment/Clean Cities					
Achieve a total of 135,000 alternative fuel vehicles (AFV's) in operation in Clean Cities which will displace 180 million gallons of gasoline and diesel a year. [MET].	Clean Cities will conduct 7 major workshops, award $6 million in special project funding, and report a total of 180,000 number of alternative fuel vehicles in operation in clean cities. Achieving these outcomes will result in an estimated displacement of 153 million gallons of petroleum based fuels. [NOT MET]	Clean Cities will conduct 7 major workshops, award $4 million in special project funding for alt fuel, anti-idling, and hybrid technology, and provide technical support to coalitions. Program will report a total number of 198,000 alternative fuel vehicles in operation in clean cities. Achieving these outcomes will result in an estimated displacement of 168 million gallons of petroleum based fuels and 70 new ethanol fueling stations. [MET]		Activity transferred to Vehicle Technologies Program.	
Gateway Deployment/ENERGY STAR®					
Recruited 375 additional ENERGY STAR® partners including retail stores, utilities and manufacturers. [MET]	Recruit 500 additional retail stores, 5 additional utilities and 10 additional manufacturers. Add domestic hot water heaters to the program. Begin work on a Commercial Window Specification. Expand room air-conditioner program to include heating cycle. Continue outreach to non-English speaking communities and Weatherization activities. [NOT MET]	Recruit 500 additional retail stores, 5 additional utilities and 10 additional manufacturers. Complete draft Commercial Window specification. Begin update of Residential Window specification. Expand coordination with all gateway activities. [PARTIALLY MET]	Increase market penetration of appliances (clothes washers, dishwashers, room air conditioners and refrigerators) to 38 to 42 percent (baseline 30 percent calendar year 2003), to 2 to 3 percent for Compact Fluorescent Lamps (baseline 2 percent calendar year 2003) and 40 to 45 percent for windows (baseline 40 percent calendar year 2004). Estimated energy savings will be 0.030 Quads and $657 million consumer utility bill savings.	Activity transferred to Building Technologies Program.	
Gateway Deployment/Inventions and Innovation					
	Continue program closeout initiated in FY 2003. [MET]				

Means and Strategies

The Weatherization and Intergovernmental Program will use various means and strategies to achieve its GPRA Unit 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 program goals. Collaborations are integral to the planned investments, means and strategies, and will provide avenues to address external factors.

Collaboration with States, agencies, and a variety of customers is integral to the investments, means and strategies planned.

WIP will implement the following means:

- Weatherization Assistance Program (WAP) will provide formula grants to States which, in turn, provide grants to Community Action Agencies to reduce the energy costs of low-income households by installing cost-effective energy efficiency improvements while ensuring the health and safety of the people served.
- The State Energy Program (SEP) will provide formula grants to States, enabling state governments to target their own high priority energy needs and expand clean energy choices for their citizens and businesses. The SEP Special Projects activity will also provide competitive grants to state and local pubic/private partnerships.
- The Tribal Energy Activities support and manage technical and financial assistance projects to promote energy, environmental, and economic development policy objectives for Native Americans. This primarily involves feasibility studies and the development of energy efficiency and renewable energy resources on tribal lands.
- The Renewable Energy Production Incentive will provide financial payments for electricity produced and sold by qualifying renewable energy generation facilities.
- The Asia Pacific Partnership will facilitate clean energy technology delivery with existing information tools and increase private sector access to developing markets.

WIP will implement the following strategies:

- The Weatherization Assistance Program will utilize a cost-effective combination of energy-saving measures selected for each home based on a comprehensive audit.
- State Energy Program formula grants will enable state energy offices to tailor energy efficiency programs to state and local needs and to leverage non-Federal resources to supplement Federal assistance.
- The State Energy Program Special Projects activity will transform markets for under-utilized and emerging technologies through competitive grants, technical assistance, and replication of best practices that focus on removing barriers and widescale market penetration DOE will collaborate with national and regional organizations that represent key decision-makers, e.g., governors, mayors, state legislators, end users, and product and service providers.

- Partnerships with tribal governments will be built to help provide technical and financial assistance for energy efficiency and renewable energy projects, and increase capacity for long range planning that meets tribal energy needs for residential, commercial and industrial uses.
- The Asia Pacific Partnership is also expected to implement the strategies used successfully in EERE Buildings Technologies and Industrial Technologies Programs to provide information and technical assistance. The implementation of those means and strategies is expected to result in both increases in available clean energy and significant reductions in the consumption of energy across fuel types in manufacturing, appliances, and buildings. These energy and emissions savings come from a portion of EERE's portfolio of diverse technologies, and resulting energy cost savings could provide the basis for economic growth and development.
- The Renewable Energy Production Incentive encourages clean energy based electricity generation by non-taxable producers.

The following external factors could affect WIP's ability to achieve its goals:

- Rates of market growth/technology adoption;
- Capital investment requirements;
- Energy supply markets and prices;
- Costs and adoption of technologies;
- Partner cost share and participation rates; and
- Geopolitical changes.

In carrying out the program's mission, WIP collaborates with several groups on its key activities including:

- The Weatherization Assistance Program (WAP) works with a network of approximately 970 local weatherization agencies. WAP coordinates with the Department of Health and Human Services Low Income Home Energy Assistance Program (LIHEAP), whose state grantees make approximately 10 percent of their funds available to local WAP agencies for weatherization improvements;
- The State Energy Program works closely with all 50 States, the District of Columbia and territories;
- Tribal Energy subprogram maintains a close collaboration with the Bureau of Indian Affairs, Department of Interior, Department of Justice, and the Environmental Protection Agency through the Federal Interagency Working Group on Environmental Justice (IWG). The IWG was created under Executive Order 12898 in 1994 and is comprised of 11 Federal agencies and several White House offices working to integrate environmental justice into individual programs; and
- The Asia Pacific Partnership closely coordinates with the Department of State and DOE's Office of Policy and International Affairs and Office of Fossil Energy.

Validation and Verification

To validate and verify program performance, the Weatherization and Intergovernmental Activities will conduct internal and external reviews and audits. These programmatic activities are subject to continuing review as described below. The table below summarizes validation and verification activities.

Data Sources:	The Energy Information Administration's (EIA) Annual Energy Review (AER), Renewable Energy Annual and Annual Energy Outlook, International Energy Annual, World Energy Outlook, Country Analysis Briefs, Commercial Building Energy Consumption Survey (CBECS), Residential Energy Consumption Survey (RECS); Central Intelligence Agency (CIA) The World Factbook; U.S. Department of Commerce (DOC) Current Industrial Reports (CIR); the Golden Field Office REPI Reimbursement tracking system; NREL and various trade publications; and information collected directly from WIP performers or partners.
Baseline:	▪ Energy savings for WIP are based on market penetration of technologies after the year 2005. Savings are relative to what energy consumption would have been in the absence of this additional market penetration. State Energy Program assumes annual energy savings of 1.03 million source Btu and annual cost savings of $7.23 for every dollar of Federal funding. The program estimates energy savings from its activities using factors that were developed by Oak Ridge National Laboratory (ORNL), which is not considered (by OMB) as an independent source. While the ORNL study was reviewed in 2005 by an external group of evaluation professionals and found to provide a "good start" to documenting program impacts, the DOE Inspector General in 2006 found that the methodology used to support this estimate did not differentiate between the program's contributions and those occurring from other influences in reporting outcomes. The report also noted that DOE "had not established or collected meaningful performance metrics" and "did not validate or compare actual results to those planned", although the IG also noted that "nothing came to our attention during our visits to six States to indicate that they (the states) were not spending funds for their intended purpose" (DOE IG OAD-M-06-05). Baseline factors could change based on actions program is taking to address IG findings. ▪ Over 1.1 billion kWh of qualified renewable energy produced in 2004. ▪ Tribal Energy 2003 baseline is 750 kW of renewable generation capacity on tribal lands. ▪ The key baselines to be used in APP will be determined by its interagency task force.
Frequency:	Annual (complete revalidation of assumptions and results can only take place every 3 to 4 years, due to the reporting cycle of two critical publications, CBECS and RECS. However, updates of most of the baseline forecast and WIP outputs will be undertaken annually).

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

- Operational field measurement as appropriate;
- Peer review by independent outside experts of both the program and subprogram portfolios;
- Annual internal Technical Program Review;
- Specialized program evaluation studies to examine process, impacts, or market baseline and effects, as appropriate, e.g., national evaluation of the Weatherization Assistance Subprogram;
- Quarterly and annual assessment of program and management results based performance through Joule (the DOE quarterly performance progress review of budget targets); PMA (the President's Management Agenda -- annual departmental and Program Secretarial Officer (PSO) based goals whose milestones are planned, reported and reviewed quarterly); and PART (common government wide program/OMB reviews of management and results); and
- Annual review of methods, and recomputation of potential benefits for the Government Performance and Results Act (GPRA).

Data Storage: EIA data sources are available on line. Trade publications are available on a subscription basis. WIP output information is contained in various reports and memoranda. Reviews and analyses conducted by Oak Ridge National Laboratory are available on line at http://www.ornl.gov/info/reports/ORNL_reports.shtml.

Verification: Calculations are based on assumptions of future market status, equipment or technology performance, and market penetration rates. These assumptions can be verified against actual performance through technical reports, market surveys and product shipments. Weatherization Assistance Program validates the number of homes by State reporting through the WinSAGA system. SEP bases results on an assessment of program outcomes conducted by Oak Ridge National Laboratory whose methodology was independently reviewed in FY 2005 by the Board of Directors of the International Energy Program Evaluation Conference. DOE's Inspector General reviewed the Oak Ridge methodology and estimates in 2006 and stated "while we concluded that the States were spending funds consistent with the broad goals of the program, we found that the Department had not established or collected meaningful performance metrics to evaluate the cost benefit of the program." The program is implementing the following improvements: undertaking an independent analysis of program benefits and effectiveness; developing metrics that directly measure the current amount of energy saved by the program, and; implementing a strategic plan which sets ambitious targets for the future.

Tribal Energy maintains project information and receives data from individual Tribal Governments. EIA and CIA data undergo regular verification reviews.

Program Assessment Rating Tool (PART)

The Department implemented a tool to evaluate selected programs. PART was developed by OMB to provide a standardized way to 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 Tribal Energy Program, Asia Pacific Partnership, and the Renewable Energy Production Incentive have not been selected for a PART review.

The Weatherization Assistance Program and the State Energy Program have incorporated feedback from OMB into the FY 2008 Budget Request, have addressed most of the PART recommendations, and are committed to addressing the remaining recommendations and improving performance.

The 2003 Weatherization PART resulted in the following scores: purpose (100 percent), planning (88 percent) management (78 percent) and results (75 percent). The PART found that the program coordinates effectively with other related government programs in its efforts to meet interrelated Departmental goals and achieves its goals of a favorable benefit-cost ratio and other performance goals, based on internal programmatic assessments. The PART recognized the program has met its planned targets for the number of homes weatherized, but also noted that program's 2003 Inspector General letter report found accounting issues that could result in overstated results. Subsequent program management actions have addressed the majority of the concerns.

Consistent with PART recommendations, the program is in the second year of a three year national evaluation designed to ensure that its objectives are being met and to validate energy savings, energy bill reductions, program costs, and program benefit estimates.

The 2004 State Energy Program PART (its initial review) rated the program "results not demonstrated" as the program's shift from measuring grants processed to measuring energy results was not sufficiently in place to demonstrate results. The PART Recommendations also encouraged the development of long-term and annual measures. In FY 2006, SEP developed a strategic plan with States which included acceptable performance measures. While noting Oak Ridge National Laboratory's assessment that the program generates significant energy and cost savings, the PART review noted that data was not available from all States and that the study was not prepared by an independent source. ORNL's second study in the series, based on data from 50 States, 4 Territories and DC, was reviewed by the Board of Directors of the International Energy Program Evaluation Conference, an independent body comprised of many recognized peer experts in the energy efficiency program evaluation field, which found the methodology to be "a good start". However, a 2006 report by the DOE Inspector General found problems with the methodology and data that the program used to support energy benefit claims. The program is planning future analyses to be conducted by external independent entities.

Expected Program Outcomes

The Weatherization and Intergovernmental Activities pursues its mission through integrated activities designed to improve the energy efficiency and productivity of our economy. Achievement of the program's goals is expected to yield energy security, economic and environmental benefits. Additionally, some of the energy efficiency measures provide less easily quantifiable benefits, such as improved lighting quality. Moreover, the benefits calculations exclude the direct socioeconomic benefits of providing lower cost energy services to the low-income households.

Estimates of the security, economic and environmental benefits from 2008 through 2050 that would result from realization of the program's goals are shown in the table below.

EERE's WIP Program Goal Case reflects the continuation of the program and the gradual penetration of the measures implemented as a result of program activities. Not included are any policy or regulatory mechanisms, or other incentives not already in existence, that might be expected to support or accelerate the achievement of the program goals. The expected benefits reflect solely the achievement of the program's goals.

The goals are modeled in contrast to the "baseline" case, in which no DOE research and development (R&D) or deployment program exists. The baseline case is identical to those used for all DOE applied energy R&D programs.[a] Further, across EERE, and across all of DOE's applied energy R&D programs, the expected outcome benefits are being calculated using the same fundamental methodology. Finally, the metrics by which expected outcome benefits are measured are identical for all of DOE's applied energy R&D programs.[b] This standardization of methods and metrics has been undertaken as part of the Department's efforts to respond to Under Secretary Garman's Strategic Management System initiative and OMB's request to make all programs' outcomes comparable.

The difference between the baseline case and the program goal case results in economic, environmental and security benefits. For example, achievement of program goals results in annual carbon emissions reductions of 15 million metrics tons in both 2030 and 2050. The results are generated by modeling the program goals within two energy-economy models: NEMS-GPRA08 for benefits through 2030, and MARKAL-GPRA08 for benefits through 2050.[c] The full list of modeled benefits appears below.[d]

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[a] The starting point for the baseline case is the Energy Information Administration's "reference case," as published in the AEO 2006. Program analysts from across DOE examined the AEO to determine the extent to which their program goals are modeled (explicitly or implicitly). If program goals are modeled in the AEO, they are removed in the GPRA baseline. Further, some programs believe that the AEO's technology representation is too conservative, even in the absence of program goals, and thus in certain cases a modification is made to make the technology representation in the baseline case more optimistic than the AEO.

[b] The set of expected outcome metrics being used this year differs in substantial ways to that of previous years. In addition to the standardization across DOE's applied energy R&D programs, the list is expanded and more comprehensive than in past years. Further, the list maps to DOE strategic goals. The expected outcome metrics represent inherent societal benefits that stem from achievement of program goals.

[c] Final documentation on the analysis and modeling, including all of the methodologies and underlying assumptions, is expected to be completed and posted on the web by March 31, 2007. Past GPRA modeling and analysis documentation can be found at http://www.eere.energy.gov/ba/pba/gpra.html.

[d] Analysts for the WIP program recently updated their estimates of the impacts of WIP due to introduction of a new market transformation initiative. Based on these revised inputs, new estimates of oil and greenhouse gas savings have been included here. There was not time, however, to estimate all of the metrics for these revised inputs. A full complement of benefits will be provided in the final GPRA benefits report for FY 2008.

FY 2008 GPRA Benefits Estimates for Weatherization and Intergovernmental Activities[a,b]

	2010	2020	2030	2040	2050
Environmental Benefits (Goal 1.2)					
Avoided carbon emissions, annual (MMTC)	2	11	15	na	na
Avoided carbon emissions, cumulative (MMTC)	5	80	221	na	na
Reduced cost of criteria pollutant control, NPV[c] (bil. 2004$)	na	na	na	na	na
Economic Benefits (Goal 1.4)					
Consumer savings, annual (bil. 2004$)	na	na	na	na	na
Consumer savings, NPV (bil. 2004$)	na	na	na	na	na
Electric power industry savings, annual (bil. 2004$)	na	na	na	na	na
Electric power industry savings, NPV(bil. 2004$)	na	na	na	na	na
Household energy expenses reduced, annual (bil. 2004$)[d]	na	na	na	na	na
Energy intensity reduced (% change in E/GDP)	na	na	na	na	na
Net energy system cost savings, annual (bil. 2004$)	NC	NC	NC	na	na
Natural gas price change, moving avg. (2004$ / TCF)[e]	na	na	na	na	na
Security and Reliability Benefits (Goal 1.1 or 1.3)					
Avoided oil imports, annual (mbpd)	ns	0.0	0.1	na	na
Avoided oil imports, cumulative (bil. bbl)	ns	0.1	0.2	na	na
Security MPG improvement (%)[f]	na	na	na	na	na
Transportation fuel diversity improvement (%)[g]	na	na	na	na	na
Oil intensity reduced (% change in bil. bbl/GDP)	na	na	na	na	na

[a] Benefits through 2030 are calculated with the NEMS-GPRA08 model. Benefits from 2035 through 2050 are calculated with the MARKAL-GPRA08 model. "NC" indicates situations in which no calculation was done because of specific model limitations.. "na" indicates that estimates were not available.

[b] Projected benefits do not include any potential policy changes that might enhance technology deployment. In addition, most technologies show diminishing benefits by 2050, because of the assumption built in to the analysis that baseline industry progress will eventually catch up with the more accelerated progress associated with EERE program success.

[c] Net present value calculations throughout this table are performed for cumulative economic metrics, and are done using a 3% real discount rate, cumulative to 2008.

[d] While overall household savings are small, this program focuses on a small portion of the population, particularly those with low income, who benefit more from energy savings.

[e] The prices reflected here are average delivered prices to all sectors, and are based on a three year moving average. Thus the measure of benefit is the change in the three year moving average delivered price, in $ per thousand cubic foot.

[f] Security MPG is the ratio of vehicle miles traveled by light duty vehicles to their usage of oil. It captures oil avoidance by efficiency and fuel alternatives.

[g] Fuel diversity is measured by the Shannon-Weiner Index (SWI) of diversity. The SWI is a measure of "proportional diversity," and hence captures both abundance and richness, i.e., how many different fuels and how much of each fuel both factor into the calculation.

WIP provides a number of benefits not directly addressed in the table above. Through the Weatherization Assistance Program, WIP improves energy affordability and safety for low income households who lack the financial resources to make these investments on their own. This program also provides the institutional basis for other sources of Federal, state, local, and utility dollars used to weatherize additional homes, and provides on-the-ground training and experience with advanced building efficiency technologies and technologies for building contractors throughout the country.

WIP also provides state and local governments with improved capability to address local air quality needs at a lower cost and with better results than would be achievable otherwise.

The expected program outcomes from the Asia Pacific Partnership are not represented by the tools or models utilized by EERE for its benefits calculations. While the Asia Pacific Partnership and its goals are still in the developing stages, there are some clear targets of opportunity for partner countries to replicate U.S. success in reducing energy intensity.

Finally, through the State Energy Program, WIP provides a basis for state and local energy emergency planning and response capabilities. Initially developed to respond to oil and natural gas shortages in the 1970s, state energy planning has provided local capabilities for addressing recent electricity shortages, emergency preparedness, and homeland security coordination in recent years.

Weatherization Assistance Program

Funding Schedule by Activity

(dollars in thousands)

	FY 2006	FY 2007	FY 2008
Weatherization Assistance Program			
Weatherization Assistance Grants	237,996	159,648	139,450
Training and Technical Assistance	4,554	4,550	4,550
Total, Weatherization Assistance Program	242,550	164,198	144,000

Description

The Department of Energy administers the Weatherization Assistance Program (WAP) by providing technical assistance and formula grants to state and local weatherization agencies throughout the United States. This support improves the energy savings per home and helps States spend non-Federal funding effectively through uniform technical assistance. A network of approximately 970 local agencies provide trained crews to perform weatherization services for eligible low-income households in single-family homes, multifamily dwellings, and mobile homes. Of the homes weatherized annually, 49 percent are occupied by an elderly person with special needs or a person with disabilities. Other priorities are given to families with children, and households that spend a disproportionate amount of their income on energy bills (utility bills make up 13.5 percent of household expenses for low income families, compared to 3.5 percent or less for all other Americans). All homes receive a comprehensive energy audit, which is a computerized assessment of a home's energy use and an analysis of which energy conservation measures are best for the home; a combination of those energy-saving measures are then installed.

Benefits

Weatherization Assistance Program grants contribute to the WIP goal by reducing the energy cost burden to low-income households that pay a disproportionate amount of household income on energy bills. Since 1976, the Weatherization Assistance Program has helped over five million American families reduce their energy bills and increase the comfort and safety of their homes resulting in average annual cost savings of $274 per household.[a] Weatherization also provides many non-energy benefits to recipient households and their communities. For example, it helps stabilize the housing stock in low-income neighborhoods and supports approximately 8,000 technical jobs in local home energy businesses. In addition to the DOE funds, the Department of Health and Human Services also provides funding for Weatherization through the Low Income Home Energy Assistance Program. Non-Federal funds also are leveraged by States, the table below summarizes the most recent data available.

[a] Meta evaluation of National Weatherization Assistance Program Based on State Studies, 1993-2002 ORNL/CON-488, February, 2003.

Weatherization Assistance Funding

(whole dollars)

State	Source of Non-Federal Funds	FY 2006 Federal DOE Funds	FY 2006 Non-Federal Funds
Alabama	N/A	$2,724,123	$275,000
Alaska	Alaska Housing Finance Corp (State)	$1,734,314	$3,000,000
Arizona	Utility funds	$1,603,527	$1,250,000
Arkansas	Utility funds	$2,202,800	$0
California	(Utility funds operated at local level)	$7,085,364	$0
Colorado	Utility funds	$5,678,125	$2,482,000
Connecticut	(Utility funds operated at local level)	$2,759,107	$5,800,000
Delaware	Utility funds	$612,727	$360,000
Dist. Columbia	Utility Funds	$712,764	$1,125,000
Florida	State Funds for WAP Repair Program	$2,592,639	$0
Georgia	Utility funds	$3,339,105	$1,900,000
Hawaii	N/A	$234,987	$0
Idaho	Utility funds and private sources	$2,076,784	$1,642,511
Illinois	State public benefit funds	$14,349,500	$7,800,000
Indiana	(Utility funds operated at local level)	$6,762,132	$2,000,000
Iowa	Utility funds	$5,153,879	$4,814,742
Kansas	N/A	$2,706,214	$0
Kentucky	N/A	$4,761,929	$0
Louisiana	N/A	$1,997,309	$0
Maine	State Public Utility Commission funds	$3,240,063	$0
Maryland	(Utility funds operated at local level)	$2,897,804	$1,850,000
Massachusetts	(Utility funds operated at local level)	$6,938,192	$23,030,692
Michigan	N/A	$15,446,624	$4,215,000
Minnesota	Utility funds and special State funds	$10,154,727	$440,500
Mississippi	N/A	$1,850,660	$0
Missouri	Utility funds	$6,368,172	$2,552,388
Montana	Utility funds	$2,623,349	$1,923,903
Nebraska	N/A	$2,586,397	$0
Nevada	Utility funds	$946,130	$3,300,000
New Hampshire	Utility funds	$1,593,171	$1,417,482

(whole dollars)

State	Source of Non-Federal Funds	FY 2006 Federal DOE Funds	FY 2006 Non-Federal Funds
New Jersey	Utility funds, landlord contributions, other private funds	$5,266,959	$3,723,000
New Mexico	Utility funds	$2,059,770	$3,873,000
New York	Utility funds, landlord contributions, other private funds	$21,818,047	$7,000,000
North Carolina	N/A	$4,576,429	$0
North Dakota	N/A	$2,589,151	$0
Ohio	Utility funds, landlord contributions, other private funds	$14,242,973	$20,000,000
Oklahoma	Landlord contributions, other private funds	$2,831,669	$20,755
Oregon	Utility funds	$2,921,655	$8,256,292
Pennsylvania	(Utility funds operated at local level)	$15,101,584	$0
Rhode Island	Utility funds	$1,253,702	$900,000
South Carolina	N/A	$1,982,643	$150,000
South Dakota	N/A	$1,991,514	$0
Tennessee	N/A	$4,534,180	$0
Texas	Utility funds	$6,607,385	$2,203,235
Utah	Utility funds, TANF	$2,161,298	$351,000
Vermont	VT Weatherization Trust Fund	$1,353,926	$5,991,917
Virginia	Emergency Home Repair funds	$4,344,862	$2,000,000
Washington	Utility funds and State capital funds	$4,688,820	$8,560,000
West Virginia	Utility funds	$3,320,985	$0
Wisconsin	Utility funds	$8,800,191	$41,101,045
Wyoming	N/A	$1,221,639	$495,000
	Headquarters Training and Technical Assistance	$4,554,000	$0
	Undistributed	$594,000	$0
Total, Weatherization Assistance Funding		$242,550,000	$175,804,462

Detailed Justification

	(dollars in thousands)		
	FY 2006	FY 2007	FY 2008
Weatherization Assistance Grants	**237,996**	**159,648**	**139,450**

This activity will provide state formula grants to enable the weatherization of an estimated 54,599 low-income homes, which the program estimates will save $1.53 in energy costs for every dollar invested over the life of the measures (based on current EIA energy price data). Ninety percent of the total Weatherization Assistance Program funding will be allocated to the States as operating funds for this purpose, i.e., for labor, materials, equipment and administrative systems.

Ten percent of the total program funding will be allocated for training and technical assistance to maintain a high standard of technology application, effectiveness and results. Most training and technical assistance will be performed at state and local levels. In FY 2006, as directed by Congress, $594,000 was provided to the Office of International Energy Market Development.

Training and Technical Assistance	**4,554**	**4,550**	**4,550**

DOE will conduct analysis, measure and document program performance, and promote (e.g., through pilot programs, publications, training programs, workshops and peer exchange) the application of advanced techniques and collaborative strategies to continually improve program effectiveness.

Traditionally, DOE uses 1.5 percent of the total Weatherization funding to fund training and technical assistance activities that can be more cost-effectively performed at national/regional levels, to support effective program operations by the network of state and local Weatherization agencies. However, in response to PART recommendations, DOE will modify the DOE/State split on T&TA funding in order to conduct a new national evaluation of the program. In 2005, DOE began funding ($600,000 from DOE T&TA) the first year of this multi-year national evaluation, estimated not to exceed $6 million, to insure that its objectives are being met and that estimates of energy savings, bill reductions, program costs, and program benefits are valid. The Weatherization Assistance Program has not conducted a national evaluation for more than a decade. The new evaluation is needed to assess the overall energy savings and cost-effectiveness of the program, assess the impact of numerous changes made to program policy and procedures, and determine the best methods to improve future program performance.

Total, Weatherization Assistance Program	**242,550**	**164,198**	**144,000**

Explanation of Funding Changes

	FY 2008 vs. FY 2007 ($000)
Weatherization Assistance Grants	
The request maintains the core WAP delivery system while redirecting the resources to enable greater investments in advanced R&D.	-20,198
Total Funding Change, Weatherization Assistance Program	**-20,198**

State Energy Program

Funding Schedule by Activity

	(dollars in thousands)		
	FY 2006	FY 2007	FY 2008
State Energy Program			
State Energy Program Formula Grants	35,640	49,457	35,000
State Energy Program Special Projects	0	0	10,501
Total, State Energy Program	35,640	49,457	45,501

Description

The State Energy Program (SEP) mission is to provide financial assistance through formula grants to States, enabling state governments to target their own high priority energy needs and expand clean energy choices for their citizens and businesses. This program was created by Congress in 1996 by consolidating two earlier efforts — the State Energy Conservation Program, and the Institutional Conservation Program, both established in the 1970s.

SEP is the only Federally funded, state-based program administered by DOE that provides resources directly to the States. With these funds and the resources leveraged by them, the State and Territory Energy Offices develop and manage a variety of programs designed to increase energy efficiency, reduce energy use and costs, develop alternative energy and renewable energy sources, promote environmentally conscious economic development and reduce reliance on oil produced outside the U.S. State Energy Offices are also instrumental in administering public benefits funds and energy emergency preparedness.

Beginning in 2007 activities supported through budget category: “Planning and Evaluation Support for State and Local Grant Programs” were switched to the SEP request. These include Oak Ridge metrics evaluation study updates, program oversight, State Energy Advisory Board support, and response to Congressionally mandated requirements under EPACT 2005 (training and technical assistance).

Benefits

SEP contributes to EERE’s market transformation goals by supporting the core capabilities of States to implement activities that promote energy efficiency and adopt renewable energy technologies. The SEP, among many other activities, funds the development and maintenance of energy emergency planning at the state and local levels, a critical security benefit. SEP has recently taken steps to better quantify the energy benefits of the program activities, including savings and emissions reductions.[a] An internal program evaluation suggests that the program achieves an annual energy cost savings of 1.17

[a] Estimating Energy and Cost Savings and Emissions Reductions for the State Energy Program Based on Enumeration Indicators Data ORNL/CON-487 January 2003. One independent study suggests the ORNL provides a “good start” to estimating benefits, but a 2006 DOE Inspector General report found that the program “had not established or collected meaningful performance metrics to evaluate the cost benefit of the program.”

million source Btu and $7.23 in annual energy cost savings for each $1 of Federal funding. An external evaluation is being implemented. The program is currently focused on supporting the implementation of the 2006 SEP Strategic Plan, which is addressing key goals of market transformation and collaboration with environmental and economic development interests.

Detailed Justification

(dollars in thousands)

	FY 2006	FY 2007	FY 2008
State Energy Program Formula Grants	**35,640**	**49,457**	**35,000**

The State Energy Program Grants (SEP) request includes $35 million in formula grants to ensure all States have energy programs and services for citizens, while maintaining the viability of the State Energy Office network.

SEP will provide formula grants to 50 States, the District of Columbia, and territories for energy efficiency/renewable programs. Support implementation of 2006 SEP Strategic Plan, addressing key goals of market transformation and collaboration with environmental and economic development interests. Assist States in strategic planning and analysis. Provide technical assistance and training to develop state level capabilities to form collaborative partnerships and conduct evaluation of the impact of state energy efficiency and renewable energy programs nationwide. Provide technical assistance to address emerging regional energy and environmental issues such as transportation and air quality. Support information technology systems for program evaluation and reporting in compliance with E-Gov initiative.

State Energy Program Special Projects	**0**	**0**	**10,501**

In FY 2008 $10.5 million will be offered competitively through SEP Special Projects. These Special Projects will focus on market transformation and crosscutting solutions targeted at market sectors. They will not be technology specific independent solicitations.

The SEP competitive special project grants will enable States to initiate innovative financially self-sustaining energy planning and program activities. DOE would seek proposals that establish policies which increase available capital for energy efficiency and renewable energy projects and implement strategies that would create a self-sustaining resource base for state programs over the long term, e.g., revolving loan funds, financing risk reduction, performance contracting, etc.

SEP will provide tailored technical assistance to States to support state and local actions that further national energy priorities and transform markets for EERE technologies and practices.

Total, State Energy Program	**35,640**	**49,457**	**45,501**

Explanation of Funding Changes

	FY 2008 vs. FY 2007 ($000)
State Energy Program Formula Grants	
The decrease reflects the shift within the State Energy Program to fund the competitive Special Projects activity. The Special Projects work will enable States to initiate innovative financially self-sustaining energy planning and program activities.	-14,457
Sta**te Energy Program Special Projects**	
Request funds competitive special project to initiate self sustaining state-run energy projects and programs.	+10,501
Total Funding Change, State Energy Program	**-3,956**

State Energy Activities

Funding Schedule by Activity

	(dollars in thousands)		
	FY 2006	FY 2007	FY 2008
State Energy Activities			
Planning and Evaluation Support for State and Local Grant Programs	495	0	0
Total, State Energy Activities	495	0	0

Description

State Energy Activities complemented the State Energy Program. Former activities, such as, metrics evaluation, program communication and oversight, are included as part of the State Energy Program request.

Benefits

State Energy Activities contribute to WIP deployment goals by supporting State Energy Program grant activities. This funding provided assistance to States to implement planning and analysis for policies, programs and projects that increased market penetration of energy efficiency and renewable energy technologies and policies.

Detailed Justification

	(dollars in thousands)		
	FY 2006	FY 2007	FY 2008
Planning and Evaluation Support for State and Local Grant Programs	**495**	**0**	**0**

Activities, including program evaluation, planning, and analysis, State Energy Advisory Board support, EPACT 2005 requirements, and State training and technical assistance are included in the State Energy Program Request. No change.

Total, State Energy Activities	**495**	**0**	**0**

Gateway Deployment

Funding Schedule by Activity

(dollars in thousands)

	FY 2006	FY 2007	FY 2008
Gateway Deployment			
Rebuild America	3,769	0	0
Energy Efficiency Information and Outreach	346	0	0
Building Codes Training and Assistance	4,455	0	0
Clean Cities	7,920	0	0
ENERGY STAR®	5,940	0	0
Inventions and Innovation	2,970	0	0
Total, Gateway Deployment	25,400	0	0

Description

Gateway activities in FY 2007 were transferred to applicable EERE technology development programs or discontinued. Activities transferred include Rebuild America (to the Building Technologies Program), Clean Cities (to the Vehicle Technologies Program) and ENERGY STAR® (to the Building Technologies Program). This realignment will result in improved coordination and linkage between activities that are focused on developing new technologies and those that are reducing the barriers to their market adoption.

Detailed Justification

(dollars in thousands)

	FY 2006	FY 2007	FY 2008
Rebuild America	**3,769**	**0**	**0**

Rebuild America is a technology information network and operations results-tracking service that develops, acquires or provides financial assistance to distribute the use of best practice decision tools for senior management in various difficult markets. In FY 2007, Rebuild America and all activities were transferred to the Building Technologies Program.

	(dollars in thousands)		
	FY 2006	FY 2007	FY 2008
Energy Efficiency Information and Outreach	**346**	**0**	**0**

Information and Outreach activities focused on key market segments, homeowners, and school officials. Outreach will include use of web based tools, media outlets and business communication channels to leverage effectiveness. Future activities will be addressed within the EERE Office of Technology Advancement and Outreach.

Building Codes Training and Assistance	**4,455**	**0**	**0**

In support of Energy Conservation and Production Act Section 304, this activity provided technical and financial assistance to States, to update and implement their energy codes. States have developed sufficient expertise in this area; therefore the activity was discontinued in FY 2007. To the extent that any future work is done in this area, activities would be carried out within the Building Technologies' Program.

Clean Cities	**7,920**	**0**	**0**

In support of Energy Policy Act Section 505, Clean Cities promotes alternative fuel efforts and expands activities to promote the use of additional petroleum displacement technologies. The technologies include anti-idling devices in heavy duty trucks and buses, expanded use of non-petroleum blends, hybrid technologies and a better public understanding of the benefits of fuel economy. The FY 2006 funding for Clean Cities includes two Congressionally Directed activities: University of Northern Iowa based Industrial Center $999,000 and Oxydiesel Demonstration project in CA and NV $495,000. In FY 2007, Clean Cities was transferred to the Vehicle Technologies' Program.

ENERGY STAR®	**5,940**	**0**	**0**

ENERGY STAR® expands consumer interest in energy efficient appliances, and updates appliance criteria, in consensus with industry. A major activity emphasis is the Home Performance ENERGY STAR®, with the goal of creating market-based residential retrofit industries in select metropolitan areas. In FY 2007, ENERGY STAR® was transferred to the Building Technologies Program.

Inventions and Innovation	**2,970**	**0**	**0**

This activity funds grants to independent inventors and small technology-based businesses. It provided assistance to small businesses and independent inventors to develop skills in technology commercialization. In accordance with Research and Development Investment Criteria regarding closeness to commercialization and potential public benefits, this activity was discontinued in FY 2007. Technology development activities will continue in individual technology programs.

Total, Gateway Deployment	**25,400**	**0**	**0**

International Renewable Energy Program

Funding Schedule by Activity

	(dollars in thousands)		
	FY 2006	FY 2007	FY 2008
International Renewable Energy Program			
International Renewable Energy Program	406	2,473	0
Congressionally Directed, International Utility Electricity Partnership	3,465	0	0
Total, International Renewable Energy Program	3,871	2,473	0

Description

The International Renewable Energy Program (IREP) promoted market transformation in international energy markets to increase the installation of domestically developed (i.e., U.S.-manufactured) technologies. Specific activities have included evaluating local energy needs, raising awareness of renewable energy opportunities, delivering training and technical assistance to foreign energy decision-makers, and apprising them of opportunities related to their domestic energy markets.

Benefits

The IREP provided technical assistance via National Laboratories and outside experts, helping meet specific commitments contained in bilateral and multilateral agreements.

Detailed Justification

	(dollars in thousands)		
	FY 2006	FY 2007	FY 2008
International Renewable Energy Program	**406**	**2,473**	**0**

International Renewable Energy (IREP) activities have been focused on technical assistance to foreign governments and companies that design and install renewable energy technologies. Focus will now be targeted at helping the U.S. and member countries of the Asia Pacific Partnership meet clean development and climate goals.

	FY 2006	FY 2007	FY 2008
	(dollars in thousands)		
Congressionally Directed, International Utility Electricity Partnership	**3,465**	**0**	**0**

Provided for the electric industry to partner with the developing world in voluntary greenhouse gas (GHG) reduction efforts.

Total, International Renewable Energy Program	**3,871**	**2,473**	**0**

Explanation of Funding Changes

	FY 2008 vs. FY 2007 ($000)
Redirected funds to the Asia Pacific Partnership will accelerate clean energy development with partner countries.	-2,473
Total Funding Change, International Renewable Energy Program	**-2,473**

Tribal Energy Activities

Funding Schedule by Activity

	(dollars in thousands)		
	FY 2006	FY 2007	FY 2008
Tribal Energy Activities			
Tribal Energy Activities	2,970	3,957	2,957
Congressionally Directed, Council of Renewable Energy Resource Tribes (CERT)	990	0	0
Total, Tribal Energy Activities	3,960	3,957	2,957

Description

Tribal Energy Activities builds partnerships with Tribal Governments to help assess Native American energy needs for residential, commercial and industrial uses. Additionally, it provides technical and financial assistance in energy efficiency and renewable energy development. The activities provide the means for Tribal leaders to make knowledgeable choices regarding their Tribes' energy future, through resource assessments, workshops, training, and energy plan development assistance. Energy projects are competitively awarded on a cost-shared basis for Native American Tribes to implement comprehensive energy plans that incorporate energy efficiency and renewable energy technologies and resources. As a result, projects are underway for the development of renewable energy resources on Tribal lands.

Benefits

Tribal Energy Activities contribute to WIP's mission by building partnerships with Tribal Governments to help assess Native American energy needs for residential, commercial and industrial uses employing EERE technologies. Tribal Energy Activities develops, implements, and manages technical and financial assistance projects to promote energy, environmental and economic development policy objectives for Native Americans. Between FY 2002 and FY 2006, 76 tribal energy projects totaling $12.4 million, leveraged by $3.3 million cost shared by the Tribes, have been competitively selected for awards. Included among these is the installation of the first utility-scale wind turbine (750 kW) on the Rosebud Sioux Reservation (FY 2003) and the installation of a substation at the Colville Indian Power and Veneer plant in Washington State, which is projected to reduce line losses and save $160,000 to $260,000 per year.

Detailed Justification

	(dollars in thousands)		
	FY 2006	FY 2007	FY 2008
Tribal Energy Activities	**2,970**	**3,957**	**2,957**

The Tribal Energy projects support the development of capacity within the 565 Federally recognized Native American Tribes to assess and meet their energy needs both for residential and economic development. Tribal Energy activities provide financial and technical assistance to Tribes for: strategic planning, energy options analysis, organizational development, capacity building, and feasibility studies.

In FY 2008, the Tribal Energy Activities will seek to assist Tribes in addressing their energy efficiency needs in collaboration with the Department of Interior and the Department of Housing and Urban Development. The need to assure that low income Tribal members have the benefits of low-cost energy efficiency technologies to reduce their energy costs is great. The Tribal Energy activities will continue to address the unique project development concerns of Tribal Governments. Tribal Energy activities will include competitive solicitations to facilitate a "project pipeline" of both renewable energy and energy efficiency projects in Indian Country. Prior year efforts will be closed out where appropriate.

Economic development is an ongoing challenge facing Tribal leaders and access to energy is a particular problem in this regard. Because of their remote locations and distance from, or access to, transmission and distribution systems, many Tribes have an inadequate energy service, which inhibits economic development efforts and programs to promote rural education, public health, and safety. In many ways, the energy problems faced by the Tribes resemble the energy problems faced by developing nations and remote populations around the world.

Congressionally Directed, Tribal Energy/Council of Renewable Energy Resource Tribes (CERT)	**990**	**0**	**0**

Provided technical expertise and training for Native Americans in renewable energy resources development.

Total, Tribal Energy Activities	**3,960**	**3,957**	**2,957**

Explanation of Funding Changes

	FY 2008 vs. FY 2007 ($000)
Tribal Energy Activities	
Funding reduction maintains core tribal energy assessment, technical assistance, and project development efforts delivery system. Redirected funds enable EERE to accelerate critical national research priorities which will benefit the entire Nation.	-1,000
Total Funding Change, Tribal Energy Activities	**-1,000**

Renewable Energy Production Incentive (REPI)

Funding Schedule by Activity

	(dollars in thousands)		
	FY 2006	FY 2007	FY 2008
Renewable Energy Production Incentive	4,950	4,946	4,946
Total, Renewable Energy Production Incentive	4,950	4,946	4,946

Description

The Renewable Energy Production Incentive (REPI) subprogram provides financial incentive payments to publicly owned utilities, not-for-profit electric cooperatives, and Tribal governments and native corporations that own and operate qualifying facilities generating renewable electricity.

Benefits

REPI supports the WIP goal to promote increases in the generation and utilization of electricity from renewable energy sources and to further the advances of renewable energy technologies.

Detailed Justification

	(dollars in thousands)		
	FY 2006	FY 2007	FY 2008
Renewable Energy Production Incentive	**4,950**	**4,946**	**4,946**

In FY 2008 REPI will continue to provide financial incentive payments to publicly owned utilities, not-for-profit electric cooperatives, and Tribal Governments and native corporations that own and operate qualifying facilities generating renewable electricity.

Total, Renewable Energy Production Incentive	**4,950**	**4,946**	**4,946**

Asia Pacific Partnership

Funding Schedule by Activity

	(dollars in thousands)		
	FY 2006	FY 2007	FY 2008
Asia Pacific Partnership	0	0	7,500
Total, Asia Pacific Partnership	0	0	7,500

Description

In his press statement on July 27, 2005, when the U.S. joined the Asia Pacific Partnership (APP), President Bush announced that the U.S. had joined with Australia, China, India, Japan, and South Korea in a new results-oriented partnership, building on a strong history of common approaches and demonstrated cooperation on clean energy technologies. APP will pursue project development, implementation assistance, and capacity building and work with foreign governments, international financial institutions, the private sector, and non-governmental organizations to establish the appropriate technology and investment frameworks and to improve governance practices in emerging markets around the world. The State Department is the lead agency for the APP. In addition to DOE, other participating agencies include the Department of Commerce and the Environmental Protection Agency. DOE's Office of Fossil Energy also requests $7.5 million for APP.

Benefits

The Asia Pacific Partnership (APP) activities within EERE will contribute to U.S. Federal Government APP efforts, in collaboration with APP partner countries, to install new renewable power generating capacity, transfer/demonstrate best manufacturing practices for targeted industries; transfer/demonstrate best design and construction practices for buildings; and encourage the adoption of efficient appliances standards. Outputs/outcomes will be refined once the APP task force finalizes goals and objectives.

Detailed Justification

	(dollars in thousands)		
	FY 2006	FY 2007	FY 2008
Asia Pacific Partnership	**0**	**0**	**7,500**

The Asia Pacific Partnership (APP) is a new activity in FY 2008, but continues activities requested for funding in the same total amount in FY 2007 within the Building Technology Program, Industrial Technology Program, Hydrogen Program, International Programs, and Program Direction.. The request would continue EERE's direct support for three of the six action areas identified by the APP task forces.

The request funds the following:

New Renewable Power Generating Capacity – Consistent with the APP Charter, EERE will provide technical assistance and collaborate with the other partners to promote and create an enabling environment for the development, diffusion, deployment and transfer of existing and emerging cost-effective, new renewable power generating technologies and practices. Initial focus will be on lower-cost clean power to areas without access to modern energy services. (+2,500)

Best Manufacturing Practices for Targeted Industries – Focus on identifying and addressing energy losses that when remedied will reduce the energy requirements of industry while stimulating economic productivity and growth. The initial industries examined with the assistance of EERE's Industrial Technologies Program developed tools are likely to be aluminum, steel, and cement. (+2,500)

Best Design and Construction Practices for Buildings; and Efficient Appliances Standards – Use the tools developed in EERE's Buildings Technologies Program to identify, assess, and address barriers to more cost-effective, cleaner, and more efficient technologies and practices in the areas of buildings and appliances. (+2,500)

	FY 2006	FY 2007	FY 2008
Total, Asia Pacific Partnership	**0**	**0**	**7,500**

Explanation of Funding Changes

	FY 2008 vs. FY 2007 ($000)
The Asia Pacific Partnership is a new activity in FY 2008. This increase is simply the result of moving the APP activities from separate chapters in the FY 2007 budget request, to this chapter. The funding level has not changed.	+ 7,500
Total Funding Change, Asia Pacific Partnership	**+7,500**

Program Direction

Funding Profile by Category

	(dollars in thousands/whole FTEs)		
	FY 2006	FY 2007	FY 2008
Headquarters			
Salaries and Benefits	44,016	40,948	47,543
Travel	2,093	2,159	2,376
Support Services	7,450	8,429	8,573
Other Related Expenses	6,579	6,894	8,938
Total, Headquarters	60,138	58,430	67,430
Full Time Equivalents	299	319	338
Golden Field Office (Project Management Center)			
Salaries and Benefits	11,776	16,228	17,585
Travel	851	520	683
Support Services	1,676	2,057	3,689
Other Related Expenses	2,182	3,319	2,574
Total, Golden Field Office	16,485	22,124	24,531
Full Time Equivalents	102	134	141
National Energy Technology Laboratory (Project Management Center)			
Salaries and Benefits	6,158	9,095	11,190
Travel	138	240	285
Support Services	401	1,135	1,577
Other Related Expenses	138	0	0
Total, National Energy Technology Laboratory	6,835	10,470	13,052
(Reimbursable Full Time Equivalents, non-add) [a]	(44)	(61)	(61)

[a] Non-EERE Federal Employees

	(dollars in thousands/whole FTEs)		
	FY 2006	FY 2007	FY 2008
Regional Offices			
Salaries and Benefits	12,488	0	0
Travel	838	0	0
Support Services	2,099	0	0
Other Related Expenses	2,985	0	0
Total, Regional Offices	18,410	0	0
Full Time Equivalents	69	0	0
Total Program Direction			
Salaries and Benefits	74,438	66,271	76,318
Travel	3,920	2,919	3,344
Support Services	11,626	11,621	13,839
Other Related Expenses	11,884	10,213	11,512
Total, Program Direction	101,868	91,024	105,013
Total, Full Time Equivalents	470	453	479
(Total, Reimbursable Full Time Equivalents, non-add)[a]	(44)	(61)	(61)

Mission

Program Direction funding helps to advance the Department's energy efficiency and renewable goals and objectives as well as implement the President's Management Agenda. Program Direction provides for the Federal staffing resources and associated costs for supporting the management and oversight of the complex network of National Laboratories, industrial partners, state and local governments, universities and private companies. It funds staff, travel, policy review and coordination, infrastructure and construction management, contracts for security and administrative support at the Golden Field Office (GO) and the National Energy Technology Laboratory (NETL), support services for budget formulation and execution, development of corporate management IT systems, IT hardware and other equipment and supplies, and general office and human capital resources management.

Headquarters

Headquarters program personnel are responsible for the following functions:

- Defining the program goals and policies;
- Developing Strategic, Multi-year and Annual Operating Plans to achieve the goals;
- Developing and defending the budget necessary to execute the plan; and

[a] Non-EERE Federal Employees

- Overseeing the technical progress of the program and feeding back lessons learned to re-baseline program activities.

The EERE Technology Programs are supported by the Deputy Assistant Secretary for Business Administration, consisting of the Offices of Program Execution Support, Planning, Budget and Analysis, and Information and Business Management Systems. Together with the EERE Project Management Center (PMC), these organizations provide centralized business management services to implement the programs. These organizations also lead the EERE President's Management Agenda initiatives for Human Capital Management, E-Government, Budget and Performance Integration, Improved Financial Management, Research & Development (R&D) Investment Criteria and Competitive Outsourcing.

In response to outside recommendations (e.g., the National Academy of Public Administration) and its own continuing self assessments, EERE is continuing implementation of its Management Action Plan to guide reforms that have been addressing identified shortcomings, including:

- Continuing a formal Program Management Initiative, focused on training for all program managers. As a result, EERE continues to progress towards a fully certified and trained program management corps;
- Expand the utility and utilization of the EERE Corporate Planning System (CPS), which provides a unified corporate approach toward annual budget planning, program execution, and performance measurement across EERE. Operations will continue through FY 2008 to expand the use of CPS at the field sites and laboratories;
- Developing stronger management oversight on the use of support service contracts, and combining that with the workforce analysis to develop a strategy for optimally and flexibly deploying support service resources for maximum benefit; and
- Working with the DOE Chief Financial Officer, the Office of Management and Budget, and the Congress to better convey and account for expenditures of program direction and policy analysis costs.

EERE PMC

The FY 2008 budget provides for the fully developed EERE PMC. The PMC is a virtual organization consisting of project management staff at the GO and the Office of Fossil Energy's NETL. In FY 2006, the activities of the six former Regional Offices were consolidated into the PMC to establish a more seamless provision of full-service project management services.

The PMC personnel are responsible for providing an integrated, multi-disciplinary function and structured approach that ensures that all program implementation activities are defined, initiated, and carried out successfully in pursuit of EERE program goals and objectives.

GO/PMC

GO serves as one of the two PMC sites under EERE's Project Management Initiative, the other being NETL. As a PMC, GO and NETL provide dedicated Contracting Officers (COs) and Contracting Officer Representatives (CORs) to perform field project management of R&D partnerships. The staff of COs and CORs is supported by Technical Monitors hired under a support-services contract. GO also supports EERE efforts through the administration of the National Renewable Energy Laboratory management and operating (M&O) contract, and serves as a field coordinator and Federal Project Managers of facility planning and construction. GO provides management support for the following programs:

- Hydrogen Technology;
- Biomass;
- Solar Energy;
- Federal Energy Management Program;
- Weatherization and Intergovernmental Activities;
- Clean Cities;
- Industrial Technologies; and
- Wind Energy.

Key activities include:

- Administering the M&O contract for the National Renewable Energy Laboratory (NREL);
- Managing the Federal Energy Management Program (FEMP) Super Energy Savings Performance Contracts and serving as the focal point for FEMP finance and procurement activities;
- Partnering with industry and academia in joint R&D projects to further develop and facilitate delivery of applied R&D, to include work with Hydrogen Technology;
- Implementing Memoranda of Understanding between DOE and other Federal agencies, such as the Environmental Protection Agency, General Services Administration, Federal Emergency Management Agency, and the Department of the Interior, to implement joint projects where the whole portfolio of EERE technologies is relevant;
- Providing EEREs national program managers at Headquarters with customer feedback on how to make their programs more effective and efficient;
- Supporting and helping deliver special initiatives of the President, Secretary, and Assistant Secretary; and
- Performing as Project Manager for western formula grant activities.

NETL/PMC

The NETL serves as the second PMC site for EERE. In FY 2008, EERE budgets for 61 reimbursable employees at NETL. NETL is primarily an Office of Fossil Energy facility, and it provides project management and financial services to other elements of DOE on a reimbursable basis. In FY 2004, EERE and FE signed a Memorandum of Agreement that formalized this reimbursable arrangement.

NETL provides procurement, financial assistance, and project management services to the following programs:

- Vehicle Technologies;

- Weatherization and Intergovernmental (formula grant) Activities;
- Building Technologies; and
- Federal Energy Management Program.

As one site of EERE's PMC, NETL provides dedicated COs and CORs to perform field project management of R&D partnerships. The staff of COs and CORs are supported by in-house procurement and legal specialists, along with other services as needed.

While EERE and NETL gain experience with the PMC business model, the exact costs of support will continue to be refined, but the table below shows the funds programmed in FY 2006 and the estimated cost allocations in FY 2007 and FY 2008.

	(dollars in thousands)		
	FY 2006	FY 2007	FY 2008
Programs Served by NETL			
Project Management Center (PMC)	0	4,214	6,508
Building Technologies	2,308	2,236	2,334
Federal Energy Management	241	234	234
Industrial Technologies	376	0	0
FreedomCAR and Vehicle Technologies	1,886	1,826	1,921
Weatherization and Intergovernmental Activities	2,024	1,960	2,055
Total, NETL funding from Program Direction	6,835	10,470	13,052
(Total, Reimbursable Full Time Equivalents, non-add)[a]	(44)	(61)	(61)

Consolidated, previous RO functions which will now be performed at both PMC locations (GO and NETL) include:

- Administering EERE's principal technology deployment grant programs, including the Weatherization Assistance Program and the State Energy Program;
- Delivering EERE's principal technical assistance programs, including Clean Cities, Rebuild America, and the Federal Energy Management Program;
- Serving as EERE's liaison to state energy offices, other state agencies, regional organizations of the National Governors Association, and other stakeholders involved in energy and environmental quality issues;
- Creating local, state, and regional partnerships and leveraging local, state, and regional resources to maximize the impact of EERE's technologies and programs; and
- Helping EERE's end use sectors deliver their programs to state and local stakeholders.

[a] Non-EERE Employees

Detailed Justification

	(dollars in thousands)		
	FY 2006	FY 2007	FY 2008
Salaries and Benefits	**74,438**	**66,271**	**76,318**

The DOE Headquarters component, consisting of 338 FTEs, is responsible for the development of policies, strategic plans and related guidance to energy efficiency and renewable energy and Hydrogen Program offices; the evaluation of program performance; the formulation, defense and execution of renewable and energy efficiency budgets; as well as technology advancement and outreach with the public and stakeholders regarding policies, funding, program performance, and related issues.

EERE Program Direction supports a GO personnel level of 141 FTEs. This maintains a centralized EERE PMC at GO, with a particular emphasis on increasing the program execution support for the President's Advanced Energy Initiative.

EERE Program Direction also supports a NETL EERE personnel level of approximately 61 reimbursable FTEs.

Current and future staff performance is measured by responsiveness to National Energy Policy goals and objectives; implementation of the President’s R&D Investment Criteria for priority decision making; continued improvement in the utilization of Federal personnel, travel, and support service activities; increases in competitive and cost-sharing procurement awards; extending the use of more efficient electronic government information systems; improving financial performance, particularly in reducing uncosted balances; and further integration of program metrics into resource allocation processes.

Travel	**3,920**	**2,919**	**3,344**

The FY 2008 request provides travel funds for 540 FTEs, including the enhanced staff of project managers at the EERE PMC.

	(dollars in thousands)		
	FY 2006	FY 2007	FY 2008
Support Services	**11,626**	**11,621**	**13,839**

Includes funding for support service contractors, including IT (LAN and PC) support and e-mail service; and general Assistant Secretary initiatives. By Congressional direction, general management support services are funded within this line-item. Support for program-specific technical analyses, road-mapping, market studies, etc., is funded within the individual R&D programs. The request provides support services needed for business management systems development and support for I-MANAGE, ePME, safety and health support; facility safeguards and security; and computer hardware and software installation, configuration, and maintenance activities. The request for FY 2008 funds landlord services at the GO and for IT services and local-area network operations. The funding level also supports our goal to move program and project management activities to GO contractors, rather than having the work subcontracted through the National Laboratories, by providing assistance in activities that are not inherently Federal, such as preparation of draft administrative paperwork, technical editing of contract and technical review documents and summary reports to GO and HQ management, funding of outside technical reviewers, and routine status tracking of contracts, outreach and communications, procurement, and financial and human capital resources management.

It will provide administrative support for technical symposia, and data-entry and analytical graphics services. The request also provides staff training.

These funds also include the estimated portion of the reimbursable work at NETL that will be applied to support services for administrative and editorial assistance to the NETL project managers.

Other Related Expenses	**11,884**	**10,213**	**11,512**

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 GO, contractual services associated with landlord support of the GO, and software purchases and licenses. Within the WCF, rent is the largest component, but the WCF also includes telephones, copying, headquarters network operations, payroll and other employee services, printing, etc.

The FY 2008 request will support:

- $8,712,000 for Headquarters WCF activities such as administrative services, rent, automated office support, contract close out, telephone services, postage, printing, graphics, and similar services; and
- $1,150,437 for rent at the GO PMC unit; and
- $1,649,563 for other related expenses, including computer equipment and support, utilities, postage, printing, graphics, administrative expenses, and security at GO, plus Workers Compensation, software licenses, publications, and conferences, plus directly reimbursable Other Related Expenses at NETL.

Total, Program Direction	**101,868**	**91,024**	**105,013**

Explanation of Funding Changes

	FY 2008 vs. FY 2007 ($000)
Salaries and Benefits	
FY 2008 request for salary reflects cost of living increases. The increase will provide for an additional 26 FTEs compared to the FY 2007 request. These new hires will fill critical skill gaps.	+10,047
Travel	
Request an increase in the travel budget, as air-travel ticket prices are expected to be higher and travel distances are increased since the consolidation of the six ROs into two PMCs, and to support additional mission-related work and improve project oversight per IG recommendations "Management controls over the State Energy Program's Formula Grants," Office of Inspector General, Office of Audit Services, April 2006 OAS-M-06-05.	+425
Support Services	
Support services funding request increases due to increasing service costs, training, information technology, and to support the continued enhancement of business information and planning systems and the associated training thereon.	+2,218
Other Related Expenses	
Increased contributions to the Working Capital Fund, communications, utilities, and miscellaneous, operations and maintenance of equipment, and supplies and materials.	+1,299
Total Funding Change, Program Direction	**+13,989**

Support Services by Category

	(dollars in thousands)		
	FY 2006	FY 2007	FY 2008
Technical Support			
Economic and Environmental Analyses	50	50	50
Surveys or Reviews of Technical Operations	40	40	40
Total, Technical Support	90	90	90
Management Support			
Directives/Management Studies	125	125	125
Automated Data Processing/IT	2,767	2,905	4,768
Preparation of Program Plans	175	175	175
Training and Education	550	500	600
Analyses of DOE Management Processes	95	95	150
Reports and Analyses Management and General	7,824	7,731	7,931
Total, Management Support	11,053	11,531	13,749
Total, Support Services	11,626	11,621	13,839

Other Related Expenses by Category

	(dollars in thousands)		
	FY 2006	FY 2007	FY 2008
Other Related Expenses			
Rent to GSA	3,152	1,100	1,151
Rent to Others	80	0	0
Communications, Utilities, Miscellaneous	602	280	432
Printing and Reproduction	260	229	220
Other Services	560	90	195
Operation and Maintenance of Equipment	340	140	257
Supplies and Materials	216	151	276
Equipment	223	238	269
Working Capital Fund	6,451	7,985	8,712
Total, Other Related Expenses	11,884	10,213	11,512

Program Support

Funding Profile by Subprogram

	(dollars in thousands)		
	FY 2006 Current Appropriation	FY 2007 Request	FY 2008 Request
Program Support			
Planning, Analysis and Evaluation	8,322	7,418	8,418
Technology Advancement and Outreach	1,534	3,512	4,863
Congressionally Directed Activities	3,465	0	0
Total, Program Support	13,321	10,930	13,281

Public Law Authorizations:

P.L. 95-91, "Department of Energy Organization Act" (1977)
P.L. 109-190, "Energy Policy Act" (2005)

Mission

The mission of the Program Support function is to enable management at all levels to achieve Departmental goals. This is done by providing corporate and integrated information to inform decisions for portfolio investment and market adoption of EERE based processes, individual technologies, and energy systems. The EERE offices use that information to guide and provide direct support to satisfy both corporate and program needs resulting in best-in-class strategic management system products which enable EERE to meet the requirements of the President's Management Agenda and to effectively achieve its goals. Program Support also enables regular, consistent outreach mechanisms and products that keep EERE stakeholders advised of corporate management issues affecting EERE operations.

Benefits

The Planning, Analysis, and Evaluation subprogram establishes and maintains the methods, information base, and standards for planning and policy analysis, budget formulation, and performance management and evaluation. The subprogram provides direct expertise and funds contracts that provide technical, economic, and policy analyses and support for strategic and multi-year planning, performance and budget integration, Government Performance and Results Act (GPRA) benefit estimation for all DOE Renewable and Energy Efficiency (EERE) programs, and foundational understanding of current and future energy and technology markets. Each of these activities is central to achieving the goals of the President's Management Agenda (PMA), each implements the requirements of GPRA, and each is also key to effective management of DOE; Energy, Science, and Environment (ESE); the EERE programs; and to informing decisions on the optimal allocation of resources among the programs. Each provides key information that enables Senior Management and the technology programs to select portfolios and pathways that will best advance the Department's goals.

The Technology Advancement and Outreach subprogram (TAO) manages and creates outreach mechanisms and products that keep EERE stakeholders advised of corporate management issues affecting EERE operations. The TAO also coordinates and manages efforts to make all of the other programs' work – their results and their potential – known to the public. This contributes both to the EERE programs' deployment goals and to Administration E-government initiatives to make government more transparent and accessible to the public. To accomplish these objectives, TAO maintains resources that provide information on request to the general public and other stakeholders through web based and toll free telephone services. Forming partnerships with industry, state and local governments, and non-government organizations (NGOs), the Office produces and disseminates documents in both English and Spanish to educate homeowners on energy saving techniques and technologies.

Planning, Analysis and Evaluation

Funding Schedule by Activity

	(dollars in thousands)		
	FY 2006	FY 2007	FY 2008
Planning, Analysis and Evaluation	8,322	7,418	8,418
Total, Planning, Analysis and Evaluation	8,322	7,418	8,418

Description

The Office of Planning, Analysis, and Evaluation (PAE) provides Senior Management with timely, high quality, independent, credible, and usable information to inform their decisions. PAE also manages EERE-wide requests and requirements, including the Government Performance and Results Act (GPRA), the President's Management Agenda, the Energy Policy Act of 2005 (EPACT) and other Departmental requirements. Finally, PAE develops corporate approaches to planning, analysis, and evaluation that help improve the EERE portfolio and enable effective implementation of the departmental Strategic Management System which enables EERE to best advance the Department's goals.

Detailed Justification

	(dollars in thousands)		
	FY 2006	FY 2007	FY 2008
Planning, Analysis and Evaluation	**8,322**	**7,418**	**8,418**

PAE delivers its management support through planning, analysis and evaluation activities and by responding to requirements external to EERE, such as the Energy Policy Act of 2005 and Departmental Requirements.

PAE's planning efforts focus on improving program planning and developing EERE-wide approaches to strategic planning and portfolio analysis. A key component of PAE's efforts is to work with the Programs to develop multi-year plans that link DOE's Strategic Plan to a program's PART, Joule and activity targets. PAE's strategic planning activities seek to improve the treatment of risk and uncertainty and to help advance Budget-Performance Integration as required by the President's Management Agenda (PMA).

PAE's activities focus on providing cross-cutting, multi-program, and integrated technical and market analysis to inform EERE corporate and program budget decisions and to meet the requirements of the Government Performance and Results Act (GPRA). PAE's approach to integrated analysis includes a

	(dollars in thousands)		
	FY 2006	FY 2007	FY 2008

focus on developing open, transparent, well-documented, and peer-reviewed assumptions and analysis methods for estimating the expected energy, economic, and environmental benefits of the EERE portfolio. EERE is working with other applied R&D offices to provide increasingly comparable estimates of the potential impacts of each program's investment and to move effectively and practically to incorporate the Benefits Analysis framework recommendations developed by the National Academy of Sciences (NAS).

PAE also develops and maintains independent, objective analytical capabilities to assess externalities, to answer Senior Management questions, to better account for technical risk and uncertainty, and to examine how benefits change under different future scenarios. Finally, as required by the President's Management Agenda (PMA), PART, and RDIC, PAE is working with the other ESE applied energy R&D programs to prepare benefits projections using common baselines, assumptions, and methods.

PAE's evaluation component works with the Programs to proactively address performance management requirements and to prepare EERE's submissions for integrated performance reporting, including PART. PAE's evaluation team also provides a full range of evaluation technical assistance, processes, and tools to help Senior Management and Programs monitor and measure success, increase Program effectiveness, and meet OMB requirements for objective and independent assessment.

PAE will expand its market transformation analysis to include an examination of the business case for accelerated deployment of EERE technologies, including those in the President's Advanced Energy Initiative; inform DOE's emerging deployment and science partnerships; and increase policy analysis to inform market-related decisions.

Total, Planning, Analysis and Evaluation	**8,322**	**7,418**	**8,418**

Explanation of Funding Changes

	FY 2008 vs. FY 2007 ($000)
Expand PAE's market transformation analysis and provide expanded analytical support.	+1,000
Total Funding Change, Planning, Analysis and Evaluation	**+1,000**

Technology Advancement and Outreach

Funding Schedule by Activity

	(dollars in thousands)		
	FY 2006	FY 2007	FY 2008
Technology Advancement and Outreach	1,534	3,512	4,863
Total, Technology Advancement and Outreach	1,534	3,512	4,863

Description

Public information and technology awareness and outreach activities in EERE are carried out by the Office of Technology Advancement and Outreach (TAO). TAO communicates the EERE mission, program plans, accomplishments, and technology capabilities to a variety of stakeholder audiences including Congress, the public, educational institutions, industry, and other government and non-government organizations.

Benefits

The Technology Advancement and Outreach subprogram coordinates and manages efforts to make all of the other programs' work – and their results – known to the public and provides a regular, consistent outreach mechanism that keeps EERE stakeholders advised of corporate issues and technology opportunities. This contributes both to the EERE programs' deployment goals and to Administration E-government initiatives to make Government more transparent and accessible to the public.

Detailed Justification

	(dollars in thousands)		
	FY 2006	FY 2007	FY 2008
Technology Advancement and Outreach	**1,534**	**3,512**	**4,863**

Increasing at a rate of 5.4 million a year, the number of web pages viewed by users in 2006 reached 39.8 million, up from 34.4 million in the 2005. Increased demand for website information requires us to increase web-server operations and maintenance and to enhance and accelerate content creation and updates. In 2007, EERE completed transfer of all websites to a centralized web hosting and applications environment including a content management system.

TAO will continue its support of the corporate EERE webpage and the consumer guide on that web-page and will operate the EERE Information Center which answers requests from consumers and users of technology submitted via toll free telephone or computer. TAO maintains a catalogue of all

	(dollars in thousands)		
	FY 2006	FY 2007	FY 2008

EERE information products, including publications, CDs, and analytic tools, and makes that information available on-line. Working with a newly developed five-year strategic outreach plan, TAO will leverage the resources of other agencies by promoting collaboratives between state, Federal and local entities to promote alternative energy sources and energy efficiency and provide interactive technology on-line to train consumers in the use of these technologies. TAO will implement programs to disseminate information through new technology avenues such as streaming video, podcasting and on-line analysis and training tools. The growing volume of calls to the information center and requests for printed documents are raising the printing budget and increasing costs for the operation of the center.

In 2008, TAO will print brochures to restock the "one-stop", centralized information center that provides information on request to the general public and other stakeholders through web-based and toll-free telephone services. On growing demand for these services, the Office produces and disseminates documents in both English and Spanish to educate homeowners on energy savings techniques and technologies. Additionally this increment will support TAO efforts to accelerate information dissemination, broaden access, and leverage resources to form partnerships with industry, state and local governments, and non-government organizations (NGOs).

The toll-free information clearinghouse provides a more personalized service than the website, and is available to consumers and businesses that do not have Internet access. The clearinghouse fielded 27,000 inquiries and delivered 300,000 publications to consumers, businesses, and schools in 2005. As awareness of EERE technologies and their benefits increases, it is expected that inquiries to the clearinghouse will rise and require increased resources to meet this demand.

In FY 2006, this main clearinghouse was combined with several program-specific clearinghouses that have been operated in the past by different EERE programs. This direct funding will pay for about half of the clearinghouse costs. In FY 2007, funding for the clearinghouse will be provided by TAO funding with no charge back to the programs.

Total, Technology Advancement and Outreach	**1,534**	**3,512**	**4,863**

Explanation of Funding Changes

	FY 2008 vs. FY 2007 ($000)
The increase will support the provisions of Section 134 of EPACT (Energy Efficiency Public Information Initiative) and the President's Advanced Energy Initiative to promote clean energy technologies and alternative fuels. Growing public awareness increases demands from the public for information on how they can save energy or use alternatives. Printing more material and providing more information through the web and its toll free telephone service is required to address the anticipated increase in information demands. The growing volume of calls to the information center and requests for printed documents are raising the printing budget and increasing costs for the operation of the center.	+1,351
Total Funding Change, Technology Advancement and Outreach	**+1,351**

Congressionally Directed Activities

Funding Schedule by Activity

	(dollars in thousands)		
	FY 2006	FY 2007	FY 2008
Congressionally Directed Activities	3,465	0	0
Total, Congressionally Directed Activities	3,465	0	0

Description

Continued Congressionally directed efforts of the National Renewable Energy Laboratory (NREL) to develop renewable energy resources uniquely suited to the Southwestern United States, through its virtual site office in Nevada.

Detailed Justification

	(dollars in thousands)		
	FY 2006	FY 2007	FY 2008
Southwestern Multi-Programs Virtual Site Office in Nevada	**3,465**	**0**	**0**

Through support of the National Renewable Energy Laboratory (NREL) virtual site office in Nevada, assisted in the development of renewable energy resources uniquely suited to the Southwestern United States. Funding is not included in the FY 2007 Budget Request in order to support higher priorities within the EERE portfolio that will contribute to the achievement of technology program goals and portfolio results.

Total, Congressionally Directed Activities	**3,465**	**0**	**0**

Electricity Delivery and Energy Reliability

Electricity Delivery and Energy Reliability

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Energy Supply and Conservation
Office of Electricity Delivery and Energy Reliability

Overview

Appropriation Summary by Program

(dollars in thousands)

	FY 2006 Current Appropriation	FY 2007 Request	FY 2007 CR	FY 2008 Request
Energy Supply and Conservation				
Electricity Delivery and Energy Reliability	158,178	124,928	145,866	114,937
Total, Energy Supply and Conservation	158,178	124,928	145,866	114,937

Preface
The Office of Electricity Delivery and Energy Reliability (OE) is requesting $114,937,000 for FY 2008, a decrease of 8 percent from the FY 2007 Request. These funds support a variety of subprograms designed to modernize the electricity transmission and distribution system, and increase energy reliability, energy and system efficiency, and security. In addition, OE activities facilitate recovery from disruptions to U.S. energy supplies. Within the Energy Supply and Conservation appropriation, OE has three subprograms: Research and Development, Operations and Analysis, and Program Direction.

Mission
The mission of the Office of Electricity Delivery and Energy Reliability is to lead national efforts to modernize the electric grid, enhance security and reliability of the energy infrastructure, and facilitate recovery from disruptions to the energy supply.

Benefits
The benefits of OE Research and Development activities include: (1) strengthened stability of the electric grid and reduced frequency and duration of operational disturbances (reliability); (2) increased efficiency of the electric delivery system through reduced energy losses (energy efficiency); (3) reduced peak price and price volatility of electricity, increased asset utilization (capacity factor of transmission and distribution), and improved accessibility to a variety of energy sources that generate electricity (system efficiency); (4) and a hardened the energy infrastructure that detects, prevents, and mitigates external disruptions to the energy sector (reliability).

The benefits of the Operations and Analysis subprogram's increased investment in electric infrastructure (accomplished primarily through implementation of the Energy Policy Act of 2005 authorities (EPAct)) include increased availability of competitively priced and environmentally responsible electricity through cross-border trade; a reduction in the vulnerability of energy assets to disruption; a faster recovery from disruptions to the energy infrastructure; and improved public safety.

Strategic Themes and Goals and GPRA Unit Program Goals
The Department's Strategic Plan identifies five Strategic Themes (one each for nuclear, energy, science, management, and environmental aspects of its mission), plus 16 Strategic Goals that tie to the Strategic

Themes. OE, under the Energy Supply and Conservation Appropriation, supports the following Strategic Themes and Goals:

Strategic Theme 1, Energy Security: Promoting America's energy security through reliable, clean, and affordable energy.

Strategic Goal 1.3, Energy Infrastructure: Create a more flexible, more reliable, and higher capacity U.S. energy infrastructure.

The programs funded within the Energy Supply and Conservation Appropriation have one Program Goal that contributes to the Strategic Goals in the "goal cascade." OE's program goal is:

Program Goal 1.3.16.00 Electricity Delivery and Energy Reliability: Lead national efforts to modernize the electric grid, enhance security and reliability of the energy infrastructure, and facilitate recovery from disruptions to the energy supply.

Contribution to Strategic Goal

Within the OE Program, the Research and Development subprogram and the Operations and Analysis subprogram contribute primarily to Strategic Goal 1.3, Energy Infrastructure.

OE pursues four strategic Critical Objectives to support the Strategic Goal and GPRA Program Goal with regard to reliability, energy efficiency, system efficiency, and security. These objectives address reducing the frequency of blackouts (reliability), reducing energy losses (energy efficiency), improving asset utilization and thereby reducing the cost of delivered electricity to consumers (system efficiency), and improving infrastructure security.

All R&D activities align with these Critical Objectives and support the Strategic Goal. Each R&D activity has at least one annual target (see the Annual Performance Results and Target table).

The Visualization and Controls activity contributes to this Strategic Goal by improving the reliability, as well as the system efficiency, of the electric delivery system, including an increase in the utilization of transmission and distribution assets with the development of real-time information and control technologies and systems. Progress is measured in part by expansion of real-time monitoring and control systems on the transmission grid. This R&D activity also contributes to the Strategic Goal by developing distributed sensing, intelligent and control technologies that improve the electric infrastructure's reliability, as well as system efficiency and energy efficiency. This activity develops communication and control systems to support adaptive intelligent grid operations. Lastly, this activity also reduces the vulnerabilities associated with traditional substation design by developing and demonstrating more effective, responsive, secure, and efficient substation equipment such as transformers, breakers, and fault current limiters. This will help provide reliable delivery of energy, improve energy efficiency, and guard against energy emergencies.

The High Temperature Superconductivity (HTS) activity contributes to the Strategic Goal primarily by improving the energy efficiency, as well as reliability, of the Nation's electric delivery system.

The Energy Storage and Power Electronics activity contributes to the Strategic Goal by developing storage technologies and power electronics that reduce power disturbances and peak electricity demand,

and improve system flexibility to reduce adverse effects to users. This primarily improves the electric infrastructure's reliability. It also addresses energy efficiency and system efficiency. Progress is measured by reductions in cost per kilowatt and cost per kilowatt-hour for new storage technologies.

In FY 2008, the Distributed Energy activity was renamed Renewable and Distributed Systems Integration to integrate on-site generation and load management efforts by merging both customer and utility research interests. The Renewable and Distributed Systems Integration[a] activity contributes to the Strategic Goal by working to develop a diverse array of cost competitive, integrated, distributed generation and thermal energy technologies. It also aims to facilitate market adoption of these technologies in homes, businesses, industry, communities, and electricity companies; increase the efficiency of electricity generation, delivery, and use; improve electricity reliability; and reduce environmental impacts.

Under the Operations and Analysis subprogram, the Permitting, Siting, and Analysis activity works to "modernize the electric grid" and "enhance reliability of the energy infrastructure" by contributing to the development and implementation of electricity policy at the Federal and State level. Implementation of EPAct sections on grid modernization and demand response relating to transmission assigned to DOE also directly supports the same portions of the program goal. Under the Federal Power Act, Congress has assigned to the States the responsibility of generating and delivering adequate retail electricity. Thus, modernizing the electric grid and enhancing its reliability cannot occur without the active involvement of States and regional bodies. The Permitting, Siting, and Analysis activity, also works with States and regions to improve their electricity-related laws, regulations, and policies.

The International Electricity Regulatory function of the Permitting, Siting, and Analysis activity issues permits for cross-border transmission lines and authorizes the export of electricity. A statutorily mandated function, the permitting of cross-border electricity trade helps achieve "modernizing the electric grid" and "enhances[ing] reliability of the energy infrastructure" components of the program goal.

Also under the Operations and Analysis subprogram is the Infrastructure Security and Energy Restoration activity. This activity brings DOE into compliance with Homeland Security Presidential Directive-7, "Critical Infrastructure Identification, Prioritization, and Protection," and Homeland Security Presidential Directive-8, "National Preparedness," as well as with the National Response Plan, implementing the Robert T. Stafford Act. This task is the mission of the Infrastructure Security and Energy Restoration Division. Its prime function is to support OE's mission with regard to "enhancing security and reliability of the energy infrastructure, and facilitating recovery from disruptions to energy supply." The President has designated DOE as the Lead Sector Specific Agency responsible for protecting the Nation's critical energy infrastructure. The Infrastructure Security and Energy Restoration activity is responsible for coordinating and carrying out these responsibilities on behalf of the Secretary of Energy.

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[a] Renewable and Distributed Systems Integration was titled Distributed Systems Integration in the FY 2007 Congressional Request.

Funding by Strategic and GPRA Unit Program Goal

	(dollars in thousands)		
	FY 2006	FY 2007	FY 2008
Strategic Goal 1.3 Energy Infrastructure			
GPRA Unit Program Goal 1.3.16.00, Electricity Delivery and Energy Reliability	158,178	124,928	114,937
Total, Strategic Goal 1.3 (Energy Supply and Conservation)	158,178	124,928	114,937

Annual Performance Results and Targets

FY 2003 Results	FY 2004 Results	FY 2005 Results	FY 2006 Results	FY 2007 Targets	FY 2008 Targets
Strategic Goal 1.3, Energy Infrastructure					
Electricity Delivery and Energy Reliability/Research and Development/High Temperature Superconductivity					
Increased the capability to reproducibly fabricate a 10-meter length of Second Generation HTS wire to carry 50 amps of electricity and 1-meter lengths that carry 100 amps from a 40-amp base. (MET GOAL)	Completed testing of 10 MVA superconducting transformer in operation on the Wisconsin Electric Power Company grid. (NOT MET)	Completed the manufacture of a 200m superconducting power cable for American Electric Power (AEP). (MET GOAL)	Operated a first-of-a-kind superconducting power cable on the electric grid for 240 hours. (MET GOAL)	Complete six months operation of superconducting cable operating on the grid at greater than 10 kilovolts.	Demonstrate prototype 50,000 A-m critical current-length for second generation wire.
Electricity Delivery and Energy Reliability/Research and Development/Visualization and Control					
	Installed and operated a prototype wide area measurement system in the Nation's Eastern Interconnection with real-time synchronized measuring instruments that feed data into two data archiving and analysis locations. (MET GOAL)	Installed four additional data concentrators at four different data archiving and analysis locations, achieving a prototype wide area measurement system in the Nation's Eastern Interconnection consisting of six fully functioning data archiving and analysis locations installed at six different utilities. (MET GOAL) Completed field hardware installation at a cumulative total of at least 100 commercial, industrial and/or municipal customers participating in the demand response and load conservation network in Connecticut, and reduce peak demand (kilowatt hours) in real- time by 5-8% on average (as compared to non-curtailed kilowatt hour consumption) for all	Facilitated the installation and operation of 30 additional measurement units and 2 additional archiving and analysis locations in a real-time measurement network, for a cumulative total of 80 measuring units and 8 archiving and analysis locations. (MET GOAL)	Develop a plan for the transfer of leadership from DOE to the Electric Reliability Organization (ERO) for the deployment of a synchronized measurement network in North America, and release the Real Time Dynamic Monitoring System (RTDMS) prototype visualization tool to industry for comment and recommendations.	Install 50 sensors (PMU) as part of developing a smart real-time switchable network.

FY 2003 Results	FY 2004 Results	FY 2005 Results	FY 2006 Results	FY 2007 Targets	FY 2008 Targets
		participating customers, thereby improving the energy efficiency of electricity usage.			
Electricity Delivery and Energy Reliability/Research and Development/Energy Storage Power and Electronics					
Supported the field test of a 100kW lithium battery system for 700 hrs at a utility site. (MET GOAL).	Tested and evaluated 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. (MET GOAL)	Complete the manufacture of and factory testing on a 2MW/2MWh zinc-bromine battery system (consisting of four 500kW / 500kWh units) for supplying extra power during peak load conditions at a utility substation. (NOT MET)	Commissioned three pioneering energy storage systems in collaboration with the California Energy Commission and collect preliminary technical and economic data. (MET GOAL)	Commission two major pioneering energy storage systems in collaboration with the CEC and NYSERDA, and complete data collection and monitoring of three systems commissioned during FY06.	Test three ionic liquids for possible use as electrolytes in batteries or electrochemical capacitors with the potential for doubling the energy and increasing the power by at least 50% for capacitors or doubling the lifetime and improving safety of rechargeable non-aqueous batteries.
Electricity Delivery and Energy Reliability/Research and Development/Renewable and Distributed Systems Integration					
					Award contracts to demonstrate improvement in grid utilization of 5% by 2009 and 20% by 2015.
Completed 4,000 hour field test of ceramic composite shroud components to demonstrate performance and emission benefits to a gas turbine. (MET GOAL)	Completed final design and initiate field testing of low emission technology with less than 7 ppm NO_{χ}. (MET GOAL)	Demonstrated emission levels of 0.25 lbs/MWh from a turbine combustion system. (MET GOAL)			
Completed the 12 Beta field test units of high efficiency natural gas-fired heat pump (60 percent better than pulse combustion furnace) and installed at field test sites hosted by major U.S. Gas Utilities. (MET GOAL)	Completed and demonstrated heating coefficient of performance of 1.4 for commercial introduction of a thermally activated system (approximately 40 percent more efficient than a conventional heating system). (MET GOAL)				

FY 2003 Results	FY 2004 Results	FY 2005 Results	FY 2006 Results	FY 2007 Targets	FY 2008 Targets
Contracted with three companies to support research on demonstrating a 5 percent increase in efficiency for an advanced microturbine. (MET GOAL)	Demonstrated 6 percentage point increase in efficiency for an advanced reciprocating engine. (MET GOAL)				
	Completed final design and initiated field testing an evaluation of a complete, fully functional integrated CHP system consisting of a turbine, absorption chiller and control system. (MET GOAL)	Completed a case study on a CHP installation that uses heat from microturbine to provide plate tank heating and sludge drying at an industrial facility, contributing to the PART long-term measure of developing a 70 percent efficient CHP integrated system. (MET GOAL)	Developed one packaged CHP system which operates at 70+% efficiency. (MET GOAL)	Develop second packaged CHP system which operates at 70+% efficiency.	
		Completed and documented two DE/CHP demonstration projects within the high tech industry, contributing to the PART long-term measure of developing a 70 percent efficient CHP integrated system. (MET GOAL)			
		Reduce by 10% the total time required by OE to complete its FY 2006 CFO, OMB and Congressional budget submissions as compared to its FY 2005 budget submissions.	Maintained total Research and Development Program Direction costs in relation to total Research and Development costs of less than 12%.[b] (MET GOAL)	Maintain total Research and Development Program Direction costs in relation to total Research and Development costs of less than 12%.	Maintain total R&D administrative overhead costs in relation to total R&D program costs of less than 12 percent. Baseline for administrative overhead rate currently being validated.

[b]The baseline for administrative overhead rate is currently being validated.

Means and Strategies

The OE Program uses various means and strategies to achieve its GPRA Unit Program goal that are designed to maximize the probability of success in an environment that includes many external factors. Collaborative activities with external stakeholders are an essential element of OE's implementation strategy.

OE's strategies to increase market penetration of electric transmission and distribution systems is achieved through 1) decreased cost and increased technology performance, and 2) the implementation of national industry consensus standards for interconnection, communications, and controls. Technology advances include development of second generation superconducting wire, development of real-time monitoring and control software tools, and development of system operating models to improve grid reliability and energy efficiency. Modernization and expansion of the electricity infrastructure is achieved by improving the reliability, energy efficiency, and cost-effectiveness of the system using the following methods: 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 and distributed energy systems that achieves commercial viability and addresses the crucial needs of the entire electric system.

In carrying out OE's program mission, the following collaborative activities are performed:

- 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:
    1) the Offices of Fossil Energy and Energy Efficiency and Renewable Energy on how to best ensure energy security (per DOE's Strategic Theme 1) with a diverse supply of reliable, affordable, and environmentally sound energy;
    2) the Energy Information Administration on market analysis;
    3) the Power Marketing Administrations and the Tennessee Valley Authority on evaluating transmission-related technologies that enhance reliability and lower costs to consumers;
    4) 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, Department of Interior, and Department of Agriculture, to develop policies, market mechanisms, regulations, laws, and programs that facilitate modernizing and expanding the Nation's grid; and both the Department of Homeland Security and the Department of Defense to develop and test technologies;
- Collaborating with organizations such as the North American Electric Reliability Council and the Electric Power Research Institute to analyze market mechanisms and develop improved approaches to grid modernization and expansion;
- Working with States and regional entities, such as regional governors' associations, the National Association of Regulatory Utility Commissioners, and the National Council of State Legislators

to develop policies, market mechanisms, regulations, State laws, and programs to improve the electric grid at the local, State and regional levels; and

- Partnering with universities to develop plans and reviews and to further R&D.

Validation and Verification

To validate and verify performance, the Office conducts internal and external reviews and audits. OE's programmatic activities are subject to continuing review by OMB, the Congress, GAO, and the Department's Inspector General. Senior management invites external reviews of office-wide planning, design, management, and programmatic results in order to improve effectiveness. Each Program activity manager conducts annual peer reviews by committees 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 by DOE's program management reporting system. In FY 2008, OE will build on previous budget and performance integration progress, and more rigorously apply its integrated project reporting system, including the monitoring of milestones, performance, cost and schedule, and the implementation of corrective actions as needed.

As part of its ongoing efforts to be results oriented and to improve its management principles, OE conducts independent peer reviews of its activities. Under Visualization and Controls, the transmission reliability and electric distribution efforts were reviewed in the Fall of 2005 and in the Fall of 2006. The Eastern Interconnection Phasor Project (EIPP) achieved all its milestones for the year. The peer review panel highlighted two areas for improvement, recommending increased emphasis on both the communications architecture to manage the vast amount of data from the EIPP, and the wide-area voltage control concepts which are applicable to all North American interconnections. The partnerships and leveraging of resources were noted as strengths in the Visualization and Controls algorithm development activities and the need to focus on higher-risk projects was identified. The Distributed Energy activities had its final review in December, 2005, highlighting the accomplishments in the program and reviewing the new strategic directions as part of OE. The need for continuing technology improvements were noted in addition to efforts that would allow better systems integration in support of the current utility structures. The program was identified as being effective at addressing grid reliability, diversifying energy resources, improving energy security, and reducing fossil fuel consumption and greenhouse gas emissions. The High Temperature Superconductivity activity was reviewed in August, 2006, to assess activities of the second generation wire, strategic research, and superconductivity partnerships. The performance of the second generation wire has set a world record for current capacity-wire length. The Energy Storage review was held October, 2005, as part of an international conference, and contained highlights of collaborations with the California Energy Commission (CEC) and the New York State Energy Research and Development Authority (NYSERDA).

After the hurricane season of 2005, OE also conducted internal reviews and stakeholder sessions to improve coordination and communications for the upcoming hurricane season. As a part of these discussions, OE has also developed better information management systems, communications protocols, and resource tracking systems.

Program Assessment Rating Tool (PART)

The Department has implemented a government-wide 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 peer reviews. The Office of Electricity Delivery and Energy Reliability - Research and Development activity was assessed in 2006 in preparation for the 2008 Budget Request.

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 2008 Budget Request, and the Department will take the necessary steps to continue to improve performance.

The 2006 PART review of the Research and Development activities found that the subprogram has a clear purpose, strong planning and management, with an overall assessment rating of Moderately Effective.   OMB rated the program 80% for Program Purpose and Design, 80% for strategic planning, 82% for Program Management and 74% for Program Results/Accountability

A common recommendation to all DOE's applied R&D programs are addressing a PART recommendation that DOE develop guidance that specifies a consistent framework for analyzing the costs and benefits of research and development investments, and use this information to guide budget decisions. The Department has specified common scenarios, methodologies, and standardized benefits measures to allow analyses of costs and benefits of R&D investments. DOE continues to work on implementation of common assumptions and a consistent approach to incorporation of risk. OE continues to seek how to incorporate unique program benefits (improved reliability of the transmission and delivery system) currently not represented in models used to assess departmental applied R&D programs.

Energy Supply and Conservation
Office of Electricity Delivery and Energy Reliability

Funding by Site by Program

	(dollars in thousands)		
	FY 2006	FY 2007	FY 2008
Argonne National Laboratory			
Research and Development	1,926	1,525	1,525
Electricity Restructuring	729	0	0
Operations and Analysis	0	700	700
Total, Argonne National Laboratory	2,655	2,225	2,225
Brookhaven National Laboratory			
Research and Development	320	400	400
Chicago Operations Office			
Research and Development	9,684	10,905	8,905
Electricity Restructuring	1,450	0	0
Operations and Analysis	0	2,035	2,035
Program Direction	561	700	704
Total, Chicago Operations Office	11,695	13,640	11,644
Golden Field Office			
Research and Development	12,286	13,477	0
Program Direction	10	0	0
Total, Golden Field Office	12,296	13,477	0
Idaho Operations Office			
Research and Development	2,260	2,025	2,025
Program Direction	10	0	0
Total, Idaho Operations Office	2,270	2,025	2,025
Idaho National Laboratory			
Research and Development	4,750	2,905	2,905
Lawrence Berkeley National Laboratory			

	(dollars in thousands)		
	FY 2006	FY 2007	FY 2008
Research and Development	2,158	1,490	1,490
Electricity Restructuring	2,328	0	0
Operations and Analysis	0	2,200	2,200
Total, Lawrence Berkley National Laboratory	4,486	3,690	3,690
Los Alamos National Laboratory			
Research and Development	6,600	5,730	5,730
National Energy Technology Laboratory			
Research and Development	37,008	19,113	30,590
Electricity Restructuring	7,026	0	0
Operations and Analysis	0	7,059	6,606
Program Direction	2,781	4,415	4,441
Total, National Energy Technology Laboratory	46,815	30,587	41,637
National Renewable Energy Laboratory			
Research and Development	3,322	5,415	5,415
Oak Ridge National Laboratory			
Research and Development	30,569	20,075	14,433
Pacific Northwest National Laboratory			
Research and Development	2,967	2,040	2,040
Electricity Restructuring	15	0	0
Operations and Analysis	0	15	15
Total, Pacific Northwest National Laboratory	2,982	2,055	2,055
Sandia National Laboratories			
Research and Development	15,910	10,520	10,520
Savannah River Operations Office			
Research and Development	950	0	0

	(dollars in thousands)		
	FY 2006	FY 2007	FY 2008
Scientific and Technical Info Office			
Research and Development	20	16	16
Washington Headquarters			
Research and Development	1,858	0	0
Electricity Restructuring	729	0	0
Program Direction	9,951	12,168	12,242
Total, Washington Headquarters	12,538	12,168	12,242
Total, Energy Supply and Conservation	158,178	124,928	114,937

Site Description

Argonne National Laboratory (ANL)

Argonne National Laboratory performs research and development including non-destructive evaluation of advanced ceramics, high temperature recuperators and coatings and laser ignition research for reciprocating engines. ANL performs research and development for the High Temperature Superconductivity R&D (HTS) activity. Argonne uses unique expertise in superconducting materials science and in developing characterization tools to help improve the understanding of current flow in HTS materials. Unique facilities such as the Intense Pulsed Neutron Source (IPNS) and the Advanced Photon Source are used for measurement and characterization in ANL's research. Argonne also provides support to energy assurance visualization activities. For the International Electricity Regulatory function under the Operations and Analysis sub-program, ANL provides analytical support on environmental impact assessments, including work under the Energy Policy Act of 2005 (EPAct) to identify energy corridors on Federal lands. ANL will also provide DOE with environmental and technical support that may be needed to implement the mandatory electric transmission permit coordination role assigned to DOE under EPAct section 1221(h).

Brookhaven National Laboratory (BNL)

BNL supports the High Temperature Superconductivity R&D activity by working with national laboratory/industry teams and universities to undertake research on fundamental wire properties and processing issues. BNL completed research on the utilization of renewable fuels such as biodiesel in microturbine energy technologies.

Chicago Operations Office (COO)

The Chicago Operations Office commissioned the solicitations for "Cooperative Research and Development for Advanced Communication and Control" and "Cooperative Research and Development for Electric Transmission and Distribution" and has been providing project management support to the financial assistance subcontracts awarded through the solicitations. The COO also administers all contracts for the composite conductor network. COO is used to issue grants to national and regional State-based non-profit organizations that have developed expertise in providing technical assistance in electric markets to States and regions. These groups include the National Association of Regulatory Utility Commissioners (NARUC), the National Governors Association, and the National Conference of State Legislatures.

Golden Field Office (GFO)
GFO administers the Superconductivity Partnership with Industry (SPI) for the High Temperature Superconductivity R&D activity. The SPI is 50 percent cost-shared with industry and consists of eight projects to develop first-of-a-kind designs for more efficient power cables, transformers, fault current limiters, industrial motors and flywheel energy systems.

Idaho Operations Office (IDO)
The Idaho Operations Office administers all financial assistance agreements consisting of Congressionally Directed funds for Alaska transmission construction projects. IDO also administers the University Cooperative Projects for the High Temperature Superconductivity R&D activity. The University projects are in cooperation with the National Laboratories and consist of seven projects to transfer new technologies developed at the universities to individual National Laboratories that would benefit from these new technologies.

Idaho National Laboratory (INL)
The Idaho Laboratory provides a Supervisory Control and Data Acquisition (SCADA) test bed to support the Visualization and Controls activity.

Lawrence Berkeley National Laboratory (LBNL)
LBNL has the lead for a national laboratory/industry/university consortium that was formed to support research in Visualization and Controls. This consortium is assisting in implementing the DOE Visualization and Controls activity. In support of the Operations and Analysis Subprogram, LBNL provides DOE with nationally recognized expert technical assistance to individual State public utility commissions and energy offices, regional transmission organizations/independent system operators and regional State groups. Also, LBNL provides transmission policy analysis support to DOE on subjects such as the identification of National Interest Electric Transmission Corridors and supporting work required to implement related requirements under EPAct. LBNL will perform analytical tasks to quantify benefits of distributed generation technologies to the customer, the system and the Nation. In addition, LBNL assists DOE in its work monitoring the implementation of increased grid reliability standards and other recommendations from the August 2003 blackout investigation.

Los Alamos National Laboratory (LANL)
LANL works with industry to develop second generation HTS wires based on the ion beam assisted deposition (IBAD) process pioneered by LANL. LANL’s expertise in film deposition processes and materials science is used to improve the performance of IBAD wires. Commercial versions are expected to carry 1,000 amperes of current through a centimeter wide metal strip coated with a film the thickness of only a few human hairs - a revolutionary change. LANL is also developing superconducting transmission cables and superconducting fault current limiters (a device that protects the electrical system against lightning strikes and other accidents). Finally, LANL provides support to energy assurance visualization activities.

National Energy Technology Laboratory (NETL)
NETL will provide strategic planning and technical support to the Renewable and Distributed Systems Integration activity as well as intra- and inter-departmental coordination support with other Federal Programs. Program Direction funds are provided to NETL for the purpose of serving as a Project Management Center, providing project management and financial services. NETL manages Congressionally-directed funds for energy assurance activities and electric grid modeling activities. Additional Congressionally-directed funds were given to NETL to continue the modification planning, design, and construction of facilities in Morgantown, West Virginia.

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 administers Congressionally directed funds for the Dine Power Authority Navajo Transmission Project and the Northwest Indiana Electric Infrastructure Project.

Oak Ridge Operations Office (OROO)
The Oak Ridge Operations Office administers the Interagency Agreement with the Department of Defense for the Title III procurement of industry pilot plants to produce Second Generation Superconducting Wire. Through extensive interaction with the Department of Defense, the industry projects will accelerate the commercial availability of Second Generation Wire by three to five years. The Office also administers the Interagency Agreements with the Department of Commerce for two projects at the National Institute of Standards and Technology. These projects involve research on superconducting materials chemistry and mechanical properties research.

Oak Ridge National Laboratory (ORNL)
ORNL is part of a national laboratory/industry/university consortium that was formed to support research in Visualization and Controls. ORNL is the primary lab for renewable and distributed systems integration research. ORNL operates the National Transmission Technology Research Center for testing transmission technologies. ORNL conducts research and development in advanced materials, heat/mass transfer and sensors for industrial gas turbines and microturbines, advanced reciprocating engines, thermally activated technologies, and combined heat and power. To conduct this research, ORNL leverages state-of-the-art, unique resources such as the High Temperature Materials Laboratory User Center and the Building Technology User Center. ORNL also develops second generation HTS wires based on the rolling-assisted biaxially textured substrate process (RABiTS) patented by ORNL. ORNL is applying its expertise in cryogenic systems and power system technology in projects to develop superconducting fault current limiters, generators, transformers and transmission cables. For the Operations and Analysis Subprogram, ORNL is providing support on the monitoring and implementation of increased reliability standards and other recommendations from the August 2003 blackout investigation. For the International Electricity function under the Operations and Analysis sub-program, ORNL will provide DOE with environmental and technical support that may be needed to implement the mandatory electric transmission permit coordination role assigned to DOE under EPAct. ORNL also participates in strategic planning for the next generation control architecture for the distribution system.

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 part of a national laboratory/industry/university consortium that was formed to support research on Visualization and Controls. 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.

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 Visualization and Controls. SNL also works to develop advanced superconductors based on the sol-gel chemical deposition process. For energy storage, SNL develops improved energy storage system components including power conversion electronics and modular multi-functional energy storage systems and manages joint DOE Storage Initiatives with the California Energy Commission and the New York State Energy Research and Development Authority. SNL supports research that is focused on developing a unique combustion strategy that will enable turbine manufacturers to build machines that meet or exceed current and future emission requirements. Finally, SNL provides support to energy assurance visualization activities.

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. The Power Systems Engineering Research Center (PSERC) is performing work in electric power systems and markets analysis through a National Science Foundation Interagency Agreement. PSERC is part of a national laboratory/industry/university consortium that was formed to support research on Visualization and Controls. DOE Headquarters operations provides specialized, technical expertise in program planning, formulation, execution, and evaluation in order to support the responsible guidance and management of the budget. DOE Headquarters also issues grants to national and regional State-based non-profit organizations that have developed expertise in providing technical assistance in electric markets to States and regions, such as the Western Governors Association. DOE Headquarters staff constantly analyzes the regional and national effects of the loss of crude oil, natural gas, refined petroleum products, and electricity. In addition, during energy disruptions, Headquarters staff issues both periodic and special reports on the real-time status of the particular energy situation, timetables for restoration of energy supplies, and other factors, as well as responds to special information requests from senior officials throughout the Executive Branch. Other activities include program management, Small Business Innovation Research (SBIR) and Small Business Technology Transfer (STTR) programs, I-Manage, and communications.

Office of Electricity Delivery and Energy Reliability

Funding Profile by Subprogram

(dollars in thousands)

	FY 2006 Current Appropriation	FY 2007 Request	FY 2008 Request
Electricity Delivery and Energy Reliability			
Research and Development	132,589	95,636	85,994
Electricity Restructuring	12,276	0	0
Operations and Analysis	0	12,009	11,556
Program Direction	13,313	17,283	17,387
Total, Electricity Delivery and Energy Reliability	158,178	124,928	114,937

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"
P.L. 109-58, "Energy Policy Act of 2005"

Mission

The mission of the Office of Electricity Delivery and Energy Reliability (OE) is to lead national efforts to modernize the electric grid, enhance security and reliability of the energy infrastructure, and facilitate recovery from disruptions to the energy supply.

Benefits

The Office's research and development (R&D) activities will lead to technologies which can improve the reliability, energy efficiency, system efficiency and security of the Nation's electricity delivery system. The R&D will: (1) strengthen grid stability and reduce frequency and duration of operational disturbances; (2) increase efficiency of the electric delivery system through reduced energy losses; (3) reduce peak price of electricity, increase asset utilization (capacity factor of transmission and distribution), and improve accessibility to a variety of energy sources for generation; and (4) harden energy infrastructure so it can detect, prevent and mitigate external disruptions to the energy sector.

The Office's Permitting, Siting and Analysis Activity, under the Operations and Analysis subprogram, includes analysis and outreach that supports States and regions in developing and improving policies, market mechanisms and activities that facilitate competitive, reliable, environmentally sensitive, and customer-friendly (i.e. demand response programs that are easy to understand and use) electric markets. Particularly of benefit will be increased electric infrastructure investment that should result from implementation of the Energy Policy Act of 2005 (EPAct) requirements in transmission and energy corridor designation and coordination of Federal agency transmission line permitting.

Also included is the statutorily required International Electricity Regulatory function where Presidential permits for Canadian and Mexican cross-border transmission lines and authorization of electricity exports are issued. The Office's Infrastructure Security and Energy Restoration activities collaborate with State and local governments, Federal partners, and the private sector to coordinate security and protection activities, share best practices and information and develop improved methodologies and approaches to reduce the vulnerability of critical energy infrastructure to both natural and terrorist events.

Research and Development

Funding Schedule by Activity

	(dollars in thousands)		
	FY 2006	FY 2007	FY 2008
Research and Development			
High Temperature Superconductivity R&D	48,649	45,468	28,186
Transmission Reliability R&D	12,516	0	0
Electricity Distribution Transformation R&D	58,453	0	0
Energy Storage R&D	2,889	0	0
GridWise	5,267	0	0
GridWorks	4,815	0	0
Visualization and Controls	0	17,551	25,305
Energy Storage and Power Electronics	0	2,965	6,803
Renewable and Distributed Systems Integration[a]	0	29,652	25,700
SBIR/STTR (non-add)	0	(2,596)	(2,497)
Total, Research and Development	132,589	95,636	85,994

Description

The mission of the Research and Development (R&D) subprogram is to develop technologies that will allow the Office of Electricity Delivery and Energy Reliability (OE) to lead national efforts to modernize the electric grid, enhance security and reliability of the energy infrastructure, and facilitate recovery from disruptions to energy supply in support of the Department of Energy's (DOE's) mission to protect national and economic security.

The FY 2008 Request continues support within the High Temperature Superconductivity (HTS) R&D subprogram for 2G wire development as well as research on dielectrics, cryogenics, and cable systems, while decreasing the effort on motors and generators. This refocus is designed to address a near-term critical need within the electric system to not only increase current carrying capacity especially in urban areas, but also to relieve overburdened cables elsewhere in the local grid. Within Visualization and Controls, OE focuses on comprehensive control system security effort. Within the Energy Storage and Power Electronics R&D activity, a funding increase is proposed to: 1) leverage understanding gained from previous Energy Storage demonstration activities to research and develop new advanced higher energy density materials and storage devices for utility scale application; and 2) in Power Electronics, focus on enhanced research to improve material and device properties needed for transmission-level applications. The Renewable and Distributed Systems Integration activity (formerly Distributed Energy) transitions away from generation technology activities toward grid integration of distributed and renewable systems.

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[a] Renewable and Distributed Systems Integration was titled Distributed Systems Integration in the FY 2007 Congressional Request.

Benefits
The Office's research and development (R&D) in Visualization and Controls, High Temperature Superconductivity, Energy Storage and Power Electronics, and Renewable and Distributed Systems Integration (formerly Distributed Energy) will develop technologies to improve the reliability, energy efficiency, system efficiency, and security of the Nation's electricity delivery system. The R&D will: (1) strengthen grid stability and reduce frequency and duration of operational disturbances (reliability); (2) increase energy efficiency of the electric delivery system through reduced energy losses (energy efficiency); (3) reduce peak prices of electricity, increase asset utilization (capacity factor of Transmission and Distribution), and improve accessibility to a variety of energy sources for electricity generation (system efficiency); and (4) harden energy infrastructure so it can detect, prevent, and mitigate external disruptions to the energy sector (reliability).

Detailed Justification

	(dollars in thousands)		
	FY 2006	FY 2007	FY 2008
High Temperature Superconductivity R&D	**48,649**	**45,468**	**28,186**
▪ **High Temperature Superconductivity**	**34,440**	**45,468**	**28,186**

The High Temperature Superconductivity (HTS) activity focuses on applying high temperature superconductivity technology to the national effort to modernize and expand America's electricity delivery system. The benefits of realization of this technology lie primarily in increased efficiency of electric power equipment across the spectrum, i.e. reduced losses with reduced footprint. Secondary benefits of HTS technology will be increased reliability of grid systems and better affordability of grid capacity expansion. In FY 2008, the program will not focus on development of HTS motors and generators initiated prior to FY 2006. The program will shift to focus on cable systems (such as cryogenics, fault current limiters, and cables) and wire development with and without a magnetic field.

Achieving the long term goal for 2G HTS power applications requires 1) solving the difficult problem of manufacturing electrical wires from HTS materials which need special processing before realizing their ability to carry large currents in the range of 800-1000 amps, and 2) improving wire performance in magnetic fields characteristic for motors, generators, and transformers.

To maximize the wire performance work in FY 2008, the program will continue to improve processing to engineer the superconductor to behave like an infinitely long single crystal instead of the unprocessed granular structure. This result can be created if a textured substrate template results in near-perfectly aligned grains in the deposited superconductor layer. Subsequent misalignment of the grain boundaries and other microstructural defects are avoided by new processing methods invented by the program.

The very high currents achieved in small laboratory samples must also be achieved by wire manufacturers in long lengths in FY 2007. Uniformity in lengths exceeding 100 m has been greatly improved in FY 2007, and U.S. companies are world leaders in this technology, while it is being developed in Asia and Europe. FY 2008 will focus on advancing conductor research activities to expand our capabilities to process long-length conductors. Our objective is to develop high performance, inherently low cost superconducting wires with 100 times the capacity of conventional copper wires at comparable cost that support the development of revolutionary electric power

	(dollars in thousands)		
	FY 2006	FY 2007	FY 2008

equipment with half the energy losses and half the size/weight of conventional equipment. Technical challenges include finding lower cost methods of processing the substrate template and faster ways to grow the deposited superconductor on the template, achieving end-to-end uniformity where the amount of current possible over short lengths is possible over long lengths, and getting current to scale with superconductor thickness. Conductor research focuses on both rolling-assisted biaxial textured substrates (RABiTS) and ion-beam assisted deposition (IBAD) substrate texturing methods which are based on discoveries at DOE laboratories funded by the program. These methods will continue to be developed by the national laboratories and their industrial partners.

Processing improvements need to be made in both coating and preparation of the underlying metal substrate. Coating improvements will include faster processes, thicker films with higher current densities, and improved uniformity in long lengths. In order to improve process control and optimization, process diagnostics need to be developed for *in situ* and *ex situ* continuously processed 2G HTS coated conductors.

In FY 2008, the program will continue to accelerate the development of 2G wire that will carry high currents in the presence of strong magnetic fields and continue to support the activity of the DOD Title III program to help assure a domestic supply of 2G wire. (First generation superconducting wire contained an expensive silver casing. Second generation wire is a coated conductor that is produced by standard semiconductor processing techniques.)

The program also continues to develop metrics and benefits, conduct independent peer reviews, and conduct project and strategic analysis in accordance with Program Assessment Rating Tool (PART). Progress achieved will be reported and available through the Internet.

	FY 2006	FY 2007	FY 2008
▪ **Congressionally Directed Activities**	**14,209**	**0**	**0**
University of Notre Dame ionic fluids research for power distribution	**1,446**	**0**	**0**
Emerson Network Power, Columbus Ohio (OH)	**1,927**	**0**	**0**
City of Nome power generation replacement project (AK)	**963**	**0**	**0**
Juneau-Green Creek-Hoonah intertie for Juneau area power system (AK)	**963**	**0**	**0**
Advanced Grid Applications Consortium (PA)	**1,927**	**0**	**0**
Pilot Energy Cost Control Evaluation Project at NETL (WV)	**1,927**	**0**	**0**
Advanced Technology Center (IL)	**963**	**0**	**0**
Hawaii/New Mexico Sustainable Energy Security Partnership (HI/NM)	**2,890**	**0**	**0**
University of Missouri-Rolla for electric grid modernization (MO)	**963**	**0**	**0**
Houston Advanced Research Center for Second Generation dish temperature super conductor	**240**	**0**	**0**

	(dollars in thousands)		
	FY 2006	FY 2007	FY 2008
development (TX)			
Transmission Reliability R&D	**12,516**	**0**	**0**
▪ **Transmission Reliability Research**	**4,044**	**0**	**0**
In FY 2007, all projects transfer to the Visualization and Controls Activity.			
▪ **Congressionally Directed Activities**	**8,472**	**0**	**0**
Electricity Transmission, Distribution, and Energy Assurance R&D at NETL	**4,814**	**0**	**0**
University of Louisville Electric Grid Monitoring (KY)	**963**	**0**	**0**
Gonzaga University electric utility transformation program (WV)	**770**	**0**	**0**
Load Control System Reliability (MT)	**1,925**	**0**	**0**
Electricity Distribution Transformation R&D	**58,453**	**0**	**0**
In FY 2007, all projects, except Distributed Energy activities, transfer to the Visualization and Controls activity.			
▪ **Peak Load Reduction**	**1,480**	**0**	**0**
▪ **Renewable and Distributed Systems Integration**	**28,067**	**0**	**0**
In FY 2007, critical projects transfer to the Distributed Energy activity, renamed Renewable and Distributed Systems Integration in FY 2008.			
▪ **Congressionally Directed Activities**	**28,906**	**0**	**0**
Thermal Energy Technologies	**11,562**	**0**	**0**
SCADA Test Facilities	**9,634**	**0**	**0**
Telecommunications Application in Kansas	**2,409**	**0**	**0**
Cleveland State Ctr. For Research in Electric and Aerospace Tech. (OH)	**964**	**0**	**0**
Advanced Energy Storage, PCRT (MA)	**964**	**0**	**0**
Tennessee Tech Univ. Optimization of High Voltage Lines (TN)	**964**	**0**	**0**
Completion of bi-polar wafer cell NI-MH electric energy storage system (CT)	**1,445**	**0**	**0**
Connecticut Demand Response Technologies Project (CT)	**964**	**0**	**0**
Energy Storage R&D	**2,889**	**0**	**0**
▪ **Energy Storage R&D**	**1,444**	**0**	**0**
In FY 2007 all activities funded under Energy Storage R&D will transfer to Energy Storage and Power Electronics.			
▪ **Congressionally Directed Activities**	**1,445**	**0**	**0**
Iowa Energy Storage Project	**1,445**	**0**	**0**
GridWise	**5,267**	**0**	**0**
In FY 2007, all projects transfer to the Visualization and Controls activity.			
▪ **GridWise**	**2,873**	**0**	**0**

	(dollars in thousands)		
	FY 2006	FY 2007	FY 2008
In FY 2007, all projects transfer to the Visualization and Controls activity.			
▪ **Congressionally Directed Activities**	**2,394**	**0**	**0**
West Virginia University Integrated control of next generation power systems project (WV)	**958**	**0**	**0**
GridWise Northwest Demonstration Project (WA)	**1,436**	**0**	**0**
GridWorks	**4,815**	**0**	**0**
▪ **GridWorks**	**2,119**	**0**	**0**
In FY 2007, all projects transfer to the Visualization and Controls activity.			
▪ **Congressionally Directed Activities**	**2,696**	**0**	**0**
Energy Security and diversification at Savannah River National Lab (SC)	**963**	**0**	**0**
Green Island Power Authority, Advanced Transmission Project (NY)	**963**	**0**	**0**
Integrated Distribution Management Systems in Alabama (AL)	**770**	**0**	**0**
Visualization and Controls	**0**	**17,551**	**25,305**

The Visualization and Controls activity supports modernization of the Nation's transmission and distribution infrastructure through advanced system monitoring, visualization, control, operations and market structure tools to monitor market and operational performance. The activity is developing the next generation system control and data acquisition (SCADA) system that features GPS-synchronized grid monitoring, secure data communications, custom visualization and operator cuing, and advanced control algorithms. Additionally, the activity supports the development of hardware that supports the operations of the grid including transformers and fault current limiters for electric substations and protective systems. Visualization and control systems will allow operators to detect disturbances and take action before problems cascade into widespread outages. Control actions will increase in complexity. The goal is to develop automatic, reconfigurable networks driven by real-time grid reliability management systems. The capabilities and tools being developed by the Consortium of Electric Reliability Technology Solutions enable enhanced techniques for modeling and simulation of contingencies, blackouts, and other grid-related events, as recommended in the *Final Report on the August 14, 2003 Blackout in the United States and Canada*. The report also provides the Department with the critical, real-time information that is needed to respond appropriately during energy emergencies.

The technology development activities to improve electric transmission and distribution planning and operations include:

- Sensors for measuring system conditions involving a variety of physical metrics across the grid;
- Operation equipment including transformers and fault current limiters that adjust and regulate power flow;
- Visualization tools for portraying real-time information to enable grid operators to identify disturbances before they cascade into serious problems;
- Market mechanisms under competitive electricity markets for grid reliability, economic efficiency,

and demand response to reduce peak prices and price volatility; and

- Next-generation control systems security for rapid response to disturbances with the ability to survive intentional cyber assaults with no loss of critical functionality.

A real-time monitoring and visualization system – based on time-synchronized measurement of frequency, voltage and current – will provide visualization screens that display the status of the transmission system over a wide area, and calculate the "health" of the grid in real time. The approach will be first to develop the capabilities for real-time data collection and begin to build a baseline for modeling system performance. The next step will be to compare actual system operations to this baseline. This will enable the development of new diagnostics and operator cuing tools and lead ultimately to automatic, real-time, switchable grid operation.

This sequential process is depicted in the following diagram.

Predictive Modeling → Real-time Data Collection →
Diagnostics/Operator Cuing → Automation

Sensors are an essential "building block" to equip system planners and operators with the real-time information they need for achieving the long-term goal of improved electric transmission and distribution planning and operations. DOE activities in this area involve working with electric utilities, vendors, regulators, and research organizations to expand the breadth of coverage of sensors in the transmission system and the depth of coverage in the distribution system. Advanced GPS time-synchronized sensors known as intelligent electronic devices (IED) are deployed in substations and include phasor measurement units (PMU), digital fault recorders, and circuit breaker monitors. Other sensors that monitor dynamic line conditions (sag monitors) are deployed directly on transmission lines. FY 2008 activities include assessing the types of sensors, frequencies of measurement, and locations on the grid that will produce information for achieving more reliable grid operations; and developing strategies and applications software with electric utilities for their cost-effective deployment across the grid. The technical objective of this activity is to accelerate the deployment of transmission-level IED sensors and to initiate deployment of these sensors at the distribution level. In FY 2008 this activity will focus on the appropriate distribution of sensors to be implemented in the transmission system by 2009 and in the distribution system by 2012 to ensure adequate coverage.

Efficient operations are critical especially in the areas of substation performance and protective systems. Research will continue in FY 2008 on advanced materials to yield devices with the capability for high voltage, high frequency, high current, and high power density operation. This equipment includes transformers and fault current limiters, which will improve system reliability.

In FY 2007, initial design of the fundamental power electronic building block (e.g., switch module; valve) for a solid-state fault current limiting device will be completed. In FY08, construction will begin on a 69kV, single-phase solid-state fault current limiter.

Improved visualization tools are essential for achieving greater wide-area visibility and display, and equipping grid operators with expanded capabilities for maintaining reliable and secure systems. Currently operators experience a lack of situational awareness outside their own control areas and a limited monitoring capability of grid dynamics. Program activities in FY 2008 will include defining real-time, interconnection-wide visualization systems, involving human factors experts to address visualization needs, and defining summary information displays to present relevant information in an integrated user-friendly fashion. These visualization tools will also facilitate monitoring of grid reliability standards compliance by the Electricity Reliability Organization (ERO) and market operations by the Federal Energy Regulatory Commission (FERC).

In FY 2007, a draft test plan for calibration of the dynamic response of phasor measurement units will be completed, and the Real Time Dynamic Monitoring System (RTDMS) prototype visualization tool will be released to industry for comment and recommendations.

Market uncertainties under restructuring are a threat to grid reliability and the efficient, economic operation of the power system. This activity involves partnering with universities, national laboratories and the electricity industry to develop the underlying theory and software for power system planning and operations applications under competitive markets. This activity will also model, simulate and experiment with new market designs and operating practices to understand and optimize the new markets for energy, ancillary services, and demand response prior to actual implementation on the power system. Customer demand reduction programs will enable energy-consuming products and processes to respond to market prices of electricity to balance supply and demand, help reduce transmission congestion, and ensure system reliability.

Enhanced control systems security is critical to the development of a reliable and resilient modern grid. A major issue to address is the currently limited ability to measure and address the vulnerabilities of control systems, detect cyber intrusion, implement protective measures and response strategies, and sustain cyber security improvements over time. Control systems have also become more vulnerable to malicious cyber attacks due to the increased adoption of standardized technologies with known vulnerabilities and the increased connectivity to the Internet and greater use of wireless technologies. Sophisticated cyber attack tools are now widely available on the Internet for adversaries with little technical knowledge to launch an attack from almost anywhere using a laptop computer and an Internet connection. The need to improve electric power control systems security is well recognized by both the private and public sectors.[b]

OE's control system security efforts in FY 2008 will partner with industry to develop a more comprehensive and national effort through the implementation of the Roadmap to Secure Control

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[b] The National Research Council identified *"protecting energy distribution services by improving the security of SCADA systems"* as one of the fourteen most important technical initiatives for making the Nation safer. This and other reports led the White House to declare that *"securing DCS/SCADA is a national priority"* in *The National Strategy to Secure Cyberspace* (February 2003).

(dollars in thousands)

Systems in the Energy Sector[c]. Activities will include development of testing methodologies to assess the cyber vulnerabilities of control system technologies, advanced security technologies to better secure data communications, innovative cryptographic key management schemes to secure legacy systems and stronger authentication technologies that don't adversely impact availability. All the activities will be coordinated with the Department of Homeland Security in accordance with Homeland Security Presidential Directive 7.

Control of loads and strategies for load management are critical to balancing the supply and demand for electric power. Currently, major impediments to broad implementation are inadequate communication infrastructure to support two –way information exchanges and lack of transparency of key information (grid operating conditions and price signals) to consumers. A technology is needed for control devices to monitor and mange supply and demand, and to enable secure two-way transmission of information between utilities. The development of industry consensus interoperability standards will continue with efforts focusing on a standard architecture for enabling information exchange.

Efforts will also continue to define metrics and benefits, conduct independent peer reviews, and conduct project and strategic analysis in accordance with Program Assessment Rating Tool (PART). Progress reports will be available through the Internet.

Energy Storage and Power Electronics	**0**	**2,965**	**6,803**
▪ **Energy Storage**	**0**	**2,465**	**2,000**

One of the distinctive characteristics of the electricity sector is that supply is relatively fixed, at least in the short term, while demand will fluctuate. Developing technology to store electrical energy so it can be available whenever needed would represent an important breakthrough. Large scale, megawatt-level electricity storage systems, or multiple smaller distributed storage systems, could significantly reduce transmission system congestion, manage peak loads, make renewable electricity sources more dispatchable, and increase the reliability of the overall electric grid. Reducing the cost and size of energy storage systems are the key to more widespread use. Effort is needed to assess opportunities for new manufacturing processes to reduce the cost of existing battery storage devices. For all types of systems, effort is needed to explore the possibilities of substituting lower cost materials without sacrificing technical performance. Advances in the design of storage devices are needed for batteries, flywheels, and capacitors, as well as evaluation of trade-offs in features and performance to lower manufacturing costs.

In FY 2006, three storage systems were commissioned in collaboration with the CEC and NYSERDA. One of these systems was a 100 kW, 15 min prototype flywheel energy storage system taking signals from the California Independent System Operator (CAISO) to compensate for short term load/demand inequalities and perform frequency regulation. Another system was a 100 kW, 15 min prototype

[c] The Roadmap to Secure Control Systems in the Energy Sector is the result of collaboration between the energy sector and government to identify concrete steps to secure control systems used in the electricity, oil, and natural gas sectors over the next ten years. This January, 2006, publication was sponsored by the U.S. Department of Energy and the U.S. Department of Homeland Security, and is available at http://www.oe.energy.gov/DocumentsandMedia/roadmap.pdf.

(dollars in thousands)

flywheel device, installed at a commercial site in NY State. Responding directly to the grid, the system performs frequency regulation and provides power quality to the facility. (With NYSERDA)
In FY 2007, two storage systems will be commissioned in collaboration with the CEC and NYSERDA. These systems will focus on NaS battery and supercapacitor technologies to provide peak shaving, backup and power smoothing. Additionally, in FY 2007, a design for a 20 MW flywheel system will be developed to provide frequency regulation for the California Independent System Operator (CAISO).

In FY 2008, the Storage Program will initiate investigations of ionic liquids for possible use as electrolytes in batteries and supercapacitors. Storage will also initiate investigation of nano-engineering of electrode materials, extending successful SBIR projects. Devices combining these technologies will be developed with a potential of doubling the energy and increasing the power by at least 50% for capacitors, and doubling the lifetime and improving safety of rechargeable non-aqueous batteries. These studies will be performed in cooperation with the DOE Office of Science. The program will also continue development of energy storage devices including advanced batteries, electrolytic capacitors, flywheels, and other energy storage systems to meet the emerging needs of the electric system.

The program will continue to develop metrics and benefits, conduct independent peer reviews, and conduct project and strategic analysis in accordance with Program Assessment Rating Tool (PART). Progress achieved will be reported and available through the Internet.

	FY 2006	FY 2007	FY 2008
▪ **Power Electronics**	**0**	**500**	**4,803**

Power electronics devices hold substantial promise for transforming the electric power system. High voltage power electronics allow precise and rapid switching of electric power to support long distance transmission. This speed and precision will allow the system to respond to system disturbances and operate with lower margins and fewer constraints, thereby reducing the need for additional infrastructure.

One of the most basic power system devices is the switch. A top priority technology need is for power electronics switches with the capability for high voltage, high speed, with little or no cooling requirements, and a favorable cost-to-value relationship. New approaches or materials (silicon carbide or diamond) that are not currently used today in power electronics will be needed. Working in this voltage and current domain will require more research into the properties and suitability of advanced materials. There is interest in exploring new materials, i.e. going beyond silicon. Diamonds and silicon-carbide are promising materials for use in power electronics.

There has been and continues to be a substantial Federal R&D investment in power electronics that OE leverages. However, utility applications are very different from the smaller power applications. For example in automotive and military applications, size and weight are the key drivers. OE will address the high voltage and high current applications. This will require additional focus on thermal management, topology development and packaging concerns.

Achieving this goal requires that a number of technical challenges will have to be addressed in

FY2008. For example:

- Overall system life-cycle costs for power electronics need to be comparable or lower in cost than existing devices to be more marketable
- Devices need to be able to withstand higher voltages, current levels, frequencies, and power densities
- Advanced topologies are needed to reach the high power levels of utility applications
- Lack of information on the proven performance, reliability, and durability of power electronics over a period of time
- Advanced control methodologies and technologies are needed to better coordinate multiple systems
- Lower cost and more modular "building block" converter units are needed for series or parallel installations that are programmable for multiple functions and have standardized interfaces

In FY 2008, power electronics activities will complete full power testing of an Emitter Turn-Off (ETO) based inverter in collaboration with a utility and the refining of a cascade inverter concept. Wide band gap semiconductor concepts, electro-optic sensing, and materials research on new high voltage, high-power wide band materials including diamond-graphite composites will be further pursued.

The program will continue to develop metrics and benefits, conduct independent peer reviews, and conduct project and strategic analysis in accordance with Program Assessment Rating Tool (PART). Progress achieved will be reported and available through the web.

	FY 2006	FY 2007	FY 2008
Renewable and Distributed Systems Integration	**0**	**29,652**	**25,700**

In FY 2008, the Distributed Energy activity was renamed Renewable and Distributed Systems Integration to integrate efforts within the office including on-site generation and load management by merging both customer and utility research interests. Systems engineering will be one of the key activities for addressing technology readiness and market acceptance issues for distributed systems and providing quantitative data on costs, benefits, business models, utility system impacts, and consumer impacts. The integrated demonstration will be conducted in collaboration with utilities, equipment manufacturers, regional, state, and local agencies, national laboratories, and universities. Currently, decision makers are unsure about investments in distributed systems because there is a lack of data about their performance in addressing electric reliability and security problems from analysis of utility-scale applications. In addition, there are very few examples of situations where portfolios of distributed systems, e.g., generation, storage, and price-based demand response have been installed as integrated systems to meet the capacity and energy needs of utilities and consumers.

In FY 2007, activities include identifying local areas across the country experiencing electricity supply and delivery constraints; soliciting ideas from utilities, states, equipment manufacturers, and consumers about using distributed systems to alleviate grid congestion in those areas; establishing multi-year data collection and analysis plans for measurement of costs, benefits, and utility and consumer impacts to assist in site and system selection; competitively awarding cost-shared agreements to install, operate, test, and evaluate distributed systems in a selected number of constrained areas.

A number of integrated demonstration projects will be awarded in FY 2007. The scope encompasses a comprehensive evaluation of distributed systems in different regions of the country, in areas experiencing different types of grid congestion issues or constraints, in areas with different market structures (e.g., vertically integrated markets and organized wholesale markets), in areas with different mixes of residential, commercial, and industrial consumers, and in areas with different development patterns and population densities (e.g., urban, suburban, ex-urban, and rural).

The technical objective for the activities under integrated demonstration projects is to verify and validate by 2015 the application of distributed systems to reduce congestion in areas experiencing electricity supply and delivery constraints. The assessment will be carried out for each of the integrated demonstration projects and will include quantitative analysis of costs and benefits for both the utility and the participating consumers. The initial activities will assess baseline values for reducing local peak demands and the associated costs of using distributed systems vs. using traditional utility approaches. Subsequent activities will assess the yearly progression toward the achievement of overall cost of distributed systems competitive with those of system/capacity upgrades.

Evaluation of the role that advanced design strategies, such as local energy networks, could play in the new grid architecture will be another one of the key activities for determining feasibility, assessing costs and benefits, and identifying profitable business models. An example of an advanced operational strategy is the concept of a microgrid. A microgrid is an integrated power delivery system consisting of interconnected loads and DER systems which, as an integrated system, can operate in parallel with the grid or in an intentional "island" mode. Potential applications include: locations experiencing electric supply and or delivery constraints, remote power (e.g., military installations, rural areas, and Native American tribal lands), critical infrastructure protection (e.g., police, fire, emergency response, hospitals, and water treatment), and economic development (e.g., industrial parks, commercial centers, and residential development). In FY 2008, work will continue on the evaluation of microgrid concepts on islands and military bases.

In FY 2006, research focused on the development of distributed generation systems and reaching the efficiency and emissions goals for each of those systems. The installation and demonstration of a combined heat and power system with at least 70% efficiency was demonstrated. In FY 2007, research will be completed on reciprocating engines with at least one engine demonstrating 44% efficiency; microtrubines subsystems (materials and low emissions) that demonstrated 7 ppm NO_x (approximately 0.15 lb/MWh); industrial gas turbines low emissions systems and materials development that demonstrated 5 ppm NO_x without impacting performance. In FY 2008, the transition to research on renewable and distributed systems integration will be completed.

The program will continue to develop metrics and benefits, conduct independent peer reviews, and conduct project and strategic analysis in accordance with Program Assessment Rating Tool (PART). Progress achieved will be reported and made available through the web.

	(dollars in thousands)		
	FY 2006	FY 2007	FY 2008
SBIR/STTR (non-add)	**0**	**(2,596)**	**(2,497)**
In FY 2006, $3,303,750 and $396,450 were transferred to the SBIR and STTR programs respectively.			
Total, Research and Development	**132,589**	**95,636**	**85,994**

Explanation of Funding Changes

	FY 2008 vs. FY 2007 ($000)
High Temperature Superconductivity R&D	
▪ **High Temperature Superconductivity**	
Decreased funding reflects a refocusing of program efforts on 2G wire properties to simplify microstructure and increase performance in magnetic fields. Activities will include supporting research in dielectrics and cryogenics. Several alternative processing methods for 2G wire will be discontinued to concentrate on core properties of wire systems moving to market.	-17,282
Visualization and Controls	
Increase supports the development/verification of advanced security visualization tools specifically for preventing cyber attacks with utility control systems, and market tools for monitoring power system planning and operations under competitive markets.	+7,754
Energy Storage and Power Electronics	
▪ **Energy Storage**	
Funding is decreased as a result of completing the demonstration of advanced storage systems.	-465
▪ **Power Electronics**	
Increase in funding supports the development of high voltage power electronic systems through advanced materials research and lower cost, higher temperature packaging.	+4,303
Total, Energy Storage and Power Electronics	**+3,838**

	FY 2008 vs. FY 2007 ($000)
Renewable and Distributed Systems Integration	
Decrease reflects the successful completion of generation research activities (microturbine engines) and a transition into activities focused on grid integration of distributed systems and renewable sources.	-3,952
Total Funding Change, Research and Development	**-9,642**

Electricity Restructuring

Funding Schedule by Activity

(dollars in thousands)

	FY 2006	FY 2007	FY 2008
Electricity Restructuring			
Electric Markets Technical Assistance	3,960	0	0
Energy Security and Assurance	4,851	0	0
Congressionally Directed Activities	3,465	0	0
Total, Electricity Restructuring	12,276	0	0

Description

The mission of the Electricity Restructuring subprogram is to provide technical assistance and analytical support to States and regions for policies, market mechanisms, and activities that facilitate competitive, reliable, environmentally sensitive, and customer-friendly wholesale and retail electric markets. The mission includes modeling and analysis to identify the causes of reliability events and to develop recommendations for avoiding such future events.

The President has designated the Department of Energy as the Lead Sector Specific Agency responsible for protecting the Nation's critical energy infrastructure. The Energy Security and Assurance activity is responsible to the Secretary of Energy for coordinating and carrying out these responsibilities of the Department of Energy. All activities of this subprogram were moved to the Operations and Analysis subprogram in FY 2007.

Detailed Justification

(dollars in thousands)

	FY 2006	FY 2007	FY 2008
Electric Markets Technical Assistance	**3,960**	**0**	**0**

All activities, excluding Congressionally directed activities, were moved to Operations and Analysis in FY 2007.

Energy Security and Assurance	**4,851**	**0**	**0**

All activities, excluding Congressionally directed activities, were moved to Operations and Analysis in FY 2007.

▪ **State/Local Government Partnerships**	**1,311**	**0**	**0**

All activities, excluding Congressionally directed activities, were moved to Operations and Analysis in FY 2007.

▪ **Exercises**	**721**	**0**	**0**

All activities, excluding Congressionally directed activities, were moved to Operations and Analysis in FY 2007.

	FY 2006	FY 2007	FY 2008
▪ **Visualization**	**885**	**0**	**0**
All activities, excluding Congressionally directed activities, were moved to Operations and Analysis in FY 2007.			
▪ **Criticality/Vulnerability Assessment**	**623**	**0**	**0**
All activities, excluding Congressionally directed activities, were moved to Operations and Analysis in FY 2007.			
▪ **Private Sector Collaboration**	**1,311**	**0**	**0**
All activities, excluding Congressionally directed activities, were moved to Operations and Analysis in FY 2007.			
Congressionally Directed Activities	**3,465**	**0**	**0**
▪ **Continued development of an energy information training facility at Camp Dawson (WV)**	**2,475**	**0**	**0**
▪ **Navajo Electrification Project (NM)**	**990**	**0**	**0**
Total, Electricity Restructuring	**12,276**	**0**	**0**

(dollars in thousands)

Operations and Analysis

Funding Schedule by Activity

(dollars in thousands)

	FY 2006	FY 2007	FY 2008
Operations and Analysis			
Permitting, Siting, and Analysis	0	5,930	5,696
Infrastructure Security and Energy Restoration	0	6,079	5,860
Total, Operations and Analysis	0	12,009	11,556

Description

The mission of the Operations and Analysis subprogram is to: (1) contribute to the development and implementation of electricity policy at the Federal and State level; (2) issue authorization for electricity exports and Presidential permits for cross-border transmission lines; and (3) enhance security and reliability of the grid infrastructure and facilitate recovery from disruptions to the energy supply. The President has designated DOE as the Lead Sector Specific Agency responsible for protecting the Nation's critical energy infrastructure.

Benefits

The Permitting, Siting, and Analysis activity contributes to the development and implementation of electricity policy at the Federal and State level. The highest priority for this activity is implementing the electricity grid modernization requirements contained in EPAct related to transmission and demand response. In addition the activity uses education, outreach, and analysis to help States, regional electric grid operators, and Federal agencies develop and improve policies, market mechanisms, regulations, State laws, and programs that assist modernization of the electric grid. Under the Federal Power Act, Congress reserves jurisdiction over most matters related to generation and retail distribution of electricity to the States, but gives jurisdiction to the Federal Energy Regulatory Commission to set the rates, terms, and conditions for the sale of bulk power for resale and the use of transmission facilities. Thus, the mission of the Office of Electricity Delivery and Energy Reliability (OE) to modernize and expand America's electric grid cannot be met without active and supportive involvement by the States. Particularly of benefit will be increased electric infrastructure investment that should result from implementation of the requirements of the Energy Policy Act of 2005 (EPAct) pertaining to transmission and energy corridor designation and the coordination of federal agency transmission line permitting.

The International Electricity Regulation function of the Permitting, Siting, and Analysis activity issues permits for cross-border transmission lines and authorizes electricity exports. Both help to ensure availability of competitively-priced electricity supplies in a competitively-and environmentally-sound manner and help modernize and assure reliability of the electric grid.

The Infrastructure Security and Energy Restoration activity will increase the security, reliability, and resiliency of the Nation's energy infrastructure. The execution of energy security and emergency response programs will be improved by participating in exercises with other Federal agencies, State and local governments, and public utilities; administering programs to facilitate information sharing and best practices; and coordinating planning among the energy sector, States, and Federal agencies. Helping

State and local governments to improve their energy assurance and response strategies and providing support for emergency operations will enhance public safety and reduce recovery time following an energy disruption. Additionally, ongoing efforts with Federal and State entities to develop strategies that encourage private investment and the implementation of cost recovery programs pertaining to security investments, will increase awareness of energy security and reliability issues and motivate increased private investment in technologies which can enhance energy security.

Working with Federal, State, and industry partners, the Infrastructure Security and Energy Restoration activity will also reduce the vulnerability of critical energy assets and key resources, decrease the attractiveness of using energy assets as weapons, and mitigate the likelihood and impact of disruptions to the energy infrastructure and other critical infrastructures by developing protection programs and facilitating site assessment visits. Further development of visualization and modeling capabilities will increase understanding of energy sector security and reliability issues and of the critical interdependencies of the energy sector and its relationship and impact on other sectors.

In coordination with governmental and private sector owners and operators, this activity will implement the National Infrastructure Protection Plan (NIPP) and the Sector Specific Plan for the energy sector.

Detailed Justification

	(dollars in thousands)		
	FY 2006	FY 2007	FY 2008
Permitting, Siting, and Analysis	**0**	**5,930**	**5,696**

The highest priority for the Permitting, Siting, and Analysis function of Operations and Analysis subprogram is implementing the electricity grid modernization requirements contained in EPAct. These include performance of an every-three-year national transmission congestion study (next is August 2009) that is coupled with periodic designation of national interest electric transmission corridors; coordination of all Federal permits for transmission projects, typically those that cross Federal lands, as submitted by applicants; identification of energy corridors on Federal lands in the east, Alaska, Hawaii, and Texas done jointly with Federal resource agencies by August 2009; provision of technical assistance to State public utility commissions and regional electricity-related organizations on various electricity policy related topics; and preparation of an annual report to Congress on electric industry economic dispatch practices.

DOE’s August, 2009, identification of energy corridors on Federal lands in the east, Alaska, Hawaii, and Texas will begin no later than in FY 2008, due to the complexity and expense of the extensive public participation and the 40-state environmental impact statement itself that is required.

DOE will be conducting analytical and outreach work to support its second national transmission congestion study, as required by EPAct to be completed by August 2009, particularly using lessons learned from the first congestion study released August 2006.

Requested funds will also be used for work on environmental assessments and other analyses needed for requests by electric transmission developers for DOE, as mandated by EPAct, to coordinate all Federal permits for transmission projects that cross Federal lands.

EPAct authorizes DOE to designate national interest electricity transmission corridors. Such designations under certain circumstances could result in FERC’s having jurisdiction to consider applications for the siting of electricity transmission facilities within the designated corridors. FERC has the authority to grant limited eminent domain to those applicants. DOE has not designated any corridors to date.

In between the every-three-year national transmission congestion studies required by Congress through EPAct, DOE will maintain attention on problem congestion areas identified in each study. This will be done by monitoring progress to relieve those problem areas using transmission or non-transmission alternatives and by performing any needed technical analysis, in order to publicly issue annual progress reports.

As an essential step in the process of gaining public acceptance and State regulatory approvals for the development of modernized grid infrastructure, expert technical assistance is also provided on an as-requested basis to State public utility commissions, State legislatures, regional State associations, regional transmission organizations/independent system operators, Federal officials, and Governors' offices. Topics requiring technical assistance or analysis are: transmission siting; regional resource and transmission planning; and portfolio management. The last topic of portfolio management includes electricity related policies and market mechanisms for demand response (reducing electricity use at peak times), energy efficiency, renewable energy, as well as addressing price risk and fuel diversity in utility resource procurement. Emphasis continues on encouraging the development of regional institutions and regional thinking among States on these and related topics that help grid modernization.

Emphasis will also be given to rapid dissemination of findings of sponsored technical analyses, accomplished in partnership with State, regional, and national organizations that have roles in electric markets and regulation. Permitting, Siting, and Analysis serves as a clearinghouse to assist and inform State- and regionally-based policymakers on electricity market policies and programs that can assist grid modernization.

Additional areas of possible electricity modernization policy analyses include subjects that were not addressed by EPAct. For example, the encouragement of electric infrastructure investments by focusing on barriers, such as tools to reach cost allocation decisions by State regulators on grid modernization investments. Another additional area is the investigation of benefits from bulk power "superhighways" and other alternative electric grid architectures that can modernize the nation's electricity grid.

The program also provides any technical analysis behind any order by the Secretary of Energy issued under Federal Power Act section 202(c) to address an electricity reliability emergency, such as was done in 2005-2007 to protect grid reliability in certain portions of Washington, DC.

Funds will support DOE's International Electricity Regulation function. The congressionally-mandated International Electricity Regulation function grants and amends Presidential permits for the construction, operation, maintenance, and connection of electric transmission facilities at U.S. international borders and authorizes exports of electric energy to foreign countries.

In FY 2006, International Electricity Regulation processed 50 electricity export authorizations and processed Presidential permit applications for 10 transmission facilities at the U.S. international borders. Before rendering any regulatory decision, the environmental impacts of the proposed action must be assessed pursuant to the requirements of the National Environmental Policy Act (NEPA), which in most cases involves preparation of environmental impact statements or environmental assessments. International Electricity also must analyze the operation of the U.S. electric power supply system to determine that the issuance of a Presidential permit or an electricity export authorization would not adversely impact the reliability of the U.S. electrical grid. These regulatory activities help promote the

	(dollars in thousands)	
FY 2006	FY 2007	FY 2008

national energy strategy goal of securing future energy supplies by enhancing international electricity infrastructures, which helps to ensure availability of competitively-priced electricity supplies in a competitively-and environmentally-sound manner.

Infrastructure Security and Energy Restoration (HS)	**0**	**6,079**	**5,860**

In compliance with Homeland Security Presidential Directive-7 (*Critical Infrastructure Identification, Prioritization and Protection*) and Homeland Security Presidential Directive-8 (*National Preparedness*), and the National Response Plan, DOE, in partnership with the Department of Homeland Security, is the designated Sector Specific Agency responsible for protecting the Nation's critical energy infrastructure and assisting State and local governments with energy disruption preparation and response. This role is highlighted by OE's initial and ongoing assistance with energy restoration after Hurricanes Katrina and Rita. The Infrastructure Security and Energy Restoration activity is responsible to the Secretary of Energy for coordinating and carrying out these DOE responsibilities. These activities were transferred from the Electricity Restructuring subprogram in FY 2007.

Infrastructure Security and Energy Restoration supports numerous crosscutting activities that enable State and local governments and private sector entities to improve their energy security practices and emergency planning and response capabilities. This activity assists States and local government with energy security activities, conducts exercises and simulations, and provides education and outreach.

Working with Federal, State, and industry partners, funds will be used to continue important initiatives to reduce the vulnerability of critical energy assets and key resources by developing protection programs, facilitating site assessment visits, and providing energy experts to assist in training teams on the assessment of domestic and international energy infrastructure. This activity also supports tactical vulnerability and security exercises conducted in cooperation with DHS. Funding will also support joint efforts with DHS to prioritize critical energy assets and nodes in the oil, gas, and electricity sectors.

The Energy Emergency Assurance Coordinators system, a communications protocol for State- and local-level energy personnel and DOE, will undergo further expansion in FY 2008.

Funding will support the continued development and expansion of visualization and modeling to create simulations useful in State and local government exercises and to track emerging energy sector problems in real time. Facilitating an increased understanding of energy sector security and reliability issues and critical interdependency issues with other sectors like banking and finance, water and transportation, will support informed decision-making during energy disruptions.

As the Sector Specific Agency responsible for energy, and as directed by Homeland Security Presidential Directive Seven, the Infrastructure Security and Energy Restoration activity will implement the National Infrastructure Protection Plan (NIPP) in cooperation with partners at all governmental levels and private sector owners and operators, and coordinate the development and implementation of the Sector Specific Plan for the energy sector as well as those sectors in which energy is a key component (e.g., transportation).

Total, Operations and Analysis	**0**	**12,009**	**11,556**

Explanation of Funding Changes

	FY 2008 vs. FY 2007 ($000)
Permitting, Siting, and Analysis	
Reduction of one laboratory staff year to accommodate program priorities.	-234
Infrastructure Security and Energy Restoration	
Reduction of one laboratory staff year to accommodate program priorities.	-219
Total Funding Change, Operations and Analysis	**-453**

Program Direction
Funding Profile by Category

	(dollars in thousands/whole FTEs)		
	FY 2006	FY 2007	FY 2008
Golden Field Office			
Travel	10	0	0
Total, Golden Field Office	10	0	0
Full Time Equivalents	0	0	0
Idaho Operations Office			
Travel	10	0	0
Total, Idaho Operations Office	10	0	0
Full Time Equivalents	0	0	0
Chicago Field Office			
Salaries and Benefits	411	494	498
Travel	80	80	80
Support Services	40	42	42
Other Related Expenses	30	84	84
Total, Chicago Field Office	561	700	704
Full Time Equivalents	2	3	3
National Energy Technology Lab			
Salaries and Benefits	2,499	3,992	4,016
Travel	120	170	171
Support Services	120	150	151
Other Related Expenses	42	103	103
Total, National Energy Technology Lab	2,781	4,415	4,441
Full Time Equivalents	13	20	20
Headquarters			
Salaries and Benefits	6,549	8,040	8,088
Travel	670	835	840
Support Services	400	1,608	1,617
Other Related Expenses	2,332	1,685	1,697
Total, Headquarters	9,951	12,168	12,242

	(dollars in thousands/whole FTEs)		
	FY 2006	FY 2007	FY 2008
Full Time Equivalents	47	47	47
Total Program Direction			
Salaries and Benefits	10,091	12,526	12,602
Travel	712	1,085	1,091
Support Services	1,080	1,800	1,810
Other Related Expenses	1,430	1,872	1,884
Total, Program Direction	13,313	17,283	17,387
Total, Full Time Equivalents	62	70	70

Mission

Program Direction covers the cost of sustaining Federal staff required to provide overall direction, management, and support for the Office of Electricity Delivery and Energy Reliability's (OE's) efforts to achieve its expanded mission "to lead national efforts to modernize the electric grid, enhance security and reliability of the Nation's energy infrastructure, and facilitate recovery from disruptions to the Nation's energy supply." Program Direction includes Federal payroll, travel, support service, and other related services.

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.

Detailed Justification

	(dollars in thousands)		
	FY 2006	FY 2007	FY 2008
Salaries and Benefits	**10,091**	**12,526**	**12,602**

Funds a total of 70 FTEs that will provide the executive management, program oversight, analysis, and information required for the effective implementation of the OE programs. The Office consists of 54 FTEs at DOE Headquarters, 13 FTEs at the National Energy Technology Laboratory (NETL), and 3 FTEs at the Chicago Field Office.

Headquarters personnel work in one of three divisions— Research and Development; Permitting, Siting, and Analysis; Infrastructure Security and Energy Restoration—and a fourth support element called Resource Management.

Research and Development Division (or Sub-Program) personnel manage a portfolio of research, development, field testing, and technology demonstration projects, including development and implementation of technology visions and roadmaps, multi-year program plans, budget materials, program evaluations and metrics, public-private partnerships, technology transfer and commercialization plans, and education and outreach strategies. They also monitor and make decisions on funding, evaluate progress toward milestones, and hold research performers and others who receive funds accountable for their performance.

(dollars in thousands)

Permitting, Siting, and Analysis Division personnel lead the formulation and implementation of DOE's policies and programs with regards to: (1) implementation of electricity policy-related provisions of EPAct assigned to DOE; (2) assistance to States and regional organizations on best practices for various electricity-related policies and programs; and (3) issuance of Presidential permits for new electric transmission lines that cross U.S. international borders and authorizations for electricity exports.

Infrastructure Security and Energy Restoration Division (or Activity) personnel represent DOE in its role as the Sector Specific Agency for the Energy Sector in support of the Department of Homeland Security, responsible for implementing the national strategy for the physical and cyber protection of critical infrastructure and key assets, and performing energy restoration support functions under the National Response Plan. They also work through State and local governments, and with private industry, to coordinate the Federal government's efforts to ensure a secure and reliable flow of energy to America's homes, industries, public service facilities, and the transportation system. Working with government and industry leaders, they analyze physical and cyber vulnerabilities of the national energy infrastructure and develop scientific and technological solutions to correct or minimize system vulnerabilities.

The Resource Management Staff provides the administrative, budgetary, financial, logistical and communications support that allows OE to achieve its mission and goals in the most strategic and cost effective manner.

	FY 2006	FY 2007	FY 2008
Travel	**712**	**1,085**	**1,091**

Travel allows OE to effectively manage R&D electricity technology programs and projects in the field; provide DOE's electricity-related outreach to regional, State and local organizations with regards to planning needs and issues, policies, siting protocols and new energy facilities; and assist the Department of Homeland Security, State and local governments, and the private sector to help protect against, and recover from, disruptions in the energy infrastructure.

	FY 2006	FY 2007	FY 2008
Support Services	**1,080**	**1,800**	**1,810**

Funding provides support services needed for energy technology specific support on critical science, engineering, environmental, and economic issues that benefit strategic planning, program and project effectiveness; technology and market analysis to improve strategic and annual goals; environmental analyses required to process an increased number of Presidential permit applications; development of management tools and analyses to improve office efficiency; and computer systems development along with subsequent hardware and software installation, configuration and maintenance activities to improve productivity.

	(dollars in thousands)		
	FY 2006	FY 2007	FY 2008
Other Related Expenses	**1,430**	**1,872**	**1,884**

This includes working capital expenses such as rent, supplies, copying, graphics, mail services, printing, and telephones. This also includes equipment upgrades and replacements, commercial credit card purchases using the simplified acquisition procedure to the maximum extent possible, training, and other needs to sustain Federal staff not identified in above categories.

Total, Program Direction	**13,313**	**17,283**	**17,387**

Explanation of Funding Changes

	FY 2008 vs. FY 2007 ($000)
Salaries and Benefits	
Slight increase provided for inflation.	+76
Travel	
Slight increase provided for inflation.	+6
Support Services	
Slight increase provided for inflation.	+10
Other Related Expenses	
Slight increase provided for inflation.	+12
Total Funding Change, Program Direction	**+104**

Support Services by Category

	(dollars in thousands)		
	FY 2006	FY 2007	FY 2008
Technical Support			
Feasibility of Design Considerations	80	128	48
Development of Specifications	80	120	50
System Definition	40	50	20
System Review and Reliability Analyses	60	90	120
Trade-Off Analyses	80	120	162
Test and Evaluation	40	100	100

	(dollars in thousands)		
	FY 2006	FY 2007	FY 2008
Surveys or Reviews of Technical Operations	40	112	120
Total, Technical Support	420	720	620
Management Support			
Analyses of Workload and Work Flow	80	120	130
Directives Management Studies	60	90	120
Automated Data Processing	40	80	80
Manpower Systems Analyses	80	120	120
Preparation of Program Plans	100	200	210
Training and Education	60	120	150
Analyses of DOE Management Processes	120	150	160
Reports and Analyses Management and General Administrative Services	120	200	220
Total, Management Support	660	1,080	1,190
Total, Support Services	1,080	1,800	1,810

Other Related Expenses by Category

	(dollars in thousands)		
	FY 2006	FY 2007	FY 2008
Other Related Expenses			
Communications, Utilities, Misc.	143	250	255
Operation and Maintenance of Equipment	80	115	120
Supplies and Materials	51	75	75
Equipment	64	77	79
Working Capital Fund	1,092	1,355	1,355
Total, Other Related Expenses	1,430	1,872	1,884

Nuclear Energy

Nuclear Energy

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Energy Supply and Conservation
Office of Nuclear Energy

Overview

Appropriation Summary by Program

(dollars in thousands)

	FY 2006 Current Appropriation	FY 2007 Request	FY 2007 CR	FY 2008 Request
Energy Supply and Conservation				
University Reactor Infrastructure and Education Assistance	26,730	0	20,240	0
Research and Development				
Nuclear Power 2010	65,340	54,031	49,477	114,000
Generation IV Nuclear Energy Systems Initiative	53,263	31,436	40,332	36,145
Nuclear Hydrogen Initiative	24,057	18,665	18,216	22,600
Advanced Fuel Cycle Initiative	78,408	243,000	59,372	395,000
Total, Research and Development	221,068	347,132	167,397	567,745
Infrastructure				
Radiological Facilities Management	54,049	49,722	63,147	53,021
Idaho Facilities Management	112,723	95,290	119,367	104,713[a]
Idaho Sitewide Safeguards and Security	74,258	0	0	0
Total, Infrastructure	241,030	145,012	182,514	157,734[a]
Program Direction	60,498	67,608	45,810	76,224
Transfer from State Department	17,238	0	0	0
Subtotal, Energy Supply and Conservation	566,564	559,752	415,961	801,703
Funding from Other Defense Activities	-122,634	0	0	0
Funding from Naval Reactors	-13,365	0	0	0
Total, Energy Supply and Conservation	430,565	559,752	415,961	801,703

[a]Beginning in FY 2008, funding is included for activities previously funded by the former Office of Environment, Safety and Health.

Preface

The Office of Nuclear Energy (NE) leads the Government's efforts to develop new nuclear energy generation technologies to meet energy and climate goals, to develop advanced, proliferation-resistant nuclear fuel technologies that maximize energy from nuclear fuel, and to maintain and enhance the national nuclear technology infrastructure. NE serves the present and future energy needs of the Nation by managing the safe operation and maintenance of the DOE critical nuclear infrastructure that provides nuclear technology goods and services.

Within the Energy Supply and Conservation appropriation, NE has eight programs: University Reactor Infrastructure and Education Assistance, Nuclear Power 2010, Generation IV Nuclear Energy Systems Initiative, Nuclear Hydrogen Initiative, Advanced Fuel Cycle Initiative, Radiological Facilities Management, Idaho Facilities Management, and Program Direction. In FY 2006, NE had two programs that were partially funded within the Other Defense Activities appropriation—Idaho Facilities Management and Program Direction. Beginning in FY 2007, funds for these programs were requested solely in the Energy Supply and Conservation appropriation.

Mission

The mission of NE is to support the Nation's diverse nuclear energy programs. NE is responsible for leading the Federal government's investment in nuclear science and technology to support energy supply diversity and security, and advance United States competitiveness.

Benefits

The benefits of nuclear power as a greenhouse gas emissions-free, reliable, and safe source of energy are an essential element in the Nation's energy and environment future. Nuclear power is the second most abundant source of electric energy in the U.S., and existing plants are among the most economic sources of electricity on the grid today. NE focuses on the development of advanced nuclear technologies to assure diversity in the U.S. energy supply. This budget request responds to the Energy Security goal to develop new generation capacity to fortify U.S. energy independence and security while making improvements in environmental quality. It builds on important work started over the last three years to deploy new nuclear plants in the U.S. by early in the next decade, and to develop advanced, next generation nuclear technology.

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 (AFCI) develops technologies that would enable the reduction of spent nuclear fuel waste requiring geologic disposal. Over the last five years, the U.S. has joined several countries in an international effort to pursue advanced technologies that could treat and transmute spent nuclear fuel from nuclear power plants, while reducing overall proliferation risk. These efforts are continued under the AFCI program through the Global Nuclear Energy Partnership (GNEP).

To facilitate the construction of new nuclear power plants in the U.S., the budget provides funds to continue licensing demonstration activities started in previous years, and to develop regulations for nuclear power plant standby support, a program authorized by the Energy Policy Act of 2005. Under this authority, the Department will be able to offer risk insurance that will protect sponsors of new nuclear power plants against the financial impact of certain delays during construction or in gaining approval for operation that are beyond the sponsors' control.

The NE budget request also supports development of new nuclear generation technologies that provide significant improvements in sustainability, economics, safety and reliability, and non-proliferation and resistance to attack. Specifically, the Nuclear Hydrogen Initiative will develop advanced technologies that can be used in tandem with next generation nuclear energy plants to generate economic, commercial quantities of hydrogen to support a sustainable, clean energy future for the U.S. The Generation IV Nuclear Energy Systems Initiative establishes a basis for expansive cooperation with international partners to develop next generation reactor and fuel cycle systems that represent a significant leap in economic performance, safety, and proliferation resistance.

Strategic Themes and Goals and GPRA Unit Program Goals

The Department's Strategic Plan identifies five Strategic Themes (one each for energy security, nuclear security, scientific discovery, environmental responsibility and management excellence) plus 16 Strategic Goals that tie to the Strategic Themes. This Energy Supply and Conservation appropriation supports the following goals:

Strategic Theme 1, Energy Security: Promoting America's energy security through reliable, clean, and affordable energy.

Strategic Goal 1.2, Environmental Impacts of Energy: Improve the quality of the environment by reducing greenhouse gas emissions and environmental impacts to land, water, and air from energy production and use.

The programs funded within the Energy Supply and Conservation appropriation have two GPRA Unit Program Goals that contributes to the Strategic Goals in the "goal cascade". These goals are:

GPRA Unit Program Goal 1.2.14.00: Develop New Nuclear Generation Technologies - By 2015, enable industry to construct and operate new nuclear power plants, promoting safe, reliable and carbon-free energy production, through the standardization of Generation III+ plant designs, the successful demonstration of nuclear plant permitting and licensing processes, the advancement of Generation IV plant technologies, the construction of pilot-scale hydrogen production experiments, and the commencement of proliferation-resistant spent nuclear fuel recycling technology demonstration activities.

GPRA Unit Program Goal 1.2.15.00: Maintain and Enhance National Nuclear Infrastructure - Maintain, enhance, and safeguard the Nation's nuclear infrastructure capability to meet the Nation's energy, medical research, space exploration, and national security needs.

Contribution to Strategic Goal

As the United States considers the expansion of nuclear energy, it is clear that the Nation must optimize its approach to managing spent nuclear fuel. While the planned geologic repository at Yucca Mountain would be sufficient for all commercial spent fuel generated in the United States through 2015, the current "once-through" approach to spent fuel will require the United States to build additional repository space to assure the continued, safe management of nuclear waste from currently operating plants and a new generation of nuclear plants. Further, long-term issues associated with the toxicity of nuclear waste and the eventual proliferation risks posed by plutonium in spent fuel remain.

The Advanced Fuel Cycle Initiative (AFCI) is focused on developing technologies which can reduce the volume and long-term toxicity of high level waste from spent nuclear fuel, reduce the long-term proliferation threat posed by civilian inventories of plutonium in spent fuel, and provide for proliferation-resistant technologies to recover the energy content in spent nuclear fuel.

Improving the way spent nuclear fuel is managed will facilitate the expansion of civilian nuclear power in the United States and encourage civilian nuclear power in foreign countries to evolve in a more proliferation-resistant manner. Once these recycling technologies are proven, the United States and other countries, having the established infrastructure, could arrange to supply nuclear fuel to countries seeking the energy benefits of civilian nuclear power, and the spent nuclear fuel could be returned to partner countries for eventual disposal in international repositories. In this way, foreign countries could obtain the benefits of nuclear energy without needing to design, build, and operate uranium enrichment or recycling technologies to process and store the waste. Related contributions are described within the Department's request for the AFCI program in support of GNEP.

The Nuclear Power 2010 program is focused on resolving the technical, institutional, and regulatory barriers to the deployment of new nuclear power plants, consistent with the recommendations of the Nuclear Energy Research Advisory Committee (NERAC) report, "A Roadmap to Deploy New Nuclear Power Plants in the United States by 2010." In order to support the "Nation Energy Policy" and the President's goal of reducing greenhouse gas intensity by 18 percent by 2012, the Nuclear Power 2010 program will help enable an industry decision to deploy at least one new advanced nuclear power plant in the U.S. early in the next decade.

To help facilitate the deployment of new nuclear power plants, the Department is authorized to develop regulations for nuclear power plant standby support through the Energy Policy Act of 2005. Under these regulations, the Department would, with appropriated funds, be able to offer risk insurance that will protect sponsors of new nuclear power plants against the financial impact of certain delays during construction or in gaining approval for operation that are beyond the sponsors' control. This insurance will provide additional certainty to the builders of new nuclear power plants and help lead to the construction of a new nuclear power plant by the 2014 timeframe.

For the longer-term future, the Department believes that new, next-generation technologies should be considered to enhance the prospects for a significant expansion in the use of nuclear energy in the United States. Engaging this area requires the kind of long-term, high-risk, high-pay-off research that only Government-sponsored research can address. As a prime example, the Department believes that the future energy picture of the United States can and should include a large role for hydrogen as a fuel for automobiles and other elements of the vast U.S. transportation infrastructure. The use of hydrogen would make it possible for this Nation to realize a primary objective of the "National Energy Policy"—to enhance the energy independence and security of the United States while making significant improvements in environmental quality. Hydrogen could someday be used to power the nation's 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 the technological infrastructure for 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 greenhouse gases—and do so at a cost that is very competitive with imported fossil fuels. The Nuclear Hydrogen Initiative will develop new technologies to generate hydrogen on a commercial scale in an economic and environmentally benign manner. The Department's Offices of Nuclear Energy; Fossil Energy; and Energy Efficiency and Renewable Energy are working in coordination to provide the technological underpinnings of the President's National Hydrogen Fuel Initiative. In the case of nuclear energy, the Department will conduct research and development into advanced thermochemical technologies which may, when used in tandem with next-generation nuclear energy systems, enable the United States to generate hydrogen at a scale and cost that would support a future, hydrogen-based economy.

Developing the next-generation nuclear systems to make hydrogen possible is one aspect of the Generation IV Nuclear Energy Systems. Through this effort, the United States will lead multi-national research and development projects to usher forth next-generation nuclear reactors and fuel cycles. This international approach allows for the development of technologies that are widely acceptable; enables the Department to access the best expertise in the world to develop complex new technologies; and allows us to leverage our scarce nuclear R&D resources. After two years of detailed analysis by over one hundred of the world's top scientists and engineers, the Nuclear Energy Research Advisory Committee (NERAC), working with the Generation IV International Forum (GIF), identified six systems in pursuit of which the international community will collaborate and conduct joint research.

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. Guided by input from NERAC, NE seeks 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 DOE nuclear technology facilities in a safe, secure, environmentally compliant and cost-effective manner to support national priorities. Central to this infrastructure is the Nation's nuclear technology laboratory, the multi-program Idaho National Laboratory (INL). The Department is proceeding with plans to establish INL as the world's finest nuclear technology laboratory within 10 years. NE also maintains the Department's vital resources and capabilities of NE-managed facilities at Oak Ridge National Laboratory (ORNL), Los Alamos National Laboratory (LANL), and Brookhaven National Laboratory (BNL). The Radiological Facilities Management program also supplies fresh reactor fuel to universities and disposes of spent fuel from university reactors across the country.

The Idaho Facilities Management program maintains the Department's facilities at Idaho in a safe, secure and environmentally compliant condition for a range of vital Federal missions.

The Program Direction account funds expenses associated with the technical direction and administrative support of NE programs. NE is responsible for leading the Federal government's investment in nuclear science and technology by investing in innovative science and preserving the national research and development infrastructure. This program supports NE's Headquarters, Idaho, and Oak Ridge offices, and the U.S. mission to the Organization for Economic Cooperation and

Development. NE plans to perform its mission, goals, and activities with excellence in accordance with the President's Management Agenda by: creating an organization that will more effectively implement the Secretary's priorities; updating and expanding the independently created Office of Nuclear Energy Workforce Plan; and continuing to recruit a well-qualified, diverse workforce.

Funding by Strategic and GPRA Unit Program Goal

	(dollars in thousands)		
	FY 2006	FY 2007	FY 2008
Strategic Goal 1.2, Environmental Impacts of Energy			
GPRA Unit Program Goal 1.2.14.00, Develop New Nuclear Generation Technologies	221,068	347,132	567,745
GPRA Unit Program Goal 1.2.15.00, Maintain and Enhance National Nuclear Infrastructure	162,553	145,012	157,734[a]
Total, Strategic Goal 1.2, Environmental Impacts of Energy	383,621	492,144	725,479
All Other			
Program Direction	29,706	67,608	76,224[a]
Total, Strategic Goal 1.2 (Energy Supply and Conservation)	413,327	559,752	801,703

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 2008 Budget Request, and the Department will take the necessary steps to continue to improve performance.

The results of the FY 2005 review for the Research and Development programs, the FY 2006 review for the Infrastructure program, and the FY 2007 review for the University program are reflected in the FY 2008 Budget Request as follows:

Nuclear Power 2010 (NP 2010) received a rating of Adequate; Generation IV Nuclear Energy Systems Initiative and Advanced Fuel Cycle Initiative (AFCI) received a rating of Moderately Effective; and National Nuclear Infrastructure and University Reactor Infrastructure and Education Assistance received a rating of Results Not Demonstrated.

[a] Beginning in FY 2008, funding is included for activities previously funded by the former Office of Environment, Safety and Health.

Four of the five programs were assessed top scores for clarity of program purpose and soundness of program design. In the planning area, the PART assessment revealed a need for stronger links between budget and performance data for several of the programs. To address these findings, stronger links between program goals and funding requests are shown in this budget submission.

In the program management area, it was determined that the R&D programs needed to improve their methods for measuring and achieving cost effectiveness in program execution. The FY 2008 budget submission includes an efficiency measure that tracks program overhead against total R&D program costs, following a common methodology adopted by all applied energy R&D programs within the Department.

In addition, the AFCI and Generation IV programs were found to rely upon process oriented, output based metrics that do not indicate whether the programs are successful or demonstrating meaningful progress. For example, it was determined that AFCI should have metrics in place that demonstrate annual progress on its various components, such as separations, fuels, and transmutation. For the Generation IV program, metrics were needed to compare the key attributes of the various reactor designs (sustainability, proliferation resistance and security, safety and reliability, and economics) more objectively. In response to these findings, NE has developed meaningful, measurable outcome based performance metrics.

The National Nuclear Infrastructure assessment found that the program is effectively targeted through the formal Idaho National Laboratory Ten Year Site Plan, which identifies the mission-essential infrastructure and facilities, planned annual work scope, and performance measures for the laboratory. In FY 2006, as a follow-up action assigned as part of this assessment, NE contracted with the National Academy of Sciences to conduct an extensive comprehensive, independent evaluation of R&D and Infrastructure program goals and plans, including the process for establishing program priorities and oversight. The evaluation is expected to result in a detailed set of policy and research recommendations and associated priorities (including performance targets and metrics) for an integrated agenda of research activities within the scope of available resources that can best advance NE's fundamental mission of securing nuclear energy as a viable, long-term commercial energy option to provide diversity in energy supply. The results of this study, which is scheduled for completion by October 2007, will inform future budget submissions.

The University Reactor Infrastructure and Education Assistance assessment determined that enrollment target levels of the program have already been met and students no longer need to be encouraged to enter into nuclear related disciplines. In addition, the number of universities offering nuclear-related programs also has increased. These trends reflect renewed interest in nuclear power. Students will continue to be drawn into this course of study and universities, along with nuclear industry societies and utilities, will continue to invest in university research reactors, students, and faculty members. Consequently, Federal assistance was considered no longer necessary, and the FY 2007 Budget proposed termination of this program.

Findings from PART assessments are also addressed in the relevant sections of this budget submission.

Indirect Costs and Other Items of Interest

Facilities Maintenance and Repair

The Department's Facilities Maintenance and Repair activities are tied to its programmatic missions, goals, and objectives. Facilities Maintenance and Repair activities funded by this budget are displayed below.

Indirect-Funded Maintenance and Repair

(dollars in thousands)

	FY 2006	FY 2007	FY 2008
Idaho National Laboratory	9,098	9,334	9,577
Total, Indirect-Funded Maintenance and Repair	9,098	9,334	9,577

Direct-Funded Maintenance and Repair

(dollars in thousands)

	FY 2006	FY 2007	FY 2008
Idaho National Laboratory	7,871	9,636	9,000
Other	2,118	2,168	1,960
Total, Direct-Funded Maintenance and Repair	9,989	11,804	10,960

Energy Supply and Conservation
Office of Nuclear Energy

Funding by Site by Program

	(dollars in thousands)		
	FY 2006	FY 2007	FY 2008
Argonne National Laboratory			
Advanced Fuel Cycle Initiative	12,471	15,000	64,160
Generation IV Nuclear Energy Systems Initiative	3,806	1,255	2,020
Nuclear Hydrogen Initiative	3,244	2,005	2,000
University Reactor Infrastructure and Education Assistance	100	0	0
Total, Argonne National Laboratory	19,621	18,260	68,180
Brookhaven National Laboratory			
Advanced Fuel Cycle Initiative	654	900	4,010
Generation IV Nuclear Energy Systems Initiative	365	216	178
Nuclear Hydrogen Initiative	0	42	12
Nuclear Power 2010	200	85	57
Radiological Facilities Management	2,650	2,905	3,200
Total, Brookhaven National Laboratory	3,869	4,148	7,457
Chicago Operations Office			
Generation IV Nuclear Energy Systems Initiative	25	40	40
Idaho Facilities Management	500	0	0
Nuclear Power 2010	85	0	0
Total, Chicago Operations Office	610	40	40
Idaho National Laboratory			
Advanced Fuel Cycle Initiative	31,884	36,000	90,250
Generation IV Nuclear Energy Systems Initiative	24,217	19,793	23,955
Idaho Facilities Management	80,761	95,290	102,263
Nuclear Hydrogen Initiative	5,515	3,580	6,100
Radiological Facilities Management	20,256	15,147	17,917
Transfer from State Department	500	0	0
University Reactor Infrastructure and Education Assistance	6,690	0	0
Total, Idaho National Laboratory	169,823	169,810	240,485

	(dollars in thousands)		
	FY 2006	FY 2007	FY 2008
Idaho Operations Office			
Advanced Fuel Cycle Initiative	10,072	10,000	10,000
Generation IV Nuclear Energy Systems Initiative	8,444	4,979	4,605
Nuclear Hydrogen Initiative	3,673	2,010	2,050
Nuclear Power 2010	64,008	52,276	113,000
Program Direction	0[a]	31,361[b]	32,676
University Reactor Infrastructure and Education Assistance	19,492	0	0
Total, Idaho Operations Office	105,689	100,626	162,331
Lawrence Livermore National Laboratory			
Advanced Fuel Cycle Initiative	225	400	8,020
Generation IV Nuclear Energy Systems Initiative	491	180	180
Total, Lawrence Berkeley National Laboratory	716	580	8,200
Los Alamos National Laboratory			
Advanced Fuel Cycle Initiative	9,589	12,000	40,100
Generation IV Nuclear Energy Systems Initiative	280	85	85
Radiological Facilities Management	16,722	17,014	18,710
Total, Los Alamos National Laboratory	26,591	29,099	58,895
National Energy Technology Laboratory			
University Reactor Infrastructure and Education Assistance	20	0	0
National Renewable Energy Laboratory			
Nuclear Hydrogen Initiative	700	700	800
NNSA Service Center			
Nuclear Power 2010	84	0	0
Oak Ridge National Laboratory			
Advanced Fuel Cycle Initiative	3,027	6,000	38,070

[a] Excludes $30,792,000 for program direction expenses at the Idaho Operations Office appropriated under Other Defense Activities.

[b] Beginning in FY 2007, funding for program direction expenses and Full Time Equivalents for the Idaho Operations Office is requested in the Energy Supply and Conservation appropriation.

	(dollars in thousands)		
	FY 2006	FY 2007	FY 2008
Generation IV Nuclear Energy Systems Initiative	14,309	1,520	1,520
Nuclear Hydrogen Initiative	650	320	550
Radiological Facilities Management	11,279	11,815	12,644
University Reactor Infrastructure and Education Assistance	80	0	0
Total, Oak Ridge National Laboratory	29,345	19,655	52,784
Oak Ridge Operations Office			
Program Direction	2,032	2,087	2,189
Radiological Facilities Management	492	491	0
University Reactor Infrastructure and Education Assistance	100	0	0
Total, Oak Ridge Operations Office	2,624	2,578	2,189
Pacific Northwest National Laboratory			
Advanced Fuel Cycle Initiative	986	500	4,010
Generation IV Nuclear Energy Systems Initiative	342	0	0
Idaho Facilities Management	513	0	0
Nuclear Hydrogen Initiative	155	0	0
Nuclear Power 2010	410	0	0
Radiological Facilities Management	339	0	0
Transfer from State Department	16,221	0	0
University Reactor Infrastructure and Education Assistance	168	0	0
Total, Pacific Northwest National Laboratory	19,134	500	4,010
Radiological and Environmental Sciences Laboratory			
Idaho Facilities Management	0	0	2,450
Program Direction	0	0	2,774[a]
Total, Radiological and Environmental Sciences Laboratory	0	0	5,224
Sandia National Laboratories			
Advanced Fuel Cycle Initiative	1,570	2,000	8,020
Generation IV Nuclear Energy Systems Initiative	730	575	575
Nuclear Hydrogen Initiative	6,365	5,190	6,200

[a] Beginning in FY 2008, funding is included for activities previously funded by the former Office of Environment, Safety and Health.

	(dollars in thousands)		
	FY 2006	FY 2007	FY 2008
Radiological Facilities Management	1,900	1,800	0
Total, Sandia National Laboratories	10,565	9,565	14,795
Savannah River National Laboratory			
Nuclear Hydrogen Initiative	1,361	1,500	1,400
Savannah River Operations Office			
Advanced Fuel Cycle Initiative	2,730	3,000	24,060
Nuclear Power 2010	50	0	0
Total, Savannah River Operations Office	2,780	3,000	24,060
University of Nevada, Las Vegas			
Advanced Fuel Cycle Initiative	4,950	4,000	4,000
Nuclear Hydrogen Initiative	1,900	1,860	2,000
Total, University of Nevada, Las Vegas	6,850	5,860	6,000
Washington Headquarters			
Advanced Fuel Cycle Initiative	250	4,000	100,300
Generation IV Nuclear Energy Systems Initiative	254	2,793	2,987
Nuclear Hydrogen Initiative	494	1,458	1,488
Nuclear Power 2010	503	1,670	943
Program Direction	27,674	34,160	38,585
Radiological Facilities Management	411	550	550
Transfer from State Department	517	0	0
University Reactor Infrastructure and Education Assistance	80	0	0
Undesignated	0	149,200	0
Total, Washington Headquarters	30,183	193,831	144,853
Total, Energy Supply and Conservation	430,565	559,752	801,703

Site Description

Argonne National Laboratory
Introduction

Argonne National Laboratory (ANL) is one of the Department of Energy's scientific research laboratories and was the Nation's first national laboratory, chartered in 1946. ANL, located in Illinois, is the main laboratory and occupies 1,500 acres, surrounded by a forest preserve about 25 miles southwest of the Chicago Loop.

Advanced Fuel Cycle Initiative

ANL staffs the Advanced Fuel Cycle Initiative (AFCI) National Technical Director position for separations technology development, providing leadership over multi-laboratory research activities in aqueous and pyroprocessing spent fuel treatment. ANL is the principal laboratory supporting the development of a fast recycling reactor. ANL also supports the AFCI/GNEP program by performing reactor physics calculations, including spent fuel throughput calculations, for existing commercial light water reactors and Generation IV thermal and fast reactor concepts. ANL also has the lead for key systems analysis activities, including certain program reports to Congress and their subsequent updates.

Generation IV Nuclear Energy Systems Initiative

ANL continues to play an important role in conducting key R&D in support of the Generation IV Nuclear Energy Systems Initiative. ANL participates in system design and evaluation activities for the Generation IV systems, makes important contributions to Generation IV fuels and materials efforts, and leads or participates in joint projects with France, Korea, Canada, Euratom, and Japan. ANL leads the United States portion of the Generation IV International Forum (GIF) coordinated research and development activities on the Sodium Fast Reactor (SFR), including the staffing of GIF SFR Steering Committee vice-chair and membership on several GIF SFR Project Management Boards. ANL is responsible for staffing the position of Generation IV National Technical Director for Design and Evaluation Methods, who coordinates the United States (U.S.) efforts on method development and validation. ANL provides one of two U.S. experts for the Generation IV International Forum (GIF) Experts Group.

Nuclear Hydrogen Initiative

ANL supports the program by conducting laboratory analyses of thermochemical hydrogen production methods, specifically alternative cycles other than sulfur-based cycles.

University Reactor Infrastructure and Education Assistance

ANL administered the International Student Exchange Program (ISEP) in FY 2006. This program provided for student exchanges between the U.S. 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. In FY 2006, ANL also administered part of the university summer internship program.

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. BNL also performs a prospective benefits analysis of the Department of Energy's nuclear energy research and development portfolio in support of the Nuclear Power 2010, Generation IV Nuclear Energy Systems Initiative, Nuclear Hydrogen Initiative and the Advanced Fuel Cycle Intiative.

Advanced Fuel Cycle Initiative
BNL supports the AFCI program in the conduct of transmutation and fuel systems analyses, and advanced fuels performance modeling.

Generation IV Nuclear Energy Systems Initiative
BNL is conducting probabilistic risk assessment tasks in support of the Generation IV proliferation resistance studies and supporting an international project on advanced gas-cooled reactors.

Radiological Facilities Management
The Brookhaven Linear Isotope Producer (BLIP) at BNL uses a linear accelerator that injects 200 million-electron-volt protons into the 33 giga-electron-volt Alternating Gradient Synchrotron. The BLIP facility operations have decreased from 20 weeks to 10 weeks per year. Isotopes such as strontium-82, germanium-68, copper-67, and others that are used in medical diagnostic applications are produced at BLIP.

Chicago Operations Office
Generation IV Nuclear Energy Systems Initiative
The Chicago Operations Office distributes the Generation IV Nuclear Energy Systems Initiative funding contribution to the EPSCoR projects.

Idaho Facilities Management
Chicago Operations Office administers a contract with BWXT Service, Inc. for continuing spent nuclear fuel and other related material storage at the BWXT Lynchburg Technology Center.

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 (NE) has assumed Lead Program Secretarial Office (LPSO) responsibility for the Idaho Operations Office (ID). With the transfer of INL from EM to NE in FY 2005, INL is the center for NE's strategic nuclear energy research and development enterprise, INL's revised mission plays a major role in Generation IV nuclear energy systems development, advanced fuel cycle development, and space nuclear power and propulsion applications. The INL continues to 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 focuses on its new role as the center for nuclear research and development, as a multi-program national laboratory, it will continue to pursue appropriate roles in national security, environmental and other activities.

Advanced Fuel Cycle Initiative
INL staffs the AFCI National Technical Director positions for Fuels and Systems Analysis, leading the efforts of several national laboratories in the Generation IV and transmutation fuels, systems analysis and computer modeling and simulation arenas. INL has the lead role for the design of the Advanced Fuel Cycle Facility (AFCF) to establish the feasibility of advanced separations processes for spent nuclear fuel. INL is also responsible for qualification of resulting waste forms. INL capabilities also

include nuclear fuel development, irradiation of AFCI transmutation and Generation IV test fuels, post-irradiation examinations, waste and nuclear material characterization, and development of dry, interim storage for spent fuel and other highly radioactive materials.

Generation IV Nuclear Energy Systems Initiative
INL is the lead laboratory for the Generation IV Nuclear Energy Systems Initiative and conducts the program's technical integration activities. INL provides the R&D leadership for the Very High Temperature Reactor (VHTR), leads or participates in system design and evaluation activities for this system, and makes important contributions to fuel, materials and energy conversion system efforts. Under the Energy Policy Act of 2005, INL is the lead laboratory for the Next Generation Nuclear Plant (NGNP) project activities. This includes the integration of NGNP research and development, design, licensing and industrial participation. INL, together with ORNL, is the principal laboratory responsible for the development of advanced gas reactor fuel for the VHTR. INL leads or participates in a number of joint projects with France, Korea, Canada, Euratom, and Japan. INL is responsible for staffing the position of Technical Director of the Generation IV International Forum (GIF) and supporting staff, and plays a key role in organizing international GIF Policy Group meetings. INL is also responsible for staffing the position of Chair of the GIF Experts Group and for the organization of the GIF Experts Group meetings

Idaho Facilities Management
The INL is a multi-program national laboratory that employs research and development assets to pursue a wide range of nuclear power research and development and other national energy security activities such as the AFCI, Generation IV, the Space and Defense Power Systems program, and the Navy's nuclear propulsion research and development program. The purpose of the Idaho Facilities Management (IFM) Program is to provide the INL with the infrastructure required to support these efforts and to ensure that the infrastructure is maintained and operated in compliance with environment, safety and health rules and regulations.

NE is responsible for 890 square miles of land west of Idaho Falls (the site) and numerous laboratory and administrative facilities located in the town of Idaho Falls. NE operates and maintains buildings and facilities and associated support structures; a full complement of site wide utilities, including power, communications and data transmission systems; 800 miles of roads; 61 miles of electrical transmission lines; and 14 miles of railroad track. Included are numerous nuclear and radiological facilities.

The INL consists of three main engineering and research campuses: (1) the Reactor Technology Center (RTC) at the site, (2) the Materials and Fuels Complex (MFC) at the site, and (3) the Science and Technology Complex (STC) in Idaho Falls. As INL Landlord, NE also operates the Central Facilities Area (CFA) at the site and various site wide infrastructure systems and facilities that support all the compounds and campuses at the site.

Nuclear Hydrogen Initiative
INL will provide leadership in executing the Nuclear Hydrogen Initiative. INL will cooperate with SNL, in its role as Generation IV National Technical Director for Energy Conversion Systems, to ensure efficient integration of Generation IV and Nuclear Hydrogen Initiative activities.

Nuclear Power 2010
INL completed 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.

Radiological and Environmental Sciences Laboratory (RESL)
Introduction
RESL is a DOE-owned and operated Federal reference laboratory with core mission capabilities in radiation measurement and calibrations, and analytical chemistry. The laboratory conducts measurement quality assurance programs to assure that key DOE missions are completed in a safe and environmentally responsible manner.

Radiological Facilities Management
INL is responsible for the radioisotope power systems heat source and test and assembly operations that were transferred from the Mound Site. Activities also include the transfer of neptunium-237 (Np-237) inventory from the Savannah River Site to the INL during FY 2005.

University Reactor Infrastructure and Education Assistance
INL administered 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 administered the peer-review of the Nuclear Engineering Education Research (NEER) program to provide competitive investigator-initiated, research grants to nuclear engineering schools; the university reactor upgrade program to provide funding for improvements and maintenance of 20-25 university research reactors; and part of the university programs summer internship program.

Idaho Operations Office
Introduction
The Idaho Operations Office provides procurement, contract, cooperative agreement, and grant support for the Generation IV, Nuclear Hydrogen Initiative, Nuclear Power 2010, and the AFCI programs.

University Reactor Infrastructure and Education Assistance
The Idaho Operations Office administered the grants for the NE & HP fellowships and scholarships and the DOE/Industry Matching Grants program, and the NE Education Opportunities program in FY 2006. ID also administers engineering management contracts in support of the AFCI/GNEP initiative.

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.

Advanced Fuel Cycle Initiative
LLNL provides expertise on the impact of separation technologies on the geological repository, advanced computer simulations and modeling efforts, and coordination with Office of Science and Civilian Radioactive Waste Management expertsfrom other laboratories.

Generation IV Nuclear Energy Systems Initiative
LLNL is working on the development of the Generation IV lead-cooled fast reactor and associated fuel cycle. LLNL and ANL together serve as the Systems Integration Manager for the lead-cooled fast reactor.

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.

Advanced Fuel Cycle Initiative
LANL supports the AFCI and Generation IV programs through advanced fuels, materials and transmutation engineering research, including accelerator-driven systems. LANL staffs the AFCI National Technical Director position for Transmutation Science. LANL is also coordinating several aspects of the GNEP international cooperation initiatives. LANL also supports activities under the transmutation science education program related to nuclear science and engineering research at U.S. universities.

Generation IV Nuclear Energy Systems Initiative
LANL conducts research on advanced Generation IV lead-cooled fast reactor materials.

Radiological Facilities Management
At LANL, a portion of the Plutonium Facility-4 at the Technical Area-55 is dedicated to Pu-238 activities and is used to purify 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) became operable in FY 2005 and produces major isotopes, such as germanium-68, a calibration source for Positron Emission Tomography (PET) scanners; strontium-82, the parent of rubidium-82, used in cardiac PET imaging; and arsenic-73 used as a biomedical tracer.

National Renewable Energy Laboratory
Introduction
The National Renewable Energy Laboratory (NREL) is located in Golden, Colorado.

Nuclear Hydrogen Initiative
NREL coordinates the research in the thermochemical area. Additionally, NREL provides the systems integration function for the DOE Hydrogen program.

Oak Ridge National Laboratory
Introduction
The Oak Ridge National Laboratory (ORNL) is a U.S. Department of Energy scientific research laboratory located in Oak Ridge, Tennessee. ORNL also maintains the DOE computer code system, software, and documentation at the Radiation Safety Information Computational Center (RSICC) and serves as a repository for DOE computational research activities, including computer software that is developed by NEER research projects. The RSICC computer software is made available to nuclear engineering departments, NERI and NEER awardees.

Advanced Fuel Cycle Initiative
ORNL conducts research in basic and applied science in support of the AFCI program. ORNL provides materials expertise to develop spallation targets and specific reactor components, conducts research and development on advanced separations technologies, transmutation fuels for advanced recycling reactors and participates in the development and deployment planning of advanced aqueous spent fuel treatment technologies.

Generation IV Nuclear Energy Systems Initiative
ORNL and INL are the principal laboratories responsible for the development of advanced gas reactor fuel for the Very High Temperature Reactor. ORNL will fabricate gas reactor fuel in a laboratory-scale facility to supply demonstration fuel for irradiation testing and fuel performance modeling. ORNL also staffs the Generation IV National Technical Director for Materials, leads the development of the Generation IV Materials handbook efforts, and conducts much of the materials testing in support of the Generation IV Nuclear Energy Systems Initiative.

Nuclear Hydrogen Initiative
ORNL conducts research on the potential for thermochemical process improvements using membranes.

Radiological Facilities Management
ORNL provides the unique capabilities for fabricating carbon insulator and iridium heat source components for radioisotope power sources used for NASA space exploration missions. These sophisticated heat source components are necessary for the safe operation of these power systems during normal operation and during launch, reentry or other deployment accidents.

Enriched stable isotopes are processed at two laboratories. The material laboratory performs a wide variety of metallurgical, ceramic, and high vacuum processing techniques; the chemical laboratory performs scraping, leaching, dissolving, oxidizing processes to remove unwanted materials and place the isotope into a “chemically stable” form. Radioactive isotopes are chemically processed and packaged in hot cells in Building 3047.

Oak Ridge Operations Office
Radiological Facilities Management
Funding provides for oversight and monitoring of the maintenance of DOE leased assets at the Paducah Gaseous Diffusion Plant site. This program assures that USEC Inc. meets its MOA commitments and

that the Government's rights and options are preserved. Beginning in FY 2008, the DOE will assume direct responsibility for these oversight and monitoring activities.

Pacific Northwest National Laboratory

Introduction

Pacific Northwest National Laboratory (PNNL) is a multi-program laboratory located on approximately 640 acres of the Department's Hanford site. PNNL also monitors a marine science lab in Sequim, Washington.

Advanced Fuel Cycle Initiative

PNNL provides technical support to the AFCI in the areas of advanced separations, fuels, nonproliferation analysis, and systems analysis.

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.

Advanced Fuel Cycle Initiative

SNL serves as NE's technical integrator for AFCI, responsible for coordinating the participation of all laboratories in the development and conduct of the AFCI R&D program. SNL is also an integral part of the AFCI systems analysis effort. SNL also has the lead for nuclear safeguards, security and regulatory requirements for GNEP proposed facilities.

Generation IV Nuclear Energy Systems Initiative

SNL is responsible for staffing the position of National Technical Director for Energy Conversion, who coordinates the U.S. R&D on advanced systems for converting nuclear-generated heat into marketable energy products. This R&D is focused on advanced gas turbo-machinery with helium or supercritical carbon dioxide as the working fluids.

Nuclear Hydrogen Initiative

SNL serves as the technical integrator for the Nuclear Hydrogen Initiative, responsible for coordinating the participation of all laboratories in the development and conduct of the Nuclear Hydrogen Initiative R&D program. SNL is conducting research and development on the sulfur-iodine thermochemical process to operate an integrated demonstration in FY 2008.

Radiological Facilities Management

The Annular Core Research Reactor (ACRR) is a highly flexible facility that has been 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. The Isotope Programs no longer has a programmatic need for the Annular Core Research Reactor (ACRR). NNSA uses the ACRR for its weapons experiments and is currently the only user.

Savannah River National Laboratory

Introduction

Savannah River National Laboratory is a multiprogram laboratory located on approximately 34 acres in Aiken, South Carolina.

Nuclear Hydrogen Initiative

Savannah River assists with thermochemical cycle activities.

Savannah River Operations Office

Advanced Fuel Cycle Initiative

Savannah River assists with separations technology activities, advanced fuels development activities, and systems analysis activities. SR also has a significant role in the development of advanced recycling facilities for GNEP.

University of Las Vegas, Nevada

Advanced Fuel Cycle Initiative

UNLV is actively engaged in experiments on lead alloy coolants and targets in accelerator-based systems and fast reactor systems. UNLV conducts systems analysis on AFCI/GNEP actvities, including the potential for deep burn gas reactor transmutation. UNLV also conducts research using student participation.

Nuclear Hydrogen Initiative

UNLV is working with the Department to perform research and development on candidate heat exchanger designs. UNLV's scope has increased to include much of the complimentary materials development activities. UNLV actively involves other universities, industry, and national laboratories, making it an effective tool for developing the future work force and an important part of the NHI program.

Washington Headquarters

FY 2006, FY 2007 and FY 2008 include funding for SBIR and other small business initiatives. For AFCI/G\NEP, this account will also fund potential industry contracts for design studies on advanced spent nuclear fuel recycling facilities and advanced recycling reactors.

Nuclear Power 2010

Includes funding for activities conducted in support of the combined Construction and Operating License (COL) demonstration projects. Also, includes funding to develop the regulations, criteria, and process under which the Department would accept, evaluate, and approve applications for standby support contracts from sponsors of new nuclear power plants.

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 2006 Current Appropriation	FY 2007 Request	FY 2008 Request
University Reactor Infrastructure and Education Assistance	26,730	0	0

Public Law Authorizations:
P.L. 109-103, Energy and Water Development Appropriations Act, 2006
P.L. 109-148, Emergency Supplemental Appropriations to Address Hurricanes in the Gulf of Mexico and Pandemic Influenza, 2006

Mission

The mission of the University Reactor Infrastructure and Education Assistance program has been to enhance the national nuclear educational infrastructure to meet the manpower requirements of the Nation's energy, environmental, health care, and national security sectors. Enrollment target levels of the University Reactor Infrastructure and Education Assistance program have been met and the program is no longer considered essential to encourage students to enter into nuclear related disciplines.

Benefits

The United States (U.S.) has led the world in the development and application of nuclear technology for many decades. This leadership, which spans energy, national security, environmental, medical, and other applications, has been possible because the Government has helped foster advanced nuclear technology education at many universities and colleges across the Nation. The Government has succeeded in helping these programs to maintain the educational and training infrastructure necessary to develop the next generation of nuclear scientists and engineers. During the 1980s and 1990s, the number of students entering nuclear engineering programs in the U.S. declined causing a corresponding decline in nuclear engineering programs and research reactors. As the decline continued, the existing expertise in the nuclear field was reaching retirement age. Thus, the demand for nuclear scientists and engineers exceeded supply. The University Reactor Infrastructure and Education Assistance program was designed to address these issues by providing support to university nuclear engineering programs and the university research reactor community.

Beginning in FY 2007, funding to continue Federal support for fuel for universities is requested in the Radiological Facilities Management budget under Research Reactor Infrastructure.

Strategic and GPRA Unit Program Goals

The Department's Strategic Plan identifies five Strategic Themes (one each for energy security, nuclear security, scientific discovery, environmental responsibility and management excellence), plus 16

Strategic Goals that tie to the Strategic Themes. The University Reactor Infrastructure and Education Assistance program supported the following goals:

Strategic Theme 1, Energy Security
Strategic Goal 1.2, Environmental Impacts of Energy: Improve the quality of the environment by reducing greenhouse gas emissions and environmental impacts to land, water, and air from energy production and use.

The University Reactor Infrastructure and Education Assistance program has one GPRA Unit Program goal which contributed to Strategic Goals 1.2 in the "goal cascade":

GPRA Unit Program Goal 1.2.15.00: Maintain and Enhance National Nuclear Infrastructure - Maintain, enhance, and safeguard the Nation's nuclear infrastructure capability to meet the Nation's energy, medical research, space exploration, and national security needs.

Contribution to GPRA Unit Program Goal 1.2.15.00 (Maintain and Enhance National Nuclear Infrastructure)

The University Reactor Infrastructure and Education Assistance Program was designed to address declining enrollment levels among U.S. nuclear engineering programs. Since the late 1990s, enrollment levels in nuclear education programs have tripled. In fact, enrollment levels for 2005 have reached upwards of 1,500 students, the program's target level for the year 2015. In addition, the number of universities offering nuclear-related programs also has increased. These trends reflect renewed interest in nuclear power. Students will continue to be drawn into this course of study, and universities, along with nuclear industry societies and utilities, will continue to invest in university research reactors, students, and faculty members. Consequently, Federal assistance is no longer necessary, and the 2007 Budget proposed termination of the University Reactor Infrastructure and Education Assistance Program. The termination is also supported by the fact that the program was unable to demonstrate results from its activities when reviewed using the Program Assessment Rating Tool (PART), supporting the decision to spend taxpayer dollars on other priorities.

Funding by Strategic and GPRA Unit Program Goal

(dollars in thousands)

	FY 2006	FY 2007	FY 2008
Strategic Goal 1.2, Environmental Impacts of Energy			
GPRA Unit Program Goal 1.2.15.00, Maintain and Enhance National Nuclear Infrastructure			
University Reactor Infrastructure and Education Assistance	26,730	0	0
Total, Strategic Goal 1.2 (University Reactor Infrastructure and Education Assistance)	26,730	0	0

Annual Performance Results and Targets

FY 2003 Results	FY 2004 Results	FY 2005 Results	FY 2006 Results	FY 2007 Targets	FY 2008 Targets
GPRA Unit Program Goal 1.2.15.00 (Maintain and Enhance National Nuclear Infrastructure)					
University Reactor Infrastructure and Education Assistance					
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 TARGET)	Fund the six existing regional reactor centers; provide fuel to University Research Reactors; fund 20 to 25 DOE/Industry Matching Grants, 20 equipment and instrumentation upgrades, and 50 Nuclear Engineering Education Research grants; and provide 18 fellowships and 47 scholarships. (MET TARGET)	Issue funding to the six existing Innovations in Nuclear Infrastructure and Education consortia; provide fuel to University Research Reactors; issue funding to 20 to 25 DOE/Industry Matching Grants, 20 equipment and instrumentation upgrades, and 50 Nuclear Engineering Education Research grants; and provide 25 fellowships and 75 scholarships. (MET TARGET)	Complete activities to enhance the nation's nuclear education infrastructure by providing financial support to universities for facility and reactor modernization and to students to enable the pursuit of careers in nuclear energy-related fields; through these activities, DOE is demonstrating its commitment to the development of nuclear technology for the Nation. (MET TARGET)	Enrollment target levels of the University Reactor Infrastructure and Education Assistance program have already been met and the program is no longer needed to encourage students to enter into nuclear related disciplines.	Enrollment target levels of the University Reactor Infrastructure and Education Assistance program have already been met and the program is no longer needed to encourage students to enter into nuclear related disciplines.

Means and Strategies

The University Reactor Infrastructure and Education Assistance program used various means and strategies to achieve its program goals. The program also performed collaborative activities to help meet its goals.

The Department implemented the following means:

- Used educational incentives, including fellowships, scholarships, research funding, faculty support and private sector funding support from our Matching Grant program, which was aimed at increasing enrollments and graduates in nuclear engineering.
- Pursued programs that were geared towards increasing 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 implemented the following strategies:

- Worked to 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.
- Improved 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.
- Met periodically throughout the year with stakeholder organizations such as the Nuclear Engineering Department Heads Organization (NEDHO); the University Working Group; the Test, Research, and Training Reactor Management Group (TRTR); and other committees of professional organizations such as the American Nuclear Society to review program activities; discuss program issues; and solicit input, advice, and guidance.

Validation and Verification

All peer-reviewed university activities grantees are required to submit annual reports to DOE outlining the progress achieved. Once annual reports are submitted, they are logged in the NE database and reviewed by the NE Program Manager for compliance with the Program's stated goals and objectives. Nuclear Engineering Education Research (NEER) annual and final reports are posted to the NEER web page at http://neer.inel.gov/. These annual reports provide an opportunity to verify and validate performance. Also, quarterly, semi-annual, and annual reviews of financial reports consistent with program plans are held to ensure technical progress, cost and schedule adherence, and responsiveness to program requirements.

Program evaluations of Innovations in Nuclear Infrastructure and Education (INIE) grant activities are typically conducted twice a year. In addition, comprehensive reviews are held with each INIE consortium to go over performance and cost. Each consortium member has an opportunity to provide progress information and input into upcoming performance. Further, INIE awardees are required to submit annual progress reports to NE on activities conducted during the year. The report was revised in

FY 2005 to make the report more standardized. They are logged in the NE database and reviewed by the NE Program Manager for compliance with program goals.

NE conducts annual reviews of existing fellowship and scholarship recipients prior to renewing any awards.

All three-year radiochemistry grants are reviewed annually through site visits by the program manager.

Program Assessment Rating Tool (PART)

The Department has 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.

A PART was completed for the University Reactor Infrastructure and Education Assistance program during the FY 2007 budget formulation cycle. The assessment determined that enrollment target levels of the program have already been met and that students no longer need to be encouraged to enter into nuclear related disciplines. In addition, the number of universities offering nuclear-related programs also has increased. These trends reflect renewed interest in nuclear power. Students will continue to be drawn into this course of study and universities, along with nuclear industry societies and utilities, will continue to invest in university research reactors, students, and faculty members. Consequently, Federal assistance is no longer necessary, and the 2007 Budget proposed termination of this program. This termination was also supported by the fact that the program lacks adequate performance measures and was unable to demonstrate results from its activities when reviewed using the PART. The 2008 Budget includes $2.9 million to provide fresh reactor fuel to universities and to dispose of spent fuel from university reactors under Research Reactor Infrastructure, within Radiological Facilities Management.

Funding Schedule by Activity

	(dollars in thousands)		
	FY 2006	FY 2007	FY 2008
University Reactor Infrastructure and Education Assistance			
University Nuclear Infrastructure	14,100	0[a]	0[b]
DOE/Industry Matching Grants Program	1,000	0	0
Fellowships/Scholarships to Nuclear Science and Engineering Programs at Universities	2,350	0	0
Health Physics Fellowships & Scholarships	300	0	0
Nuclear Engineering Education Research (NEER) Grants	5,000	0	0
Nuclear Engineering Education Opportunities	600	0	0
Radiochemistry Awards	650	0	0
University Nuclear Education Infrastructure and Assistance	2,730	0	0
Total, University Reactor Infrastructure and Education Assistance	26,730	0	0

Detailed Justification

	(dollars in thousands)		
	FY 2006	FY 2007	FY 2008
University Nuclear Infrastructure	**14,100**	**0**[a]	**0**[a]

The UNI program provided fuel for the universities; instrumentation, electronics, hardware, and software upgrades for the research reactors; and reactor sharing and research support for educational institutions to facilitate the development of the Nation's next generation of nuclear scientists and engineers.

In FY 2006, the program awarded 20 grants permitting universities without research reactors to have access to reactors for training, educational, and research purposes.

In FY 2006, the program supported 19 universities to address maintenance and upgrades to equipment required at university research reactors; provided new equipment to replace antiquated equipment; maintained reactor systems; and upgraded experimental capabilities.

In FY 2006, Innovations in Nuclear Infrastructure and Education (INIE) grant initiative encompassed 38 universities aligned in six regional INIE consortia. The INIE grants assist universities in continuing the integration of academics and reactor research, which enhances the quality of student education, and encourages universities to better work with the Department's national laboratories, private industry and

[a] $2,947,000 for fuel is requested in the Radiological Facilities Management Budget under Research Reactor Infrastructure.

	FY 2006	FY 2007	FY 2008

(dollars in thousands)

other universities. Promoting this collaborative effort expands the use of university facilities for research, education, and training of nuclear engineers and scientists by establishing regional research and training centers and strategic partnerships.

No funding is requested for these activities in FY 2007 or FY 2008. Funding to provide fresh reactor fuel for universities is requested in the Radiological Facilities Management budget under Research Reactor Infrastructure.

	FY 2006	FY 2007	FY 2008
DOE/Industry Matching Grants Program	**1,000**	**0**	**0**

In FY 2006, the DOE/Industry Matching Grants program awarded grants to 24 universities for education, training, and innovative research. This program provided grants up to $60,000 that were matched by industry.

No funding is requested for this activity in FY 2007 or FY 2008.

	FY 2006	FY 2007	FY 2008
Fellowships/Scholarships to Nuclear Science and Engineering Programs at Universities	**2,350**	**0**	**0**

In FY 2006, a total of 21 fellowships and 76 scholarships were awarded to students enrolled in nuclear science and engineering at U.S. universities. Fellowships are provided to M.S. and Ph.D. students and scholarships to undergraduate students.

The University Partnership program encouraged students enrolled at minority-serving institutions to pursue a nuclear engineering degree in cooperation with universities that grant those degrees. In FY 2006, the Department funded eight university partnerships.

No funding is requested for this activity in FY 2007 or FY 2008.

	FY 2006	FY 2007	FY 2008
Health Physics Fellowships & Scholarships	**300**	**0**	**0**

In FY 2006, three fellowships were provided to graduate students enrolled in Health Physics programs at U.S. universities.

No funding is requested for this activity in FY 2007 or FY 2008.

	FY 2006	FY 2007	FY 2008
Nuclear Engineering Education Research (NEER) Grants	**5,000**	**0**	**0**

In FY 2006, awards were made under existing grants, but no new NEER grants were awarded. The NEER program provided grants allowing nuclear engineering faculty and students to conduct innovative research in nuclear engineering and related areas. No funding is requested for this activity in FY 2007 or FY 2008.

	(dollars in thousands)		
	FY 2006	FY 2007	FY 2008
Nuclear Engineering Education Opportunities	**600**	**0**	**0**

The teacher workshops program was conducted in conjunction with the American Nuclear Society, which used qualified volunteers from its membership to train teachers and students, keeping costs down. In FY 2006, the teacher workshops reached over five hundred teachers enabling them to teach nuclear science and engineering principles to their students.

In FY 2006, the program applied the model used in the Pittsburgh pilot to other programs across the country on a cost-share basis with regional sponsors.

No funding is requested for this activity in FY 2007 or FY 2008.

Radiochemistry Awards	**650**	**0**	**0**

The Department provided grants every three years to support faculty and graduate/post doctorate students in radiochemistry. In FY 2006, the program continued to fund three existing radiochemistry grants and began a new one.

No funding is requested for this activity in FY 2007 or FY 2008.

University Nuclear Education Infrastructure and Assistance	**2,730**	**0**	**0**

The Department provided funding to support collaboration of the Institute of Nuclear Science and Engineering at Idaho National Laboratories with local universities and colleges.

No funding is requested for this activity in FY 2007 or FY 2008.

Total, University Reactor Infrastructure and Education Assistance	**26,730**	**0**	**0**

Research and Development

Funding Profile by Subprogram

	(dollars in thousands)		
	FY 2006 Current Appropriation	FY 2007 Request	FY 2008 Request
Research and Development			
Nuclear Power 2010	65,340	54,031	114,000
Generation IV Nuclear Energy Systems Initiative	53,263	31,436	36,145
Nuclear Hydrogen Initiative	24,057	18,665	22,600
Advanced Fuel Cycle Initiative	78,408	243,000	395,000
Total, Research and Development	221,068	347,132	567,745

Public Law Authorizations:
P.L. 109-103, Energy and Water Development Appropriations Act, 2006
P.L. 109-148, Emergency Supplemental Appropriations to Address Hurricanes in the Gulf of Mexico and Pandemic Influenza, 2006

Mission

The mission of the Office of Nuclear Energy's (NE) Research and Development (R&D) program is to secure nuclear energy as a viable, long-term commercial energy option, providing diversity in the energy supply. In the short term, government and institutional barriers will be addressed to enable new plant deployment decisions by nuclear power plant owners and operators who wish to be among the first to license and build new nuclear facilities in the United States. In the longer term, new nuclear technologies that can compete with advanced fossil and renewable technologies will be developed, enabling power providers to select from a diverse group of generation options that are economical, reliable, safe, secure, and environmentally acceptable.

Benefits

The benefits of nuclear energy R&D to our society are numerous and increasingly important to the Nation's future. Nuclear energy provides promising solutions to the world's long-term energy challenges. Nuclear energy has the potential to generate electricity for our 21st century economy, to produce economical hydrogen for transportation use without emitting greenhouse gases, and to produce heat and clean water to support growing industry and populations worldwide. NE is a key participant in on-going integrated benefits assessment activities conducted for applied R&D programs in the Department. Analyses to measure the benefits of the NE R&D portfolio compared its programs' contributions to nuclear technologies against other electricity-generating and hydrogen-producing fossil and energy efficiency and renewable energy technologies. These analyses showed that the economic benefit of the NE R&D portfolio, in terms of energy system cost saving, potentially could total $45 billion per year by 2050, many times the cost of the government's cumulative investment. Moreover, the additional reduction in carbon-dioxide emissions from nuclear technologies influenced by NE R&D could be 246 million tonnes of carbon equivalents per year by 2050. These projected savings show that NE R&D plays a significant role in the Energy, Science, and Environment portfolio, which, taken together, is estimated to save $256 billion and 730 million tonnes of carbon equivalent per year. These results help substantiate the Department's applied R&D portfolio investments.

At the same time, nuclear energy presents challenges that must be met. Some of these challenges will be met through excellence in the use of nuclear power (e.g., nuclear safety). Many others, such as nuclear waste and economic issues, can only be achieved 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 this research is far beyond the reach of private industry, given its long-term, high-risk nature; thus, the role of government in establishing a long-term future for nuclear power is clear.

Strategic and GPRA Unit Program Goals

The Department's Strategic Plan identifies five Strategic Themes (one each for energy security, nuclear security, scientific discovery, environmental responsibility and management excellence), plus 16 Strategic Goals that tie to the Strategic Themes. The NE R&D program supports the following goals:

Strategic Theme 1, Energy Security
Strategic Goal 1.2, Environmental Impacts of Energy: Improve the quality of the environment by reducing greenhouse gas emissions and environmental impacts to land, water, and air from energy production and use.

The NE R&D program has one GPRA Unit Program goal which contributes to Strategic Goal 1.2 in the "goal cascade":

GPRA Unit Program Goal 1.2.14.00: Develop New Nuclear Generation Technologies - By 2015, enable industry to construct and operate new nuclear power plants, promoting safe, reliable and carbon-free energy production, through the standardization of Generation III+ plant designs, the successful demonstration of nuclear plant permitting and licensing processes, the advancement of Generation IV plant technologies, the construction of pilot-scale hydrogen production experiments, and the commencement of proliferation-resistant spent nuclear fuel recycling technology demonstration activities.

Contribution to GPRA Unit Program Goal 1.2.14.00 (Develop New Nuclear Generation Technologies)

The NE R&D program supports near-term technology development and demonstration activities that advance the goals of the National Energy Policy and Energy Policy Act of 2005 to enhance long-term U.S. energy independence and reliability and expand the contribution of nuclear power to the Nation's energy portfolio. The Nuclear Power 2010 program supports this program goal by identifying sites for new nuclear power plants, developing and bringing to market advanced standardized nuclear plant designs, evaluating the business case for building new nuclear power plants, and demonstrating untested regulatory processes leading to an industry decision in the next few years to seek NRC approval for building and operating new advanced light water reactor nuclear plants in the United States.

The Generation IV Nuclear Energy Systems Initiative supports this program goal through the development of innovative, next-generation reactor and fuel cycle technologies. The Generation IV program supports R&D that could help achieve the desired goals of sustainability, economics, and proliferation resistance. Further investigation of technical and economic challenges and risks will help inform a decision on whether or not to proceed with a demonstration of the Very-High-Temperature Reactor as the core technology for the Next Generation Nuclear Plant (NGNP). The NGNP is being developed for economical production of electricity, hydrogen gas and other desirable products derived from high quality heat. The Generation IV program is also investing in the development of sodium-cooled fast reactor technologies that can be operated in support of the Global Nuclear Energy Partnership (GNEP) to advance sustainability goals and reduce nuclear waste generation.

The Nuclear Hydrogen Initiative contributes to this program goal by researching, developing, and demonstrating economical hydrogen production technologies using high temperature heat from advanced nuclear energy systems. The initiative will develop hydrogen production technologies that are compatible with nuclear energy systems through scaled experiments.

The Advanced Fuel Cycle Initiative supports this program goal by developing enabling technologies to reduce high level waste volume and separate and transmute long-lived, highly radiotoxic elements. These activities directly support the vision and goals of GNEP. In addition to advanced fuel cycle R&D activities, the program will develop an Advanced Burner Reactor, which will be a Generation IV design (exceeding the standards of Generation III+ technologies) that will establish an engineering reference point for equivalent industry designed, constructed and operated nuclear plants. A nuclear fuel recycling center will employ state-of-the-art technologies to provide proliferation-resistant light water reactor (LWR) separations capability. Finally, the Advanced Fuel Cycle Facility will provide technology development capability to support fast reactor transmutation fuel design and development.

Funding by Strategic and GPRA Unit Program Goal

(dollars in thousands)

	FY 2006	FY 2007	FY 2008
Strategic Goal 1.2, Environmental Impacts of Energy			
GPRA Unit Program Goal 1.2.14.00, Develop New Nuclear Generation Technologies			
Nuclear Power 2010	65,340	54,031	114,000
Generation IV Nuclear Energy Systems Initiative	53,263	31,436	36,145
Nuclear Hydrogen Initiative	24,057	18,665	22,600
Advanced Fuel Cycle Initiative	78,408	243,000	395,000
Total, Strategic Goal 1.2 (Research and Development)	221,068	347,132	567,745

Annual Performance Results and Target

FY 2003 Results	FY 2004 Results	FY 2005 Results	FY 2006 Results	FY 2007 Targets	FY 2008 Targets
GPRA Unit Program Goal 1.2.14.00 (Develop New Nuclear Generation Technologies)					
Research and Development					
		Achieve cumulative variance of less than 10 percent from each of the cost and schedule baselines for the Advanced Fuel Cycle, Generaton IV Nuclear Energy Systems and Nuclear Hydrogen Initatives. (MET TARGET)	Maintain total administrative overhead costs in relation to total program costs of less than 8 percent. (Baseling for administrative overhead rate is currently being validated) (MET TARGET)	Maintain total administrative overhead costs in relation to total program costs of less than 8 percent.	Maintain total administrative overhead costs in relation to total program costs of less than 8 percent.
Nuclear Power 2010					
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 TARGET)	Select for award at least one cost-shared project with a power generating company-led team for activities required to demonstrate for the first time the combined Construction and Operating License (COL) process. (MET TARGET)	Issue project implementation plans for two Construction and Operating Licensing (COL) Demonstration Projects. (MET TARGET)	Complete engineering and licensing demonstration activities necessary to implement the NP 2010 program in accordance with the principles of project management, to help ensure that program performance goals are achieved on schedule and within budget. (MET TARGET)	Complete NP 2010 engineering and licensing activities, focusing on the resolution of reactor certification and design issues and the preparation and review of Construction and Operation License (COL) applications, to enable an industry decision in 2010 to build a new nuclear power plant.	Complete NP 2010 engineering and licensing activities, focusing on the resolution of reactor certification and design issues and the preparation and review of Construction and Operation License (COL) applications, to enable an industry decision in 2010 to build a new nuclear power plant.
Generation IV Nuclear Energy Systems Initiative					
Develop preliminary functional requirements for the Generation IV Very-High-Temperature Reactor. (MET TARGET)	Award one or more contracts for the Next Generation Nuclear Plant (NGNP) pre-conceptual design. (NOT MET)	Issue the final design documents for the fuel capsule, test train, fission product monitoring system, and control system for the fuel irradiation shakedown test (AGR-1). (MET TARGET)	Complete Generation IV research and development activities to inform a design selection for the next generation nuclear power plant by FY 2011. (MET TARGET)	Complete Generation IV research and development activities, focusing on fuels and materials testing and next generation nuclear power plant development, to inform a design competition for the next generation of nuclear power plant by FY 2011.	Complete Generation IV research and development activities, focusing on fuels and materials testing and next generation nuclear power plant development, to inform a design competition for the next generation of nuclear power plant by FY 2011.

FY 2003 Results	FY 2004 Results	FY 2005 Results	FY 2006 Results	FY 2007 Targets	FY 2008 Targets
Nuclear Hydrogen Initiative					
	Complete final designs for the baseline thermochemical and high-temperature electrolysis laboratory-scale experiments. (MET TARGET)	Issue conceptual design documents for the thermochemical and high-temperature electrolysis pilot scale experiments. (MET TARGET)	Complete development of key technologies and infrastructure requirements in preparation for the thermochemical and high-temperature electrolysis integrated laboratory-scale experiments. (MET TARGET)	Complete NHI research and development activities focused on thermochemical and high-temperature electrolysis (HTE) processes to support the Department's selection of a hydrogen production technology in 2011.	Complete NHI research and development activities focused on thermochemical and high-temperature electrolysis (HTE) processes to support the Department's selection of a hydrogen production technology in 2011.
Advanced Fuel Cycle Initiative					
Complete fabrication of test articles containing proliferation resistant transmutation fuels for irradiation in the ATR beginning in FY 2004. (MET TARGET)	Complete fabrication and irradiation of advanced light water reactor (LWR) proliferation-resistant transmutation fuel samples, and initiate post-irradiation examination of the samples. (MET TARGET)	Issue preliminary report on the post-irradiation examination (PIE) of actinide-bearing metal and nitride transmutation fuels in the Advanced Test Reactor (ATR). (MET TARGET)	Complete research and development activities that allow the AFCI program to support the Secretary of Energy's determination of the need for a second geologic repository for spent nuclear fuel by FY 2008. (MET TARGET)	Complete research and development activities, focused on advanced fuel separations technology development and demonstration, to support the Secretary of Energy's determination of the need for a second geologic repository for spent nuclear fuel by FY 2008.	Complete AFCF Conceptual Design and obtain Critical Decision (CD) 1, Approve Alternative Selection and Cost Range, in support of the mid-2008 Secretarial decision for GNEP.
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 TARGET)	Achieve variance of less than 10 percent from cost and schedule baselines for Advanced Fuel Cycle Initiative (AFCI) activities. (MET TARGET)	Conduct laboratory-scale test of group actinide separation process (plutonium, neptunium, americium and curium extracted together) with actual light water reactor (LWR) spent fuel and report preliminary results. (MET TARGET)			Complete two competing Separation Process Module conceptual design studies in support of the mid-2008 Secretarial decision for GNEP.
	Issue the report on the demonstration of a laboratory-scale separation of americium/curium from spent nuclear fuel to support the development of advanced fuel cycles for enhanced repository performance. (MET TARGET)				Complete ABR industry design studies and select the most promising reactor technology(s) to proceed into conceptual design.

Means and Strategies

The R&D program will use various means and strategies to achieve its GPRA Unit 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.

The Department will implement the following means:

- A joint government/industry cost-shared effort to identify sites for new nuclear power plants, develop advanced standardized Generation III+ nuclear plant designs, evaluate the business case for building new nuclear power plants, and demonstrate untested regulatory processes leading to an industry decision in the next few years to seek the NRC's approval to build and operate new advanced nuclear power plants in the United States.

- Hydrogen production technologies compatible with nuclear energy systems are being developed by the Nuclear Hydrogen Initiative. This program includes participation of the national laboratories, industry, and university research communities as well as international research partners. While these technologies are not sufficiently mature to require industry cost sharing at this time, cost sharing will be required for the final engineering-scale demonstration. The initiative will employ competitive selection processes for design, construction, and operation activities.

- Advanced, next-generation reactor systems that offer the most sustainable, cost-competitive, reliable, and secure means of generating electricity and hydrogen are being developed by the Generation IV Nuclear Energy Systems Initiative. The program includes participation by the national laboratories, industry, and university research communities as well as the international research community represented by the Generation IV International Forum. Industrial and international cost sharing will be pursued where practical during the R&D on these intermediate- and long-term reactor technologies.

- R&D on advanced, proliferation-resistant fuels and fuel cycle technologies that support current operating reactors, Generation III+ advanced light water reactors and Generation IV reactor concepts are being developed by the Advanced Fuel Cycle Initiative. These fuels and fuel cycle technologies aim to reduce civilian plutonium inventories in light water reactor spent fuel, and reduce volume and radiotoxicity of waste requiring geologic disposal. The program includes participation by the national laboratories, industry, and university research communities as well as the international research community. Industrial and international cost sharing will be pursued during the R&D on these intermediate- and long-term fuel cycle technologies.

- Collaborate with industry to define the most commercially viable designs and business models under which the AFCI technologies could be deployed, as well as provide industry representation on appropriate expert review panels and ultimately construct the AFCI facilities.

The Department will implement the following strategies:

- Partnering with the private sector, national laboratories, universities, and international partners to develop and deploy advanced nuclear technologies to increase the use of nuclear energy in the United States.

- Leading the international community in pursuit of advanced nuclear technology that will benefit the United States with enhanced safety, improved economics, and reduced production of wastes.

- Conducting international cost-shared R&D in the Generation IV Nuclear Energy Systems Initiative, Advanced Fuel Cycle Initiative, and Nuclear Hydrogen Initiative.

These strategies will result in the efficient and effective management of NE programs - thus putting the taxpayer's dollars to more productive use.

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

- Whether new nuclear plant technology is deployed depends to a large extent on power demand and economic and environmental factors beyond the scope of DOE R&D programs. In the near term, it depends on complex economic decisions made by industrial partners.

- Deployment of advanced fuel cycle technologies will depend upon policy decisions that will determine the implementation of advanced spent fuel reprocessing technologies (e.g. the Secretary of Energy's mid-2008 decision on GNEP).

- All nuclear energy research programs rely heavily on data produced through collaborations with foreign nations. Should vital data from foreign partners prove unavailable, an increased U.S. effort in technology development would be required.

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

- The Department and the NRC coordinate program planning to assure that their R&D activities are complimentary, cost effective, and not duplicative.

- 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 R&D of these next-generation nuclear energy systems.

- Participation in international experiments related to the development of advanced fuel cycle technologies is being performed in support of the objectives of the Advanced Fuel Cycle Initiative and Global Nuclear Energy Partnership.

- NE collaborates with other programs within the Department, such as the Office of Science and the Office of Energy Efficiency and Renewable Energy, on the President's Hydrogen Fuel Initiative.

- NE will collaborate with other programs within the Department, such as the Office of Science, the Office of Civilian Radioactive Waste Management, and the National Nuclear Security Administration, all of whom have roles supporting the Global Nuclear Energy Partnership.

Validation and Verification

To validate and verify program performance, NE conducts various internal and external reviews and audits. NE's programmatic activities are subject to periodic review by Congress, the Government Accountability Office, the Department's Inspector General, the NRC, 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 R&D programs—the Nuclear Power 2010 program, the Generation IV Nuclear Energy Systems Initiative, the Nuclear Hydrogen Initiative, and the Advanced Fuel Cycle Initiative. Periodic internal and external program reviews evaluate progress against established plans. These reviews provide an opportunity to verify and validate performance. Monthly, quarterly, semi-annual and annual reviews, consistent with program management plans and project baselines, are held to ensure technical progress, cost and schedule adherence, and responsiveness to program requirements.

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 NE. NERAC has several active subcommittees examining various aspects of nuclear technology R&D. Reports issued by these subcommittees that address the future of nuclear energy include: the "Long-Term Nuclear Technology Research and Development Plan", the "Nuclear Science and Technology Infrastructure Roadmap", "A Roadmap to Deploy New Nuclear Power Plants in the United States by 2010", "A Technology Roadmap for Generation IV Nuclear Energy Systems", "Report of the Subcommittee on Nuclear Laboratory Requirements", and "An Evaluation of the Proliferation Resistant Characteristics of Light Water Reactor Fuel with the Potential for Recycle in the United States".

In FY 2006, NE contracted with the National Academy of Sciences to conduct an extensive comprehensive, independent evaluation of R&D and Infrastructure program goals and plans, including the process for establishing program priorities and oversight. The evaluation will result in a comprehensive and detailed set of policy and research recommendations and associated priorities (including performance targets and metrics) for an integrated agenda of research activities within the scope of available resources that can best advance NE's fundamental mission of securing nuclear energy as a viable, long-term commercial energy option to provide diversity in energy supply. The results of this study, scheduled for completion by October 2007, will inform future budget submissions.

Program Assessment Rating Tool (PART)

The Department has 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. NE's R&D programs have incorporated feedback from OMB into the FY 2008 Budget Request, and have taken the necessary steps to continue to improve performance.

The results of the FY 2005 review are reflected as follows: For the Nuclear Power 2010 program, an overall PART score of 69 was achieved with a perfect 100 score for Section I, Program Purpose & Design. A score of 89 was achieved for Section II, Strategic Planning reflecting the need to improve the linkage between budget and performance data at the Departmental level. A score of 88 was achieved for Section III, Program Management reflecting the need to measure and achieve cost effectiveness in program execution. A score of 45 was achieved for Section IV, Program Results/Accountability, indicating that the program needs to establish on an annual basis an independent assessment of the overall program, evaluating the program's progress against established annual and long-term goals. In addition, OMB did recognize that the NP 2010 is a relatively new program with limited progress in achieving its long-term goals. This area was strengthened in early FY 2004 by the establishment of the new NERAC Subcommittee on Evaluations.

For the Generation IV Nuclear Energy Systems Initiative, an overall PART score of 79 was achieved with perfect scores of 100 for Section I, Program Purpose & Design, and Section III, Program Management. These scores reflect the continued effective management of the program. A score of 90 was achieved for Section II, Strategic Planning reflecting the need to improve the linkage between budget and performance data at the Departmental level. A score of 60 was achieved for Section IV, Program Results/Accountability, which reflects the strengthening of long-term performance goals for the program compared with the previous year's performance goals. The need for improvements in the conduct of independent evaluations was identified. This area was strengthened in early FY 2004 by the establishment of the new NERAC Subcommittee on Evaluations.

For the Advanced Fuel Cycle Initiative (AFCI), an overall PART score of 76 was achieved with top scores of 100 in Section I, Program Purpose & Design, and Section III, Program Management. These scores are attributable to the continued use of effective program management practices. A score of 90 was achieved for Section II, Strategic Planning reflecting the need to improve the linkage between budget and performance data at the Departmental level. A score of 53 was achieved for Section IV, Program Results/Accountability, indicating the need to better demonstrate the cost effectiveness of the program. To address these findings, the program revised its near and long-term goals, and is working to increase cost effectiveness by continuing to increase international cost-shared R&D costs through expanded collaborations.

In addition, the AFCI and Generation IV programs were found to rely upon process oriented, output based metrics that did not indicate whether the program is successful or demonstrating meaningful progress. These programs revised their performance measures in FY 2006 to capture progress made on the programs' core elements. By focusing on a future outcome, the measure allows for trending of annual progress toward a consistent objective.

In accordance with a follow-up action assigned as part of the FY 2006 assessment of the National Nuclear Infrastructure program, NE contracted with the National Academy of Sciences (NAS) to conduct an extensive comprehensive, independent evaluation of R&D and Infrastructure program goals and plans, including the process for establishing program priorities and oversight. The evaluation will result in a comprehensive and detailed set of policy and research recommendations and associated priorities (including performance targets and metrics) for an integrated agenda of research activities within the scope of available resources that can best advance NE's fundamental mission of securing nuclear energy as a viable, long-term commercial energy option to provide diversity in energy supply. The NAS expects to complete its evaluation by late 2007.

Nuclear Power 2010

Funding Schedule by Activity

	FY 2006	FY 2007	FY 2008
	(dollars in thousands)		
Nuclear Power 2010			
Cost-shared Program with Industry	65,340	52,276	113,000
Standby Support Program	0	1,755	1,000
Total, Nuclear Power 2010	65,340	54,031	114,000

Description

The Nuclear Power 2010 program supports near term technology development and regulatory demonstration activities that advance the National Energy Policy (NEP) goals of enhanced long-term United States (U.S.) energy independence and reliability and expanded contribution of nuclear power to the Nation's energy portfolio. Because nuclear energy is the only large-scale, non-greenhouse gas-emitting energy source that can be expanded to meet growing demand over the next twenty years, efforts taken with industry to increase the production of nuclear-generated electricity are vital to meeting the country's energy and environmental goals.

Nuclear Power 2010 is a joint government/industry cost-shared effort to identify sites for new nuclear power plants, develop and bring to market advanced standardized nuclear plant designs, demonstrate untested regulatory processes, and evaluate the business case for building new nuclear power plants. These efforts are designed to pave the way for industry decisions to build and operate new, advanced nuclear power plants in the U.S.

Benefits

The deployment of new nuclear plants supports the National Energy Policy and the Energy Policy Act of 2005 objectives for energy supply diversity and energy security. With about 20 percent of our Nation's current electricity production generated by nuclear power plants, it is important to deploy new baseload, nuclear generating capacity to maintain nuclear power's contribution to the national electricity production portfolio at 20 percent as the Nation's demand for electricity increases. Projections contained in the Energy Information Administration's "Annual Energy Outlook 2006" indicate that the U.S. will need to construct more than 345 gigawatts of new generating capacity by 2030 at a rate of between 8 and 12 gigawatts per year. To achieve the objective of new nuclear plant deployment, the technical, regulatory, and institutional barriers that currently exist must be addressed successfully and cooperatively by government and industry. More specifically, these obstacles include the uncertainties associated with new nuclear plant designs, the Federal regulatory and licensing processes, and the business risks resulting from these uncertainties. The Nuclear Power 2010 program was designed to address these obstacles through partnership with industry. Benefits derived from the Nuclear Power 2010 program are assessed annually as part of the overall analysis of the prospective benefits of the Nuclear Energy Research and Development Portfolio conducted by Brookhaven National Laboratories.

The technology focus of the Nuclear Power 2010 program is on Generation III+ advanced, light water reactor designs, which offer advancements in safety and economics over the Generation III designs certified in the 1990s by the Nuclear Regulatory Commission (NRC). To reduce the regulatory uncertainties and enable the deployment of new Generation III+ nuclear power plants in the U.S., it is essential to demonstrate the untested Federal regulatory processes for the siting, construction, and operation of new nuclear plants. In addition, design finalization of two standard plant designs and NRC certification of these near-term Generation III+ advanced reactor concepts are needed to reduce the high initial capital costs of the first new plants so that these new technologies can be competitive in the deregulated electricity market and deployable within the next decade.

The FY 2008 budget request continues the licensing demonstration activities started in previous years. Activities include completion of the last Early Site Permit demonstration projects and continuation of the New Nuclear Plant Licensing Demonstration projects that will exercise the untested licensing process to build and operate a new nuclear plant and complete and obtain certification of two advanced Generation III+ advanced reactor designs. Engineering activities in support of the submission of two combined Construction and Operating License (COL) applications to NRC will continue. In addition, the two reactor vendors will continue first of a kind design activities for two standard nuclear plants, the AP1000 and the Economic Simplified Boiling Water Reactor (ESBWR), with a focus on the engineering and design necessary to initiate procurement of long lead equipment (e.g. reactor vessel), and to develop firm project construction cost and schedule estimates needed by the utilities to request cost recovery through their Public Utility Commissions and begin loan discussions with financial institutions.

The project teams, Dominion Energy and NuStart Energy Development LLC. (NuStart) involved in these licensing demonstration projects represent power generation companies and reactor vendors that operate more than two-thirds of all the U.S. nuclear power plants in operation today. As a result of the Nuclear Power 2010 program and Energy Policy Act of 2005 financial incentives, twelve power companies have announced their intention to apply for combined construction and operating licenses. Several have specifically stated that they are building on work being done in the Nuclear Power 2010 program as the basis for their applications.

Title VI, Section 638, “Standby Support for Certain Nuclear Plant Delays,” of the Energy Policy Act of 2005 authorizes the Secretary to pay covered costs to project sponsors if full power operation of an advanced nuclear facility is delayed by regulatory or litigation occurrences as defined in the final rule for Standby Support. Standby Support is a form of insurance protection from delay in nuclear plant operation beyond the control of the power company owner. The Secretary is permitted to enter into contracts covering a total of six reactors to insure against certain delays. Prior to entering into contracts, the Secretary must deposit funds into accounts sufficient to pay covered costs of delays under the Standby Support regulations. The Department anticipates that sponsors will submit applications for standby support contracts as soon as FY 2008. When received, the Department will review these applications and enter into conditional agreements with sponsors in advance of executing standby support contracts at the start of construction. This risk insurance provides an additional incentive when the nuclear power industry decides in the next few years to proceed with new plant construction by reducing their financial risk.

Detailed Justification

	(dollars in thousands)		
	FY 2006	FY 2007	FY 2008
Cost-shared Program with Industry	**65,340**	**52,276**	**113,000**

To demonstrate the untested regulatory process for obtaining NRC approval for siting new nuclear power plants, the Department established competitively selected, cost-shared cooperative agreements in FY 2002 with three nuclear power generating companies to obtain Early Site Permits (ESP) for three commercial sites. Currently, the three ESP applications are in various stages of review by NRC staff and the NRC's Advisory Committee on Reactor Safety (ACRS). The Atomic Safety and Licensing Board (ASLB) hearings for the three ESPs are being held in FY 2007 and are expected to be followed by NRC decisions on the three ESP applications in FY 2007 and early FY 2008.

To demonstrate the untested regulatory process for obtaining NRC approval for constructing and operating a new nuclear power plant, the Department established competitively selected, cost-shared cooperative agreements in FY 2005 with industry to obtain combined Construction and Operating Licenses (COLs) and to complete design certification and completion of state-of-the-art Generation III+ standard nuclear plant designs for Westinghouse's Advanced Passive Pressurized Water Reactor, the AP 1000, and General Electric's Economic Simplified Boiling Water Reactor, the ESBWR. The Department selected two power company-led consortia to obtain two NRC licenses to construct and operate new nuclear power plants. The licensing and engineering activities necessary to complete the first COL application began in FY 2006 and are planned for completion in FY 2007 followed by an independent quality review prior to application submission to the NRC early in FY 2008. In FY 2008, the COL project teams will be interfacing with the NRC staff resolving COL application questions arising from the NRC staff review. Reactor vendor activities will focus on completion of the AP 1000 and ESBWR standard nuclear plant designs. In addition, General Electric will be interfacing with the NRC to obtain the Final Design Approval for the ESBWR in FY 2008.

In FY 2006, the Department:

- Continued activities under Early Site Permits demonstration projects focused on completing Safety Evaluation Reports, Environmental Impact Statements, and preparation for the ASLB hearings for the three ESPs.
- Continued the industry cost-shared project to develop generic COL application preparation and submittal guidance and to resolve generic COL regulatory issues. Completed resolution of NRC comments on the COL application preparation guidance document.
- Continued the New Nuclear Plant Licensing Demonstration Projects. Specifically:
  - Baseline budgets and schedules were established based on detailed work breakdown structures for the entire project leading up to the receipt of approved COLs and power company decisions to build.
  - Westinghouse AP1000 design was certified by the NRC and General Electric responded to NRC inquiries on the ESBWR design certification application.
  - Continued preparation of the first-ever COL applications under the new licensing process.

- Continued engineering and design activities to support COL application preparation and design finalization including unresolved open items from the design certification.

In FY 2007, the Department is:

- Continuing support of industry on the ESP demonstration projects to complete the ASLB hearings and issuance of at least two Early Site Permits by the NRC. These will be the first NRC-approved sites available for building new nuclear power plants in over 25 years.
- Continuing the New Nuclear Plant Licensing Demonstration Projects. Specifically:
  - Preparation of the Dominion and the NuStart COL applications continues including pre-application licensing interactions with the NRC. Initial draft applications will undergo an industry peer review process prior to submittal to the NRC.
  - Open items in the ESBWR design certification draft safety evaluation report are being resolved.
  - The first-of-a-kind engineering required to prepare COL applications for the ESBWR and AP 1000 reactor designs and close all design certification COL action items are being completed.
  - Design finalization activities are being continued for the ESBWR and AP 1000 standardized designs. This includes the engineering analyses and calculations, design criteria documents, and design technical information necessary for an industry purchase of a new nuclear plant.

In FY 2008, the Department, in conjunction with partners NuStart, Dominion, Westinghouse, and General Electric will:

- Continue support of the remaining industry ESP demonstration projects for issuance of the last Early Site Permit by the NRC.
- Continue the New Nuclear Plant Licensing Demonstration Projects. Specifically:
  - COL applications, including resolution of industry peer review comments, will be completed with submission of the Dominion and NuStart COL applications to the NRC in FY2008.
  - Interactions with NRC will begin through initial questions on the COL applications and will include NRC Requests for Additional Information (RAIs).
  - First-of-a-kind design finalization activities for the standardized AP1000 and ESBWR designs will continue and will include preparation of the engineering analyses and calculations, design criteria documents, and design technical information and total cost and schedule necessary for an industry purchase of a new nuclear plant.
  - Open items related to the ESBWR will be resolved to allow the NRC to issue the Final Design Approval and initiate the design certification rulemaking.

	(dollars in thousands)		
	FY 2006	FY 2007	FY 2008
Standby Support Program	**0**	**1,755**	**1,000**

The Energy Policy Act of 2005 authorizes the Secretary to create standby support contracts for six new advanced nuclear reactors.

In FY 2006, the Department:

- Issued a final rulemaking in August 2006, in accordance with the requirements of the Energy Policy Act of 2005, regulating these contracts.

In FY 2007, the Department will:

- Develop the process and criteria under which the Department would accept and approve applications for agreements between the Department and project sponsors that will convert to standby support contracts once plant construction has commenced. The Department will contract with subject matter experts to assist in the development of the criteria and financial guidance.

In FY 2008, the Department will:

- Receive and evaluate applications for standby support contracts from sponsors of new nuclear power plants using financial and technical subject matter experts.

Total, Nuclear Power 2010	**65,340**	**54,031**	**114,000**

Explanation of Funding Changes

	FY 2008 vs. FY 2007 ($000)
Cost-shared Program with Industry The increase is needed to maintain the overall NP2010 schedule to continue the reactor designs and implement licensing interactions with the NRC to support utility decisions by FY 2010 to build new nuclear plants. The increase is needed to maintain the overall NP 2010 schedule to finalize reactor designs and support licensing interactions with NRC, with the goal of enabling a utility decision by FY 2010 to build new nuclear plants. Funds support the expansion of licensing activities focused on design and engineering activities, including increased interactions between NRC and the power companies and reactor vendors to resolve outstanding issues. Funds also support the completion of first-of-a-kind engineering activities, including nuclear plant construction cost and schedule estimates. These estimates are required by the power companies for submission to their public utility commissions in early FY 2009 as a precursor to a utility decision to build a new nuclear plant.	+60,724

	FY 2008 vs. FY 2007 ($000)
Standby Support Program The decrease is due to the reduction of program activities resulting from the transition from rule and implementation process development in FY 2007 to the receipt and evaluation of applications for standby support.	-755
Total Funding Change, Nuclear Power 2010	**+59,969**

Generation IV Nuclear Energy Systems Initiative

Funding Schedule by Activity

	FY 2006	FY 2007	FY 2008
	(dollars in thousands)		
Generation IV Nuclear Energy Systems Initiative			
Generation IV R&D	10,243	6,139	5,553
Next Generation Nuclear Plant R&D	40,000	23,436	30,000
International Nuclear Energy Research Initiative (I-NERI)	3,020	1,000	0
SBIR/STTR	0	861	592
Total, Generation IV Nuclear Energy Systems Initiative	53,263	31,436	36,145

Description

Both the President's National Energy Policy and the Energy Policy Act of 2005 (EPAct) recognize the potential for nuclear energy to help meet our nation's growing need for safe, reliable, and environmentally responsible energy supply. The goal of the Generation IV Nuclear Energy Systems Initiative (Gen IV) is to address the fundamental research and development (R&D) issues necessary to establish the viability of next-generation nuclear energy system concepts. Successfully addressing the fundamental R&D issues of Generation IV system concepts that excel in safety, sustainability, cost-effectiveness, and proliferation-resistance will allow these advanced systems to be considered for future commercial development and deployment by the private sector. Specific international benchmarking methodologies are being developed to enable the critical evaluation of each Generation IV systems' relative merits. This includes the development of an economics evaluation and modeling of proliferation resistance and physical protection.

In consideration of national priorities established in EPAct, the President's Hydrogen and Advanced Energy Initiatives, and the DOE Strategic Plan, Gen IV program is focused on developing sodium-cooled fast reactor technologies that may be used to close the nuclear fuel cycle in the Global Nuclear Energy Partnership (GNEP) and very-high temperature reactor technologies for use in the Next Generation Nuclear Plant (NGNP) to produce hydrogen and other energy products. The Department will continue to monitor the international development of other Generation IV systems and participate where possible in collaborative research activities that may be advantageous to the United States.

Benefits

The Department's strategic plan lays the groundwork of the ambitious, long-term vision of a zero-emission future, free of the reliance on imported energy. Gen IV is a vital component of this vision and contributes to a portfolio of nuclear programs to provide for near-term (NP 2010), medium-term (GNEP), and long-term (Gen IV) sustained advances in nuclear technology. R&D conducted under the Gen IV program has direct application and benefits for both the NP 2010 and GNEP programs in the areas of nuclear regulation and licensing by pioneering the use of risk-informed licensing to supplement prescriptive criteria; instrumentation and controls by developing advanced systems to accurately measure system operating parameters for use in multiple reactor types; and fast-reactor design and development that will be useful in the near term deployment of transmutation reactors needed by GNEP. For the long term, the Gen IV will develop new nuclear energy systems that can compete with advanced fossil and renewable technologies, enabling power providers to select from a diverse group of options that are economical, reliable, safe, secure, and environmentally acceptable. In addition, the NGNP reactor concept will be capable of providing high-temperature process heat for various industrial applications, including the production of hydrogen in support of the President's Advanced Energy Initiative.

Gen IV nuclear energy systems are being developed to use high-burnup fuel, transmutation fuel, and recycled fuel. Such fuel cycle strategies allow for more efficient utilization of domestic uranium resources and minimization of waste generation. Proliferation resistance and physical protection improvements are being designed into Gen IV nuclear energy systems to help thwart those who would target nuclear power plants for terrorist acts or use them improperly to develop nuclear weapons materials. Gen IV plants will feature advances in safety—with a goal of eliminating the possibility of accidental radiological releases beyond the plant boundary—to improve public confidence in the safety of nuclear energy while providing enhanced investment protection for plant owners. Competitive life-cycle costs and acceptable financial risk are being factored into Gen IV designs with high-efficiency electricity generation systems, modular construction, and shortened development schedules before plant startup.

The FY 2008 budget request maintains critical R&D that will help achieve the desired goals of sustainability, economics, and proliferation resistance. Further investigation of technical and economical challenges and risks is needed before a decision can be made to proceed with a demonstration of a next-generation reactor. Key to the strategy for conducting all Gen IV R&D is the multiplication effect on investment derived from international collaboration. By coordinating U.S. efforts with those of the Generation IV International Forum (GIF) partner nations, our funding is leveraged by a factor of two to ten depending on the reactor concept involved.

Detailed Justification

	(dollars in thousands)		
	FY 2006	FY 2007	FY 2008
Generation IV R&D	**10,243**	**6,139**	**5,553**

The Gen IV R&D activity focuses on long-term technology advances to further improve the safety performance and lower production costs of Gen IV reactor systems. Gen IV R&D activities are performed in a parallel and coordinated fashion with the R&D conducted in support of medium-term projects involving the development of sodium-cooled fast reactor (SRF) technology to support a closed fuel cycle (as part of GNEP), and the development of very high temperature reactor (VHTR) technology to support the production of hydrogen and alternative energy products (as part of the NGNP). These medium-term projects will utilize updated technology currently in use and will not rely on long-term Gen IV technology developments. The Gen IV R&D program is focused on the long-term support for SFR, VHTR, and GIF activities.

The U.S. will continue to collaborate with the international community via GIF and bilateral agreements pioneered under the International Nuclear Energy Research Initiative (I-NERI) to support developments in the SFR and the VHTR. Gen IV R&D activities will be conducted, in part, through the Nuclear Energy Research Initiative (NERI) in which the United States' university research community is engaged as a partner. Competitive solicitations for NERI research grants will focus on Gen IV R&D and other research programs. Funding for these research projects are included in the respective program areas that benefit from the research. NERI will continue to be executed using independent peer reviews which are critical to ensuring the pursuit of leading edge technologies. In addition, beginning in FY 2008, Gen IV may sponsor a limited number of fellowships for students in relevant fields of study.

Below is a discussion of the VHTR and SFR R&D activities. The application of VHTR technology for the NGNP is also discussed below. The application of SFR technology in GNEP is discussed in the Advanced Fuel Cycle Initiative budget request.

Very-High-Temperature Reactor: The VHTR system features a helium-cooled reactor with excellent passive safety features. The VHTR uses a coated-particle fuel form that can withstand extreme temperatures (up to about 1600C) while maintaining its fission product inventory. This makes the VHTR uniquely capable of delivering high-temperature heat (up to 1000C) to industrial processes, including innovative efficient hydrogen production processes. A number of GIF partner countries are cooperating with the United States in the accelerated design and construction of a prototype reactor. The GIF System Arrangement for the VHTR was signed in November 2006 by Canada, Euratom, France, Japan, Korea, Switzerland, and the United States. The first second-tier implementing arrangement, the VHTR Project Arrangement for Materials, will be signed in FY 2007.

In FY 2006, VHTR R&D activities focused on:

- Co-chairing the GIF VHTR Steering Committee and preparing joint GIF R&D Plans. Participating in the GIF System Arrangement and Project Arrangement negotiations for VHTR.
- Selecting materials and conducting test irradiations.

In FY 2007, VHTR R&D activities are focused on:

- Co-chairing the GIF VHTR Steering Committee and implementing the requirements of the VHTR System Arrangement.
- Participating in GIF VHTR Projects for Design, Safety, and Integration; Computational Methods and Benchmarks; Materials; and Fuel and Fuel Cycle and implementing the requirements of the VHTR Project Arrangements.
- Continuing materials selection activities and test irradiations.
- Initiating studies on the management of VHTR spent particle-fuel in collaboration with GNEP.
- Collaborating with Japan on zirconium-carbide fuel particle coatings.

In FY 2008, VHTR R&D activities will focus on:

- Co-chairing the GIF VHTR Steering Committee.
- Participating in GIF VHTR Projects.
- Continuing materials development activities and test irradiations.
- Continuing studies on the management of VHTR spent particle-fuel in collaboration with GNEP.
- Continue collaborations with Japan on zirconium-carbide fuel particle coatings.

Sodium-Cooled Fast Reactor: The SFR system features a fast-spectrum reactor with spent fuel recycling. The primary mission for the SFR is the management of high-level wastes and, in particular, management of plutonium and other actinides. The U.S. participates in SFR with the objective of developing a medium-sized (~600 MWe) SFR with the flexibility to consume transuranic actinides (TRUs). The primary system operates at essentially atmospheric pressure. A secondary sodium system acts as a buffer between the radioactive sodium in the primary system and the energy conversion system in the power plant. A number of GIF partner countries are cooperating with the United States in the accelerated design and construction of a prototype reactor. The GIF System Arrangement for the SFR was signed in February 2006 by France, Japan, Korea, and the United States; Euratom acceded in November 2006. The first second-tier implementing arrangement, the SFR Project Arrangement for Advanced Fuels, will be signed in early FY 2007. The R&D in support of the design of the demonstration SFR will be shared between the GNEP and Gen IV.

In FY 2006, SFR R&D activities focused on:

- Co-chairing the GIF SFR Steering Committee and preparing joint GIF R&D Plans for the SFR.
- Participating in the GIF System Arrangement and Project Arrangement negotiations for SFR.
- Selecting materials and conducting test irradiations, in collaboration with France, under the materials crosscut activities.
- Advanced turbo-machinery concept studies using supercritical carbon dioxide as the working fluid.

In FY 2007, SFR R&D activities are focused on:

- Co-chairing the GIF SFR Steering Committee and implementing the requirements of the SFR System Arrangement.
- Participating in GIF SFR Projects for Advanced Fuels, Design and Safety, Component Design and Balance of Plant (BOP), and Global Actinide Cycle International Demonstration and implementing the requirements of the SFR Project Arrangements.
- Continuing materials selection activities and test irradiations in collaboration with France under their FUTURIX SMI program.
- Designing of a small turbine and compressor, using supercritical carbon dioxide as the working fluid, scaled to explore the major viability issues of this concept.

In FY 2008, SFR R&D activities will focus on:

- Co-chairing the GIF SFR Steering Committee.
- Participating in GIF SFR Projects for Advanced Fuels, Design and Safety, Component Design and BOP, and Global Actinide Cycle International Demonstration.
- Continuing materials selection activities and test irradiations in collaboration with France under their FUTURIX SMI program.

Continuing the design and starting construction of a small turbine and compressor, using supercritical carbon dioxide as the working fluid, scaled to explore the major viability issues of this concept.

As discussed above, Gen IV is focused on developing the SFR and VHTR reactor technologies that support GNEP and NGNP, respectively. The program will continue to monitor international R&D activities on the Lead-Cooled Fast Reactor, Gas-Cooled Fast Reactor, and Supercritical-Water-Cooled Reactor, and collaborate with GIF partner nations in areas that may be advantageous to the United States. These reactor technologies are discussed below.

Lead-Cooled Fast Reactor: The Lead-Cooled Fast Reactor (LFR) concept is a lead (Pb) or lead-bismuth-eutectic (LBE) 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 LBE coolant to achieve high core outlet temperatures, which will allow realization of high system efficiency. Efficiency improvements with either lead or LBE might be obtained through the use of an innovative energy conversion system with supercritical carbon-dioxide as the working fluid referred to under SFR. The reactor will accommodate a closed fuel cycle while ensuring substantial proliferation resistance by limiting access to fuel and associated fuel handling infrastructure. GIF partner countries including EURATOM, Japan, Switzerland, and Korea have expressed interest in exploring this concept in cooperation with the United States.

In FY 2006, LFR R&D focused on:

- Tested and analyzed LFR materials with the objective of selecting key structural materials and cladding for lead-bismuth compatibility. LFR materials R&D are closely coordinated with the Office of Science to leverage and accelerate the understanding of materials corrosion, particularly in the area of irradiation testing.
- Completed the preliminary concept design of the LFR reactor and associated systems. This includes analyses to ensure that the systems meet design objectives of 15-30 year core refueling intervals for enhanced proliferation resistance, natural circulation, and other passive safety features and autonomous load-following.

In FY 2007, LFR activities are focused on:

- Monitoring international R&D, participation in GIF LFR forums, and completion of bilateral collaboration projects with Euratom and Korea.

In FY 2008, LFR activities will focus on:

- Monitoring international R&D and participation in GIF LFR forums.

Gas-Cooled Fast Reactor: The Gas-Cooled Fast Reactor (GFR) system features a fast-spectrum, helium-cooled reactor and closed fuel cycle as the reference concept. The GFR uses a direct-cycle helium turbine for highly efficient electricity production. An alternate GFR concept, which uses supercritical carbon dioxide as the coolant, may offer similar high efficiency while maintaining lower coolant temperatures. The GFR's fast neutron spectrum makes it possible to utilize available fissile and fertile materials (including depleted uranium from enrichment plants) several orders of magnitude more efficiently than thermal-spectrum gas reactors with once-through fuel cycles. Furthermore, through the combination of a fast neutron spectrum and full recycle of actinides, GFRs minimize the production of long-lived radioactive waste isotopes and can be designed for management of minor-actinides in spent fuel. Interest for the GFR is high in GIF member countries EURATOM, France, Japan, Korea, South Africa, and the U.K.

In FY 2006, GFR R&D focused on:

- Fabrication and characterization of structural material test samples and irradiation testing under the FUTURIX SMI collaboration.
- Initiation of thermal-hydraulic experiments using the Matched-Index-Refraction flow test system developed by the Idaho National Laboratory (INL).
- Continuation of preliminary concept design of the core and safety systems based on the optimized safety systems studies completed in FY 2005.

In FY 2007, GFR activities are focused on:

- Monitoring international R&D and participation in GIF GFR forums.

In FY 2008, GFR activities will focus on:

- Monitoring international R&D and participation in GIF GFR forums.

Supercritical-Water-Cooled Reactor: The Supercritical-Water-Cooled Reactor (SCWR) concept is a high-temperature, high-pressure water-cooled reactor that operates above the thermodynamic critical point of water. The system may have a thermal or fast neutron spectrum depending upon the core design. The 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 of core thermal power, elimination of discontinuous heat transfer regimes within the core, and the elimination of steam dryers, steam separators, re-circulation pumps, as well as steam generators. Therefore, the SCWR will be a simpler plant with fewer major components and better economics. There is strong international interest in the SCWR within the GIF from Canada, EURATOM, Japan, and Korea.

In FY 2006, SCWR R&D focused on:

- Design and execution of laboratory-scale, multi-sample, stress-corrosion cracking, supercritical-water loop experiments for investigating candidate materials.

(dollars in thousands)

In FY 2007, SCWR activities are focused on:

- Monitoring international R&D and participating in GIF SCWR forums.

In FY 2008, SCWR activities will focus on:

- Monitoring international R&D and participating in GIF SCWR forums.

In the past, crosscutting research activities, were conducted where results will have applicability to two or more of the Gen IV concepts.

In FY 2006, crosscutting research activities focused on:

- Design and Evaluation – modified and validated computer models for the use in design and safety analyses; development and verification of the methodology for evaluating the economics of hydrogen production with Gen IV systems; development and testing of the methodology for evaluating proliferation resistance and physical protection; and ongoing U.S. participation in GIF activities.
- Materials - continued mechanical scoping tests of high-temperature materials; initiation of the development of the rules for the use of low-temperature design criteria for reactor pressure vessels in limited high-temperature service; initiation of creep-fatigue tests and the development of creep-fatigue damage models for modified 9Cr-1Mo steel and Alloy 617; and completion of the design of a web-based materials database for use by researchers, vendors, and regulatory authorities.
- Energy Conversion – completed a system and turbo-machinery design study for a 300 megawatt-electric supercritical-carbondioxide commercial cycle; and initiated the design of a scaled supercritical-carbondioxide demonstration experiment.

In FY 2007, the following crosscutting research activities are focused on:

- Design and Evaluation – no crosscutting activities are funded in FY 2007.
- Materials – complete initial scoping irradiation of candidate high-temperature metallic internals. Continue initial population of Generation IV Materials Handbook with historical data and new data developed in the Gen IV Program.
- Energy Conversion - no crosscutting activities are funded in FY 2007.

In FY 2008, there are no crosscutting activities planned as research germane to the SFR will be funded independent of VHTR and NGNP research.

	FY 2006	FY 2007	FY 2008
Next Generation Nuclear Plant R&D	**40,000**	**23,436**	**30,000**

The NGNP will utilize a Gen IV VHTR configured for process heat production for the generation of hydrogen, electricity, and other industrial commodities. The Energy Policy Act of 2005 (EPAct) authorized the Department to create a two phased NGNP Project at INL. The Department is presently engaged in Phase 1 of the EPAct defined scope of work which includes: developing a licensing strategy, selecting and validating the appropriate hydrogen production technology, conducting enabling R&D for the reactor system, determining whether it is appropriate to combine electricity generation and hydrogen production in a single prototype nuclear reactor and plant, and establishing key design parameters. Phase I will continue until 2011, at which time the Department will evaluate the need for continuing into the design and construction activities called for the Phase II. Periodic external reviews will be conducted by the Nuclear Energy Research Advisory Committee (NERAC); the outcomes of these reviews will be captured in reports to the Department and to Congress. INL serves as the project integrator for NGNP.

The Department plans to work closely with both the international community and the U.S. private sector to continue further R&D on the NGNP. The Department is engaging the international community via GIF and bilateral agreements pioneered under I-NERI. The Department is optimistic about potential collaborations with countries such as Canada, France, Japan, the Republic of South Africa, Switzerland, the Republic of Korea, and the European Union. We are working with the U.S. private sector to establish industrial requirements, produce design information for the NGNP, and explore potential public-private partnerships to advance the project.

The Department's NGNP R&D program is focused on critical path needs that will enable a 2011 decision on the future of the project. Key issues are the availability of a licensable fuel form for the reactor, high temperature metals for use in the heat exchanger between the reactor and the hydrogen production plant, and nuclear grade graphites qualification.

The Department initiated pre-conceptual design work for the NGNP with industry in FY 2006. The industry driven design(s) will be completed in FY 2007 and will include descriptions of the reactor, hydrogen production and electricity generation systems, the integrated plant layout, details on design selection rationale, cost and schedule forecasts, and R&D needs for producing a demonstration reactor.

NGNP R&D activities will be conducted in part through the NERI which engages the United States' university research community is engaged as a partner. Competitive solicitations for NERI research will include key research components for the NGNP. NERI will continue to be executed using independent peer reviews critical to ensuring the pursuit of leading edge technologies. In addition, beginning in FY 2008, the Generation IV Nuclear Energy Systems Initiative may sponsor a limited number of fellowships for students in relevant fields of study.

In order to prepare for the 2011 Phase I decision to determine whether to proceed on to design and construction activities called for in Phase II, the program is conducting activities related to licensing, pre-conceptual design, and fuel development. These specific activities for FY 2006-2008 are discussed below.

In FY 2006, the Department:

- Initiated, in accordance with EPACT, a collaborative effort with the U.S. Nuclear Regulatory Commission (NRC) to develop a licensing strategy for the NGNP.
- Engaged with industry to help guide our R&D investments, including the production of pre-conceptual design information for the NGNP.

- Engaged with industry to develop a Business Plan for collaboration on the NGNP.
- Prepared for the Advanced Test Reactor (ATR) irradiation of the first fuel specimens in the state-of-the-art, multi-cell capsule and test train to provide shakedown test information for NGNP type fuel.
- Continued the support of industry code committees in qualifying high-temperature materials and analytical methods.
- Completed preliminary high-flux irradiations, initiated post-irradiation examination of potential metallic alloys for reactor internals, and initiated mechanical testing of candidate materials in the VHTR coolant environment.
- Purchased pre-production lots of candidate graphite materials and supported specification standards development for VHTR graphite with the American Society for Testing and Materials (ASTM).
- Developed models to predict the behavior of candidate VHTR pressure boundary materials and very-high-temperature component materials under expected operating conditions.
- Investigated the use of liquid salt as a coolant in a VHTR.

In FY 2007, the Department is:

- Completing the pre-conceptual design studies for the NGNP that define NGNP plant layout, key design parameters and additional R&D needs.
- Completing collaborations with industry in developing a Business Plan for the NGNP, including the identification of potential partners and partnership mechanisms.
- Conducting a study to identify the fueling options for the NGNP, including foreign and domestic manufacturer readiness and their ability to obtain a NRC manufacturing license.
- Commencing irradiation of the first fuel test supporting the NGNP in ATR at INL.
- Fabricating the graphite-creep irradiation test capsule for later insertion in the ATR at INL.
- Continuing the support of industry code committees in qualifying high-temperature materials and analytical methods.
- Continuing the development of the NGNP Licensing Strategy with the NRC in accordance with EPACT.
- Initiating the planning and design of the post-irradiation fuel examination tests and associated post-irradiation fuel examination facility modifications.
- Leading GIF collaborations on very high temperature reactor development including fuels, materials, and codes and methods.

In FY 2008, the Department will:

- Complete the joint development of the NGNP Licensing Strategy with the NRC and submit the strategy to Congress as required by EPACT.
- Continue the irradiation of the first NGNP fuel tests in the ATR.
- Incorporate the findings from the fuel trade study conducted in FY 2007 into the NGNP fuels research plan.
- Complete required design studies and planning for modifications on the irradiation test capsule for the next fuel test supporting the NGNP in the ATR at INL.

	(dollars in thousands)		
	FY 2006	FY 2007	FY 2008

- Continue the support of industry code committees in qualifying high-temperature materials and analytical methods.
- Lead GIF collaborations on very high temperature reactor development including fuels, materials, and codes and methods.

International Nuclear Energy Research Initiative (I-NERI)	**3,020**	**1,000**	**0**

The Generation IV Technology Roadmap identifies near-term reactor concepts being investigated by the international research community that have relevancy to U.S. technology needs. These International Near-Term Deployment (INTD) concepts identified by Nuclear Energy Research Advisory Council and GIF allow the U.S. to engage the international community in bi-lateral fashion beyond the six Gen IV concepts. 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 I-NERI agreements with France, the Republic of Korea, Organization for Economic Co-operation and Development Nuclear Energy Agency, the European Union, Canada, Brazil, and Japan. Negotiations to establish new agreements are underway with the Republic of South Africa and the United Kingdom.

In FY 2006, the Department used the requested funding to initiate new INTD R&D projects under the bilateral agreements with GIF member countries.

In FY 2007, the Department is using the requested funding to complete INTD R&D projects initiated in FY 2005.

In FY 2008, no funds are requested.

SBIR/STTR	**0**	**861**	**592**

The FY 2007 and FY 2008 amounts shown are estimated requirements for the continuation of the SBIR and STTR program.

Total, Generation IV Nuclear Energy Systems Initiative	**53,263**	**31,436**	**36,145**

Explanation of Funding Changes

	FY 2008 vs. FY 2007 ($000)
Generation IV R&D The decrease reflects the priority given the VHTR and NGNP while maintaining sufficient budget to advance Gen IV R&D goals.	-586

	FY 2008 vs. FY 2007 ($000)
Next Generation Nuclear Plant R&D The increase will restore critical R&D spending to nuclear reactor fuel development. It will also provide for the completion of the EPACT mandated NGNP Licensing Strategy. NRC is jointly developing the NGNP Licensing Strategy with the Department using DOE funds. The fuel testing and qualification program requires increased resources to maintain a schedule that is supportive of the EPACT mandated timeline for Phase 1 and Phase 2 of the NGNP Project.	+6,564
International Nuclear Energy Research Initiative (I-NERI) The decrease is due to a shift from performing R&D activities through bi-lateral agreements to one which utilizes the multi-lateral agreements being established under GIF.	-1,000
SBIR/STTR The decrease is due to a more accurate accounting of R&D expenditures subject to SBIR in FY 2007 and projected R&D expenditures subject to SBIR in FY 2008.	-269
Total Funding Change, Generation IV Nuclear Energy Systems Initiative	**+4,709**

Nuclear Hydrogen Initiative

Funding Schedule by Activity

	FY 2006	FY 2007	FY 2008
	(dollars in thousands)		
Nuclear Hydrogen Initiative			
Nuclear Hydrogen Initiative	24,057	18,142	22,102
SBIR/STTR	0	523	498
Total, Nuclear Hydrogen Initiative	24,057	18,665	22,600

Description

The Nuclear Hydrogen Initiative (NHI) will conduct research and development of enabling technologies, demonstrate nuclear-based hydrogen production technologies, and study potential hydrogen production strategies to support the President's vision for a future Hydrogen economy. The objective of the Nuclear Hydrogen Initiative is to develop technologies that will apply heat and/or electricity from next generation nuclear energy systems to produce hydrogen at a cost competitive with other alternative transportation fuels.

Benefits

With increased international concern about global climate change and greenhouse gases, there is an ongoing global effort to reduce carbon dioxide emissions and to develop carbon-free fuels. Hydrogen is the most promising non-carbon fuel. Currently, the only economical, large-scale method of hydrogen production involves the conversion of methane into hydrogen through a steam reforming process. This process produces ten kilograms of greenhouse gases for every kilogram of hydrogen, defeating a primary advantage of using hydrogen—its environmental benefits. Another existing method, electrolysis, converts water into hydrogen using electricity. Electrolysis is typically used for small production quantities and is inherently less efficient because electricity must first be produced to run the equipment used to convert the water into hydrogen. Additionally, the environmental benefits of electrolysis are negated unless a non-emitting technology, such as nuclear or renewable energy, is used to produce the electricity. The NHI is developing processes that operate across a range of temperatures for the various advanced reactors being researched by the Generation IV Nuclear Energy Systems Initiative. These processes, coupled with advanced nuclear reactors, have the potential for high-efficiency, large-scale production of hydrogen.

Detailed Justification

	(dollars in thousands)		
	FY 2006	FY 2007	FY 2008
Nuclear Hydrogen Initiative	**24,057**	**18,142**	**22,102**

The program focuses on research and development activities associated with thermochemical and high-temperature electrolysis processes designed to demonstrate the viability of using heat and/or electricity from various advanced reactors being researched by the Generation IV Nuclear Energy Systems Initiative (GEN IV), with the goal of producing hydrogen at the price that is cost competitive with other alternative fuels. Much of the program's focus is vested in the most promising technologies—the sulfur-iodine (S-I) and hybrid sulfur thermochemical cycles and high-temperature electrolysis. However, alternative processes with significant potential continue to be evaluated. The objective of this program is to demonstrate the technologies at increasingly larger scales culminating in an industrial scale that would be technically and economically suited for commercial deployment. FY 2005 and FY 2006 activities were focused on the validation of individual processes and components; FY 2007 and FY 2008 are focused on the design, construction and operation of integrated laboratory scale experiments. Based on the outcomes of the integrated laboratory scale experiments, a technology down select to the most promising technology for a pilot scale experiment will be made in 2001, with construction of a pilot scale by 2013 and industrial scale by 2019.

Based on their level of maturity, the sulfur family of thermochemical cycles (S-I and hybrid sulfur) and high-temperature electrolysis are considered "baseline" processes and have the highest R&D priority. The S-I thermochemical cycle is a series of chemical reactions that convert water to hydrogen and oxygen. This process offers the potential for high-efficiency hydrogen production at large-scale production rates but has technical issues related to the development of materials suitable for use in the high temperature (approx 900C), highly corrosive environment required for the chemical processing systems and heat exchangers. Operation of an integrated laboratory-scale experiments on S-I thermochemical system in FY 2008 will be used to confirm the technical and economic viability of the chosen materials. To better leverage this research and increase the probability of achieving the program schedule and objective, the hybrid sulfur cycle will be investigated (this cycle is similar to the S-I cycle but replaces two challenging chemical steps with a single electrolytic step.

High-temperature electrolysis (HTE) produces hydrogen from steam using electricity. This method has the potential for higher efficiencies than commercially available electrolysis processes and can operate across a range of temperatures. Because of the modular nature of the high-temperature electrolysis process, the Department has already been able to realize positive research results by operating small cell stacks at prototypical conditions. In January and February 2006, the Idaho National Laboratory successfully operated a stack of high-temperature electrolysis cells, which continuously produced hydrogen at a rate of over 100 liters per hour for 1,000 hours. This test achieved the highest throughput to date in the NHI program and produced the data required to take the next process development step.

In addition, research on alternative processes that operate over a range of temperatures will include focused small-scale experiments to verify process potential. The alternative cycles involve significantly more technical risk because less is known about them, but their lower temperature requirements and, in some cases, reduced complexity make them worthy of continued research—

particularly since the lower temperatures could facilitate the production of hydrogen using fast reactors. The supporting technologies required at these lower temperatures and the overall objective to improve process performance will involve overcoming many technical challenges, including the development of advanced materials, advanced heat exchanger technologies, and separation membranes. As some alternative hydrogen production technologies may also be pursued by other DOE offices, all such work is coordinated carefully to avoid duplication of effort.

NHI R&D activities will be conducted through several vehicles including international collaborations via the Generation IV International Forum (GIF) and bilateral agreements pioneered under the International Nuclear Energy Research Initiative and domestically via the national laboratories and through the Nuclear Energy Research Initiative (NERI) in which the United States' university research community is engaged as a partner. Competitive solicitations for NERI research will focus on NHI R&D and other research programs identified elsewhere. While previously funded directly as a line item, these research projects will now be funded directly out of the respective program areas that benefit from the research. NERI will continue to be executed using independent peer reviews critical to ensuring the pursuit of leading-edge technologies. Program reviews are conducted twice a year as a part of the planning and evaluation process and annually as a part of DOE's Hydrogen Program Annual Merit Review. Additional reviews will be performed in conjunction with the The Hydrogen Technical and Fuel Cell Advisory Committee established under Section 807 of the Energy Policy Act of 2005. Finally, NHI's program goals and plans are being evaluated as part of the National Academy of Science's evaluation of NE's R&D and Infrastructure program, including the process of establishing program priorities and oversight. This evaluation, scheduled for completion in October 2007, will result in a detailed set of policy and research recommendations and associated priorities that defines NHI's role in an integrated agenda of NE research activities that will best advance NE's fundamental mission of securing nuclear energy as a viable, long-term commercial energy options to provide diversity in energy supply.

As described above, near-term activities are focused on constructing integrated laboratory-scale thermochemical and high-temperature electrolysis hydrogen production systems. Contributing to this effort were activities conducted in FY 2006 on the validation of individual processes and components.

In FY 2006, the Department:

- Constructed major components for the S-I cycle reaction sections in preparation for integrated laboratory-scale system operation in FY 2008.
- Completed facility preparations for the S-I integrated laboratory-scale experiment (including facility selection, facility modifications, and safety analysis documentation).
- Identified requirements for process interfaces, control systems approach, and diagnostics for the integrated laboratory-scale S-I thermochemical experiment.
- Characterized and analyzed multiple H2O/SO2 electrolyzer configurations for integration into the Hybrid Sulfur laboratory-scale experiment.
- Completed flowsheet analysis for most promising alternative thermochemical cycles.
- Operated a 25 cell HTE stack at 100 Normal liters per hour for 1000 hours.

(dollars in thousands)		
FY 2006	FY 2007	FY 2008

- Completed initial assessment of codes and standards applicable to a hydrogen production facility coupled to a nuclear reactor.
- Continued research on candidate high-temperature process heat exchanger concepts and materials for baseline technologies; continued engineering design of heat exchanger designs to be tested before pilot and engineering-scale technology experiment; and continued thermal hydraulic and structural analyses of heat exchanger concepts for use with alternative hydrogen production technologies.

In FY 2007, the Department is moving ahead with construction of integrated laboratory-scale system experiments for the two technologies by:

- Completing assembly of integrated laboratory-scale S-I thermochemical system and pre-operational testing consisting of system operation using water as a surrogate fluid.
- Completing initial longevity testing for materials for pilot-scale, sulfur-based thermochemical process equipment.
- Developing and testing electrolyzer membranes for Hybrid-Sulfur thermochemical process.
- Conducting component reaction tests and design laboratory-scale experiments for most promising alternative cycles.
- Completing assembly and pre-operational testing of integrated laboratory-scale HTE system consisting of verification of individual component performance.
- Beginning feasibility studies to determine whether the use of existing nuclear power plants is a cost-effective means of producing hydrogen.
- Incorporating materials and heat exchanger test data into the system interface model for integrating nuclear and hydrogen plants.
- Performing laboratory-scale tests on heat exchangers and materials.
- Identifying high-level functional design and safety requirements for baseline pilot-scale experiments.

In FY 2008, the Department will complete construction of integrated laboratory-scale system experiments and begin testing to enable the 2011 selection of the technology that will be demonstrated in a pilot scale hydrogen production experiment, schedule to begin operation in 2013:

- Conduct integrated laboratory-scale experiments on S-I thermochemical system to confirm the technical viability of the integrated system.
- Conduct Hybrid-Sulfur electrolyzer tests.
- Conduct key technology experiments to determine feasibility of selected alternate cycle(s).
- Initiate design activities for S-I and HTE pilot-scale experiments.
- Operate solid oxide electrolysis cell stacks at prototypic temperatures (750 – 900 C) to confirm efficiency and demonstrate cell sealing and interconnect technologies.
- Conduct HTE integrated laboratory-scale experiment operation of 60 cell stack array at 15 kWe power level.
- Conduct heat exchanger testing to support design of pilot-scale experiments for baseline processes.
- Develop and test advanced interface components to connect the nuclear heat source to the hydrogen production plant.

	FY 2006	FY 2007	FY 2008
	(dollars in thousands)		

- Complete model for combined reactor and hydrogen process plant to evaluate the impact of operations and transients of one plant or the other.
- Identify and document issues related to combined nuclear – chemical plant safety to guide design of commercial-scale plant.

	FY 2006	FY 2007	FY 2008
SBIR/STTR	**0**	**523**	**498**

The FY 2007 and FY 2008 amounts shown are estimated requirements for the continuation of the SBIR and STTR program.

	FY 2006	FY 2007	FY 2008
Total, Nuclear Hydrogen Initiative	**24,057**	**18,665**	**22,600**

Explanation of Funding Changes

	FY 2008 vs. FY 2007 ($000)
Nuclear Hydrogen Initiative The increase of $3,960,000 is to construct and conduct experiments to determine the feasibility of alternative cycles selected for further development, and to begin design activities for pilot-scale experiments for thermochemical and high-temperature electrolysis production methods.	+3,960
SBIR/STTR The decrease of $25,000 is due to changed R&D levels within the NHI program.	-25
Total Funding Change, Nuclear Hydrogen Initiative	**+3,935**

Advanced Fuel Cycle Initiative

Funding Schedule by Activity

(dollars in thousands)

	FY 2006	FY 2007	FY 2008
Advanced Fuel Cycle Initiative			
Separations Technology Development	16,137	22,000	35,000
Advanced Fuels Development	8,187	60,000	40,000
Transmutation Science	5,316	20,000	10,000
Systems Analysis/Advanced Computing & Simulation	5,940	20,000	79,000
Transmutation Education	13,365	0	4,000
Advanced Fuel Cycle Facility	6,930	20,000	30,000
Recycling Demonstration Program	14,118	60,000	37,000
Advanced Burner Reactor Demonstration Analysis	4,950	40,000	25,000
GNEP Technology Development	0	0	133,000
Materials Test Station	3,465	0	0
SBIR/STTR	0	1,000	2,000
Total, Advanced Fuel Cycle Initiative	78,408	243,000	395,000

Description

The mission of the Advanced Fuel Cycle Initiative (AFCI) is to develop fuel cycle technologies that will support the economic and sustained production of nuclear energy while minimizing waste and satisfying requirements for a controlled, proliferation-resistant nuclear materials management system. The AFCI is developing these new technologies so that they may be deployed to support the operation of current nuclear power plants, Generation III+ advanced light water reactors, and Generation IV advanced reactors. The successful deployment of these technologies will significantly reduce the amount of high-level radioactive waste requiring geologic disposal, significantly reduce accumulated plutonium from civilian spent fuel, and extract more energy from nuclear fuel.

Benefits

Of the challenges that must be addressed to enable future expansion of nuclear energy in the U.S. and worldwide, none is more important or more difficult than dealing effectively with spent nuclear fuel and high level waste. Compared to other industrial waste, the spent nuclear fuel generated per unit of electricity is relatively small in mass. However, it contains components that are radioactive for many thousands of years, and its disposal requires resolution of many political, social, technical, and regulatory issues. For many years, several countries have pursued advanced technologies that could treat and transmute spent nuclear fuel from nuclear power plants. These technologies have the potential to significantly reduce the quantity and radiotoxicity of waste requiring geologic disposal.

In addition to supporting optimal use of the first U.S. repository and reducing the technical need for additional repositories, these technologies can also enhance national security by reducing proliferation risk through the reduction of inventories of commercially-generated plutonium (which is contained in all commercial spent fuel) throughout the world.

The U.S. currently has 103 operating commercial nuclear reactors providing approximately 20 percent of our domestically produced electricity, and producing over 2000 tonnes of spent fuel per year. Under current Nuclear Regulatory Commission (NRC) extended operating license guidelines, these nuclear plants will begin to arrive at the end of their operating life about the year 2030. During that same period, forecast expansion of nuclear power in the U.S. would increase the amount of spent fuel requiring disposal. Continuing the current path of a once-through fuel cycle will require additional spent fuel repositories at a cost approaching $100 billion each. Closing the fuel cycle as outlined under the GNEP Strategic Plan will eliminate the need for additional U.S. repositories in this century. It will also provide a major non-proliferation benefit to the world by developing and demonstrating advanced spent fuel recycle technologies, allowing global replacement of the current plutonium and uranium recovery by the extraction process which produces separated plutonium. Additionally, recycling spent fuel in fast reactors will extract more useful energy from material now considered waste.

In collaboration with the NNSA, AFCI/GNEP will help enhance the international non-proliferation regime by demonstration of advanced materials accountability and control, monitoring and safeguards systems that will contribute to enhancing proliferation resistance of integrated spent fuel recycling systems, here and potentially throughout the world.

AFCI/GNEP international collaboration could provide a near-term means for an off-set in the cost of development of the various reactor and fuel cycle technologies. Fuel irradiation and qualification testing in foreign fast reactors would provide the U.S. a cost savings of approximately $100-200 million over the next 10 years. Fuel cycle technology collaboration not only off-sets cost, but actually accelerates development time by sharing knowledge and experimental data.

AFCI/GNEP is expected to be a major stimulant to the revitalization of the domestic nuclear industry and our related nuclear infrastructure. AFCI/GNEP is composed of several major systems, each contributing value to this revitalization.

Specifically, the prototype advanced recycling reactor accomplishes four key objectives of a sustainable domestic nuclear renaissance:

1. It is necessary to support development of the fast reactor systems in the current Generation IV Nuclear Energy Systems portfolio. Three of those reactor systems are fast reactors. Without a domestic fast reactor, the U.S. must either buy time in foreign fast reactors to develop its Generation IV technological contributions, or it must limit its innovations to those which can be accomplished without in-reactor experimentation. These limitations restrict the range of potential contributions U.S. firms can make to the development of Generation IV reactor technology, and restrict the magnitude of potential patentable inventions and their industrial applications.

2. It is necessary to consume transuranics and other actinides in a closed nuclear fuel cycle, reducing both heat and waste loads on a geologic repository, expanding its capacity by a factor of at least an order of magnitude.

3. Once built, it will be the only fast reactor in the U.S. portfolio of nuclear development tools capable of producing the fast neutron flux needed for future fast reactor testing and development. As in the case of the Generation IV program, without a domestic fast reactor any development that can not be adequately pursued via simulation modeling will require the U.S. to purchase in-reactor test time from foreign states.

4. It is the technology development platform for future fast reactors capable of recycling LWR fuel that provides the natural progression of nuclear technology beyond the current LWR fleet and GNEP program.

The reprocessing nuclear fuel recycling center will demonstrate key elements of a SNF recycling program – the separation of LWR and fast reactor SNF into usable components and the fabrication of transmutation fuel from those components.

AFCI/GNEP is pursuing a research agenda that supports the National Energy Policy and Energy Policy Act of 2005 to explore advanced spent fuel treatment technologies in cooperation with our international partners. The Department will continue to emphasize joint collaborative activities in spent fuel treatment research, design and development. Considerable expertise in these technologies has been developed internationally, and the potential for significant cooperation, cost-sharing and collaboration is very high. The Department is currently collaborating with France, Switzerland, the European Union, Canada, Japan and the Republic of Korea in separations, fuels, transmutation engineering and test facilities. Additional collaborations with other fuel cycle states such as Russia, China and India are being considered as well.

Near and Long-Term Goals

The AFCI's near-term goals are to develop and demonstrate advanced, proliferation-resistant fuel cycle technologies for treatment of commercial light water reactor spent fuel, to develop an integrated spent fuel recycling plan, and to inform and support a recommendation by the Secretary of Energy regarding the need for an additional geologic repository. Current legislation requires the Secretary to make a recommendation to Congress regarding the need for a second repository as early as January 1, 2007, but before January 1, 2010. The AFCI conducts research and development of spent fuel treatment and recycling technologies to support an expanding role for nuclear power in the United States (U.S) and to promote world-wide expansion of nuclear energy in a proliferation-resistant manner as envisioned for the Global Nuclear Energy Partnership (GNEP). The AFCI is the main U.S. component of the GNEP.

In accordance with the National Security Strategy of the United States, issued March 16, 2006, the United States "will build the Global Nuclear Energy Partnership to work with other nations to develop and deploy advanced nuclear recycling and reactor technologies. This initiative will help provide reliable, emission-free energy with less of the waste burden of older technologies and without making available separated plutonium that could be used by rogue states or terrorists for nuclear weapons.

These new technologies will make possible a dramatic expansion of safe, clean nuclear energy to help meet the growing global energy demand."

GNEP seeks to bring about a significant, wide-scale use of nuclear energy, and to take actions now that will allow that vision to be achieved while decreasing the risk of nuclear weapons proliferation and effectively addressing the challenges of nuclear waste disposal. GNEP will advance the nonproliferation and national security interests of the United States by reinforcing its nonproliferation policies and limiting the spread of enrichment and reprocessing technologies, and will eventually eliminate excess civilian plutonium stocks that have accumulated. The AFCI budget request supports the Department's goal of realizing the GNEP vision. AFCI activities in FY 2007 and FY 2008 are focused on developing a detailed roadmap for implementing all aspects of the GNEP vision and informing the Secretary's decision in mid-2008 on the path forward for GNEP.

The United States seeks to pursue and accelerate cooperation with fuel cycle states to:

- Expand nuclear power to help meet growing energy demand in an environmentally sustainable manner.

- Research, develop, demonstrate, and deploy advanced technologies for recycling spent nuclear fuel that do not separate plutonium, with the goal over time of ceasing global separation of plutonium and eventually eliminating excess stocks of civilian plutonium and drawing down existing stocks of civilian spent fuel. Such advanced fuel cycle technologies would substantially reduce nuclear waste, simplify its disposition, and help to ensure the need for only one geologic repository in the United States through the end of this century.

- Research, develop, demonstrate, and deploy advanced reactors that consume transuranic elements from spent light-water reactor (LWR) fuel and spent fast reactor fuel. These reactors will be designed to use fuel produced from the components of spent fuel to generate electricity while reducing the burden on the Yucca Mountain geologic repository.

- Establish supply arrangements among fuel supplier nations to provide reliable fuel services worldwide for generating nuclear energy by providing nuclear fuel and taking back spent fuel for recycling, without spreading enrichment and reprocessing technologies.

- Research, develop, demonstrate, and deploy advanced, proliferation-resistant nuclear power reactors appropriate for the power grids of developing countries and regions.

- In cooperation with the International Atomic Energy Agency, develop enhanced nuclear safeguards to effectively and efficiently monitor nuclear materials and facilities, to ensure commercial nuclear energy systems are used only for peaceful purposes.

In the long term, AFCI/GNEP will develop and demonstrate an advanced, proliferation-resistant closed nuclear fuel cycle system involving spent fuel partitioning and recycling of actinides and other long-lived radioactive elements for destruction through transmutation in fast reactors that could result in a de facto fifty-fold increase in the effective capacity of the planned Yucca Mountain repository. This increase would come principally from the destruction of actinides that generate the heat that limits repository capacity. Such a capacity increase would be more than enough to accommodate all the spent fuel generated in the U.S. this century from any reasonably conceivable deployment scenario for nuclear energy.

A U.S. spent fuel treatment and recycling capability is a critical element in the U.S. initiative to support the expansion of nuclear power generation worldwide in a proliferation resistant manner. The demonstration of spent fuel recycling technology and advanced recycling reactor technology is part of a multifaceted program that involves recycling spent fuel, fabricating transmutation fuel that contains long-lived actinides removed from the spent fuel, using the fuel in a fast reactor, and developing waste disposal technologies for the remaining fission products, radioisotopes and process wastes.

The Department will purse industry participation in the development of conceptual design and engineering studies for the domestic spent fuel treatment and recycling facilities in order to develop cost and schedule information in sufficient detail to allow confidence in the cost of deploying GNEP. The conceptual design and engineering studies will address recycling at scales from engineering- to commercial. The industry participation will assist in the Secretary's June 2008 decision. In FY 2007, the Department initiated efforts to engage industry and obtain information on the scope, cost, schedule, and risks associated with the overall GNEP program.

Taken as a whole, the AFCI/GNEP program will accomplish several prerequisites to closing the domestic fuel cycle: separate commercial LWR SNF into usable and waste components; fabricate and recycle fast reactor fuel containing transuranic elements; and convert transuranics into shorter-lived radioisotopes while producing electricity. Specifics on each of these prerequisites follow.

<u>Separate commercial LWR SNF into its usable and waste components</u>. SNF contains uranium, transuranics (plutonium and other long-lived radioactive elements), and fission products. The fission products make up less than five percent of the SNF. The uranium would be stored as low level waste for possible reuse as fuel later. Buildup of fission products within the fuel inhibits nuclear fission reactions, so the spent fuel must be replaced periodically with fresh fuel for continued operation. The transuranics in SNF would be separated from the fission products and then fabricated into new fuel for a fast spectrum reactor, which would consume transuranics, while simultaneously recovering their energy content.

In FY 2007, the Department shifted its advanced fuel cycle research and technology development focus to explore, with industry, the design of engineering- and commercial-scale demonstrations of the most promising technologies, such as uranium in an aqueous-based solvent extraction process, and sodium-cooled fast reactors.

To date, a successful laboratory-scale demonstration of the UREX+ aqueous spent fuel separations technology has been conducted as a precursor to a prototype demonstration of the technology to treat SNF from commercial light water reactors. The most technically mature processes and technologies will be developed in collaboration with industry. The SNF recycling program would use advanced separation processes. As discussed below, the products of these advanced separation processes can be used in a fast spectrum reactor that would consume transuranics to produce electricity.

Fabricate and recycle fast reactor fuel containing transuranic elements. Fabricating, testing, and qualifying fast reactor fuel containing transuranic elements (i.e., transmutation fuel) obtained from recycled spent fast reactor and LWR fuel is required to provide fresh fuel for the fast reactors. The Department will focus its transmutation fuel development activities on those needed for an engineering- to commercial-scale demonstration sodium-cooled fast reactor facility – essentially an advanced recycling reactor. This concept will be targeted because of its technical maturity and U.S. and international experience in operating sodium-cooled fast reactors. Sodium-cooled fast reactors have been built and successfully operated for limited periods in the United States, and longer-term in Russia, France, Japan and other countries. A sodium-cooled fast reactor would provide a platform for demonstrating transmutation of spent LWR fuel and fast reactor recycle fuel. During FY 2007 and FY 2008, the Department will collaborate with international and industry partners to refine the advanced recycling reactor component of GNEP. Research and technology development related to advanced pyroprocessing technologies, waste and storage forms, and both metal and oxide transmutation fuels will continue to support this near-term objective. The program will conduct the necessary research and technology development to fabricate, irradiate, and examine transmutation fuels to qualify them for use in an advanced fast recycling reactor.

Convert transuranics into shorter-lived radioisotopes while producing electricity. The GNEP program envisions that transuranic elements extracted in the LWR spent fuel separation process will be manufactured into fuel for fast reactors. Fast reactors produce the high-energy neutrons required to fission long-lived transuranics efficiently, transmuting them into shorter-lived radioisotopes or stable isotopes. As the transuranics are consumed, significant energy is released that can produce electricity. This process uses material that would otherwise be considered waste and potentially require disposal in a geological repository. An advanced recycling reactor is expected to operate using conventional fast reactor fuel for several years in order to qualify and transition to transmutation fuel operation, after which recycling of fast reactor transmutation fuel can be demonstrated. In FY 2008, the Department will initiate conceptual design studies of the advanced recycling reactor.

In 2008, the Department will continue design of an advanced fuel cycle research facility for advanced separations, fuels fabrication, safeguards instrumentation and scale-up capabilities to support the AFCI/GNEP program. This facility will provide important experimental data to support advanced simulation and modeling in order to accurately predict reactor and fuel performance, and reduce the need for lengthy irradiation campaigns in test reactors. In collaboration with the National Nuclear Security Administration (NNSA), NE will incorporate advanced safeguards and monitoring equipment into all new fuel cycle facility designs, and pursue international programs for assured fuel supplies that meet the GNEP nonproliferation objective.

Environmental analyses to comply with the National Environmental Policy Act (NEPA) are also being carried out in support of the program objectives. Finally, industry and international collaborations will continue and expand where appropriate in pursuit of this objective.

Additional steps will be necessary to accomplish GNEP's goal to create an international regime that supports a substantial increase in global nuclear energy use. Those efforts include:

Advanced computing and simulation. In FY 2007, an effort was initiated to transform the approach to the design and analysis of nuclear systems by further developing and applying advances in software and massive parallel computing demonstrated under the NNSA's Advanced Simulation and Computing (ASC) program and the Advanced Scientific Computing Research (ASCR) Program in the Office of Science. Tools are being developed and applied to key problems, including shortening the qualification time for new transmutation fuels; optimizing the performance and scaling of proliferation- resistant separations processes; improving the cost, performance and safety of fast reactors utilized for burning transuranics; assuring the safety and licensability of recycling facilities being considered by the GNEP; and analyzing and designing advanced waste forms to assure safe storage and handling of nuclear waste over the expected lifetime that wastes remain a radiation hazard. This work will be done in close collaboration with facilities and capabilities developed under ASC and ASCR, and will engage the leading scientists and engineers at our national laboratories and leading academic research institutions. Close ties with industry will be established to assure the applicability and usability of simulation codes for nuclear applications.

<u>International collaboration</u>. AFCI/GNEP international collaboration offers the opportunity for the U.S. to leverage its fuel cycle research and development (R&D) with countries that have fuel cycle research facilities and fast spectrum test reactors. These countries currently include Russia, France, and Japan. On December 15, 2006, the Secretary of Energy and Director of the Federal Atomic Energy Agency of the Russian Federation submitted to Presidents Bush and Putin a report titled: *U.S.-Russian Civil Nuclear Energy Working Group: A Bilateral Action Plan to Enhance Global and Bilateral Nuclear Energy Cooperation.* This "Action Plan" outlines cooperative research in advanced reactors, exportable small and medium reactors, nuclear fuel cycle technologies, and nonproliferation. Implementation of this plan, and other equivalent plans with France and Japan, will require the host country to modify or construct specific experiments to meet specific GNEP research needs. Examples include 1) development of experimental equipment to house transmutation fuels for irradiation testing in fast reactors, and the associated safety analysis to meet their respective regulatory requirements;
2) construction of experimental equipment and testing of advanced separations technology; and
3) development of fuel fabrication technologies to manufacture transmutation fuels.

Fulfillment of the GNEP vision to reduce proliferation risk will require the development of reactors that are "right sized" for the international arena. These reactors must be based on technologies focused on reducing proliferation risk. The FY 2008 request will fund domestic and international activities to evaluate proliferation-resistant reactor designs. Additionally, the results of a requirements study will be used to initiate cooperative R&D and preconceptual design activities on promising candidate reactor technologies.

<u>Nuclear fuel supply strategy</u>. GNEP will develop a nuclear fuel supply strategy between existing nuclear fuel production states and those states that do not produce their own fuel, to ensure a secure fuel supply for global commercial nuclear reactors while reducing the risk of nuclear proliferation. Through the development of international fuel supply and leasing arrangements, nuclear power consumer states will no longer retain spent nuclear fuel, meaning that both state-level proliferation risks and terrorist access to spent fuel will be reduced compared to the current system.

A GNEP Strategic Plan has been created to harness and coordinate the strengths, capabilities and resources of industry, national laboratories, universities, and international partners with the clear objective of deploying commercial scale facilities that accomplish the GNEP vision as quickly and economically as possible. At the core of this effort will be the development of a sound, achievable business plan. The task at hand is to assemble the requisite technology, economic, and environmental information describing the path forward to commercial scale facilities that can inform the Secretary of Energy in 2008. Specific programmatic actions planned (subject to funding, risk and project management processes specified in DOE Orders) to reach this decision-point include:

1. Obtain input from U.S. and international industries and governments on what technology and policy issues must be resolved, and what business obstacles must be overcome, in order to deploy GNEP facilities.
2. Develop a detailed GNEP technology roadmap for demonstrating solutions to remaining technical issues in order to support GNEP facilities. Inform and adjust this roadmap with input received from industry, international partners, and the policy community.
3. Pursue industry participation in the development of conceptual design and other engineering studies that support both the engineering- and commercial- scale nuclear fuel recycling center and demonstration advanced recycling reactor.
4. Prepare a programmatic GNEP Environmental Impact Statement.
5. Prepare a decision package for the Secretary of Energy to proceed with a government-industry partnership for building an engineering- or commercial- scale nuclear fuel recycling center and advanced recycling reactor.

Development of a credible U.S. program for fuel cycle technology development and for construction of engineering- or commercial- scale fuel cycle facilities is critical to convincing other nations considering beginning a nuclear energy program that they can rely on the U.S. for their fuel cycle needs. Establishing the U.S. as a key player in fuel cycle technology is vital to fulfilling the GNEP vision.

Detailed Justification

	(dollars in thousands)		
	FY 2006	FY 2007	FY 2008
Separations Technology Development	**16,137**	**22,000**	**35,000**

The goal of the Separations Technology Development activity is to develop advanced aqueous and pyrochemical separations technology alternatives capable of treating the existing and projected inventory of spent nuclear fuel and fast reactor recycle fuel in a safe, efficient and proliferation-resistant manner. Information developed under this activity will be used to help inform a recommendation by the Secretary of Energy in mid-2008 on the future course of the GNEP, and by January 2010 on the technical need for a second repository. The current suite of advanced aqueous processes has potential for meeting proliferation-resistant separations objectives, while minimizing the waste generation associated with current aqueous separations technologies. While the current suite has the potential to help address the spent fuel challenge associated with today's light water reactors, pyroprocessing may be better suited to address the requirements of sodium-cooled fast reactor fuels. This R&D provides alternative solutions for important parts of the separations processes where a high or moderate risk is present. This task also supports long-term R&D for next-generation facilities. Data for modeling and simulation validation is developed under this activity. In FY 2008, the Department will conduct separations experiments at multiple national laboratories with the goal of successfully separating actual spent fuel into its usable constituents.

	(dollars in thousands)		
	FY 2006	FY 2007	FY 2008
▪ **Advanced Proliferation-Resistant Aqueous Fuel Treatment**	**9,355**	**18,000**	**20,000**

Laboratory-scale experiments completed by AFCI have proven the advanced, aqueous-based UREX technology to be capable of removing uranium from spent fuel at purity levels of 99.999 percent and free of high-level radioactive contaminants. The resulting material could possibly be disposed of as low-level waste or reused as reactor fuel. If spent fuel were processed in this manner, the volume of high-level waste requiring disposal in a geologic repository could be significantly reduced, potentially lowering the cost of storing the remaining high-level waste and increasing the effective capacity of a geologic repository.

Additional research is underway to evaluate aqueous chemical treatment methods to separate selected actinide and fission product isotopes from the process stream after the uranium has been removed. Long-lived fission products (i.e., iodine-129 and technetium-99) are significant contributors to the potential dose from a repository and the long-term radiotoxicity of spent fuel, and could also be separated for transmutation or incorporation into new waste forms for safe disposal.

In FY 2006, hot tests at a laboratory scale of various UREX+ flowsheet variations were conducted to allow a final selection of the reference flowsheet in FY 2007. The Department also carried out tests to allow the scale-up of hot laboratory testing to an engineering-scale experiment. The scale-up tests included cold testing of centrifugal contactors. Waste qualification experiments and data analysis were conducted on spent fuel processing. Conceptual design of a modular advanced fuel cycle research facility was initiated, with one module dedicated to scale-up research, process improvements, and advanced monitoring and safeguards technologies for UREX+ and other advanced aqueous spent fuel treatment technologies. Collaboration was pursued with the French Atomic Energy Commission, CEA, to conduct joint group actinide extraction tests at laboratory scale, at U.S. laboratories, as well as at the CEA Atalante facility, where the French group actinide extraction processes are being studied.

In FY 2007, the AFCI Separations Technology Development activity continues to advance the knowledge of advanced aqueous separations process development though refined and focused laboratory based demonstrations, data collection, and evaluations. Specifically, there will be laboratory-scale end-to-end demonstrations of a recycling technology using actual spent LWR fuel at multiple national laboratories to develop a statistical performance database, a modified process run with a voloxidation head-end step, reduced tributyl phosphate concentration with a high acid concentration, a test involving separation of Americium and Curium, qualification of fission product extraction as a potential replacement for the CCD-PEG process to increase system operability and reduce system cost and complexity, and demonstration of the recovery and conversion of soluble technetium.

Demonstration of uranium and transuranic product conversion and treatment of undissolved solids and cladding hulls will also be performed. Work is continuing on product and waste storage forms, particularly for transuranics, strontium/cesium, iodine and technetium.

Work performed under this activity will inform a decision to pursue a recycling facility.

In FY 2008, the Department will continue the end-to-end demonstrations of recycling technologies. The demonstrations are expected to produce separated transuranics for use in the transmutation fuel development program. Additional activities will include: integrating laboratory-scale tests of the separations process selected for the recycling demonstration prototype; process demonstration of various advanced separations technologies capable of isolating transuranics (collectively or individually); the collection and recovery of various volatile fractions from voloxidation of spent uranium dioxide fuel; alternate storage methods for rare fission gases such as krypton-85; separations processes for rare fission gases to fractionate inert xenon from radioactive krypton; and advanced waste forms for iodine and technetium and other long-lived radionuclides. Advanced instrumentation will also be tested under simulated conditions to identify candidates for later testing in either a recycling demonstration prototype or the Advanced Fuel Cycle Facility (AFCF), depending upon the ultimate design of these facilities. In collaboration with the Department's Office of Science, research will be conducted to understand the basic chemistry of aqueous separations, including the structure of organic complexes.

	FY 2006	FY 2007	FY 2008
▪ **Other Separations Processes (Including Pyroprocessing)**	**6,782**	**4,000**	**15,000**

Pyroprocessing is a proliferation-resistant non-aqueous approach to separate the actinides in spent fuel from fission products. AFCI pyroprocessing activities support the reduction of the radiotoxicity of nuclear waste through the separation of minor actinides from spent fuel in certain designs of liquid metal-cooled fast reactors for recycle back into fast reactors or to dedicated transmuter devices. While using pyroprocessing to treat spent fuel from the Experimental Breeder Reactor-II (EBR-II), pyrochemical process improvements have been made, which increase its applicability to other advanced reactor fuels.

In FY 2006, the Department conducted research into alternative advanced separation technologies, which involved combined aqueous/pyrochemical hybrid processes. These processes offer increased versatility compared with aqueous and pyrochemical processes operating separately. Pyrochemical tests on the separation of cesium and strontium from molten salts was also initiated, along with testing of the separation of individual and group transuranic elements. Development of high-throughput electrorefiners and metal waste forms continued. The Department also continued pyrochemical treatment of EBR-II spent driver fuel and investigated more cost-effective alternative technologies for processing blanket fuel.

In FY 2007, pyrochemical treatment of EBR-II spent driver fuel and testing of high-throughput electrorefiners continues as does the testing of processes involving the combined use of both aqueous and pyrochemical separations technologies. The aqueous portion of the process development included an extension of process instrumentation development for on-line, real-time accountability measurements applied to separations facilities for increased proliferation resistance. Studies will continue on the applicability of pyrochemistry to the separation of cesium and strontium from spent fuels. The most promising approaches to the application of pyrochemistry to the separation of americium and curium are being evaluated, and the process with the highest promise will be studied in greater detail for its application to the recycle of fast reactor fuel and the preparation of long-term storage forms. Improved sampling and other monitoring activities are being conducted in order to increase proliferation resistance.

In FY 2008, the Department will continue R&D on advanced recycle processes for fast reactor spent fuel. Such processes must be capable of separating uranium and transuranics from fission products in fuel with very high radioactivity, thus requiring remote handling. The advanced recycle process activities required are: treatment of fast reactor metal fuels, laboratory-scale liquid cadmium cathode (LCC) testing of group actinide recovery, high throughput electrorefining, the investigation of crucible materials for LCC applications; advanced sampling methods for pyroprocessing technologies; reductive extraction of actinides and electrolytic drawdown from salt waste; americium separation from curium using pyrochemical and pyrometallurgical methodologies as part of the EuroPart cooperative program; and advanced processing methods for spent oxide reactor fuel; cold testing; irradiated fuel testing and integrated electrochemical modeling as part of an ongoing International Nuclear Energy Research Initiative (I-NERI) project with the Korea Atomic Energy Research Institute; and the development of engineering-scale oxide reduction equipment. In collaboration with the Department of Energy's Office of Science, research will be conducted to better understand the basic chemistry of pyroprocessing.

	FY 2006	FY 2007	FY 2008
Advanced Fuels Development	**8,187**	**60,000**	**40,000**

The AFCI advanced fuels R&D activity provides solutions for important parts of the fuel development process where a high or moderate risk is present (for example, alternative fuels such as nitride fuels, dispersion fuels, sphere-pac fuels, inert matrix fuels and transmutation targets). This activity also supports long-term R&D for next-generation facilities, including data for modeling and simulation validation. The Department has been fabricating and irradiating reactor fuel test samples with proliferation-resistance that are intended to enable the consumption of significant quantities of plutonium and minor actinides from accumulated spent fuel, while simultaneously extracting more useful energy from the spent fuel materials. Analysis has shown that recycle in LWRs or gas-cooled reactors has limited value in reducing proliferation risk from accumulated plutonium, but only modestly enhances repository performance. Consequently, the program is focused on supporting fast reactors to complete the transmutation mission of the AFCI/GNEP program and realize the maximum benefit to repository loading capability.

Current Advanced Fuel Development work is focused on near term R&D in support of qualifying transmutation fuel for an advanced recycling reactor. Fuel development work is closely coupled with the technology development activities that support an advanced fuel cycle research facility. Specifically, the Advanced Fuel Development work provides critical transmutation fuel performance input to the design of engineering scale processing equipment at an advanced fuel cycle research facility capable of fabricating sufficient transmutation fuel for lead test assemblies. The lead test assemblies will be irradiated in an advanced burner reactor and will provide the performance data needed by the NRC for fuel qualification. Currently, advanced transmutation fuels are fabricated at fuel pin quantities using bench-scale facilities. Development priority for this effort was transitioned in FY 2006 to focus on advanced fast burner reactor transmutation fuel, and is being tailored toward lead candidates for application to an advanced recycling reactor (metal and oxide).

In FY 2006, the Department issued the final report on the post-irradiation examination (PIE) of the first mixed-oxide LWR recycle fuel irradiation test conducted in the Advanced Test Reactor (ATR) at the Idaho National Laboratory, and tabled, with appropriate documentation, the LWR mixed-oxide and inert matrix recycle fuel development program. The final report of the PIE of the initial actinide-bearing metal and nitride fuel irradiation tests in the ATR was also issued.

The Department continued its international cooperation that supports development of advanced transmutation fuels, including: shipping U.S. advanced transmutation fuel test pins to France for irradiation in the Phenix fast test reactor; examining fuel supply sources for the initial Advanced Burner Reactor (ABR) reactor core; and planning for international fast reactor fuel irradiations in the JOYO reactor in Japan.

In FY 2007, high burnup transmutation fuel tests continue in the ATR. Ongoing irradiation tests of the initial set of high burnup transmutation fuels in the ATR will be completed and PIEs initiated. One new GNEP-oriented advanced fuel metal and oxide transmutation irradiation test will be initiated in the ATR.

Two U.S. origin fast reactor transmutation fuel irradiation tests (FUTURIX-FTA and MI) will be initiated in the French Phenix reactor. Advanced transmutation fuel remote fabrication capabilities will be developed at multiple national laboratory sites to support a pending selection of the final fuel type for an advanced recycling reactor (i.e., metal or oxide). An international arrangement for transmutation fuel irradiation tests in the JOYO fast reactor will be finalized. Expansion of international fast spectrum irradiation test possibilities will also be explored in 2007.

In FY 2008, the Department will continue development of transmutation fuels for qualification of transmutation fuel for an advanced recycling reactor. The remote transmutation fuel fabrication activity will continue under the AFCF technology development program. ATR irradiation tests and PIEs will be completed. Fabrication, characterization and preparation for irradiation of advanced oxide and metal test fuels for an advanced recycling reactor qualification will be conducted. International collaborations in the fabrication, irradiation in fast test reactors, and PIE of advanced metal and oxide fuels will also continue.

	(dollars in thousands)		
	FY 2006	FY 2007	FY 2008
Transmutation Science	**5,316**	**20,000**	**10,000**

Transmutation, as it applies to AFCI/GNEP, converts long-lived radioactive isotopes into shorter-lived and generally lower radiotoxicity isotopes. Transmutation can convert the most significant radiotoxic long-lived isotopes to below that of natural uranium ore by reducing the time for decay from hundreds of millennia to as little as centuries. Transmutation of transuranics is best performed in fast reactors. Consequently, GNEP is focused on transmutation in fast reactors.

R&D in transmutation science supports advanced recycling reactor activities. Included are reactor and transmutation physics (including cross section measurements, nuclear physics data and codes), and development of advanced cladding and structural materials for use in commercial fast reactors. This activity is focused on long-term R&D for next-generation facilities to reduce operational uncertainties, improve fast reactor performance, and reduce costs through development of high-temperature materials with greater endurance. Data for modeling and simulation validation is developed under this activity. Activities will be coordinated with AFCI/GNEP international partners.

The near-term technology development activities under this program will directly support the demonstration work for an advanced recycling reactor, as well as longer term research and development to improve the design, safety, reliability and economic competitiveness of future commercial advanced recycling reactors that may be deployed by private sector utilities.

In FY 2006, the Department refined physics cross sections for advanced transmutation and fast reactor designs and provided design support for advanced fast burner reactors. Additionally, the Department performed mechanical testing of structural material samples previously irradiated in the Fast Flux Test Facility (FFTF), and updated the AFCI Materials Handbook.

In FY 2007, technology development activities include advanced concept studies to identify the most promising innovative technologies to reduce cost and improve the performance of advanced fast reactors. Specific activities include: evaluation and refinement of cross sections for plutonium isotopes to support the advanced transmutation reactor fuel cycle; mechanical testing and analysis of structural materials irradiated in the FFTF; the selection of structural materials for use in fast spectrum transmutation systems; and coordination of international activities dealing with transmutation systems.

In FY 2008 the Department will continue support in areas related to fast reactor design and development, including: evaluation and refinement of physics cross sections for plutonium isotopes to support the advanced transmutation reactor fuel cycle; mechanical testing and analysis of structural materials irradiated in the FFTF; the selection of structural materials for use in fast spectrum transmutation systems; and coordination of international activities dealing with transmutation systems. The Department expects to integrate advanced modeling and simulation activities with results of materials and physics experiments as input into the design of a safe, economical advanced recycling reactor.

	(dollars in thousands)		
	FY 2006	FY 2007	FY 2008
Systems Analysis/Advanced Computing & Simulation	**5,940**	**20,000**	**79,000**

Systems Analysis: The Systems Analysis activity examines the possible combinations of nuclear technologies to optimize the technical, economic, and environmental aspects of the fuel cycle as a whole, from mining to waste disposal. Systems Analysis develops and applies evaluation tools to formulate, assess, and guide program activities to evaluate various combinations of reactor types, reprocessing techniques, and waste disposal systems to meet program goals and objectives. The focus of Systems Analysis is the evaluation and down-selection of the most promising spent fuel treatment technologies, fuels technologies, reactors, and advanced fuel cycle deployment strategies acquired from AFCI and Generation IV research and development activities. Proliferation resistance analysis is included as a high-priority, ongoing activity, especially in the area of advanced separations technologies. Additionally, Systems Analysis investigates optimal systems architecture to reduce the burden on potential geologic repositories by removing the uranium and major heat-generating components of spent nuclear fuel, and optimizing the destruction of actinides to reduce the time it takes for the radiotoxicity of the waste to decay to levels comparable to the radiotoxicity of uranium ore (from 300,000 years to possibly less than 1,000 years). Cost-benefit, proliferation resistance, safety and sustainability analyses are 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 Analysis is closely involved with similar efforts in DOE's RW office. Joint efforts are focused on establishing consistent cost bases for use in evaluating the potential impact of advanced fuel cycle technologies on repository performance and costs. To this end, the 2005 "AFCI Cost Basis Report" provides a comprehensive set of cost data for use in evaluating impacts and benefits of a wide range of AFCI and Generation IV technology deployment options. The report and its associated modeling efforts are intended to aid the evaluation of those elements that dominate nuclear fuel cycle costs, and help develop more efficient and less costly fuel cycle systems. Relatedly, Systems Analysis produces the annual "AFCI Comparison Report" for Congress, which compares various separations, fuels, and reactor technologies being researched by the AFCI and Generation IV programs against the goals and objectives of those programs.

In FY 2006, the Department focused its systems analysis efforts on evaluating the integrated fuel cycle system being considered for deployment under GNEP. A "Spent Fuel Recycling Plan" for integrating a spent fuel recycle capability with interim storage of commercial spent nuclear fuel was developed and submitted to Congress, as requested in the FY 2006 Appropriations language.

The Department also expanded its cost-benefit analyses by conducting integrated nuclear fuel cycle system studies, transmutation system studies and technology and facility assessments. In conjunction with the Office of Science, planning for a Simulations Laboratory was initiated, which will provide a robust capability for research and simulation and visualization modeling of advanced integrated fuel cycles. Development of a Simulations Laboratory will take several years and will result in a virtual laboratory that utilizes the advanced high-performance computing capabilities of the DOE complex in close coordination with academia and industry. It will help advance applied nuclear sciences, as well as state-of-the-art computing and visualization tools to expedite the design, construction, and operation of advanced spent fuel treatment, fuel fabrication, and reactor facilities.

In FY 2006, the Department also conducted analyses regarding the optimum mix of facilities and systems and associated R&D priorities to support the preparation of the 2010 Secretarial recommendation on the technical need for a second repository. This information was captured in the annual “AFCI Comparison Report,” submitted to Congress in July 2006.

In FY 2007, Systems Analysis activities will focus on the development of key technical and economic information to support a Secretarial recommendation to Congress by January 2010 on the need for second repository, and the development of key technical and economic information to support the Secretary’s decision in mid-2008 on the GNEP path forward. These analyses compare direct disposal of spent fuel with disposal after the fuel has been recycled and actinides have been consumed in ABRs. The Office of Nuclear Energy (NE), in cooperation with the Office of Science, will develop modern, efficient reactor and safety software to enable access to the suite of state-of-the-art supercomputers operated by the Office of Science. These programs must be placed under configuration control, with compliance to Quality Assurance standards. Development of an integrated, systems-level model will be initiated to analyze all elements of the fuel cycle including economics, safety and environmental issues, proliferation issues, and sustainability.

The functionality of this systems-level model will be enhanced each year. Applications of this model, when it is available, and the Verifiable Fuel Cycle Simulation Model Code (VISION) model developed by AFCI to model the complete fuel cycle, will include a yearly analysis of the future deployed recycling system as well as a yearly analysis of the recycling technology demonstration system. The program will update the “AFCI Cost Basis Report” and will initiate business studies of the accelerated recycling program to obtain inputs from the industry, investment and academic communities on implementation of a large scale advanced fuel cycle complex in the U.S. and across the globe. These activities will lead to the development of a technology roadmap, a business plan containing cost projections and comparisons to other fuel cycle alternatives, and a plan outlining a schedule, waste streams, milestones, and performance metrics.

In addition, deployment systems analyses are being conducted for a variety of deployment system alternatives and supporting technology development. These analyses will provide overall guidance to the GNEP implementation. In FY 2008, activities will focus on completing analyses and developing information for the mid-2008 Secretarial decision on whether to move forward with one or more of the GNEP demonstration facilities. Emphasis will be placed on the international aspects of GNEP that will impact technical program activities, such as international transportation of materials, differences in repository requirements, and the influence of repository requirements on the GNEP integrated waste management strategy.

Major FY 2008 program activities will include:

- Input and integration support for CD-1 packages for AFCI/GNEP Facilities
- Integration and support for NEPA alternatives and technology options evaluations
- A comprehensive report on GNEP Facilities and Fuel Cycle Strategies
- GNEP deployment fuel cycle options
- Initial assessment of global proliferation risk and GNEP impact
- Evaluation of material management requirement for fuel take-back strategies
- Update GNEP Deployment Systems Analysis

Advanced Computing and Simulation: This activity supports the Department of Energy's Advanced Simulation and Applied Science program which is being initiated in FY 2007 with the goal of applying Department of Energy assets in science and high performance computer simulations to achieve long-term GNEP goals.

This effort is being planned and executed in collaboration with NNSA and the ASCR, Basic Energy Sciences and Nuclear Physics programs in the Office of Science. This activity will be executed through the DOE national laboratory system in collaboration with domestic industry and with foreign partners. It will engage our leading research universities in the development of models and methods as well as provide training of students in fields relevant to the nuclear enterprise. These activities will leverage computational and experimental assets, resources, capabilities and experience throughout the Department of Energy to avoid duplication and to reduce development times.

Validation and Verification (V&V) and Uncertainty Quantification (UQ) are the bedrock of nuclear safety. In FY 2007, Initial uncertainty quantification efforts will begin in 2007 with a study of significant reactor issues using existing codes and data as input to future simulation code and model development requirements. This effort is cognizant of and will be done in parallel with the V&V and UQ efforts ongoing in the NNSA, but adapted to problems and methods resident in the nuclear engineering community. Methods and techniques will be jointly shared between the NE and NNSA efforts.

Experience from the Office of Science's ASCR program has shown the need to couple physical model development to the development of high performance simulation code development at the outset, which is the function of the Applied Sciences sub-element. The program will conduct exploratory research to understand important phenomena, obtain necessary data and validate models. This effort will involve laboratory scale experiments to validate models and codes with particular emphasis on actinide fuels, nuclear and reprocessing chemistry, radiation effects on materials, and thermal and fluid processes important to reactor and nuclear system safety and performance. This effort has been planned in collaboration with the Office of Science, and is designed to be complementary to, and extract value from, the more fundamental basic and enabling research efforts conducted by the Office of Science.

A strong interface with the Nuclear Regulatory Commission will be established in FY 2007 to facilitate integration of advanced simulation methods into the regulatory process, and to establish qualifications standards for new high performance safety and design codes.

While this program activity seeks to transform the way nuclear safety and design are performed though the development and deployment of high performance codes, it will also survey, evaluate and, where useful and feasible, update legacy design and safety codes in the near term in order to support the immediate needs of designers engaged in conceptual design of GNEP recycling facilities.

In FY 2008, Modeling and Simulation (M&S) activities will be significantly expanded. Computer simulation has significant potential to reduce overall costs in all aspects of nuclear plant design and operation. For most of the technologies related to the GNEP demonstration projects, testing is extremely expensive, protracted, and in some cases, not feasible. Complementing or replacing testing with high-fidelity computer simulation will make it possible to collect simulated data that can, in conjunction with a sound experimental validation program, be used to understand fundamental processes that affect facility efficiency, safety, and cost. For example, virtual prototyping of reactor cores may yield data that leads to more accurate identification of design margins, allow early experimentation with novel design concepts, and significantly reduce timelines for plant licensing and deployment. In other areas such as advanced fuel fabrication, atomistic fuel simulations could make it possible to target a small subset of promising candidate fuel types for further experimentation, thus greatly reducing the number of experiments to be performed.

The tools developed will be validated with targeted experiments, with the level of validation dependent on the end-use of the particular tool. Therefore, this program activity includes support for development and validation of the models, as well as the cost of the experiments.

Major FY 2008 activities will include:

- Release Version 1 of the GNEP System Level Planning Tool
- M&S tools (legacy and developing) directly supporting the ABR will be identified, qualified through verification & validation assessments, and placed under configuration control in conformance with a quality assurance plan
- M&S tools (legacy and developing) directly supporting the spent fuel separation technology demonstration will be identified, qualified through verification & validation assessments, and placed under configuration control in conformance with a quality assurance plan

Transmutation Education	**13,365**	**0**	**4,000**

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. Transmutation Education activities include the successful university fellowship program, which is developing new U.S. scientists and engineers for the fields of transmutation and advanced nuclear fuel cycle technologies.

(dollars in thousands)

In FY 2006, the Department continued its Nuclear Energy Research Initiative (NERI) university grant program. The AFCI fellowship program awarded twelve fellowships (compared with eight in previous years). University student research programs continued at the University of Nevada Las Vegas, Idaho Accelerator Center and the University of Nevada Reno.

In FY 2007 and FY 2008, the Department will continue to fund previously awarded NERI grants.

	FY 2006	FY 2007	FY 2008
Advanced Fuel Cycle Facility	**6,930**	**20,000**	**30,000**

The AFCF will be the world's foremost nuclear fuel cycle research and technology development facility, having engineering scale capabilities for the development of advanced proliferation-resistant fuel recycling technologies. In the near term, the AFCF will focus on demonstrating remote fabrication of transmutation fuels at a scale necessary for commercialization. It will be the only facility in the world capable of providing this assistance to industry.

AFCF will demonstrate advanced fuel recycling technologies as part of an integrated fuel cycle, an important element to the cost-effective commercialization of this technology. Fuel cycle operations will include: remote fabrication of various transmutation fuels; advanced aqueous and pyroprocessing separations; and advanced waste forms. AFCF will also provide a test bed capability for advanced nuclear material accounting and control systems, one of the primary technologies for significantly reducing nuclear weapon proliferation risks.

In the long term, the AFCF is needed for the U.S. to regain a leadership role in the nuclear fuel cycle. This is essential if the U.S. is to influence and promote the non-proliferation goals of GNEP. Moreover, the AFCF will be needed to continually improve the performance and cost-effectiveness of an integrated fuel cycle and help the U.S. to remain competitive in the global nuclear market.

In FY 2006, the program received Approval of Mission Need (Critical Decision-0) for the facility, which allowed the initiation of conceptual design and supporting development work on the AFCF concepts.

In FY 2007, work will continue on the AFCF with completion of 30 percent of conceptual design activities. Key elements of the conceptual design are the four technology modules of AFCF: remote transmutation fuel fabrication, advanced aqueous separations, pyroprocessing, and advanced waste forms. The AFCF design work is instrumental in identifying near term technology development requirements associated with each of the advanced technology modules.

In FY 2008, conceptual design work will continue, focusing on the transmutation fuel fabrication module of AFCF. Conceptual design work will continue at a reduced level on the other AFCF technology modules (i.e. advanced aqueous separations, pyroprocessing, and advanced waste forms), as well as the balance of plant. FY 2008 work will result in the completion of 70 percent of the conceptual design, and will include development of cost and schedule range estimates in support of the Secretarial decision in June 2008.

(dollars in thousands)

	FY 2006	FY 2007	FY 2008
Recycling Demonstration Program	**14,118**	**60,000**	**37,000**

The Recycling Demonstration Program will provide essential capabilities needed to recycle spent nuclear fuel in the U.S. Specifically, the light water reactor spent fuel separations technology demonstrated at a nuclear fuel recycling center will enable improved management of the resultant waste and reusable products. Some high-level waste will continue to require disposal in a geologic repository, but new waste forms can be managed in ways that are more commensurate with their lower hazards. The reusable transuranic products can be placed in fast reactor fuel for consumption while producing electricity. The program will engage with industry partners to establish spent fuel separations capability as a cornerstone for U.S. nuclear energy leadership.

In FY 2006, the program received Approval of Mission Need (Critical Decision-0) for the facility, which allowed the initiation of conceptual design and supporting development work on the spent fuel separations concepts for a nuclear fuel recycling center. Technology and engineering alternative studies were started, and a preliminary project risk management assessment identified early program risks and priorities. Departmental efforts seeking industry and international input for the spent fuel separations technologies was also initiated.

In FY 2007, the program will initiate the competitive industrial engagement necessary to start design activities on engineering- and commercial-scale nuclear fuel recycling center concepts that will meet GNEP proliferation-resistance, waste management, and product management objectives. This competition is focused specifically on chemical separations processes and product management components that are the most complex and important components needed to meet the GNEP objectives. This process will include a solicitation to provide conceptual design information on core technology that will remove near-term heat generating isotopes (i.e., Cesium and Strontium) for decay storage and long-term heat generating and radiotoxic transuranic isotopes (i.e., plutonium, neptunium, americium, and curium) for fast-reactor transmutation fuel fabrication. This technology will be applied with enhanced proliferation-resistance features using system design and state-of-the-art instrumentation.

Laboratory based testing and demonstrations of the recycling process and operational parameters are also being performed in FY 2007. This demonstration activity will prove the "repeatability" of the separations process results while testing a range of parameters to determine process sensitivity and the ability to meet performance requirements over a range of conditions. In parallel with this effort, GNEP light water reactor separations program requirements will be refined and evaluated through a series of engineering alternative studies. The studies include establishing a technical basis, evaluating a generic separations process, revising the technology risk management assessments, and developing system throughput studies, new waste form qualification requirements, and refining the estimated cost and schedule ranges for a spent fuel recycling facility.

	(dollars in thousands)		
	FY 2006	FY 2007	FY 2008

The competing teams selected in FY 2007 will be based on the expectation of public-private cost-sharing and will explore the possibility of private financing. These studies may identify other technical and programmatic opportunities that positively influence the GNEP business model. Based on the level of industry interest expressed to date, the Department is confident that industry involvement in engineering- or commercial-scale application of spent fuel chemical separations technology will enhance its effectiveness.

In FY 2008, the program will complete the industry-led conceptual design studies. Information developed during the conceptual design studies will provide a comprehensive basis for the mid-2008 Secretarial decision on the GNEP path forward.

Specific products to be provided by the industry-led conceptual design studies include concept drawings, equipment lists, facility layouts, site plans, and cost and schedule estimate ranges commensurate with the early phase of these design concepts, but of sufficient detail to outline scope, cost and schedule information to inform the Secretarial Decision. These studies will also provide detailed business case modeling, based on the each team's technical approach, which will analyze and measure the commercial feasibility of the proposed concept in the context of specific business parameters.

Advanced Burner Reactor Demonstration Analysis	**4,950**	**40,000**	**25,000**

The transmutation technology envisioned for GNEP is a fast-spectrum advanced recycling reactor, known as the ABR, which will consume transuranic elements from spent LWR fuel and spent fast reactor fuel. The ABR will use fuel produced from the components of spent fuel to generate electricity while reducing the burden on the Yucca Mountain geologic repository.

Input from industry and international partners confirm the feasibility of deploying a prototype fast reactor in the 2020-2025 timeframe. With the shutdown of the FFTF and EBR-II in the 1990s, there are no fast spectrum reactors currently operating in the U.S.

The ABR project will be implemented through two closely integrated paths. An industry-led path will design and build a prototype reactor which will demonstrate transmutation, qualify advanced reactor fuels and materials, demonstrate advanced design and safety features, and employ modern reactor safeguards. A complimentary path, led by the national laboratories, has two objectives. In the near-term, it will identify and deliver the most promising technologies for incorporation into the prototype ABR. In addition, the labs will conduct the long-term research and engineering to assure that subsequent commercial ABRs will be economically competitive with modern light water reactors. The Department will collaborate with international and industry partners on both paths.

In FY 2006, the program received Approval of Mission Need (Critical Decision-0) for the facility, which allowed the initiation of conceptual design and supporting development work on the ABR concepts.

(dollars in thousands)

In FY 2007, the Department will solicit and award design studies of the various competing fast reactor technologies. The design, cost and schedule information developed will help to determine the optimal technical parameters for the reactor prototype (size, power level, conversion ratio, etc.). Industry will also begin to develop input on the "technology roadmap" which will determine the technology development required (both near-term and longer-term) to support ABR deployment. The roadmap will define what needs to be done, who will do it (industry or government), when it is required and appropriate contingency plans or off-ramps. Options for fuel types and fabrication (or acquisition) will be evaluated. The establishment of an appropriate regulatory framework and a compliance strategy for licensing advanced fast reactors will be coordinated between DOE, the NRC and industry. International collaboration activities will be pursued, as well as support for the NEPA process.

In FY 2008, the Department will complete the multiple competitive ABR industry design studies begun in FY 2007. In addition to the technology roadmap, industry will provide input to the business model for GNEP, which will assure that the ABR project is part of an overall sound plan to commercialize a closed fuel cycle. The business model will consider the risks, incentives, revenues, and market considerations needed to establish the appropriate framework for an effective industry and government partnership.

Following the decision by the Secretary in mid-2008, the Department will select the most promising reactor technology(s) to proceed with conceptual design. The Department will work closely with industry and the NRC to develop an appropriate regulatory framework and compliance strategy for advanced fast reactors. Advanced concept studies will be conducted to evaluate alternatives for improving the capital, operating and maintenance costs for fast reactors. The Department will also evaluate options, including a new or refurbished facility to fabricate the fuel for initial plant startup and operations (including fuel reloading) until such time as transmutation fuel is available and the ABR core is converted. A selection on the fuel type and fabrication facility options is planned for FY 2008.

	FY 2006	FY 2007	FY 2008
GNEP Technology Development	**0**	**0**	**133,000**

The GNEP Technology Development activity provides support to each of the three GNEP projects (the engineering- to commercial-scale demonstration nuclear fuel recycling center, advanced recycling reactor, and AFCF), and supports the international collaboration and small reactor efforts.

The technology development activities described below are fully integrated with the design and construction schedules for each of these projects.

In FY 2006 and FY 2007, funds related to this area were requested as part of three separate budget elements (Advanced Fuel Cycle Facility, Recycling Demonstration Program, and Advanced Burner Reactor Demonstration Analysis.

The FY 2008 request for technology development funds the engineering- to commercial-scale demonstration nuclear fuel recycling center, advanced recycling reactor, and the AFCF. Unlike the

R&D work, this funding will be used to further develop technology that has been shown to be feasible at the laboratory or engineering scale as well as to optimize design parameters and size equipment.

In FY 2008, the following technology development activities will be conducted:

- Continue recycling technology development activities to address design and technology risks with input from the selected industry teams. The recycling technology development activities will provide necessary technology optimization and performance information to support the GNEP business model development and commercial deployment. Specifically, the Department will complete laboratory-based recycling process waste form and product form demonstration of the Cesiums/Strontium solidification technology, and of the fission product and off-gas treatment process waste forms; complete initial characterization of the mixed-transuranic solid product; and initiate demonstration of remote waste form packaging. These national laboratory activities will feed directly into the industry-led activities described above for the engineering- and commercial-scale concepts in order to refine the development of new waste form and product form designs and qualification activities. These activities are essential to reduce project risk and cost.

- Technology development activities in support of an advanced recycling reactor (known as the ABR) are focused on establishing the functional and operating requirements for the prototype; restoring the domestic infrastructure required to design, fabricate and test sodium components; validating the analytical tools used for reactor design; procurement of fast reactor irradiation services for transmutation fuel performance testing; and provision of necessary support facilities. The existing suite of fast reactor codes was based on the computer architecture of 20 years ago. These codes need to be updated, validated, and modified to operate on modern, massively parallel computer systems. Focused and innovative engineering tasks will identify the biggest cost drivers and most promising technologies to reduce the costs to design, construct and operate future commercial ABRs, as well as improve plant performance. Examples include: reactor fuel handling machines, intermediate heat exchangers, advanced liquid metal pumps, reactor control technologies, and balance of plant technologies unique to fast reactor applications.

- Continue AFCF technology development activities to support design of advanced fuel cycle systems to be installed in AFCF. Much of the FY 2008 work will involve fabrication of transmutation fuels that have high radiation fields and, as a result, will need to be performed remotely in hot cells. Work required to modify existing hot cells and install remote fuel fabrication equipment is included in the FY 2008 budget. Also included is feedstock preparation of the minor actinides, americium and curium. Other AFCF work will involve the development of instrumentation and control logic for nuclear material control and accountability. Instruments will be tested in a representative environment. Finally, domestic and international irradiation fuel tests will be required as part of the AFCF technology development activity.

AFCI/GNEP international collaboration offers the opportunity for the U.S. to leverage its fuel cycle research and development with countries that have fuel cycle research facilities and fast spectrum test reactors. These countries include Russia, France, and Japan.

	(dollars in thousands)		
	FY 2006	FY 2007	FY 2008

To fully meet the GNEP vision will require the deployment of numerous reactors in dozens of countries, many of which are in the developing world and do not currently use nuclear energy. However, because many countries in developing world have small and immature electricity grids, the currently available Generation III reactors are unsuitable since they are too large, too expensive, and too complex. Therefore, new types of reactors must be developed for international deployment that are "right sized" for the developing countries and that are based on technologies, designs, and policies focused on reducing proliferation risk. International collaborations will be pursued in nearly every aspect of the program and maximum use will be made of existing organizations, agreements, and collaborations.

The FY 2008 request will fund new international collaboration activities with foreign governments, including Russia. A small reactor effort will be initiated to evaluate small, proliferation-resistant reactors for potential U.S. manufacture and export in the near-term. Additionally, the results of a requirements study will be used to initiate cooperative R&D and preconceptual design activities on promising next-generation candidate reactor technologies.

Materials Test Station	**3,465**	**0**	**0**

This activity includes the design, fabrication and installation of a spallation neutron source into an existing experimental area at an operating linear accelerator national user facility (the Los Alamos Neutron Science Center, LANSCE). This project is being managed as the acquisition of a major item of equipment.

In FY 2006, the Department developed preconceptual designs for the proposed MTS at the LANSCE Accelerator. No specific funds are requested for the MTS in FY 2007 or 2008. A decision to support design and construction of MTS is dependent on two factors: 1) NNSA support of the LANSCE-Refurbishment project, which is a necessary prerequisite for MTS, and 2) availability of other international fast neutron sources for the testing and qualification of advanced transmutation fuels for the advanced recycling reactor. A portion of the requested Advanced Fuels Development budget is for fast neutrons to conduct the desired irradiation tests.

SBIR/STTR	**0**	**1,000**	**2,000**

The FY 2007 and FY 2008 amounts shown are estimates of the requirement for the continuation of the SBIR and STTR program.

Total, Advanced Fuel Cycle Initiative	**78,408**	**243,000**	**395,000**

Explanation of Funding Changes

	FY 2008 vs. FY 2007 ($000)
Separations Technology Development	
• The increase represents enhanced R&D activity to support qualification of the flowsheet to be utilized in GNEP processing through the conduct of multiple end-to-end tests using actual LWR spent fuel.	+13,000
Advanced Fuel Development	
• The decrease reflects the transfer some fuel development activities into the GNEP Technology Development budget element, mostly dealing with the development of remote fuel fabrication facilities. Fuels R&D will increase efforts towards enhanced test article qualification and fabrication for U.S. and international irradiation tests.	-20,000
Transmutation Science	
• The decrease reflects transfer of enhanced materials development supporting the ABR design into the GNEP Technology Development budget element.	- 10,000
Systems Analysis/Advanced Computing & Simulation	
• The increase represents significant enhancement in fundamental modeling analysis supporting GNEP, as well as expansion of analysis activities to include international aspects of GNEP.	+59,000
Transmutation Education	
• The increase reflects the cost associate with funding NERI grants.	+4,000
Advanced Fuel Cycle Facility	
• The increase reflects expanded conceptual design activities, particularly in the areas of process equipment design, nuclear safety, and cost estimation. This work is critical to the Secretary's decision in mid-2008.	+10,000
Recycling Demonstration Program	
• The decrease represents the completion of competing industry-led conceptual design studies for a light water reactor spent fuel treatment facility that support the Secretary's decision in mid-2008, and the consolidation of Recycling Demonstration design-driven technology development activities under the GNEP Technology Development program.	-23,000
Advanced Burner Reactor Demonstration Analysis	
• The decrease reflects the shift of technology development and research supporting the ABR into the GNEP Technology Development budget element.	-15,000

	FY 2008 vs. FY 2007 ($000)
GNEP Technology Development	
• The increase represents consolidation of all technology development activities supporting the GNEP AFCF, ABR, and Recycling Demonstration projects.	+133,000
SBIR/STTR	
• The increase doubles SBIR coverage related to the overall increase in GNEP R&D funding.	+1,000
Total Funding Change, Advanced Fuel Cycle Initiative	**+152,000**

Infrastructure

Funding Profile by Subprogram

	(dollars in thousands)		
	FY 2006 Current Appropriation	FY 2007 Request	FY 2008 Request
Infrastructure			
Radiological Facilities Management	54,049	49,722	53,021
Idaho Facilities Management	81,774[a]	95,290	104,713 [b]
Total, Infrastructure	135,823	145,012	157,734

Public Law Authorizations:
P.L. 109-103, Energy and Water Development Appropriations Act, 2006
P.L. 109-148, Emergency Supplemental Appropriations to Address Hurricanes in the Gulf of Mexico and Pandemic Influenza, 2006

Mission

The mission of the Infrastructure program within Energy Supply and Conservation appropriation is to manage the planning, acquisition, operation, maintenance, and disposition of nuclear facilities and infrastructure to conduct advanced nuclear energy research; to meet the growing demand for isotopes used in medicine, scientific research and homeland security; to provide radioisotope power systems for space exploration and national security; and to ensure the long term future of the domestic nuclear fuel supply.

The Infrastructure program includes Radiological Facilities Management and Idaho Facilities Management. The Radiological Facilities Management core program is funded under the Energy Supply and Conservation appropriation. Beginning in FY 2007, funding for the Idaho Facilities Management program was requested only under the Energy Supply and Conservation appropriation. Prior to FY 2007, the Idaho Facilities Management program was funded in both the Energy Supply and Conservation and the Other Defense Activities appropriations.

Benefits

The Infrastructure program keeps mission supporting DOE facilities and infrastructure in a user-ready status. Activities supported by this program include: operation and maintenance of reactors, hot cells, and infrastructure needed to carry out nuclear energy research and development; construction of power systems for national security missions and space exploration; production, packaging, and shipment of radioisotopes for medical and scientific applications; and testing of new fuels and core components for the Naval Nuclear Propulsion Program. DOE enables advances in science by making its nuclear facilities available to national and international users. The Department does not subsidize programmatic costs incurred by non-DOE users.

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[a] Excludes $17,584,000 appropriated under Other Defense Activities and $13,365,000 from Naval Reactors.
[b] Includes $2,450,000 for Radiological and Environmental Sciences Laboratory.

In FY 2005, the Department created the Idaho National Laboratory (INL) to serve as the center for the Department's nuclear energy research and development efforts. The INL plays a lead role in the Global Nuclear Energy Partnership, the Generation IV Nuclear Energy Systems Initiative, the Next Generation Nuclear Power Plant Program, the Nuclear Hydrogen Initiative, Space and Defense Power Systems, testing of naval reactor fuels and reactor core components, and a range of national security technology programs. While the laboratory focuses its research and development on 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. ATR currently conducts virtually all irradiation testing of Navy reactor fuels and core components and is vital to achieving the Department's Strategic 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. A series of independent studies have shown that the ATR can operate until mid-century and potentially beyond. In FY 2007, a study will be conducted to evaluate converting the ATR to a national user facility. Such an alternative funding arrangement would stabilize the funding base and make the reactor an attractive research tool for industrial and university researchers while supporting existing national security programs.

The Idaho Facilities Management (IFM) Program supports the Energy Policy Act of 2005 and the Atomic Energy Act of 1954 by maintaining and operating the INL site infrastructure that supports advanced nuclear energy technology research and development and multi-program use. IFM manages common-use equipment, facilities, land, and support services that are not otherwise funded by programs. Key activities conducted under these programs include ensuring that all landlord facilities meet essential safety and environmental requirements and are maintained at user-ready levels. Other key activities include managing all special nuclear materials contained in these facilities and managing some aspects of the site's environmental monitoring, D&D and waste management activities. The scope of this program will continue to increase as the Office of Environmental Management work at the site reaches various completion milestones.

Strategic and GRPA Unit Program Goals

The Department's Strategic Plan identifies five Strategic Themes (one each for energy security, nuclear security, scientific discovery, environmental responsibility and management excellence) plus 16 Strategic Goals that tie to the Strategic Themes. The Infrastructure program supports the following goal:

Strategic Theme 1, Energy Security
Strategic Goal 1.2, Environmental Impacts of Energy: Reduce greenhouse gas emissions and other environmental impacts (water use, land use, criteria pollutants) from our energy production and use.

The Infrastructure program has one GPRA Unit Program goal which contributes to Strategic Goals 1.2 in the "goal cascade":

GPRA Unit Program Goal 1.2.15.00: Maintain and Enhance National Nuclear Infrastructure - Maintain, enhance, and safeguard the Nation's nuclear infrastructure capability to meet the Nation's energy, medical research, space exploration, and national security needs.

Contribution to GPRA Unit Program Goal 1.2.15.00 (Maintain and Enhance 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 ensuring that all NE facilities meet essential safety and environmental requirements and are maintained at user-ready levels. Other key activities include managing all special nuclear materials contained in these facilities and the disposition of DOE materials under NE ownership.

Funding by Strategic and GPRA Unit Program Goal

(dollars in thousands)

	FY 2006	FY 2007	FY 2008
Strategic Goal 1.2, Environmental Impacts of Energy			
GPRA Unit Program Goal 1.2.15.00, Maintain and Enhance National Nuclear Infrastructure			
Radiological Facilities Management	54,049	49,722	53,021
Idaho Facilities Management	81,774[a]	95,290[b]	104,713
Total, Strategic Goal 1.2 (Infrastructure)	135,823	145,012	157,734

[a] Excludes $17,584,000 appropriated under Other Defense Activities and $13,365,000 from Naval Reactors.
[b] Beginning in FY 2007, all funding for Idaho Facilities Management is requested under Energy Supply and Conservation appropriation.

Annual Performance Results and Targets

FY 2003 Results	FY 2004 Results	FY 2005 Results	FY 2006 Results	FY 2007 Targets	FY 2008 Targets
GPRA Unit Program Goal 1.2.15.00 (Maintain and Enhance National Nuclear Infrastructure)					
Infrastructure					
Consistent with safe operations, achieve cumulative variance of less than 10 percent from each of the cost and schedule baselines for the Radiological Facilities Management and Idaho Facilities Management programs. (MET TARGET)	Consistent with safe operations, achieve cumulative variance of less than 10 percent from each of the cost and schedule baselines for the Radiological Facilities Management and Idaho Facilities Management programs. (MET TARGET)	Consistent with safe operations, achieve cumulative variance of less than 10 percent from each of the cost and schedule baselines for the Radiological Facilities Management and Idaho Facilities Management programs. (MET TARGET)	Consistent with safe operations, achieve cumulative variance of less than 10 percent from each of the cost and schedule baselines for the Reactor Technology Complex and the Materials and Fuels Complex. (MET TARGET)	Consistent with safe operations, achieve cumulative variance of less than 10 percent from each of the cost and schedule baselines for the Radiological Facilities Management (RFM) and Idaho Facilities Management (IFM) programs at INL.	Consistent with safe operations, achieve cumulative variance of less than 10 percent from each of the cost and schedule baselines for the Radiological Facilities Management (RFM) and Idaho Facilities Management (IFM) programs at INL.
Radiological Facilities Management					
Keep cost and schedule milestones for upgrades and construction of key nuclear facilities within 10 percent of approved baselines. (MET TARGET)	Keep cost and schedule milestones for upgrades and construction of key nuclear facilities within 10 percent of approved baselines, using the cost-weighted mean percent variance (+/-10 percent) approach. (MET TARGET)	Keep cost and schedule milestones for upgrades and construction of key nuclear facilities within 10 percent of approved baselines, using the cost-weighted mean percent variance (+/-10 percent) approach. (MET TARGET)	Maintain operability of Radiological Facilities Management and Idaho Facilities Management-funded facilities to enable accomplishment of Nuclear Energy, other DOE and Work-for-Others milestones by achieving a Facility Operability Index of 0.9. (MET TARGET)	Maintain operability of key Radiological Facilities Management and Idaho Facilities Management-funded facilities to enable accomplishment of Nuclear Energy, other DOE and Work-for-Others milestones by achieving a Facility Operability Index of 0.9.	Maintain operability of key Radiological Facilities Management and Idaho Facilities Management-funded facilities to enable accomplishment of Nuclear Energy, other DOE and Work-for-Others milestones by achieving a Facility Operability Index of 0.9.
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 TARGET)	Consistent with safe operations, maintain and operate key nuclear facilities so the unscheduled operational downtime will be kept to less than 10 percent, on average, of total scheduled operating time. (MET TARGET)				
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	Maintain and operate radioisotope power systems facilities with less than 10 percent unscheduled downtime from approved baseline. (MET TARGET)				

FY 2003 Results	FY 2004 Results	FY 2005 Results	FY 2006 Results	FY 2007 Targets	FY 2008 Targets
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 TARGET)					
Idaho Facilities Management					
Keep cost and schedule milestones for upgrades and construction of key nuclear facilities within 10 percent of approved baselines, using the cost-weighted mean percent variance (+/-10 percent) approach. (Same target used for Radiological Facilities Management). (MET TARGET)	Keep cost and schedule milestones for upgrades and construction of key nuclear facilities within 10 percent of approved baselines, using the cost-weighted mean percent variance (+/-10 percent) approach. (Same target used for Radiological Facilities Management). (MET TARGET)	Keep cost and schedule milestones for upgrades and construction of key nuclear facilities within 10 percent of approved baselines, using the cost-weighted mean percent variance (+/-10 percent) approach. (Same target used for Radiological Facilities Management). (MET TARGET)	Maintain operability of radiological Facilities Management and Idaho Facilities Management-funded facilities to enable accomplishment of Nuclear Energy, other DOE and Work-for-Others milestones by achieving a Facility Operability Index of 0.9.(MET TARGET)	Maintain operability of key Radiological Facilities Management and Idaho Facilities Management-funded facilities to enable accomplishment of Nuclear Energy, other DOE and Work-for-Others milestones by achieving a Facility Operability Index of 0.9.	Maintain operability of key Radiological Facilities Management and Idaho Facilities Management-funded facilities to enable accomplishment of Nuclear Energy, other DOE and Work-for-Others milestones by achieving a Facility Operability Index of 0.9.

Means and Strategies

The Infrastructure program will use various means and strategies to achieve its GPRA Unit 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.

The Department will implement the following means:

- Ensure that mission essential systems, resources, and services are identified, maintained, and operated in compliance with DOE, Federal, and State safety and environmental requirements in a secure and cost-effective manner. The Idaho Facilities Management has established an INL Ten Year Site Plan to accomplish this that will be updated semi-annually and approved by the DOE.

- Maintain isotope processing 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.

- Aggressively implement contracting reforms, including fixed price competitive bidding, earned value management, capital planning processes in accord with DOE Order 413.3, independent external evaluations, etc., to ensure that the infrastructure program is operating effectively and efficiently to meet the Department's highest priority program needs.

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 be based on this Plan that will be updated semi-annually.

- Efficient use of existing isotope processing 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.

- Meet periodically throughout the year with INL, Nuclear Regulatory Commission, NNSA and the Test, Research, and Training Reactor management Group (TRTR) to review university research reactor activities; discuss program issues; and solicit input, advice and guidance.

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

- Medical Isotope Infrastructure Key External Factors: The Department is working to address its responsibilities to maintain the infrastructure required to produce isotopes used in medical research and treatment and in industrial applications. Funding priority will be placed upon maintaining existing infrastructure.

- Idaho Facilities Management Key External Factors: Increased nuclear energy R&D would impact the focus and direction of the Idaho Facilities Management Program, but not necessarily impact its overall costs and long-term liabilities. On the other hand, increased nuclear energy R&D needs resulting from new mission initiatives could require accelerated recapitalization to support enhanced use of research facilities, new construction and earlier enhancement of the existing infrastructure.

With the award of the new Idaho National Laboratory contract in FY 2005, Idaho is developing as a multi-program national laboratory with NE as the lead program. Through the Idaho Operations Office, NE integrates and oversees program activities, and manages the Department of Energy and Work for Others contracts. The Office of Environmental Management (EM), through the execution of the Idaho Cleanup Project (ICP), is currently the largest program at the site, but that will change over time as the clean-up progresses.

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

- Coordinates with national security agencies and NASA in developing 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 isotope production and distribution expenses for isotopes that are not commercially available or are in short supply through cash collections from both Federal and non-Federal customers. The program is working to address its customers' requirements and to forecast future trends. This is being done through frequent interactions between customers and program staff, data obtained from customer site visits and attendance at society conferences (*e.g.*, the Society of Nuclear Medicine), and coordination of isotope activities with stakeholders in the isotope community, including other Federal agencies.

- Coordinates with the National Nuclear Security Administration to convert the university research reactors with highly enriched uranium to low enriched uranium.

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 periodic review by the Congress, the General Accountability Office, the Department's Inspector General, the Nuclear Regulatory Commission, the U.S. Environmental Protection Agency, state environmental and health agencies, 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 and the Idaho Facilities Management 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.

Over the last ten years, studies conducted by the American Nuclear Society and Society of Nuclear Medicine have identified consequences of radioisotope shortages on needed medical research, diagnosis, therapy, homeland security, and industrial applications. Studies have concluded that there is a national shortage of isotopes needed to conduct research. To address these concerns, NE is evaluating options with National Institute of Health (NIH), and will address future needs for radiopharmaceutical development and medical research isotope supply.

In FY 2006, the Office of Nuclear Energy contracted with the National Academy of Sciences to conduct an extensive comprehensive, independent evaluation of R&D and Infrastructure program goals and plans, and the process for establishing program priorities and oversight. The evaluation will result in a comprehensive and detailed set of policy and research recommendations and associated priorities (including performance targets and metrics) for an integrated agenda of research activities within the scope of available resources that can best advance NE's fundamental mission of securing nuclear energy as a viable, long-term commercial energy option to provide diversity in energy supply. The results of this study, scheduled for completion by October 2007, will inform future budget submissions.

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. NE's Infrastructure program has incorporated feedback from OMB into the FY 2008 Budget Request and has taken the necessary steps to continue to improve performance.

The results of the FY 2006 review are reflected as follows:

The assessment found that the program is effectively targeted through the formal Idaho National Laboratory Ten Year Site Plan that identifies the mission-essential infrastructure and facilities, planned annual work scope, and performance measures for the laboratory. An overall PART score of 49 was achieved with a perfect 100 score for Section I, Program Purpose & Design; a score of 89 for Section II, Strategic Planning; a perfect 100 score for Section III, Program Management; and a score of 0 for Section IV, Program Results/Accountability since the program is too new to have demonstrated accomplishments. The assessment also found that the program needed to collect timely and credible performance information to manage the Idaho Facilities Management program in providing effective and efficient infrastructure support to INL's program missions. The program has developed measures to track its performance against cost and schedule baselines for FY 2007 and beyond. Further, the program has developed a Facility Operability Index measure that assesses the operability of key indicator facilities required for the achievement of NE, other DOE and Work-For-Others milestones.

Radiological Facilities Management

Funding Schedule by Activity

(dollars in thousands)

	FY 2006	FY 2007	FY 2008
Radiological Facilities Management			
Space and Defense Infrastructure	39,303	30,650	35,110
Medical Isotopes Infrastructure	14,251	15,634	14,964
Enrichment Facility Infrastructure	495	491	0
Research Reactor Infrastructure	0	2,947	2,947
Total, Radiological Facilities Management	54,049	49,722	53,021

Description

The mission of the Radiological Facilities Management program is to maintain nuclear facilities, primarily those housing large glove boxes, hot cells, and their associated support facilities in a safe, environmentally-compliant and cost-effective manner to support national priorities. The Radiological Facilities Management program funds the management of the Department's vital resources and capabilities at Office of Nuclear Energy (NE) managed facilities at Idaho National Laboratory (INL), Oak Ridge National Laboratory (ORNL), Los Alamos National Laboratory (LANL), and Brookhaven National Laboratory (BNL).

Benefits

These funds assure that the infrastructure for the above mentioned NE nuclear facilities meet essential safety and environmental requirements and are maintained at operable user-ready levels. Programmatic activities, including production and research, are funded either by other DOE programs, by the private sector, or by other Federal agency users.

Specifically, the Department maintains unique facilities and capabilities at the Idaho, Oak Ridge, and Los Alamos National Laboratories that enable the Department to provide the radioisotope power systems for space exploration and national security applications. Departmental funding maintains the basic facilities and associated personnel whereas mission specific development or hardware fabrication costs are provided by the user agencies. This arrangement is essential in order to preserve the basic capability regardless of periodic fluctuations in the demand of the end product users.

In addition, the Department maintains one-of-a-kind facilities at the Idaho, Oak Ridge, Brookhaven, and Los Alamos National Laboratories for isotope production and processing. These isotopes are used to help improve the accuracy, effectiveness, and continuation of medical diagnoses and therapy, enhance homeland security, improve the efficiency of industrial processes, and provide precise measurement and investigative tools for materials, biomedical, environmental, archeological, and other research. Actual operations, production, research or other activities are funded either by other DOE programs, by the private sector, or by other Federal agency users.

Finally, the Department provides fresh reactor fuel to universities and disposes of spent fuel from university reactors. Currently, there are 27 operating university research reactors at 27 institutions in the United States (U.S.). Many of these facilities have permanent fuel cores and therefore do not require regular fuel shipments. However, DOE supplies approximately a dozen universities with fresh fuel and shipments of spent fuel as needed.

Detailed Justification

	(dollars in thousands)		
	FY 2006	FY 2007	FY 2008
Space and Defense Infrastructure	**39,303**	**30,650**	**35,110**
▪ **Idaho National Laboratory (INL)**	**20,503**	**12,200**	**14,970**
• **Radioisotope Power Systems Assembly Operations**	**16,380**	**8,000**	**9,170**

The Department's funding maintains the facilities at INL in an operational status and the user agencies fund mission specific assembly or testing operations. The fueling operations for the New Horizons/Pluto mission were conducted from mid-FY 2005 through early FY 2006, and the radioisotope power system was delivered to National Aeronautics and Space Administration (NASA) and launched aboard the New Horizons mission to Pluto. The focus in FY 2008 is to support the readiness for assembly and testing of generators for two national security applications. The first set of generators for a national security application is scheduled to be delivered in early FY 2009. In conjunction with the national security applications INL will also be working towards the qualification of a Multi-Mission Radioisotope Thermoelectric Generator (MMRTG) for NASA. In FY 2008, INL will begin the process of fueling the qualification unit for the MMRTG. NASA will potentially use the new MMRTG for the upcoming Mars Science Laboratory Mission scheduled to launch in 2009. This will be the first time assembly operations for two independent programs will be conducted at the same time. In addition, the Department will continue to transfer its inventory of neptunium-237 (Np-237) from the Savannah River Site to the INL in FY 2007. The Np-237 is required to produce new Pu-238.

• **Capital Equipment for Radioisotope Power System Assembly Operations**	**200**	**200**	**1,500**

In order to sustain the facility in an operational status, a continuing level of capital equipment funding is required for routine maintenance and infrastructure support. The increase in funding in FY 2008 is primarily for replacement of shipping containers that can no longer be used due to regulations or age.

• **Safety/Program Analysis and Testing Infrastructure**	**3,923**	**4,000**	**4,300**

The Department maintains an analytical and testing infrastructure at INL and other sites that enable the Department to analyze the performance and ensure the safety of the radioisotope power systems for various applications. This capability allows the operation and update of sophisticated analytical codes that can analyze the behavior of materials and systems under potential accident environments. These codes will also predict performance under different operational conditions for various types of systems. The Department funding maintains the

	(dollars in thousands)		
	FY 2006	FY 2007	FY 2008

basic capability and infrastructure, but if additional mission specific analysis or testing is required, the user agency provides the funding for these mission specific efforts. In FY 2007 and FY 2008, analysis techniques and computer codes will be updated to incorporate more advanced capabilities that can provide more accurate and detailed projections in support of future missions.

	FY 2006	FY 2007	FY 2008
▪ **Los Alamos National Laboratory (LANL)**	**13,800**	**13,800**	**15,060**
• **Pu-238 Encapsulation and Scrap Recovery Facilities**	**12,500**	**12,500**	**13,760**

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. These unique facilities provide the only U.S. capability to purify, pelletize and encapsulate the Pu-238 so that it can be used in radioisotope power systems. These facilities will be operational at least through FY 2014 and thus available to help meet agency missions. The focus in FY 2007 and FY 2008 will be on national security applications and the multi-mission radioisotope thermoelectric generator for NASA. The funding request maintains the basic capabilities and infrastructure in operational status and produces some qualified product as part of this process. If expanded effort is required to produce material for specific missions or applications, the funding for this extra effort is provided by the user agencies. FY 2008 funding will allow continued safe and reliable operation of the facility while conducting programs for two separate user agencies.

	FY 2006	FY 2007	FY 2008
• **Capital Equipment for the Pu-238 Facilities**	**1,300**	**1,300**	**1,300**

Maintenance of the Pu-238 facilities requires regular upgrades and replacement of gloveboxes and equipment in the processing, encapsulation, and scrap recovery lines. Installation of new gloveboxes and upgrading or maintenance of other gloveboxes and equipment will take place in FYs 2007 and 2008.

	FY 2006	FY 2007	FY 2008
▪ **Oak Ridge National Laboratory (ORNL)**	**5,000**	**4,650**	**5,080**
• **Iridium Fabrication Facilities for Radioisotope Power Systems**	**4,500**	**4,150**	**4,580**

The Department maintains a unique infrastructure and capability at ORNL to fabricate iridium cladding and carbon insulators used to encapsulate and contain the Pu-238 pellets used in radioisotope power systems. These heat source components are necessary for the safe operation of the radioisotope power systems. FY 2008 funding will allow continued operation of the facility.

	FY 2006	FY 2007	FY 2008
• **Capital Equipment for Iridium Fabrication Facilities**	**500**	**500**	**500**

In FY 2008, ORNL will continue to upgrade and replace antiquated equipment to support iridium processing and fabrication at ORNL.

	FY 2006	FY 2007	FY 2008
	(dollars in thousands)		
Medical Isotopes Infrastructure	**14,251**	**15,634**	**14,964**
▪ **Oak Ridge National Laboratory (ORNL)**	**6,279**	**7,165**	**7,564**
• **Building 3047 Hot Cells**	**2,866**	**3,100**	**0**

As part of the ORNL consolidation and facility revitalization, all isotope processing has been transferred at the end of FY 2006. FY 2007 funding will be used to remove remaining equipment and supplies and cleanup of the hot cells to prepare for decontamination and decommissioning and to start up the hot cells activities in building 4501 and 7920.

	FY 2006	FY 2007	FY 2008
• **Buildings 4501 and 7920 Hot Cells**	**0**	**0**	**3,800**

All isotope processing activities have been transferred to Buildings 4501 and 7920 from Building 3047. The Department will maintain these facilities in a safe and environmentally compliant condition for processing, packaging, and shipment of radioisotopes and other related services needed in medical diagnostic and therapeutic applications, homeland security applications, and other scientific research used by Federal and non-Federal entities. Activities include maintenance, radiological monitoring, facility inspections, inventory and delivery tracking. Isotope customers will pay the full cost of isotope processing in this facility.

	FY 2006	FY 2007	FY 2008
• **Buildings 9204-3 and 5500 – Chemical and Materials Laboratories**	**2,763**	**3,000**	**3,764**

Funding maintains the two laboratories in a safe and environmentally compliant condition for the processing, packaging, and shipment of stable isotopes, customer accountability 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, facility inspections and customer order and account tracking. Over the next several years, the Department will continue to phase out the Calutrons in Building 9204-3 at Y-12.

	FY 2006	FY 2007	FY 2008
• **Isotope Production**	**650**	**715**	**0**

FY 2006 and 2007 funding provided for the Department's isotope business management including 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. Business trend analyses, surveys, and tracking responses to customer inquiries are also centralized at ORNL. This E-Government isotope business management information system not only expedites customer orders, but also saves several hundreds of thousands of dollars of administration expenses annually. Starting in FY 2008, funds for these activities are included in the other ORNL activity lines.

	FY 2006	FY 2007	FY 2008
• **Capital Equipment**	**0**	**350**	**0**

In FY 2007, upgrade the NRC license for one type of shipping container to a type BU-96 to enable shipment of a larger number of isotope products to customers and between isotope producing sites.

	FY 2006	FY 2007	FY 2008
	(dollars in thousands)		
▪ **Los Alamos National Laboratory (LANL)**	**2,922**	**3,214**	**3,650**
• **Isotope Production Facility/TA-48 Hot Cell, Building RC-1**	**2,922**	**3,214**	**3,650**

Maintain facilities in a safe and environmentally compliant condition for the production, processing, packaging, and shipment of radioisotopes and other services needed in medical diagnostic and therapeutic applications, and other scientific research used by Federal and non-Federal entities. Activities include maintenance, radiological monitoring, and facility inspections. Isotope customers will pay the full cost of isotope processing in these facilities.

	FY 2006	FY 2007	FY 2008
▪ **Sandia National Laboratories (SNL)**	**1,900**	**1,800**	**0**
• **TA-5 ACRR & Hot Cells**	**1,900**	**1,800**	**0**

The Isotope Programs no longer has a programmatic need for the Annular Core Research Reactor (ACRR). National Nuclear Security Administration (NNSA) uses the ACRR for its weapons experiments and is currently the only user. In FY 2006, an agreement was reached with NNSA to initiate transfer of the ACRR back to them in FY 2007. The transfer of the ACRR to NNSA and hot cell that have been maintained in a non-nuclear status will be completed by the end of FY 2007.

	FY 2006	FY 2007	FY 2008
▪ **Brookhaven National Laboratory (BNL)**	**2,650**	**2,905**	**3,200**
• **Brookhaven Linear Isotope Producer (BLIP) Building 931 and Hot Cell Building 801**	**2,650**	**2,905**	**3,200**

Maintain the BLIP Building 931 and Hot Cell Building 801 facilities in a safe, environmentally compliant condition and state of readiness for the production of radioisotopes and other services needed in medical diagnostic, therapeutic applications, and other scientific research used by Federal and non-Federal entities. Activities include maintenance, radiological monitoring, and facility inspections. Isotope customers will pay the full cost of isotope processing in this facility.

	FY 2006	FY 2007	FY 2008
▪ **Other Activities**	**500**	**550**	**550**
• **Associated Nuclear Support**	**500**	**550**	**550**

This funding provides for requirements applicable to isotope producing sites. Such items include annual Nuclear Regulatory Commission certification of isotope shipping casks, independent financial audits of the revolving fund, and other related expenses.

	FY 2006	FY 2007	FY 2008
Enrichment Facility Infrastructure	**495**	**491**	**0**
▪ **Oak Ridge Operations Office**	**495**	**491**	**0**

Funding provides for oversight and monitoring of the maintenance of DOE leased assets at the Paducah Gaseous Diffusion Plant site. The DOE-owned Paducah site is the only operating domestic enriched uranium production facility. Its continued operation is essential to assure an adequate supply of nuclear fuel for the Nation’s electric utilities. The Paducah GDP lessee, U.S.

Enrichment Corporation Inc. (USEC), committed, in a DOE-USEC Memorandum of Agreement on June 17, 2002, to maintain the long-term operability of the Department-owned Paducah GDP until new centrifuge enrichment technology is deployed by the end of this decade. This program will inspect and analyze operating and maintenance data, and observe industrial activities at the Paducah GDP, and validate GDP maintenance each year, to assure that USEC meets its MOA commitments and that the Government's rights and options are preserved. Beginning in FY 2008, Oak Ridge Operations Office will assume direct responsibility for these oversight and monitoring activities.

	FY 2006	FY 2007	FY 2008
Research Reactor Infrastructure	**0**	**2,947**	**2,947**
▪ **Idaho Operations Office**	**0**	**2,947**	**2,947**

The Department is responsible for providing fresh reactor fuel to universities and disposing of spent fuel from university reactors. In FY 2006, the Department continued to provide fresh fuel to universities and ship spent fuel from university reactors to designated storage facilities. During FY 2007 and 2008, the program will continue to provide fuel services to universities that have recurring fuel needs. In 2008, the current certification for the BMI-1 shipping cask will expire. A two year period is required to fabricate a cask. If fabrication begins in FY 2009, a cask will need to be leased during FY 2009 and 2010 to enable continuation of spent fuel shipments from reactors at the Massachusetts Institute of Technology, the University of Missouri and various other university reactors.

	FY 2006	FY 2007	FY 2008
Total, Radiological Facilities Management	**54,049**	**49,722**	**53,021**

Explanation of Funding Changes

	FY 2008 vs. FY 2007 ($000)
Space and Defense Infrastructure	
▪ **Idaho National Laboratory (INL)**	
• **Radioisotope Power Systems Assembly Operations** The increase of $1,170,000 allows the program to continue safe power system assembly operations with increased reliability under the increased demands of conducting programs for two separate user agencies.	+1,170
• **Capital Equipment for Radioisotope Power System Assembly Operations** The increase of $1,300,000 will allow the Department to replace 7 of the 13 required shipping containers used for the shipment of Pu-238 in order to comply with new Federal regulations; replace antiquated weld equipment and magnetics test equipment.	+1,300

	FY 2008 vs. FY 2007 ($000)
• **Safety/Program Analysis and Testing Infrastructure** The increase of $300,000 permits DOE to carry out its safety assessment role in the Presidential launch approval process under the National Security Council Presidential Directive 25 (NSC/PD-25) and to maintain a predictive capability to locate DOE radioisotope power sources in the event of an orbital decay accident.	+300
▪ **Total, Idaho National Laboratory**	**+2,770**
▪ **Los Alamos National Laboratory (LANL)**	
• **Pu-238 Encapsulation and Scrap Recovery Facilities** The increase of $1,260,000 allows the program to continue safe operations for fuel production with increased reliability under the increased demands of conducting programs for two separate user agencies.	+1,260
▪ **Oak Ridge National Laboratory (ORNL)**	
• **Iridium Fabrication Facilities for Radioisotope Power Systems** The $430,000 increase will provide funding required for the Department to continue safe, reliable operations of this facility.	+430
Total, Space and Defense Infrastructure	**+4,460**
Medical Isotopes Infrastructure	
▪ **Oak Ridge National Laboratory (ORNL)**	
• **Building 3047 Hot Cells** As part of the ORNL consolidation and facility revitalization, all isotope processing has been transferred at the end of FY 2006. FY 2007 funding will be used to prepare the hot cells for decontamination and decommissioning.	-3,100
• **Buildings 4501 and 7920 Hot Cells** In place of Building 3047, Buildings 4501 and 7920 will be used for processing isotopes. These funds will permit maintaining the recently enhanced 4501 hot cells as a Food and Drug Administration approved current Good Manufacturing Practices facility needed for medical isotopes as well as maintaining the isotope inventory and tracking system.	+3,800
• **Buildings 9204-3 and 5500 – Chemical and Materials Laboratories** The increase of $764,000 will be used to maintain the two laboratories in a safe and environmentally compliant condition for the processing, packaging, and shipment of stable isotopes and maintaining the isotope customer order and accounts tracking systems consistent with FY 2007 funding level.	+764
• **Isotope Production** The decrease of $715,000 is due to these activities no longer being funded under this program.	-715

	FY 2008 vs. FY 2007 ($000)
• **Capital Equipment** The decrease of $350,000 reflects completion of the upgrade to the NRC license for one type of shipping container to a BU-96 shipping container, enabling shipment of a larger number of isotope products.	-350
▪ **Total, Oak Ridge National Laboratory**	**+399**
▪ **Los Alamos National Laboratory (LANL)**	
• **Isotope Production Facility/TA-48 Hot Cell, Building RC-1** The increase of $436,000 will be used to maintain these facilities consistent with the FY 2007 funding level and permit improvements to comply with the Food and Drug Administration requirements for maintaining current Good Manufacturing Practices facilities needed for medical isotopes.	+436
▪ **Sandia National Laboratories (SNL)**	
• **TA-5 ACRR & Hot Cells** The decrease of $1,800,000 reflects the transfer of the reactor to NNSA and hot cells. There is no mission need or isotope program activities conducted at ACRR.	-1,800
▪ **Brookhaven National Laboratory (BNL)**	
• **Brookhaven Linear Isotope Producer (BLIP) Building 931 and Hot Cell Building 801** The increase of $295,000 will be used to maintain the facility consistent with the FY 2007 funding level and permit improvements to comply with the Food and Drug Administration requirements for maintaining current Good Manufacturing Practices facilities needed for medical isotopes	+295
Total, Medical Isotopes Infrastructure	**-670**
Enrichment Facility Infrastructure	
▪ **Oak Ridge Operations Office**	
• **Enrichment Facility Infrastructure** Beginning in FY 2008, Oak Ridge Operations Office will assume direct responsibility for oversight and monitoring of the maintenance of DOE leased assets at the Paducah Gaseous Diffusion Plant site. This program assures that USEC Inc. meets its MOA commitments and that the Government's rights and options are preserved.	-491
Total Funding Change, Radiological Facilities Management	**+3,299**

Capital Operating Expenses and Construction Summary

Capital Operating Expenses

(dollars in thousands)

	FY 2006	FY 2007	FY 2008
Capital Equipment	2,000	2,350	3,300
Total, Capital Operating Expenses	2,000	2,350	3,300

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: Los Alamos National Laboratory, Brookhaven National Laboratory, and Oak Ridge National Laboratory. Each of the sites' production expenses for processing and distributing isotopes will be offset by revenue generated from sales. See the Radiological Facilities Management section for justification of the direct appropriations requested.

Description

The Isotope Programs (Isotope Production and Distribution Program Fund) produces and sells radioactive and stable isotopes, byproducts, surplus materials, and related isotope services world wide. The Isotope Programs operates under a revolving fund established by the 1990 Energy and Water Appropriations Act (Public Law 101-101), as modified by Public Law 103-316. Each isotope will be priced such that the customer pays the cost of production. The DOE will continue to sell commercial isotopes at full-cost recovery.

The Program's fiscal year appropriation is received via transfer from the Radiological Facilities Management Unit. The appropriation is used to maintain and upgrade the infrastructure that is needed to assure continued reliable production, with the production costs borne by the customers. No Radiological Facilities Management program funds will be expended on the development or production of isotopes.

The combination of the annual direct appropriation and revenues from isotope sales are deposited in the Isotope Production and Distribution Program Fund, the revolving fund. 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.

Benefits

The Department has supplied isotopes and related services for more than 50 years. These isotope products and services are used by medical institutions, universities, research organizations, and industry for a wide array of uses and applications. These isotope products and services are also provided too many Federal agencies either directly or indirectly. For example, isotopes are provided to the National Institutes of Health and their grantees, Environmental Protection Agency, and Homeland Security.

As the range of available isotopes and the recognized uses for them have increased, new or improved isotope products have contributed to progress in medical research and practice, new industrial processes, and scientific investigation. Substantial national and international infrastructures have been built around the use of isotopes and are dependent on the Department's products and services. Isotopes are used for hundreds of research, biomedical, homeland security, and industrial applications that benefit society every day, for example, heart imaging, cancer therapy, smoke detectors, neutron detectors, explosive detection, oil exploration, and tracers for climate change.

Isotope applications are widely used in medical research, diagnosis, and therapies, which are 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. It is estimated that one in every three people treated at a hospital makes use of a radioisotope in their laboratory tests, diagnoses, or therapy. Each day, over 40,000 medical patients receive nuclear medicine procedures in the United States. Such nuclear procedures are among the safest diagnostic tests available. They save many millions of dollars each year in health care costs and enhance the quality and effectiveness of patient care by avoiding costly exploratory surgery and similar procedures. For example, it has been demonstrated that the use of myocardial perfusion imaging in emergency department chest pain centers can reduce duration of stay on average from 1.9 days to 12 hours. 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.

Isotope uses in Homeland Security applications are also increasing. Some isotope applications are: radiation portal monitors used to find unshielded or lightly shielded radiological material; imaging systems used to find densely shielded material; systems to detect presence of nitrogen-based chemical explosives; and other forms of explosive detection.

For the future, the Department foresees more than moderate growth in isotope demand, coupled with possible needs for new isotope products for homeland security, medicine, and industry. In order to satisfy the needs of its customers, the program seeks to meet supply requirements for year-round availability of isotopes for scientific and medical research and, in particular, for human clinical trials. The program's production capability may be called upon for initial ramp-up of production of major new isotope products until market forces bring in private producers who are willing to invest and produce the needed isotopes.

Idaho Facilities Management

Funding Schedule by Activity

(dollars in thousands)

	FY 2006	FY 2007	FY 2008
Idaho Facilities Management			
Idaho National Laboratory Infrastructure			
INL Operations and Infrastructure	70,929	89,260	102,263
INL Construction	10,845	6,030	0
Radiological and Environmental Sciences Laboratory	0	0	2,450
Total, Idaho Facilities Management	81,774[a]	95,290	104,713[b]

Description

The Idaho Facilities Management (IFM) Program operates and maintains the three main engineering and research campuses and the Central Facilities Area (CFA) at the Idaho National Laboratory (INL). The three main engineering and research campuses are: (1) the Advanced Test Reactor (ATR) Infrastructure in the Reactor Technology Complex (RTC), (2) the Materials and Fuels Complex (MFC), and (3) the Science and Technology Campus (STC). RTC and MFC are located at the site, an 890 square mile reservation west of Idaho Falls, and STC is located within Idaho Falls. As INL landlord, the IFM Program operates and maintains the CFA at the site, which provides site-wide support services and from which various site infrastructure systems and facilities, such as electrical utility distribution, intra-laboratory communications systems, and roads are managed and maintained. Also included within the CFA is the Radiological and Environmental Sciences Laboratory operated by the Office of Nuclear Energy (NE).

Benefits

The IFM program supports National Energy Policy goals by maintaining and operating the INL's basic infrastructure that is required to support facilities dedicated to advanced nuclear energy technology research and development and many other Federal government programs. Additional activities include managing special nuclear materials contained in these facilities and the disposition of DOE legacy waste materials under NE ownership. The Atomic Energy Act of 1954, Chapter 4, Sections 31, 32, and 33, mandates that the Department conduct research and development for nuclear energy. Section 955 of the Energy Policy Act of 2005 (EPACT 2005) directs the Secretary of Energy to operate and maintain civilian nuclear infrastructure and facilities to support nuclear energy activities, including the development of recapitalization priorities and a timeline and proposed budget for the completion of deferred maintenance on plants and equipment. It also requires the development of a comprehensive plan for INL facilities.

[a] Funding excludes $17,584,000 appropriated under Other Defense Activities and $13,365,000 from Naval Reactors.

[b] Beginning in FY 2008, funding is included for activities previously funded by the former Office of Environment, Safety and Health.

NE has developed an INL Ten Year Site Plan (TYSP) that serves as a guide to annual budget requirements for the IFM Program, provides a mission needs analysis of facilities and infrastructure, and identifies the maintenance and recapitalization investments that could be undertaken at the site to support projected missions such as: the Global Nuclear Energy Partnership; the Next Generation Nuclear Plant Program; the Generation IV Nuclear Energy Systems Initiative; the Nuclear Hydrogen Initiative; Space and Defense Power Systems; the Naval Reactors Program; a range of national security technology programs; and the Idaho Cleanup Project (ICP) under the Office of Environmental Management (EM). The plan meets the requirements of DOE Order 430.1B, *Real Property Asset Management* (RPAM).

Prior to FY 2007, the IFM Program was funded in both the Energy Supply and Conservation and the Other Defense Activities appropriations. Beginning in FY 2007, the IFM Program is requested only under the Energy Supply and Conservation appropriation.

Detailed Justification

	(dollars in thousands)		
	FY 2006	FY 2007	FY 2008
INL Operations and Infrastructure	**70,929**	**89,260**	**104,713**
▪ **Base Operations**	**44,239**	**55,088**	**51,300**

IFM Base Operations provides funding to support the MFC and the Site Wide Infrastructure (SW) Base Operations. Beginning in FY 2008, funding to support the RTC Base Operations is requested under ATR infrastructure. The MFC Base Operations provides infrastructure support, including environmental services, to all MFC facilities and laboratories. It also maintains and operates ten major nuclear and radiological facilities and associated support systems. The MFC occupies about 100 acres and includes 50 major buildings and 19 major support structures.

SW Base Operations manages and maintains the STC in Idaho Falls, the CFA at the site, and the INL common-use facilities, utilities, equipment, and land. The CFA consists of 72 buildings and 60 major support structures. The STC includes 30 DOE owned and leased buildings consisting primarily of office space and extensive laboratory facilities. SW facilities, outside NE campuses and the ICP work complexes, consist of 34 buildings and 35 major utility systems and structures.

▪ **Routine Maintenance and Repair**	**7,197**	**9,636**	**9,000**

The IFM Program addresses the routine maintenance and repair of property and facilities for MFC and SW. The Department has directed that routine maintenance and repair be funded within the industry range of 2% to 4% of Replacement Plant Value (RPV). The use of this industry benchmark was recommended by the National Research Council's Congressionally-sponsored 1998 study, "Stewardship of Federal Facilities". Beginning in FY 2008, funding to support the RTC Routine Maintenance and Repair is requested under ATR infrastructure. The amount of funding being requested in FY 2008 represents the current best estimate of maintenance required that the INL can accomplish for the MFC and SW.

	(dollars in thousands)		
	FY 2006	FY 2007	FY 2008
▪ **General Plant Projects (GPP) & Deferred Maintenance Reduction – Idaho Facilities and Infrastructure Recapitalization Program (IFIRP)**	**3,465**	**0**	**23,863**

The IFIRP is a program to fund GPPs and the Deferred Maintenance Backlog Reduction efforts necessary to recapitalize the INL in accordance with DOE Order 430.1B, *Real Property Asset Management,* and the TYSP. It is modeled on the FIRP Program initiated by the National Nuclear Security Administration. These projects will provide necessary infrastructure to support the current and projected INL missions. In addition to recapitalizing the INL facilities and infrastructure with a planned program of General Plant and Operating Funded Projects, the Department requires that a Deferred Maintenance Reduction program be established and funded annually at 1% of the RPV for real property assets if the Deferred Maintenance Backlog is over 5% of RPV. The current Deferred Maintenance Backlog for INL real property assets is about 11% of RPV. Detailed Facilities and Infrastructure Recapitalization project planning and Deferred Maintenance Reduction goals are provided in the INL Ten Year Site Plan in accordance with Department Order 430.1B, *Real Property Asset Management*.

▪ **Capital Equipment**	**653**	**0**	**0**

This funding primarily provides replacements for aged, deteriorated equipment, and procurement of new equipment to meet emerging requirements. This includes such things as shop and miscellaneous maintenance equipment, vehicles, heavy equipment, and laboratory equipment. Capital Equipment planning goals are provided in the INL Ten Year Site Plan in accordance with Department Order 430.1B, *Real Property Asset Management*.

▪ **Essential State Environmental Compliance**	**0**	**0**	**4,000**

Perform remedial actions for NE legacy waste contained in Voluntary Consent Orders between the Department and the State of Idaho.

▪ **ATR Infrastructure**	**0**	**0**	**11,000**

The ATR Infrastructure provides landlord services and infrastructure support, including environmental services, to the ATR. The ATR cannot operate unless this infrastructure is functional.

The ATR Infrastructure request also addresses the routine maintenance and repair of property and facilities at the RTC. The Department has directed that routine maintenance and repair be funded within the industry range of 2% to 4% of RPV. The use of this industry benchmark was recommended by the National Research Council's Congressionally-sponsored 1998 study, "Stewardship of Federal Facilities". In FY 2006 and FY 2007, these activities at RTC were funded under Base Operations and Routine Maintenance. Beginning in FY 2008, funding for RTC activities is requested in ATR infrastructure and represents the current best estimate of maintenance required that the INL can accomplish at the RTC during FY 2008.

	(dollars in thousands)		
	FY 2006	FY 2007	FY 2008
▪ **ATR Life Extension Program (LEP)**	**6,564**	**20,200**	**3,100**

The ATR is essential to ongoing and planned national security and energy research programs at the Idaho National Laboratory. Independent review teams from DOE and the commercial nuclear industry have found that the ATR, while currently safe to operate, requires recapitalization of systems to remain a safe and productive research tool into the middle of the century, which is the planned mission life. The NE ATR LEP will plan and accomplish the needed upgrades, fund the reconstitution of the Nuclear Safety Design Basis for the reactor, replenish spare parts inventories and restore systems to their originally designed condition, and replace systems and equipment with modern, more reliable components that are carefully integrated into the reactor's operation and safety basis. The decrease in LEP funding for FY 2008 reflects recognition that the LEP activities to date have revealed that the material condition of the ATR is better than anticipated and thus the ten year scope of the LEP will be smaller than the original estimate of $70 million. In addition, a business plan for the ATR as a user facility will be developed in FY 2007 that will inform funding decisions for the ATR in FY 2009 and beyond. In the interim, it is prudent to pursue the LEP in FY 2008 at a slower pace and address only the most immediate LEP issues.

▪ **Gas Test Loop Upgrade (GTL) at the ATR (Other Project Costs – Operating)**	**1,980**	**4,336**	**0**

This upgrade would provide a fast neutron flux gas test loop in the ATR. This capability could have application to next generation reactor designs and the Advanced Fuel Cycle Initiative. The project is being terminated at the end of FY 2007, at which point the technical development will have been completed. There is no funding being requested in FY 2008.

▪ **Science and Technology Complex Utility Corridor**	**2,475**	**0**	**0**

This was one-time funding in FY 2006 to provide utility services for planned new facilities at the Center for Advanced Energy Studies within the STC.

▪ **IT Investments**	**4,356**	**0**	**0**

This was one time funding for FY 2006. It provided the connectivity and high performance computing capabilities at INL that are required for research under the new NE nuclear energy research and national security mission areas. Additionally, external connectivity was improved to facilitate collaborative research and file transfer between other DOE complex labs involved in the mission research.

▪ **Radiological and Environmental Sciences Laboratory**	**0**	**0**	**2,450**

Beginning in FY 2008, funding is included for the Radiological and Environmental Sciences Laboratory (RESL) activities which were previously funded by the Office of Environment, Safety and Health. RESL is a DOE-owned and operated laboratory located at the Central Facilities Area of the Idaho site. Its core mission capabilities are in analytical chemistry and in radiation measurements and calibrations. It performs a reference laboratory role for DOE, conducting measurement quality assurance programs to assure that key DOE missions are completed in a safe and environmentally responsible manner. These programs include the DOE Laboratory Accreditation Program (DOELAP) and the Mixed Analyte Performance

	(dollars in thousands)		
	FY 2006	FY 2007	FY 2008

Evaluation Program (MAPEP). They provide unbiased technical data and analysis for DOE oversight of contractor and support lab operations that provide worker radiation protection and analytical services at DOE sites. By assuring the quality and stability of key laboratory measurement systems throughout DOE, and by providing expert technical assistance to improve those systems, RESL helps assure the accuracy and reliability of data on which key programmatic decisions that protect workers, the public, and the environment are based. Funding covers non-federal technical support to federal staff at RESL to conduct these programs, technical support services, laboratory supplies, and capital equipment requirements.

	FY 2006	FY 2007	FY 2008
INL Construction	**10,845**	**6,030**	**0**
▪ **06-E-200, Nuclear Energy Project Engineering and Design (PED)**	**7,791**	**6,030**	**0**

PED funding for the GTL Project in the ATR is not being requested in FY 2008. The project is being terminated at the end of FY 2007, at which point the technical development will have been completed.

The Remote Treatment Project (RTP) at the MFC was initiated to address near-term waste management needs stemming from the nuclear research legacy waste atINL. PED funding for the RTP is not required in FY 2008. The project is being conducted as a cooperative, cost-saving effort with EM using one of their facilities engaged in the ICP.

	FY 2006	FY 2007	FY 2008
▪ **06-E-201, GTL in the ATR**	**3,054**	**0**	**0**

This upgrade would provide a fast neutron flux gas test loop in the ATR. This capability could have application to the Next Generation Nuclear Plant Program and the Global Nuclear Energy Partnership. The project is being terminated at the end of FY 2007, at which point the technical development will have been completed. There is no funding being requested in FY 2008.

	FY 2006	FY 2007	FY 2008
Total, Idaho Facilities Management	**81,774**	**95,290**	**104,713**

Explanation of Funding Changes

	FY 2008 vs. FY 2007 ($000)
INL Operations and Infrastructure	
▪ **Base Operations** The decrease of $3,788,000 reflects the net result of the transfer of the RTC from Base Operations into ATR Infrastructure (-$4,983) and the increase in Base Operations for safety analysis upgrades at MFC (+$1,195).	-3,788
▪ **Routine Maintenance and Repair** The decrease of $636,000 reflects net result of the transfer of RTC Routine Maintenance and Repair to ATR Infrastructure (-$3,000); and the increase in MFC and SW Routine Maintenance and Repair (+$2,364) to work towards the 2% to 4% of RPV per Department Directives.	-636
▪ **General Plant Projects (GPP) & Deferred Maintenance Reduction – Idaho Facilities and Infrastructure Recapitalization Program (IFIRP)** The increase of $23,863,000 reflects the initiation of necessary recapitalization at the INL and reduces the Deferred Maintenance Backlog to within 5% of RPV at the INL.	+23,863
▪ **Essential State Environmental Compliance** The increase of $4,000,000 reflects required funding for mitigation of NE legacy waste contained in Voluntary Consent Orders with the State of Idaho.	+4,000
▪ **ATR Infrastructure** The increase of $11,000,000 reflects the transfer of funding for RTC Base Operations and Routine Maintenance and Repair to ATR Infrastructure.	+11,000
▪ **ATR Life Extension Program (LEP)** The decrease of $17,100,000 reflects recognition that the LEP activities to date have revealed that the material condition of the ATR is better than anticipated and thus the ten year scope of the LEP will be smaller than the original estimate of $70 million. The LEP activities in FY 2008 will be conducted at a slower pace and address only the most immediate LEP issues.	-17,100
▪ **Gas Test Loop Upgrade (GTL) at the ATR (Other Project Costs – Operating)** The decrease of $4,336,000 reflects completion of planned work scope under GTL operating funds in FY 2007 with no additional funding requested in FY 2008.	-4,336

	FY 2008 vs. FY 2007 ($000)
▪ **Radiological and Environmental Sciences Laboratory** The increase of $2,450,000 reflects the transfer of activities previously funded by the Office of Environment, Safety and Health to the Office of Nuclear Energy beginning in FY 2008.	+2,450
INL Construction	
▪ **06-E-200, Nuclear Energy Project Engineering and Design (PED)** The decrease of $6,030,000 reflects completion of planned PED work scope in FY 2007 with no additional funding required in FY 2008.	-6,030
Total Funding Change, Idaho Facilities Management	**+9,423**

Capital Operating Expenses and Construction Summary

Capital Operating Expenses

(dollars in thousands)

	FY 2006	FY 2007	FY 2008
General Plant Projects & Deferred Maintenance Reduction	3,465	0	23,863
Capital Equipment	653	0	0
Total, Capital Operating Expenses	4,118	0	23,863

Construction Projects

(dollars in thousands)

	Total Estimated Cost (TEC)	Prior-Year Appro-priations	FY 2006	FY 2007	FY 2008	Unappro-priated Balance
06-E-201, Gas Test Loop in the Advanced Test Reactor, Idaho	80,000	—	3,054	0	0	N/A
06-E-200, Nuclear Energy PED, Idaho	26,591	—	7,791	6,030	0	N/A
Total, Construction			10,845	6,030	0	

Program Direction
Funding Profile by Category

	(dollars in thousands/whole FTEs)		
	FY 2006	FY 2007	FY 2008
Idaho Operations Office			
Salaries and Benefits	0	24,035	25,189
Travel	0	1,000	996
Support Services	0	925	866
Other Related Expenses	0	5,401	5,625
Total, Idaho Operations Office	0[a]	31,361[b]	32,676
Full Time Equivalents	0[a]	197[b]	197
Radiological and Environmental Sciences Laboratory			
Salaries and Benefits	0	0	2,724
Travel	0	0	45
Support Services	0	0	0
Other Related Expenses	0	0	5
Total, Radiological and Environmental Sciences Laboratory	0	0	2,774[c]
Full Time Equivalents	0	0	19
Oak Ridge Operations Office			
Salaries and Benefits	1,799	1,870	1,945
Travel	43	44	45
Support Services	49	50	52
Other Related Expenses	141	123	147
Total, Oak Ridge Operations Office	2,032	2,087	2,189
Full Time Equivalents	14	14	14
Headquarters			
Salaries and Benefits	18,652	23,201	26,461
Travel	1,000	1,360	1,560

[a] Excludes $30,792,000 for program direction expenses at the Idaho Operations Office and 197 Full Time Equivalents appropriated under Other Defense Activities.
[b] Beginning in FY 2007, funding for program direction expenses and Full Time Equivalents for the Idaho Operations Office is requested in the Energy Supply and Conservation appropriation.
[c] Beginning in FY 2008, funding is included for activities previously funded by the former Office of Environment, Safety and Health.

	(dollars in thousands/whole FTEs)		
	FY 2006	FY 2007	FY 2008
Support Services	3,710	5,881	5,938
Other Related Expenses	4,312	3,718	4,626
Total, Headquarters	27,674	34,160	38,585
Full Time Equivalents	146	161	171
Total Program Direction			
Salaries and Benefits	20,451	49,106	56,319
Travel	1,043	2,404	2,646
Support Services	3,759	6,856	6,856
Other Related Expenses	4,453	9,242	10,403
Total, Program Direction	29,706	67,608	76,224
Total, Full Time Equivalents	160	372	401

Mission

Program Direction provides the Federal staffing resources and associated costs required to provide overall direction and execution of the Office of Nuclear Energy (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 Federal 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 nuclear facilities and infrastructure to meet the growing demand for isotopes used in medicine, scientific research and homeland security; to provide radioisotope power systems for space exploration and national security; and to ensure the long term future of the domestic nuclear fuel supply.

In addition to appropriated funds, NE also manages over $209 million dollars annually in work for others and reimbursable funding. This includes over $95 million annually from the National Aeronautics and Space Administration and the Department of Defense for the development of advanced radioisotope power systems for space exploration and national security missions. In addition, NE manages the High Flux Isotope Reactor for the Office of Science.

NE is programmatically diverse, and is faced with significant human capital challenges in pursuing its mission. Extensive downsizing several years ago resulted in numerous skill imbalances and adversely impacted 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, NE faces a variety of staffing challenges in managing its expanding programs.

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.

The NE Workforce Plan was updated in February 2006 to reflect mission changes and identify skills gaps. 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 49.1 years, just slightly higher than the 46.3 year average age of the Federal workforce overall. Currently 21 percent of the workforce is eligible to retire and an additional 3 percent will be eligible by the end of FY 2008. 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.

Detailed Justification

	(dollars in thousands)		
	FY 2006	FY 2007	FY 2008
Salaries and Benefits	**20,451**	**49,106**	**56,319**

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. Currently 21 percent of the workforce is eligible to retire and an additional 3 percent will be eligible by the end of FY 2008; therefore, it is essential that program direction resources are available to compete for needed skills. In addition to the Headquarters staff, NE funds field employees at the Idaho Operation Office (197), the Oak Ridge Operations Office (14) staff, and one employee who supports the U.S. mission to the Organization for Economic Cooperation and Development. Beginning in FY 2008, funding is included for 19 FTEs who support the Radiological and Environmental Sciences Laboratory in Idaho. These FTE's were previously funded by the former Office of Environment, Safety and Health.

The FY 2008 budget funds an additional 10 FTEs, including lead project managers to support the acceleration of the Advanced Fuel Cycle Initiative (AFCI) program through the Global Nuclear Energy Partnership (GNEP) initiative. The additional staff will include expertise needed for National Environmental Policy Act determination, nuclear facility design, project management, safety, licensing, environmental protection, and project integration.

Travel	**1,043**	**2,404**	**2,646**

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. The increase in travel reflects the funding required for the additional FTEs in support of the GNEP.

Support Services	**3,759**	**6,856**	**6,856**

Support Services includes funding for technical and management support services provided to NE Headquarters and Operations Office employees. The use of support services will allow the Department to hire the best available industry experts in construction project management to assist federal staff in

	(dollars in thousands)		
	FY 2006	FY 2007	FY 2008

managing the large complex nuclear projects required under GNEP. In addition to rapidly acquiring this expertise, using support services will provide unlimited flexibility in team composition as the needs of the projects evolve. The size of the support service staff will increase and decrease as the project progresses with no residual cost to the government at projects' end.

Other Related Expenses	**4,453**	**9,242**	**10,403**

The major expenditure in the Other Related Expenses category in FY 2008 is $3,488,000 million earmarked for the Headquarters Working Capital Fund (WFC). The Department's Chief Financial Officer established a WCF to provide funding for mandatory administrative costs, such as building occupancy and telephone services, copying, printing and graphics, networking, desktop support, procurement management, payroll and personnel, corporate training services, and project management career development program. The Other Related Expense category also includes support for the Nuclear Energy Research Advisory Committee, training, and expenses associated with the one employee who serves on the staff of the Organization for Economic Cooperation and Development such as housing, training, office communications, supplies, miscellaneous expenses and International Cooperative Administrative Support Services (ICASS). The increase in FY 2008 is associated with the increase the WCF, training and other expenses associated with the additional staff to support GNEP.

Total, Program Direction	**29,706**	**67,608**	**76,224**

Explanation of Funding Changes

	FY 2008 vs. FY 2007 ($000)
Salaries and Benefits An increase of $2,382,000 reflects a 2.5 percent escalation in accordance with established guidelines and funds for promotions and within-grade salary increases; salaries and benefits for the additional 10 FTEs required in support of GNEP ($1,682,000); and the inclusion of $3,149,000 for the Radiological and Environmental Sciences Laboratory in FY 2008.	+7,213
Travel An increase of $242,000 is primarily due to the increase in travel required to support GNEP and for the inclusion of the Radiological and Environmental Sciences Laboratory in FY 2008.	+242
Other Related Expenses An increase of $1,161,000 is primarily due to an increase in the Working Capital Fund costs and training associated with the additional FTEs required to support GNEP and inclusion of the Radiological and Environmental Sciences Laboratory in FY 2008.	+1,161
Total Funding Change, Program Direction	**+8,616**

Support Services by Category

	(dollars in thousands)		
	FY 2006	FY 2007	FY 2008
Technical Support			
System Review and Reliability Analyses	0	1,036	1,050
Economic and Environmental Analyses	250	310	310
Surveys Or Reviews of Technical Operations	2,010	3,835	3,596
Total, Technical Support	2,260	5,181	4,956
Management Support			
Automated Data Processing	1,250	1,275	1,300
Reports and Analyses Management and General Administrative Services	249	400	600
Total, Management Support	1,499	1,675	1,900
Total, Support Services	3,759	6,856	6,856

Other Related Expenses by Category

	(dollars in thousands)		
	FY 2006	FY 2007	FY 2008
Other Related Expenses			
Working Capital Fund	2,330	3,093	3,488
Advisory and Assistance Services	1,200	100	200
Operations and Maintenance of Equipment	430	1,000	804
Printing and Reproduction	41	150	172
Training	86	400	503
Rent and Utilities	0	900	964
Communications, Utilities, Misc.	28	2,100	2,300
Supplies and Materials	122	150	115
Other Services	216	1,349	1,857
Total, Other Related Expenses	4,453	9,242	10,403

Legacy Management

Legacy Management

Energy Supply and Conservation
Office of Legacy Management

Overview
Appropriation Summary by Program

(dollars in thousands)

	FY 2006 Current Appropriation	FY 2007 Request	FY 2007 CR	FY 2008 Request
Energy Supply and Conservation				
Legacy Management	33,187	33,139	33,515	35,104
Total, Energy Supply and Conservation	33,187	33,139	33,515	35,104
Other Defense Activities				
Legacy Management	45,366	167,851	27,848	159,063
Subtotal, Other Defense Activities	45,366	167,851	27,848	159,063
Less Use of Prior Year Balances	-741	0	0	0
Total, Other Defense Activities	44,625	167,851	27,848	159,063
Total, Energy Supply and Conservation and Other Defense Activities	77,812	200,990	61,363	194,167

Preface

During FY 2008, the Department continues its efforts to reduce risk to human health and the environment at its contaminated sites, manage its pension and benefit responsibilities for former contractor personnel, and manage DOE property at closed sites. By conducting these functions, the Office of Legacy Management (LM) provides a sustainable solution to liabilities associated with the Department's closed sites and allows Environmental Management to concentrate on further risk reduction and site closure.

Within the Energy Supply and Conservation appropriation, the Office of Legacy Management (LM) has one program: Legacy Management.

Mission

The mission of the Office of Legacy Management is to manage the Department's post-closure responsibilities – including long-term surveillance and maintenance, pension and benefit continuity for former contractor retirees, and archives management – and ensure the future protection of human health and the environment. This Office has control and custody for legacy lands, structures, and facilities and is responsible for maintaining them at levels suitable for their long-term use.

Benefits
The greatest benefit of the Office of Legacy Management is to serve as a visible demonstration of the Department's resolve to honor its responsibilities for the communities near its remediated facilities and for the former contractor workforce.
The Office of Legacy Management program provides benefits to the Department following mission change or site closure. For sites where cleanup is completed, Legacy Management activities ensure that the remediation measures implemented during closure are protecting human health and the environment, that labor responsibilities for the contractor workforce are being satisfied, and that other Departmental legacy responsibilities are met. By managing the real and personal property assets that remain after cleanup and closure, Legacy Management helps the Department reduce the magnitude of its physical resource management, the costs associated with such management, and actively promotes the beneficial reuse of those mission excess properties.

Strategic Themes and Goals and GPRA Unit Program Goals
The Department's Strategic Plan identifies five Strategic Themes (one each for nuclear, energy, science, management, and environmental aspects of the mission) plus 16 Strategic Goals that tie to the Strategic Themes. The Other Defense Activities appropriation supports the following goal:

Strategic Theme 4, Environment Responsibility: Protecting the environment by providing a responsible resolution to the environmental legacy of nuclear weapons production.

Strategic Goal 4.2, Managing the Legacy: Manage the Department's post-closure environmental responsibilities and ensure the future protection of human health and the environment.

The programs funded within the Energy Supply and Conservation Appropriation have one GPRA Unit Program Goal that contributes to the Strategic Goals in the "goal cascade". This goal is:

GPRA Unit Program Goal 4.2.55.00: Legacy Management – By 2015, the Office of Legacy Management will be responsible for the cost effective management of land, structures, facilities and/or records for over 120 sites; employee benefits for the Department's former contractor work force at seven sites; and the disposal of real property at five sites.

Contribution to Strategic Goals
Within the Program Goal for the Legacy Management program, there are three subgoals that contribute to the strategic goals.

Legacy Management contributes to Strategic Goal 4.2 as follows:

- Protect human health and the environment through effective and efficient long-term surveillance and maintenance – Activities associated with this subgoal contribute to the general 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.

- Manage legacy land and assets, emphasizing protective real and personal property reuse and disposition – These activities promote more efficient management of remediated resources. This allows more resources to be focused on further risk reduction.

- Support an effective and efficient workforce structured to accomplish Departmental missions and assure contractor worker pension and medical benefits – The Legacy Management program manages the Department's labor relations and oversees some pension and benefit programs to meet the Department's contractual commitments. By managing these activities, the Office of Legacy Management enables the Office of Environmental Management to focus on further risk reduction by remediating other sites.

Funding by Strategic and GPRA Unit Program Goal

(dollars in thousands)

	FY 2006	FY 2007	FY 2008
Strategic Goal 4.2, Managing the Legacy			
GPRA Unit Program Goal 4.2.55.00, Legacy Management	33,187	33,139	35,104
Total, Strategic Goal 4.2 (Energy Supply and Conservation)	33,187	33,139	35,104

Annual Performance Results and Targets

FY 2003	FY 2004	FY 2005	FY 2006	FY 2007	FY 2008
Strategic Goal 4.2, Managing the Legacy Legacy Management Program/Legacy Management					
		Ensure continued effectiveness of cleanup remedies through surveillance and maintenance activities at 61 sites funded under the Energy Supply appropriation in accordance with legal agreements. This target was achieved.	Ensure continued effectiveness of cleanup remedies through surveillance and maintenance activities at 64 sites funded under the Energy Supply appropriation in accordance with legal agreements. This target was achieved.	Maintain the protectiveness of installed environmental remedies through inspections and other actions at 100 percent of sites within LM's responsibility	Maintain the protectiveness of installed environmental remedies through inspections and other actions at 100 percent of sites within LM's responsibility
				<u>Reduce the cost of performing required long-term surveillance and maintenance activities by 2 percent while meeting all regulatory requirements. Base is previous year's costs less inflation rate, costs for additional sites, and one-time actions.</u>	<u>Reduce the cost of performing required long-term surveillance and maintenance activities by 2 percent while meeting all regulatory requirements. Base is life-cycle baseline estimate for that year.</u>

Means and Strategies

The Legacy Management Program will use various means and strategies to achieve its GPRA Unit Program goal. However, various external factors may impact the ability to achieve the goal. The program also performs collaborative activities to help meet its goal.

The Department will implement the following means:

- Long-term surveillance and maintenance will be performed in accordance with the regulatory decisions for each site. Activities range from maintaining records to routine inspections and maintenance at sites where remediation measures are substantially completed and the operations and maintenance of remedial action systems.

- Adequate staffing will be maintained to oversee the program. A large portion of the surveillance and maintenance will be performed by contractors.

The Department will implement the following strategies:

- The Office of Legacy Management will only accept responsibility for a site after active remediation is complete and all necessary long-term remedies are in place and operating.

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

- Significant changes in remedy performance could cause the site to be returned to EM for additional remediation.

In carrying out the program's surveillance and maintenance functions, LM performs the following collaborative activities:

- Evaluation of remedy performance, as determined by surveillance and maintenance activities, is coordinated with regulators, local communities, and other stakeholders.

Validation and Verification

The Department is operating a performance tracking system to measure performance. The Office of the Chief Financial Officer has developed action plans for the primary functions. Quarterly updates for site inspections are reported using an automated system.

For payments of medical benefits not tracked by the automated system, the Office of Legacy Management will obtain quarterly updates to judge progress of the programs.

The Legacy Management program has not performed a Program Assessment Rating Tool (PART) evaluation to date but such a review and the measures resulting from it would also provide verification.

The observed results of surveillance and maintenance activities are recorded in annual inspection and compliance reports and retained as long as specified in Federal requirements for records retention. To validate and verify program performance, LM will conduct various internal and external reviews and audits. LM's programmatic activities are subject to continuing reviews by the Congress, the General

Accountability Office, the Department's Inspector General, the U.S. Environmental Protection Agency, the U.S. Nuclear Regulatory Commission, state environmental and health agencies, and the Department's Office of Engineering and Construction Management. Additionally, LM Headquarters senior management staff conduct quarterly, in-depth reviews of cost, schedule, and scope to ensure projects are on-track and within budget.

Facilities Maintenance and Repair

The Department's Facilities Maintenance and Repair activities are tied to its programmatic missions, goals, and objectives. Facilities Maintenance and Repair activities funded by this budget are displayed below.

Direct-Funded Maintenance and Repair

(dollars in thousands)

	FY 2006	FY 2007	FY 2008
Legacy Management			
Legacy Management			
Long-Term Surveillance and Maintenance			
Non-CERCLA[a] Sites	598	514	1,800
CERCLA Sites	175	203	276
Total, Long-Term Surveillance and Maintenance	773	717	2,076
Total, Legacy Management	773	717	2,076
Total, Direct-Funded Maintenance and Repair (Energy Supply and Conservation)	773	717	2,076

[a] Comprehensive Environmental Response, Compensation, and Liability Act

Energy Supply and Conservation
Office of Legacy Management

Funding by Site by Program

	(dollars in thousands)		
	FY 2006	FY 2007	FY 2008
Grand Junction Office	16,869	19,531	18,874
Paducah Gaseous Diffusion Plant	4,079	3,401	3,711
Portsmouth Gaseous Diffusion Plant	12,239	10,207	11,134
Washington Headquarters	0	0	1,385
Total, Energy Supply and Conservation	33,187	33,139	35,104

Major Changes or Shifts by Site

Grand Junction Office

Under the Energy Supply and Conservation appropriation the Department will continue to perform long-term surveillance and maintenance activities for 77 existing sites and will add five more in FY 2008 (Inhalation Toxicology Laboratory, NM; Ray Point, TX; Shirley Basin North and Split Rock, WY; and Shpack Landfill, MA).

Site Description

Grand Junction Office

The Grand Junction Office is located in western Colorado. The oversight of the long-term surveillance and maintenance and the reuse and property management activities are the staff's primary functions. The long-term surveillance and maintenance activities managed from this office include environmental monitoring, long-term treatment of contaminants, and maintaining site security.

Paducah Gaseous Diffusion Plant

The Paducah Plant in Paducah, KY, was leased to a private company in 1998. Under agreements with the United States Enrichment Corporation (USEC), the Department retains responsibility for medical and life benefits for part of the former USEC contractor workforce.

Portsmouth Gaseous Diffusion Plant

The Portsmouth Plant in Piketon, OH, was leased to a private company in 1998. Under agreements with the United States Enrichment Corporation (USEC), the Department retains responsibility for medical and life benefits for part of the former USEC contractor workforce.

Washington Headquarters

The Office of Legacy Management Washington headquarters staff manages one program activity under the Energy Supply and Conservation Appropriation. That program activity is reuse and property management on sites where the Department's mission has ended.

Legacy Management

Funding Profile by Subprogram

(dollars in thousands)

	FY 2006 Current Appropriation	FY 2007 Request	FY 2008 Request
Legacy Management			
Legacy Management	33,187	33,139	35,104
Total, Legacy Management	33,187	33,139	35,104

Public Law Authorizations:

Public Law 95-91, “Department of Energy Organization Act (1977)
Public Law 95-604, Uranium Mill Tailings Radiation Control Act (1978)
Public Law 100-616, Uranium Mill Tailings Remedial Action Amendments Act of 1988
Public Law 103-62, Government Performance and Results Act of 1993
Public Law 106-398, National Defense Authorization Act for Fiscal Year 2001
Public Law 106-377, Energy and Water Development Appropriations Act, 2001
Public Law 107-66, Energy and Water Development Appropriations Act, 2002
Public Law 107-314, Bob Stump National Defense Authorization Act for Fiscal Year 2003
Public Law 108-136, National Defense Authorization Act for Fiscal Year 2004
Public Law 108-375, Ronald W. Reagan National Defense Authorization Act for Fiscal Year 2005
Public Law 109-103, Energy and Water Development Appropriations Act, 2006

Mission

The mission of the Office of Legacy Management is to accept transition of sites and to support the Department’s commitments to protect the nearby communities, ensure former contractor personnel receive the benefits to which they are entitled, and promote and manage use of DOE assets. The activities that are used to accomplish this mission include: (1) conduct long-term surveillance and maintenance (also referred to as long-term stewardship) at DOE facilities where remediation measures have been substantially completed; (2) oversee the management of pensions and benefits for former contractor employees; and, (3) manage and, if appropriate, dispose of assets no longer needed for the Department’s missions.

Benefits

The Legacy Management program contains important elements to assist the Office of Environmental Management achieve the strategic goal of providing a resolution to the environmental legacy of the Cold War. As the Office of Environmental Management completes its cleanup activities, certain aspects of the Department’s mission responsibilities remain. These activities include: long-term groundwater pump and treat operations, remedy surveillance and maintenance, records management, long-term retirement pension and benefits for contractor personnel, and management of the DOE assets at the respective sites. A long-term commitment to manage the resources and activities beyond the completion of active remediation is required. 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 2006	FY 2007	FY 2008
Legacy Management			
Long-Term Surveillance and Maintenance	15,778	18,413	17,590
Pension and Benefit Continuity	17,409	14,726	16,129
Reuse and Property Management	0	0	1,385
Total, Legacy Management	33,187	33,139	35,104

Description

The mission of the Legacy Management subprogram is to conduct long-term surveillance and maintenance (also referred to as long-term stewardship) at DOE facilities where remediation measures have been substantially completed, oversee the management of pensions and benefits for former contractor employees, and manage the use of DOE assets on the sites. These activities support the Department's commitments as contained in regulatory decisions, contracts, and legal agreements.

Benefits

The Legacy Management subprogram contains the essential elements to assist the Office of Environmental Management achieve the strategic goal of providing a resolution to the environmental legacy of the Cold War, ensure that the Department fulfills its long-term commitments to protect the environment and to ensure continuity of benefits to former contractor workers, and promote the most effective and efficient use of remaining real and personal property. By funding the long-term activities in the Legacy Management program, the Office of Environmental Management is able to concentrate its resources on risk reduction and site closure.

Detailed Justification

(dollars in thousands)

	FY 2006	FY 2007	FY 2008
Long-Term Surveillance and Maintenance	**15,778**	**18,413**	**17,590**

Funding will allow the Office of Legacy Management to monitor and maintain environmental remedies at its sites in accordance with requirements contained in legal, contractual, and regulatory agreements. Sites in this program include: sites associated with the Uranium Mill Tailings Radiation Control Act (UMTRCA); sites associated with the Formerly Utilized Sites Remedial Action Program (FUSRAP); and other sites remediated under the Comprehensive Environmental Response, Compensation, and Liability Act/Resource Conservation and Recovery Act (CERCLA/RCRA); and other sites remediated by the Corps of Engineers to be transferred to the Department after remediation is complete. 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.

		(dollars in thousands)	
	FY 2006	FY 2007	FY 2008
Pension and Benefit Continuity	**17,409**	**14,726**	**16,129**
▪ **USEC Facilities**	**16,318**	**13,608**	**14,845**

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 was 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 was expanded to include retired employees working at the Gaseous Diffusion Plant to the date of USEC privatization as further defined by the MOA between OMB and USEC, dated April 6, 1998.

This funding does not include benefits to former DOE contractor employees covered by the Uranium Enrichment Decontamination and Decommissioning Fund.

▪ **Grand Junction LM Office**	**1,091**	**1,118**	**1,284**

The Department is providing retirees from former DOE contractors with medical insurance benefits in accordance with contractual requirements.

Reuse and Property Management	**0**	**0**	**1,385**

This activity was part of the long-term surveillance and maintenance during FY 2006 and FY 2007 but has become of sufficient magnitude that it has been separated in FY 2008. Isolating the funding as a separate activity also allows the Office of Legacy Management (LM) to align the budget with its subgoals and also to improve the integration of budget and performance.

Funding will allow the Office of Legacy Management to manage the real and personal property on its sites, promote reuse of the sites, and, if appropriate, dispose of the sites to other governmental agencies or to private ownership. If the land is transferred to a private interest it would allow land to be put back into productive reuse and reduce the Department's "footprint."

Total, Legacy Management	**33,187**	**33,139**	**35,104**

Explanation of Funding Changes

	FY 2008 vs. FY 2007 ($000)
Long-Term Surveillance and Maintenance If Reuse and Property Management was part of Long-Term Surveillance and Maintenance in FY 2008 as it is during FY 2007, the activity would experience a small increase of about $0.6 million. This increase in funding would reflect a transfer into LM of several sites (UMTRCA Title II and FUSRAP) where long-term surveillance and maintenance activities will be performed. But, separating Reuse and Property Management as a separate activity (see below) results in a net decrease.	-823
Pension and Benefit Continuity	
▪ **USEC Facilities** Medical inflation rates increase the FY 2008 estimate at rates higher than normal inflation.	+1,237
▪ **Grand Junction Office** Medical inflation rates increase the FY 2008 estimate at rates higher than normal inflation.	+166
Total, Pension and Benefit Continuity	**+1,403**
Reuse and Property Management Funding for this function had formerly been included as part of Long-Term Surveillance and Maintenance. The activity has increased in importance sufficiently to separate it as a distinct activity in order to align the budget with Legacy Management's subgoals and improve the integration of budget and performance.	+1,385
Total Funding Change, Legacy Management	**+1,965**

Environment, Safety and Health

Environment, Safety and Health

Energy Supply and Conservation
Office of Environment, Safety and Health

Overview

Appropriation Summary by Program

(dollars in thousands)

	FY 2006 Current Appropriation	FY 2007 Request	FY 2007 CR	FY 2008 Request[a]
Energy Supply and Conservation				
Environment, Safety & Health (non-defense)	27,720	29,121	28,589	0
Total, Energy Supply and Conservation	27,720	29,121	28,589	0
Other Defense Activities				
Environment, Safety & Health (defense)	76,259	80,814	78,717	0
Total, Other Defense Activities	76,259	80,814	78,717	0
Total, Other Defense Activities and Energy Supply and Conservation	103,979	109,935	107,306	0

Preface

The Office of Environment, Safety and Health (EH) is committed to ensuring that the safety and health of the Department of Energy (DOE) workforce and members of the public and the protection of the environment are integrated into all Departmental activities.

Within the Energy Supply and Conservation appropriation, the Office of Environment, Safety and Health has one program: Environment, Safety and Health (two subprograms) as well as Program Direction.

Mission

The mission of EH is to provide the corporate leadership, performance goals, assistance, policies, programs and feedback to enable DOE to excel in mission performance while achieving excellence in safety and environmental stewardship.

Environment, Safety and Health performs critical functions which directly support the mission of the Department. These functions include providing technical support and assistance; assessing performance; ensuring quality assurance is properly applied; developing corporate safety and health policy, guidance, rules, orders and standards; and supporting an effective collaborative radiological and non radiological health studies program.

[a] FY 2008 funding for these activities are now included in the Offices of Health, Safety and Security; Management and Administration; General Counsel, Nuclear Energy, Environmental Management, and NNSA.

Benefits

The Office of Environment, Safety and Health performs critical functions which directly support the mission of the Department. These functions include:

- Environment – Ensure the protection of the environmental resources affected by DOE activities.

- Safety – Operate to industry standards where they are relevant and available and provide regulations and standards for those operations that are unique to DOE; perform at a level equal to or better than private industry.

- Health – Promote the health and safety of DOE's workers and communities surrounding DOE sites, develop comprehensive and effective safety and health policy for DOE workplace hazards, and conduct studies and medical screening to understand the effects of radiation, chemical and other potential hazards of DOE operations on humans.

- Corporate Performance Assessment – Necessary DOE-wide environment, safety, and health functions that provide assistance to line managers in demanding improved performance from DOE contractors. Specifically these programs include support for the accreditation of worker radiation protection monitoring programs required by 10 CFR 835, DOE's Voluntary Protection Program, the collection and maintenance of DOE and contractor personnel radiation exposure records, and corporate analysis of performance. Best practices and lessons learned are shared which help lead to improved performance.

- Information Management – Ensure that information technology is acquired and information resources are managed in a manner that implements the policies and procedures of legislation and the President's Management Agenda. Provides the necessary policy, guidance, and corporate direction.

- Nuclear/Worker Safety Enforcement - Implement DOE's congressional mandates to investigate safety conditions or events and apply enforcement sanctions to contractors for unsafe actions or conditions that violate DOE nuclear safety and worker safety requirements for protecting workers and the public.

DOE environment, safety and health performance expectations are communicated in Policies, Standards and Guidance, and DOE-Wide ES&H Programs are developed to achieve the expected level of performance. A consistent and stable safety infrastructure is provided that leads to credible, reliable and defensible operations and programs. EH leverages its resources and personnel to provide DOE's line management programs with essential environment, safety and health performance expectations: environment, safety and health performance measures and analysis; management tools to promote the safe conduct of work; and guidance for pollution prevention and the protection of the environment in and around DOE sites. Integral to the Department's success is EH's skill in fostering increased awareness and providing support to line management throughout the Department, using open communications, coordinating with other industry and governmental organizations, and performance feedback on environmental, safety, and health activities, to provide the safety infrastructure that allows for and promotes the safe and environmentally responsible conduct of work.

Major Program Shift

On October 1, 2006, the Secretary of Energy integrated certain DOE Headquarters level functions for health, safety, and security from the former Offices of Environment, Safety and Health (EH); Security and Safety Performance Assurance (SSA); and the Departmental Representative to the Defense Nuclear Facilities Safety Board (DR) into the Office of Health, Safety and Security (HSS). The creation of HSS ensures that all health and safety functions previously managed by EH continue in a more integrated and effective manner to improve the protections afforded DOE workers and the public. Additionally, all safety and security functions previously managed by SSA continue to be effectively implemented. The analysis of the former EH and SSA organizations identified a number of functions that should be transferred to other organizations because they are either line management responsibilities (such as laboratory operations) or would function better through a more appropriate alignment in a different DOE program office. The functions that were transferred from EH are described within the detailed justification sections of this budget document.

Annual Performance Results and Targets

Annual effectiveness and efficiency performance targets associated with these activities are now included in the FY 2008 Office of Health, Safety and Security budget within the Other defense Activities appropriation..

Means and Strategies

Not applicable.

Validation and Verification

Not applicable.

Energy Supply and Conservation
Office of Environment, Safety & Health

Funding by Site by Program

	(dollars in thousands)		
	FY 2006	FY 2007	FY 2008[a]
Argonne National Lab	394	736	0
Brookhaven National Laboratory	49	74	0
Lawrence Livermore National Laboratory	49	74	0
Oak Ridge Associated Universities	193	193	0
Oak Ridge National Laboratory	910	1,259	0
Pacific Northwest National Laboratory	336	439	0
Washington Headquarters	25,789	26,346	0
Total, Energy Supply and Conservation	27,720	29,121	0

Site Description

Argonne National Laboratory

Argonne National Laboratory (ANL) is 25 miles southwest of Chicago's Loop. This laboratory provides support in resolving the Nation's environmental, safety, and health problems and promotes environmental, safety and health stewardship. ANL provides specialized technical expertise on environmental and public protection issues, including analysis of emerging environmental rulemakings; develops input for inclusion in environmental guidance materials and implementation tools; and provides specialized technical expertise for the development of DOE performance summaries on air resource protection and environmental releases. ANL also provides technical expertise for water resource analyses, human and ecological risk assessments, and modeling capabilities for the analysis of radiological releases to the environment related to DOE operations. In addition, ANL provides technical support in the review of environmental impact statements (EISs) and other National Environmental Policy Act (NEPA)-related documents. It also provides technical expertise for pollution prevention opportunity assessments.

Brookhaven National Laboratory

Brookhaven National Laboratory (BNL) is located in Upton, New York, on Long Island. As a non-defense research institution, BNL is dedicated to basic and applied investigation in a multitude of scientific disciplines. BNL also provides specialized subject matter technical expertise in conducting reviews of safety analysis and risk assessment documents such as Safety Analysis Reports (SARs), and Basis for Interim Operations (BIO). BNL provides specialized technical expertise input to be used by the Federal staff to develop rules, orders, safety guides, and standards. These documents may include SARs, technical safety requirements, waste disposal standards, fire protection standards, lightning and wind protection standards, and facility operation.

[a] FY 2008 funding for these activities are now included in the Offices of Health, Safety and Security; Management and Administration; General Counsel, Nuclear Energy, Environmental Management, and NNSA.

Lawrence Livermore National Laboratory

Lawrence Livermore National Laboratory (LLNL), located in California's Tri-Valley region east of San Francisco provides specialized expertise in seismic analysis, structural response, natural phenomena hazards standards and energy security safety analysis.

Oak Ridge Associated Universities/Oak Ridge Institute for Science and Education (ORISE)

The Oak Ridge Institute for Science and Education (ORISE), operated by Oak Ridge Associated Universities (ORAU), is located on a 150-acre site in Oak Ridge, Tennessee. On behalf of the Department, the Radiological Exposure Monitoring System (REMS) collects and maintains radiation exposure records for DOE and contractor personnel.

Oak Ridge National Laboratory

Oak Ridge National Laboratory (ORNL) is a multi-program science and technology laboratory. Scientists and engineers at the laboratory provide specialized technical expertise in environment, safety, and health activities; criticality codes and standards; and restoration and protection of the environment. ORNL provides specialized technical expertise in the operational reviews of the DOE Technical Standards Program and development of web-based platforms for environmental guidance materials and compliance tools. The laboratory provides specialized technical expertise in the development of risk-based, integrated worker safety programs through the development of input and resource information for various technical standards and guides. ORNL also supports technical reviews of the potential impacts of proposed environmental regulations on DOE operations and EH efforts to promote cultural resource protection. ORNL is also involved in project development, protocol development, and input to developmental needs to revise or update worker protection requirements. ORNL also supports technical reviews of EISs and other NEPA-related documents.

Pacific Northwest National Laboratory

Pacific Northwest National Laboratory (PNNL), Richland, Washington, develops and delivers new and effective environment, safety, and health technologies. PNNL provides specialized technical expertise on environmental and public protection issues, including analysis of emerging rulemakings and input for the development of environmental guidance materials and implementation tools. This specialized support includes input for the development of DOE performance summaries on air resource protection and implementation of Clean Air Act requirements, water resources, and human and ecological risk assessments related to DOE releases. PNNL provides specialized technical expertise in all aspects of radiological operations at DOE sites with Radiological Control Programs. This expertise involves knowledge of radiological operations, radiological practices, processes, and systems across the DOE complex. Specialized technical expertise provides input for health physics, development of implementation guides, technical standards and technical solutions for specific radiological control problems. PNNL's specialized technical expertise supports the development and implementation of the DOE Laboratory Accreditation Program, and other DOE corporate safety programs. PNNL provides technical support in the review of EISs and other NEPA-related documents. It also provides specialized support for the affirmative procurement of environmentally preferable products.

Washington Headquarters

The Office of Environment, Safety and Health Headquarters, located in the Washington, D.C. area, supports the EH mission by funding Federal staff responsible for directing, administering, and supporting the EH program in the areas of facility and nuclear safety, worker safety, corporate performance assessment, environment, health, and enforcement. In addition, Federal staff is responsible for management, policy, personnel, technical/administrative support activities, budget, finance, and contracts. The Office of Environment also requires contractor support in reviewing cost and technical issues relating to implementing the requirements of proposed and new environmental legislation and regulations at DOE operations; in the development of models and other tools to perform quantitative and trending analysis of DOE's environmental performance; and in updating standards for radiation protection and waste management. In addition, the Office requires contractor support in reviewing Environmental Impact Statements and other NEPA-related documents and in developing pollution prevention strategies for the reduction of waste generation and environmental releases during DOE operations. The Office of Health requires contractor support for the development of worker-based safety programs, collection of lessons learned and best practices, review of the literature and knowledge of standards setting bodies to assure a sound scientific basis for worker protection policies and programs, and program development strategies for each of the organizational elements in the Office of Health. The Office of Information Management requires contractor support to ensure that information technology is acquired and information resources are managed in a manner that implements the policies and procedures of the President's Management Agenda, and legislation including the Paperwork Reduction Act and the Clinger-Cohen Act. This office establishes, implements, and maintains a comprehensive and effective cyber/computer security, Capital Planning and Investment Control, and Federal Enterprise Architecture programs in order to support the President's Management Agenda initiative to Expand Electronic Government.

Environment, Safety and Health (non-defense)

Funding Profile by Subprogram

(dollars in thousands)

	FY 2006 Current Appropriation	FY 2007 Request	FY 2008 Request[a]
Environment, Safety and Health (non-defense)			
Policy, Standards & Guidance	2,980	3,814	0
DOE-Wide ES&H Programs	4,049	5,314	0
Total, Environment Safety and Health (non-defense)	7,029	9,128	0

Public Law Authorizations:
Public Law 83-703, "Atomic Energy Act of 1954"
Public Law 91-190, "The National Environmental Policy Act of 1969"
Public Law 95-91, "Department of Energy Organization Act"
Public Law 103-62, "Government Performance and Results Act of 1993"

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 and Conservation appropriation, EH plays a key role in achieving the Department's mission. EH develops and maintains a stable and predictable safety infrastructure by establishing Departmental policy and expectations that help ensure safe and secure workplaces across the complex. EH identifies and addresses emerging safety vulnerabilities and partners with line management to resolve safety issues concerning nuclear, radioactive, chemical, and industrial hazards. Many of the activities involve performing crosscutting DOE-wide environment, safety, and health functions similar to those performed by any corporate safety office. These programs are necessary DOE-wide environment, safety, and health functions that provide assistance to line managers in demanding improved performance from DOE contractors. Specifically these programs include support for the accreditation of worker radiation protection monitoring programs required by 10 CFR 835, DOE's Voluntary Protection Program, the collection and maintenance of DOE and contractor personnel radiation exposure records, and corporate analysis of performance. Best practices and lessons learned are shared which help lead to improved performance, and necessary policy, guidance, and corporate direction are provided. EH also 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.

[a] FY 2008 funding for these activities are now included in the Offices of Health, Safety and Security; Management and Administration; General Counsel, Nuclear Energy, Environmental Management, and NNSA.

EH ensures compliance with the National Environmental Policy Act of 1969, which is a prerequisite to program mission implementation. EH staff also provides corporate advice and consultation to DOE managers in developing improved strategies for including environment, safety and health in planning and conducting work; on implementing external regulations affecting DOE operations (e.g., providing implementation guidance on Environmental Protection Agency (EPA) regulations); and promulgating DOE policy, requirements, and implementation guidance. EH actions encourage line program efforts to prevent injuries and illnesses; establish environment, safety, and health budget priorities; participate in advocating cost-effective regulation from external sources; establish protective, cost-effective internal environment, safety, and health policies and guidance; and avoid risks attendant to the unprecedented hazards that must be managed effectively across DOE.

EH activities funded within the Energy Supply and Conservation 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.

Major Program Shift

On October 1, 2006, the Secretary of Energy integrated certain DOE Headquarters level functions for health, safety, and security from the former Offices of Environment, Safety and Health (EH); Security and Safety Performance Assurance (SSA); and the Departmental Representative to the Defense Nuclear Facilities Safety Board (DR) into the Office of Health, Safety and Security (HSS). The creation of HSS ensures that all health and safety functions previously managed by EH continue in a more integrated and effective manner to improve the protections afforded DOE workers and the public. Additionally, all safety and security functions previously managed by SSA continue to be effectively implemented. The analysis of the former EH and SSA organizations identified a number of functions that should be transferred to other organizations because they are either line management responsibilities (such as laboratory operations) or would function better through a more appropriate alignment in a different DOE program office. The functions that were transferred from EH are as follows:

- National Environmental Policy Act (NEPA) Program. This function was assigned to the Office of the General Counsel (GC) because it complements the functions of GC in ensuring that the Department’s activities comply with applicable legal requirements including NEPA and other environmental laws. This transfer locates in one office both the legal and technical support personnel who assist program offices in meeting NEPA obligations, thus enabling the Department to further improve its NEPA documents and decision-making processes while maintaining the responsibility of the Under Secretaries and Assistant Secretaries with line management responsibility to ensure conformance of the Department’s activities to environmental protection laws and principles.

- A portion of the funding for the extended common integrated technology environment (eXCITE) fees were transferred to the Offices of Management and Administration, GC, Nuclear Energy, Environmental Management; and NNSA for the activities transferred to those organizations.

Policy, Standards and Guidance

Funding Schedule by Activity

(dollars in thousands)

	FY 2006	FY 2007	FY 2008[a]
Policy, Standards and Guidance	2,980	3,814	0
Total, Policy, Standards and Guidance	2,980	3,814	0

Description

Policy, standards and guidance are issued to assure that workers and the public, property and the environment are adequately protected from the hazards of DOE activities.

The Program Goals of Environment, Safety and Health will be accomplished not only through the efforts of the direct (GPRA Unit) programs but with additional efforts from subprograms which support the GPRA Units in carrying out their mission. The Policy, Standards and Guidance subprogram performs the following functions in support of the overall mission of Environment, Safety and Health.

Benefits

For most DOE facilities, DOE assumes direct regulatory/enforcement authority for safety and health as provided by the Atomic Energy Act of 1954, as amended. Safety policy, standards and guidance must therefore take into account the unique nuclear, chemical and industrial hazards posed by DOE operations and must be current with worldwide technologies, knowledge and experience.

Detailed Justification

(dollars in thousands)

	FY 2006	FY 2007	FY 2008
Policy, Standards and Guidance	**2,980**	**3,814**	**0**
Beginning in FY 2008, these activities are funded by the Office of Health, Safety and Security.			
Total, Policy, Standards and Guidance	**2,980**	**3,814**	**0**

Explanation of Funding Changes

	FY 2008 vs. FY 2007 ($000)
Beginning in FY 2008, these activities are funded by the Office of Health, Safety and Security.	-3,814
Total Funding Change, Policy, Standards and Guidance	**-3,814**

[a] FY 2008 funding for these activities are now included in the Offices of Health, Safety and Security; Management and Administration; General Counsel, Nuclear Energy, Environmental Management, and NNSA.

DOE-Wide Environment, Safety and Health Programs

Funding Schedule by Activity

	(dollars in thousands)		
	FY 2006	FY 2007	FY 2008[a]
DOE-Wide Environment, Safety and Health Programs	4,049	5,314	0
Total, DOE-Wide Environment, Safety and Health Programs	4,049	5,314	0

Description

DOE-Wide Environment, Safety and Health (ES&H) Programs improve worker and nuclear facility safety, and protect the public and the environment. EH's activities under these programs often require the development of state-of-the-art analysis tools and approaches, because the nature and mix of radioactive, hazardous, and toxic materials at DOE facilities are unique. EH's efforts span the design, construction, operation, maintenance, decontamination and decommissioning, and cleanup of nuclear weapons productions and research-related facilities. Efforts also include construction safety; work planning activities, including techniques to identify, evaluate and eliminate hazards; methods for reducing or eliminating release of pollutants; and the identification of technologies and innovative adaptations of existing practices. Information Management services such as desktop and network access, database and systems development, and operation and maintenance enable staff to complete the program mission.

The Program Goals of Environment, Safety and Health will be accomplished not only through the efforts of the direct (GPRA Unit) programs but with additional efforts from subprograms which support the GPRA Units in carrying out their mission. The DOE-Wide Environment, Safety and Health (ES&H) Programs subprogram performs the following functions in support of the overall mission of Environment, Safety and Health.

Benefits

EH's DOE-Wide Environment, Safety and Health (ES&H) Programs improve worker and nuclear facilities safety and protect the public and the environment through the efficient management of several DOE-wide programs.

[a] FY 2008 funding for these activities are now included in the Offices of Health, Safety and Security; Management and Administration; General Counsel, Nuclear Energy, Environmental Management, and NNSA.

Detailed Justification

	(dollars in thousands)		
	FY 2006	FY 2007	FY 2008
DOE-Wide Environment, Safety and Health Programs	**4,049**	**5,314**	**0**
Beginning in FY 2008, NEPA activities are funded by the Office of General Counsel. eXCITE fees associated with transferred activities are funded by the Offices of Management and Administration, General Counsel, Nuclear Energy, Environmental Management; and NNSA. All other activities are funded by the Office of Health, Safety and Security.			
Total, DOE-Wide Environment, Safety and Health Programs	**4,049**	**5,314**	**0**

Explanation of Funding Changes

	FY 2008 vs. FY 2007 ($000)
Beginning in FY 2008: • NEPA activities are funded by the Office of General Counsel; and • eXCITE fees associated with transferred activities are funded by the Offices of Management and Administration, General Counsel, Nuclear Energy, Environmental Management, and NNSA. All other activities are funded by the Office of Health, Safety and Security.	-5,314
Total Funding Change, DOE-Wide Environment, Safety and Health Programs	**-5,314**

Program Direction

Funding Profile by Category

(dollars in thousands/whole FTEs)

	FY 2006	FY 2007	FY 2008[a]
Headquarters			
Salaries and Benefits	16,342	14,865	0
Travel	20	640	0
Other Related Expenses	4,329	4,488	0
Total, Program Direction	20,691	19,993	0
Total, Full Time Equivalents	101	101	0

Mission

Program Direction in this account provides overall direction and support for Environment, Safety and Health (EH) Energy Supply and Conservation programs to ensure that all operations are conducted in the most efficient and effective manner.

The EH mission requires experts to develop overall environment, safety, and health policy for DOE sites and facility operations; to provide a central and coordinated source of technical expertise to all of the Department elements; to provide a central clearing house for information, analysis and feedback regarding new efforts, present activities, and unforeseen occurrences taking place at the multitude of diverse facilities within the DOE complex; to provide the Department with the capability to perform activities relative to environment, safety, and health programs across the DOE complex; and oversee the Department's health studies endeavors.

Detailed Justification

(dollars in thousands)

	FY 2006	FY 2007	FY 2008
Salaries and Benefits	**16,342**	**14,865**	**0**
Beginning in FY 2008, a portion of this funding will be provided by the Offices of Management and Administration, General Counsel, and NNSA for activities transferred to those organizations. The remainder of the funding will be provided by the Office of Health, Safety and Security.			
Travel	**20**	**640**	**0**
Beginning in FY 2008, a portion of this funding will be provided by the Offices of Management and Administration, General Counsel, and NNSA for activities transferred to those organizations. The remainder of the funding will be provided by the Office of Health, Safety and Security.			
Other Related Expenses	**4,329**	**4,488**	**0**
Beginning in FY 2008, a portion of this funding will be provided by the Offices of Management and Administration, General Counsel, Nuclear Energy, Environmental Management; and NNSA for the activities transferred to those organizations. The remainder of the funding will be provided by the Office of Health, Safety and Security.			
Total, Program Direction	**20,691**	**19,993**	**0**

[a] FY 2008 funding and FTE for these activities are now included in the Offices of Health, Safety and Security; Management and Administration; General Counsel, Nuclear Energy, Environmental Management, and NNSA.

Explanation of Funding Changes

	FY 2008 vs. FY 2007 ($000)
Beginning in FY 2008, a portion of this funding will be provided by the Offices of Management and Administration, General Counsel, Nuclear Energy, Environmental Management; and NNSA for the activities transferred to those organizations. The remainder of the funding will be provided by the Office of Health, Safety and Security.	-19,993
Total Funding Change, Program Direction	**-19,993**

Other Related Expenses by Category

	(dollars in thousands)		
	FY 2006	FY 2007	FY 2008[a]
Other Related Expenses			
Training	72	99	0
Working Capital Fund	4,208	4,339	0
Other Services	49	50	0
Total, Other Related Expenses	4,329	4,488	0

[a] FY 2008 funding for these activities are now included in the Offices of Health, Safety and Security; Management and Administration; General Counsel, Nuclear Energy, Environmental Management, and NNSA.