

FY 2006 Budget-in-Brief



U.S. Department of Energy

Energy Efficiency and Renewable Energy

Bringing you a prosperous future where energy is clean, abundant, reliable, and affordable

www.eere.energy.gov

TABLE OF CONTENTS

	<u>Page</u>
<i>Introduction</i>	3
<i>Biomass</i>	6
<i>Building Technologies</i>	8
<i>Distributed Energy Resources</i>	11
<i>Federal Energy Management Program</i>	14
<i>Geothermal Technologies</i>	16
<i>Fuel Cell Technologies</i>	18
<i>Hydrogen Technologies</i>	21
<i>Industrial Technologies</i>	24
<i>Solar Energy Technologies</i>	28
<i>Vehicle Technologies</i>	31
<i>Weatherization & Intergovernmental Programs</i>	38
<i>Wind & Hydropower Technologies</i>	41
<i>Program Direction/Management</i>	45
<i>FY 2006 Budget Tables</i>	47

Introduction

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

Throughout the country, EERE employees are working to ensure that our Nation has clean, abundant, reliable and affordable energy. The research, development and deployment (RD&D) of advanced clean energy technologies funded through EERE's programs are already making a difference in the everyday lives of Americans today and will make an even larger difference in years to come. Advanced energy efficient technologies and practices that use less energy, as well as renewable energy technologies that produce power and heat more cleanly than conventional sources, are well on their way to becoming today's answers to tomorrow's energy and environmental challenges and needs.

The Fiscal Year 2006 budget request is designed to continue to provide results to the American people by advancing technologies that are making their way into energy-related products and services that are an integral part of America's energy economy. For instance, in the last four years EERE-supported research has been awarded 37 R&D 100 awards, ten in 2004 alone. Homeowners, soldiers, and campers are the benefactors of one of the technologies that received a 2004 R&D 100 award – a lightweight, mobile power source made of a thin-film Copper Indium Gallium diSelenide (CIGS) photovoltaic (PV) module that was developed by the National Renewable Energy Laboratory and Global Solar Energy.

The EERE programs being funded in the Fiscal Year 2006 budget request will continue to make greater use of our abundant, clean domestic renewable energy resources and continue to use all of our energy resources more productively, thereby providing critical economic, environmental, and security benefits to the United States. Energy costs per unit of energy will continue to be lower, thus making Americans less susceptible to energy price fluctuations. Emissions of Clean Air Act criteria pollutants, mercury, and carbon dioxide will continue to be reduced, thereby improving the nation's air quality. Technologies being researched and developed in the Fiscal Year 2006 budget request have the potential to play a key role in enhancing America's energy security by reducing our dependence on imported petroleum. Our nation's security will also continue to be enhanced as energy efficiency advances lower the loads on our energy infrastructure so that there is less potential for wide-spread energy outages. Distributed energy resources will continue to increase the reliability of our nation's energy supplies, particularly in the growing information economy.

In addition to advancing and deploying critical energy-related technologies, EERE has made good on its strategic goal of "changing the way it does business." In 2002, EERE dramatically restructured itself, both organizationally and programmatically, by streamlining program management and centralizing administrative functions, with a focus on developing uniform, efficient, results-oriented business practices. This strategic focus has enabled EERE to fund the right mix of R&D and to get more technical work done for every R&D dollar spent in the laboratory. After an 18-month review of EERE's reorganization, the National Academy of Public Administration (NAPA) in its September 2004 report "observed that the basic construct of the reorganization—eliminating the sector organizations and restructuring around the major programs; and consolidating the business

administration function—was sound,” and that “EERE has made great strides [in the last two years] to reinvent how it does business.”

The Department continues to allocate more funding for energy efficiency and renewable energy than it does for any other energy activity. The Fiscal Year 2006 Budget Request for EERE is \$1.2 billion, a \$48.2 million decrease compared to Fiscal Year 2005 funding. Even with fewer funds being requested in Fiscal Year 2006 when compared with Fiscal Year 2005, this budget builds on successes already achieved and represents a firm resolve to stay the course and deliver on promises and commitments made by the Administration during the past four years. The Department’s Fiscal Year 2006 budget request continues to implement the priorities established in the National Energy Plan and Department of Energy Strategic Plan, and reflects priorities set forth in the President’s Management Agenda. For instance, EERE was guided by and used the research and development investment criteria (R&DIC) called for in the President’s Management Agenda as well as the Office of Management and Budget’s (OMB) Program Assessment Rating Tool (PART) to evaluate its portfolio and to focus its research and development dollars on long-term, potentially high payoff activities that require Federal involvement to be successful and achieve public benefit.

Finally, the Fiscal Year 2006 budget continues to reflect the Administration’s ongoing challenge to the Department to take a bold approach towards the successful accomplishment of EERE-sponsored work. Recognizing an increasing dependence on energy from areas of the world that can be unstable, and the possibility that questions surrounding climate change could force a focus on a carbon free society, the Administration in 2001 directed that EERE take a *revolutionary*, rather than an *evolutionary* approach to meeting National Energy Policy goals of increased energy security, greater freedom for Americans in their energy choices, and reduced costs and environmental impacts associated with those choices.

- One such revolutionary approach is embodied in two interrelated, complementary initiatives; the DOE Secretary’s *FreedomCAR* and the President’s *Hydrogen Fuel Initiative*, the goal of which is an industry decision by 2015 to commercialize hydrogen-powered fuel cell vehicles. To the extent that hydrogen is produced from domestic resources in an environmentally sound manner, hydrogen fuel cell vehicles will require no petroleum-based fuels and emit no criteria pollutants or carbon dioxide, and their commercial success would essentially remove personal transportation as an environmental issue and substantially reduce our dependence on foreign oil. *The FreedomCAR and Hydrogen Fuel Partnership* now includes three auto manufacturers and five energy companies, helping to ensure that hydrogen will be available and affordably priced when fuel cell vehicles are ready for commercialization. Over the past two years significant R&D advances have increased our confidence that the 2015 goal is realistic and attainable. Together with programs in Fossil Energy, Nuclear Energy and Science, the Department’s Fiscal Year 2006 commitment to these two initiatives is more than \$357 million.
- Solid State Lighting represents a revolutionary approach to lighting our homes and businesses that has the potential to more than double the efficiency of general lighting systems in the coming decades, conserving enough electricity nationally to power the states of Arizona, Colorado, and Mississippi. The Fiscal Year 2006 Budget Request of \$11.0 million for Solid State Lighting keeps the Department on track to overcoming technical barriers to everyday use of these innovative technologies.
- In the deployment area, the Fiscal Year 2006 budget maintains the President’s commitment to increase funding for the Weatherization Assistance Program with a budget of \$230 million,

enough to weatherize 92,300 homes. This effort takes on special significance given increases in natural gas and heating oil prices. Weatherization Assistance helps low income families reduce their energy bills, resulting in average annual cost savings of \$237 per household at current energy prices.

This *Budget in Brief* summarizes these and other key activities in the EERE Fiscal Year 2006 Budget Request. The *Budget in Brief* is a consolidated document organized by individual program rather than appropriation¹. Charts delineating the budget by both appropriation and individual program are found on page 48. Additional information on the Fiscal Year 2006 EERE Budget Request can be obtained at www.eere.energy.gov.

¹ The EERE budget is funded through two separate appropriations – Interior/Related Agencies and Energy/Water Development, and budgets are normally presented separately for each appropriation.

Biomass and Biorefinery Systems

The mission of the Biomass and Biorefinery Systems R&D Program (“Biomass Program”)² is to foster research and development on advanced technologies that will transform the Nation’s domestic biomass resources into affordable biofuels, biopower, and high-value bioproducts.

The program’s research focus is in three areas: Feedstock Infrastructure, for reducing the cost of collecting and preparing raw biomass; Platforms R&D, for reducing the cost of outputs and byproducts from biochemical and thermochemical processes; and Utilization of Platform Outputs, for developing technologies and processes that utilize the intermediates from Platforms R&D (such as sugars and syngas) to co-produce fuels, chemicals and materials, and heat and power, and on integrating those technologies and processes in biorefinery configurations. The next generation biorefinery will produce value-added chemicals and materials together with fuels and/or power from non-conventional, lower cost feedstocks such as agricultural and forest residues and other biomass materials.

The program receives appropriations from both the Energy and Water Development and the Interior and Related Agencies subcommittees. Energy and Water activities focus on (a) technologies for converting biomass to intermediates, i.e., low cost sugars, syngas and pyrolysis oils; and, (b) technologies for producing transportation fuels and power from the intermediate products. Interior activities focus on developing bio-based products technologies for integration into both existing and future biorefineries, reducing processing energy requirements and production costs, and increasing efficiency and effectiveness in biomass processing plants and integrated industrial biorefineries.

FY 2006 Budget Request Biomass & Biorefinery Systems R&D

Activity	Funding (dollars in thousands)		
	FY 2004 Approp	FY 2005 Approp	FY 2006 Request
Biomass and Biorefinery Systems R&D (Energy Supply)	84,608	80,846	50,359
Feedstock Infrastructure	982	1,984	1,000
Platforms R&D	28,874	30,073	43,360
Utilization of Platform Outputs	13,518	13,455	5,999
Congressionally Directed Activities	41,234	35,334	0
Biomass and Biorefinery Systems R&D (Conservation)	6,966	7,253	21,805
Utilization of Platform Outputs	6,570	6,859	21,205
Technical/Program Management	396	394	600
TOTAL	91,574	88,099	72,164

In Fiscal Year 2006, the Department is requesting \$72.2 million for Biomass Program activities, a decrease of \$15.9 million from the Fiscal Year 2005 Comparable Appropriation. The Fiscal Year 2005 Energy and Water Development biomass appropriation included \$35.3 million in Congressionally Directed Activities.

² Biomass includes agricultural crops and trees, wood and wood wastes and residues, plants, grasses, residues, fibers, animal wastes, municipal solid wastes, and other waste materials. Biorefineries are processing facilities that extract carbohydrates, oils, lignin, and other materials from biomass, and convert them into multiple products such as transportation fuels, chemicals, and materials.

Feedstock Infrastructure (Energy Supply)

In Fiscal Year 2006, Feedstock Infrastructure systems work will continue for single-pass harvester development for wheat straw and corn stover collection, and supporting infrastructure analysis. (\$1.0 million)

Platforms R&D (Energy Supply)

- Thermochemical Platform conducts research, testing, integration, and feasibility studies on thermochemical conversion of biomass to provide the foundation for advanced and integrated systems that focus on syngas and pyrolysis oils. In Fiscal Year 2006, the program will test the continuous production, cleanup and conditioning of biomass syngas and pyrolysis oils suitable for conversion to fuels, chemicals or hydrogen. (\$15.0 million)
- Bioconversion Platform R&D for Sugars will continue work with industry on pretreatment and analytical technologies, and improved process integration capabilities to enable industrial biorefineries. The program will fund partnerships to further improve the integration of pretreatment and enzyme operations leading to cheaper biomass-based sugars. This will benefit current and future biorefinery projects and partnerships. (\$28.4 million).

Utilization of Platform Outputs (Energy Supply)

- Integration of Biorefinery Technologies will continue to integrate and test handling, pretreatment, hydrolysis, and fermentation operations to evaluate performance and costs of converting biomass to fuels and co-products. (\$6.0 million)

Utilization of Platform Outputs (Conservation)

To reduce market penetration risks for biorefineries, increased funding is being requested for projects with industrial partners that will focus on developing further value-added products such as chemicals and materials, and their integration into both existing and future biorefineries. Such integration will improve both the effectiveness and efficiency of biorefineries. Additional work with industry, universities and the National Laboratories will focus on improvements to increase the efficiency of individual process steps, e.g., catalysis and separations, and the development of both biological and thermochemical pathways to produce the building-block chemicals identified in the program's recent Top Ten Chemicals report. (\$21.2 million)

Building Technologies Program

The mission of the Building Technologies Program is to develop technologies, techniques, and tools for making residential and commercial buildings more energy efficient, productive, and affordable. Energy use by residential and commercial buildings accounts for over one-third of the Nation's total energy consumption, including two-thirds of the electricity generated in the United States. This level of energy use costs the Nation about \$240 billion annually. Improving the energy efficiency of buildings and equipment reduces energy consumption—especially during critical peak demand periods—which also reduces America's vulnerability to energy supply disruptions, energy price spikes and constraints on the Nation's electricity infrastructure. The funding supports a portfolio of activities that includes solid-state lighting, improved energy efficiency of other building components and equipment, and their effective integration using whole-building-system-design techniques. The program also includes the development of codes and standards.

FY 2006 Budget Request Building Technologies

The Fiscal Year 2006 request for the Building Technologies Program is \$57.97 million, a decrease of \$7.5 million from the Fiscal Year 2005 Comparable Appropriation.

Activity	Funding (\$ in thousands)		
	FY 2004 Approp	FY 2005 Approp	FY 2006 Request
Residential Buildings Integration	12,937	16,800	18,311
Commercial Buildings Integration	4,440	5,125	4,541
Emerging Technologies	28,286	31,420	25,358
Equipment Standards and Analysis	10,265	10,147	8,256
Oil Heat Research for Residential Buildings	494	493	0
Technical/Program Management Support	1,377	1,479	1,500
TOTAL	57,799	65,464	57,966

Residential Buildings Integration

The long-term goal of Residential Buildings Integration is to develop cost effective technologies and building practices that will enable the design and construction of net Zero Energy Buildings (ZEB)—houses that produce as much energy as they use on an annual basis—by 2020.

- Research and Development: Building America will focus on reducing total energy use in a new home by 60 to 70 percent. During Fiscal Year 2006, research for production-ready new residential buildings that are 30 percent more efficient for all five climates will be completed and research at the 40 percent efficiency level for all five climates will continue. Activities will be carried out in partnership with designers, builders and component manufactures. (\$17.7 million)
- Residential Building Energy Codes. Energy efficient revisions to the International Energy Code Council 2009 Edition, the National Fire Protection Association and the National Fenestration Rating Council will be proposed, and appropriate revisions to the residential building codes will be developed that support the cost effective design, construction, and operation of Zero Energy Buildings. (\$0.6 million)

Commercial Buildings Integration

The long-term goal of the Commercial Buildings Integration subprogram is to develop cost effective technologies and building practices that will enable the design and construction of net Zero Energy Buildings – commercial buildings that produce as much energy as they use on an annual basis – by 2025.

- Research and Development. Fiscal Year 2006 activities will focus on developing packages of cost-effective technologies for small commercial buildings to reach 30 percent energy savings over ASHRAE Standard 90.1-2004. These packages will build on the knowledge gained from the intensive case studies of six high performance buildings, completing the broad-based assessments of technology and market opportunities, system optimization methods and design strategies and continuing work with designers, developers and owners of high performance buildings. (\$4.0 million)
- Commercial Building Energy Codes. Energy efficient revisions to the International Energy Code Council 2009 Edition/ASHRAE Standard 90.1-2007, the National Fire Protection Association and the National Fenestration Rating Council will be proposed. Code change proposals will be developed that encourage code officials to accept newer technologies in support of the 2025 goal of marketable zero energy commercial buildings. (\$0.54 million)

Emerging Technologies

The Emerging Technologies subprogram seeks to develop cost effective technologies, e.g., lighting, windows, and space heating and cooling, for residential and commercial buildings that can reduce the total energy use in buildings by 60 to 70 percent. The improvement in component and system energy efficiency when coupled with research to integrate onsite renewable energy supply systems into the commercial building can result in marketable net zero energy designs.

- Solid State Lighting can capture at least a 50 percent electricity peak demand reduction in commercial buildings' lighting load, while continuously saving energy during all operating hours. Projects will be continued (from the Fiscal Year 2004 and 2005 solicitations) to develop general illumination technologies that achieve energy efficiencies of up to 70 lumens per watt, through creation of a technical foundation to revolutionize the energy efficiency, appearance,

visual comfort, and quality of lighting. Activities will focus on the areas of ultra-violet emissions, power conversion efficiency, and white light phosphorus in light emitting diodes (LED); and material science, light extraction and device structures in organic LEDs to enable manufacture of LEDs. (\$11.0 million)

- Conventional Lighting R&D will focus on the development of conventional lighting system technologies, strategies and guidelines that have the potential to increase conventional lighting system efficiency by 20 to 30 percent. (\$2.0 million)
- Space Conditioning and Refrigeration R&D will focus on space conditioning technology applications that will reduce peak electric demand in residential and commercial buildings by 50 percent for new construction and 30 percent for existing buildings. (\$2.9 million)
- Appliance and Emerging Technologies R&D will launch four to six new projects with both the highest potential to contribute to building energy reduction and the greatest potential appeal to large buyers, as indicated by the screening study and buyers group identification tasks completed in the prior year. The new projects will speed commercial introduction of new, highly efficient products through public-private partnerships to improve the cost and performance attributes of selected products by late-stage engineering and development in cooperation with users. (\$1.7 million)
- Building Envelope R&D will conduct research to reduce the technical hurdles to increase the size and improve the performance of dynamic windows. Research will focus on improvements in the performance, manufacturer yields, and fundamental processes of prototype electrochromic devices developed in Fiscal Year 2005. Research will also be continued on highly insulating windows. (\$4.9 million)
- Analysis Tools and Design Strategies will focus its research on developing, improving, verifying and maintaining software packages for engineers, architects, and builders who design or retrofit buildings to be more energy efficient and comfortable. Activities will focus on research and additions to the EnergyPlus whole-building energy simulation software that enables building designers, operators, owners, and researchers to evaluate technologies for improving the energy efficiency and comfort of buildings while reducing operating costs. (\$2.8 million)

Equipment Standards and Analysis

The Equipments Standards and Analysis subprogram seeks to develop minimum energy efficiency standards that are technologically feasible and economically justified. During Fiscal Year 2006, the focus will be on completing the energy efficiency standards rulemakings for three priority products: electric distribution transformers; commercial central air conditioners and heat pumps; and residential furnaces and boilers. (\$8.3 million)

Distributed Energy Resources Program

The mission of the Distributed Energy Resources (DER) Program is to strengthen America's energy infrastructure and provide utilities and consumers with a greater choice of energy efficient technologies for the on-site generation of electricity and use of thermal energy. The program seeks to develop and deploy by 2015 a diverse array of integrated distributed generation and thermal energy technologies that are competitively priced and highly efficient. Distributed energy technologies can expand the use of the Nation's aging electricity power infrastructure, relieve congestion on transmission and distribution systems, increase supplies during periods of peak demand, and reduce environmental emissions.

FY 2006 Budget Request Distributed Energy Resources

Activity	Funding (\$ in thousands)		
	FY 2004 Approp	FY 2005 Approp	FY 2006 Request
Distributed Generation Technology Development	39,497	39,322	35,485
End-Use System Integration and Interface	19,676	20,571	20,500
Technical/Program Management Support	511	523	644
TOTAL	59,684	60,416	56,629

The Fiscal Year 2006 Budget Request for Distributed Energy Resources is \$56.6 million, a \$3.8 million reduction from the Fiscal Year 2005 Comparable Appropriation. The reduction reflects the reallocation of funds given advances made in previous years and changes within the overall energy R&D portfolio.

Distributed Generation Technology Development

This effort seeks to develop a portfolio of electricity generation and heat utilization technologies with a focus on efficiency, emissions, RAMD (reliability, availability, maintainability and durability) and meeting cost targets. By improving the efficiency of thermally activated systems and advancing the efficiency and emissions characteristics of these power generation technologies, the program provides the building blocks necessary to develop advanced integrated systems.

- Industrial Gas Turbines focuses on advanced materials research, such as composite ceramics and thermal barrier coatings that will improve performance and durability. Research will test cost effective low emissions technologies, and continue efforts to lower manufacturing costs and increase durability of ceramics, combustion systems, and combustor designs for gas turbines. (\$2.5 million)

- Microturbines are a new type of combustion turbine for use in distributed energy generation applications. About the size of a refrigerator, microturbines produce 25 to 500 kilowatts of energy and can be located on sites with limited space for power production. Waste heat recovery can be used in combined cooling, heating, and power (CHP) systems with the potential to achieve energy efficiency levels greater than 80 percent. Activities will include a national effort to design, develop, test, and demonstrate a new generation of microturbines for DER applications that are cleaner, more affordable, reliable, and efficient than products currently available. (\$5.7 million)
- Advanced Reciprocating Engines offer a wide range of power generation at less cost than other technologies. Reciprocating engines can be used for many purposes, such as, local power grid and substation support, peak-shaving, remote power, on-site generation, combined CHP applications and others. Activities will include a national effort to design, develop, test, and demonstrate a new generation of gas-fired reciprocating engines for distributed energy applications that are cleaner, more affordable, reliable, and efficient than products commercially available today. (\$10.0 million)
- Advanced Materials and Sensors, such as ceramics and environmental barrier coatings, are some of the key enabling technologies to improve the efficiency of stationary industrial gas turbines, microturbines and reciprocating engines. Engineered ceramics offer all the advantages of ceramics -- resistance to heat, corrosion, erosion, and chemical activity -- while adding strength and thermal shock resistance that conventional ceramics do not demonstrate. (\$8.3 million)
- Fuel Combustion (formerly Fuel Flexibility) will evaluate the long-term combustion technologies for low emissions focusing on next-generation dual fuels (gaseous or liquids). Research will evaluate fuel characteristics and effects of fuel variations on distributed generation equipment for long-term availability and durability. (\$1.0 million)
- Thermal Energy Technologies (formerly Thermally-Activated Technologies) convert natural gas, exhaust, or rejected heat into heating, cooling, humidity control, or bottoming cycles. Utilizing thermal energy is an essential building block for CHP integrated systems, widely recognized as the next wave of energy efficient power generation devices that will complement central power station electric power generation into discrete, economical, reliable, and secure distributed power generation. (\$8.0 million)

End-Use System Integration and Interface

The focus of the End-Use Integration and Interface subprogram is to develop highly efficient integrated energy systems that can be replicated across end-use sectors that will help demonstrate an R&D objective or address a technical barrier.

- Distributed Energy Systems Applications Integration facilitates acceptance of distributed energy resources in end-use sectors by partnering with industry consortiums in commercial building, light industrial, supermarkets, hotels, healthcare and education. Projects will: 1) quantify the energy and emissions benefits and installation and retrofit costs; 2) research integration issues and recommend improvements; and 3) correlate data to analytical models and

tools for end use customers. Research will include activities on electronics and supervisory control strategies to better optimize electrical and thermal needs and synchronize with the grid. (\$8.5 million)

- Cooling, Heating and Power Integration (CHP) reduces energy costs and emissions by using energy resources more efficiently. In conventional conversion of fuel to electricity, over two-thirds of the energy input is discarded as heat to the environment and not used for productive purposes. CHP makes greater use of fuel inputs by utilizing the discarded heat with system potential efficiencies from 60 to 80 percent. Research and development are focused on integration of prime movers such as turbines, microturbines, and reciprocating engines with thermally activated technologies (chillers, dehumidification, etc) for plug-and-play high efficiency integrated CHP systems. The activity will continue support of the Regional Application Centers and educational programs under the State Energy Programs (special projects). (\$12.0 million)

Federal Energy Management Program

Federal Energy Management Program (FEMP) assists federal agencies in increasing their use of energy efficiency and renewable energy technologies through contract support, technical assistance and annual reporting support. FEMP facilitates the award of alternative financing contracts between Federal agencies and the private sector to fund energy efficiency improvements at no net cost to taxpayers. FEMP also 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 conducts an awards program to recognize individuals and groups within Federal agencies who achieve excellence in energy management. The focus of FEMP in FY 2006 is to promote energy efficiency, water conservation and improved energy security for Federal agencies.

The Departmental Energy Management Program (DEMP) implements the FEMP mission specifically for Department of Energy (DOE) facilities by providing funding support and technical assistance for energy management projects and expanding the use of private sector financing for energy management. The Department owns or leases about 11,000 buildings at more than fifty sites across the United States. Overall, DOE has already reduced its energy intensity per square foot by more than 50 percent (compared to 1985) and will save more than \$100 million annually in avoided costs.

FY 2006 Budget Request Federal Energy Management Program

Activity	Funding (\$ in thousands)		
	FY 2004 Approp	FY 2005 Approp	FY 2006 Request
Federal Energy Management Program (Energy Conservation)			
Project Financing	7,830	7,133	6,827
Technical Guidance and Assistance	8,140	8,160	7,720
Planning, Reporting and Evaluation	2,571	2,638	2,600
Technical/Program Management Support	879	0	0
Departmental Energy Management Program (Energy Supply)			
Energy Management Project Support	1,472	1,455	1,506
Energy Management Model Program Development	491	496	513
TOTAL	21,383	19,882	19,166

The Fiscal Year 2006 request is \$17.1 million for FEMP and \$2.0 million for DEMP, \$0.7 million less than the Fiscal Year 2005 comparable appropriations, to continue meeting the goals of reducing Federal energy consumption. As FEMP's core activities have evolved, efficiencies have increased, enabling a reduced funding level in Fiscal Year 2006. More efficient use of resources in meetings, awards, publications and technical funding projects will allow FEMP to continue to meet its historically high level of achievement.

Project Financing

FEMP alternative financing programs help agencies access private sector financing to fund needed energy improvements. FEMP helps Federal agencies use Energy Savings Performance Contracts (ESPC) and Utility Energy Service Contracts (UESC) to finance energy saving improvements at no net cost to taxpayers. These funds pay for energy improvements at Federal facilities that are in need of significant energy system retrofits. Projects include all types of energy improvements including lighting upgrades, new heating and ventilation systems, and improved control systems. (\$6.8 million)

Technical Guidance and Assistance

This effort helps Federal energy managers identify, design, and implement new construction and facility improvement projects that incorporate energy efficiency and renewable energy. FEMP provides unbiased, expert technical assistance through audits for buildings and industrial facilities. FEMP also helps Federal facilities manage peak load and deploy new technologies, including combined heat and power and distributed energy and renewable technologies. In addition, FEMP helps agencies acquire the most energy efficient products through procurement training, product efficiency recommendations, communications and outreach, and assistance to agencies in amending their guide specifications to incorporate requirements for energy efficient products. FEMP provides training for federal agency energy managers and issues publications on energy technologies and best practices. (\$7.7 million)

Planning Reporting and Evaluation

Through this activity, FEMP promotes building energy security through the whole building design approach, facilitates meetings with senior Federal energy officials, and provides support to the Federal Energy Management Advisory Committee. In Fiscal Year 2006 FEMP will collect and publish data for the Annual Report to Congress, provide support to ensure accuracy in reporting and analysis of trends and conduct a Federal awards program (\$2.6 million)

Energy Management Project Support

DEMP provides direct financial assistance for energy projects at DOE facilities to increase energy efficiency and reduce future utility and maintenance costs. Funding will be provided to multiple projects that are selected through competition to both maximize return on investment and demonstrate leadership in implementing emerging energy savings technologies. DEMP will fund approximately 4-13 energy projects that will provide a rate of return of at least 20 percent per dollar invested and achieve annual savings of 12 billion Btus. (\$1.5 million)

Energy Management Model Program Development

Energy management model program development involves a comprehensive approach to making energy improvements at DOE facilities by providing direct funding for the implementation of “best practices.” Model programs have included such initiatives as sustainable building design, the acquisition of ENERGY STAR[®] Labels for buildings, building re-commissioning, and energy consumption reductions in excess buildings. (\$0.5 million)

Geothermal Technologies Program

The Geothermal Technologies Program works in partnership with industry to establish geothermal energy as an economically competitive contributor to the U.S. energy supply. Geothermal energy production, a \$1.3 billion a year industry, generates electricity or provides heat for direct applications including aquaculture, crop drying, and district heating, or for use in heat pumps to heat and cool buildings. The technologies developed by this program will provide the Nation with new sources of electricity that are highly reliable and cost competitive and do not add to America's air pollution or the emission of greenhouse gases. Geothermal electricity generation is not subject to fuel price volatility and supply disruptions from changes in global energy markets.

The current technology relies on extracting energy in the form of steam or hot water from geothermal reservoirs. In order to sustain productivity of the resource, used geothermal water and condensed steam typically are injected back into the reservoir. As a result, the typical geothermal plant has few surface emissions and minimal environmental impacts.

FY 2006 Budget Request Geothermal Technologies

The Fiscal Year 2006 Budget Request for Geothermal Technologies is \$23.3 million, a \$2.0 million decrease from the Fiscal Year 2005 Comparable Appropriation. The Fiscal Year 2005 appropriation included \$3.6 million in funds for Congressionally Directed Activities.

Activity	Funding (\$ in thousands)		
	FY 2004 Approp	FY 2005 Approp	FY 2006 Request
Technology Development	16,425	15,480	19,799
Technology Application	6,238	6,232	3,500
Congressionally Directed Activities	1,962	3,558	0
TOTAL	24,625	25,270	23,299

Technology Development

- 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, and remote sensing as exploration tools. Available exploration technology from related industries (e.g., petroleum, mining, waste management) is evaluated for adaptation to geothermal environments. In Fiscal Year 2006, the program will conduct extensive field tests of technologies for exploration, such as remote sensing, geophysical, and geochemical techniques to locate hidden geothermal resources. The program will expand and accelerate the geothermal resource assessment being conducted in collaboration with the U.S. Geological Survey (USGS) and state agencies. (\$3.7 million)
- Enhanced Geothermal Systems (EGS) are engineered reservoirs created to produce energy from geothermal resources deficient in economical amounts of water and/or permeability. EGS technology will increase the productivity and lifetime of those reservoirs. DOE estimates that the application of EGS technology could quadruple the amount of viable geothermal resources

in the West. In Fiscal Year 2006, the program will conduct the following major activities: complete long-term flow testing of the enhanced reservoir at the Coso Hot Springs geothermal field on the U.S. Naval Weapons Air Station (China Lake, California); work to identify an EGS field test site will begin; and an analysis of EGS reservoir testing at foreign and domestic sites will be performed. (\$7.9 million)

- Systems Development includes research on drilling and energy conversion systems. 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. Systems Development also focuses on improved energy conversion technologies including better heat exchangers and condensers. In Fiscal Year 2006, the program will: demonstrate an integrated Diagnostics-While-Drilling data management system with user-selected displays; verify the field-worthiness of advanced primary cementing technology; complete field demonstrations of hydraulically augmented drag bits and high-strength drill pipe; complete development of standards for thermally sprayed metallic coatings; and complete development of a laser-based instrument for detection of hydrogen sulfide in cooling towers. (\$8.2 million)

Technology Application

- 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. In Fiscal Year 2006, the program will continue to collaborate with industry partners to find and evaluate new geothermal resources using DOE-sponsored technology improvements. This activity builds on prior exploration and will directly contribute to the addition of new resources in the western United States. One competitively selected power system project will advance to the design and construction phase. (\$2.0 million)
- Technology Deployment activities are aimed at mitigating or removing non-technical barriers to the deployment of geothermal systems. An example of such a barrier is a complex and often inconsistent process to gain access to geothermal resources on public lands. This can prevent the transition from a prototype to a commercial product. In Fiscal Year 2006, the program will conduct outreach activities focused on decision and policy makers who can affect key regional, state, and local development issues. In addition, analytical work will continue on the performance and economics of geothermal systems (\$1.5 million).

Fuel Cell Technologies Program

The Fuel Cell Technologies Program works closely with the Hydrogen Technology Program to research, develop, and validate fuel cell and hydrogen production, delivery, and storage technologies for transportation and stationary applications. The program seeks to have hydrogen produced from diverse domestic resources and used in a clean, safe, reliable, and affordable manner in fuel cell vehicles and distributed heat and power applications. The Fuel Cell Technologies Program supports the President's *Hydrogen Fuel Initiative* and FreedomCAR activities, aligned with the vision of a diverse, secure, and emissions-free energy future. The major focus of the Fuel Cell Technologies Program continues to be high-risk research and development to overcome technical barriers centered on core research of key polymer fuel cell components, with industry focused on engineering development of complete systems.

FY 2006 Budget Request Fuel Cell Technologies

The Fiscal Year 2006 Fuel Cell Technologies budget request is \$83.6 million, an \$8.7 million increase over the Fiscal Year 2005 Comparable Appropriation.

Activity	Funding (\$ in thousands)		
	FY 2004 Approp	FY 2005 Approp	FY 2006 Request
Transportation Systems	7,317	7,495	7,600
Distributed Energy Systems	7,249	6,902	7,500
Stack Component R&D	24,551	32,541	34,000
Fuel Processor R&D	14,442	9,721	9,900
Technology Validation	9,828	17,750	24,000
Technical/Program Management Support	395	535	600
TOTAL	63,782	74,944	83,600

Transportation Systems

This subprogram conducts research, development and analysis that address key barriers to fuel cell systems for transportation applications. Key systems level barriers include cost and durability. The activity supports development of individual component technology critical to systems integration as well as systems level modeling activities that serve to guide research and development and integration activities, benchmark systems progress, and explore alternate systems configurations. Other activities include studies to assess the status of critical performance measures (such as cost) and assess important materials issues (such as catalyst usage). Transportation Systems also supports the development of vehicle Auxiliary Power Units (APU) for automotive or heavy vehicle applications and the demonstration of the feasibility of fuel cells for portable power applications. Systems components

developed under Transportation Systems include compressor/expanders, sensors, actuators, heat exchangers and water management devices. (\$7.6 million)

Distributed Energy Systems

This effort develops high-efficiency Polymer Electrolyte Membrane (PEM) fuel cell power systems as an alternative power source to grid-based electricity for buildings and other stationary applications. The Distributed Energy Systems activity 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. Distributed energy fuel cell systems benefit from transportation fuel cell R&D, particularly in the areas of developing improved materials for high temperature membranes, improving fuel cell component durability, and water and thermal management. (\$7.5 million)

Stack Component R&D

This effort focuses on overcoming critical technical hurdles at the component level to improve overall fuel cell performance and durability while lowering cost. Addressing these hurdles at the component level supports the industrial effort to integrate the fuel cell system and develop full-scale fuel cell stacks. In Fiscal Year 2006, the Department plans to implement a major research initiative to address technology shortfalls associated with cold-weather start-up and operations. Through open competition, the program will address this technology hurdle, as well as the material cost and performance barriers of major components, i.e., membranes, electrodes and catalysts, gas diffusion layers, bipolar plates, etc. Additionally, the impact of hydrogen quality (i.e. tolerance to impurities) on fuel cell performance and durability will be evaluated. DOE seeks to secure participation by the country's leading scientists and engineers from universities and national labs, along with strong involvement from leading developers from the private sector, in conducting this important research. Component research and development activities for transportation and stationary fuel cell applications are synergistic. Transportation fuel cell components depend on the early market success of stationary fuel cells to establish the component manufacturing facilities, while stationary fuel cells benefit from the investment of the automotive manufacturers, which are motivated by large transportation markets. (\$34.0 million)

Fuel Processor R&D

In August 2004, the Department made a decision to discontinue on-board vehicle fuel processing R&D. The decision was based on several key conclusions: current fuel processing technologies did not meet the technical and economic targets; there was no clear path forward to meet the more difficult criteria necessary for full implementation/integration in fuel cell vehicles; there was no interest from the U.S. auto industry; and competing technologies available today (e.g. gasoline, hybrid-electric vehicles) offer similar efficiency and emissions to a fuel cell vehicle operating on gasoline that is reformed on-board the vehicle. Fiscal Year 2005 was used to complete and redirect on-board fuel processing activities. The program continues to develop fuel processors for stationary applications and to develop fundamental catalysts suitable for a variety of fuel processing applications such as fuel processing for auxiliary power applications. Fuel processing research on APU will support the 21st Century Truck initiative and the Office of Fossil Energy's Solid State Energy Conversion Alliance.

Until a new hydrogen production and delivery infrastructure is fully established, it would be beneficial if the existing fuel infrastructure could be used to supply hydrogen for stationary power plants and heavy duty vehicle APU applications. (\$9.9 million)

Technology Validation

For the automotive, utility, and fuel industries to make commercialization decisions by 2015, integrated vehicle and infrastructure systems need to be validated and individual component targets need to be met under real-world operating conditions. Automotive and energy partners are matching public dollars on a “50-50” cost-shared basis, and the DOE is beginning to receive critical performance and durability data necessary to guide the polymer fuel cell research program. The hydrogen infrastructure portion of this effort is funded through Hydrogen Technology. The integrated project allows the Department, the Office of Management and Budget, and Congress to link program performance to budget, in accordance with the President’s Management Agenda. By measuring progress under real-world driving conditions, the Department can most accurately monitor progress in overcoming remaining fuel cell technology barriers and progress towards the 2015 commercialization decision. In Fiscal Year 2006 this activity will validate 1,000 hours of fuel cell durability ‘on the road’. (\$24.0 million)

Hydrogen Technology Program

The Hydrogen Technology Program is a major portion of the President's Hydrogen Fuel Initiative. The Hydrogen Technology research focus is to enable cost-competitive production of hydrogen from renewables and distributed natural gas, to provide storage technology that enables greater than 300 mile driving range for vehicles, and to validate technology developments under "real world" conditions to help refocus research efforts. Additional key activities include underlying safety research to support the development of codes and standards; systems analyses of hydrogen pathways and transition scenarios to assess energy, environmental and economic impacts of hydrogen and fuel cell technologies; and education activities in response to the President's National Energy Policy recommendation to communicate the benefits of alternative energy, including hydrogen.

FY 2006 Budget Request Hydrogen Technology

The Fiscal Year 2006 Budget Request for Hydrogen Technology in EERE is \$99.1 million, a \$5.1 million increase over the Fiscal Year 2005 Comparable Appropriation. Consistent with the program's plan, additional resources are primarily for hydrogen production from renewables. Note that the Fiscal Year 2005 appropriation included more than \$37 million in funds in congressionally directed activities, most of which do not support program goals. Continued funding for these activities is not requested, and the total of \$37 million is also applied as an increase to the program's key activities.

Activity	Funding (\$ in thousands)		
	FY 2004 Approp	FY 2005 Approp	FY 2006 Request
Production and Delivery R&D	10,083	14,218	32,173
Storage	13,174	23,654	29,890
Infrastructure Validation	5,784	9,484	14,945
Safety, Codes, and Standards Utilization	5,615	5,954	13,121
Education	2,417	0	1,881
Systems Analysis	1,372	3,404	7,084
Congressionally Directed Activities	41,967	37,292	0
TOTAL	80,412	94,006	99,094

Production and Delivery R&D

The focus of this effort is research and development of advanced technologies for producing hydrogen using diverse, domestic resources such as renewables (solar, biomass, and wind) and domestic feedstocks such as distributed natural gas. Additional efforts include research and development of cost-competitive, safe, and efficient hydrogen delivery technologies. The majority of EERE funding for hydrogen production focuses on renewable resources, while work involving other feedstocks is largely funded by, and coordinated with, other DOE offices (i.e. Fossil Energy and Nuclear Energy). Note that natural gas is viewed only as a transitional feedstock (using the existing distribution system) because of long term energy security issues. Technology areas include fuel-flexible reformers (natural gas/renewable liquids), catalysis, membranes for separations, purifiers, electrolyzers, and highly efficient compressors. (\$32.2 million)

Storage

The Hydrogen Storage activities focus on developing lightweight, low-cost, and efficient on-board vehicular hydrogen storage systems to achieve a driving range of greater than 300 miles, without impacting vehicular cargo or passenger space. The activity emphasizes research and development of materials-based technologies, both solids and liquids, which are either reversible on-board or may be regenerated off-board the vehicle. Concerted, collaborative efforts with multiple university, industry, and national laboratory partners will focus on three key areas: metal hydrides, carbon-based materials, and chemical hydrogen storage. Independent projects by industry and universities will also explore new materials and concepts, as well as off-board storage and analyses of system performance, cost and life cycle efficiency. (\$29.9 million)

Infrastructure Validation

A critical component of the program is validation of hydrogen infrastructure and fuel cell technologies under 'real world' operating conditions to help refocus research activities where needed. This effort provides critical statistical data on the status of infrastructure technology in meeting targets in the areas of efficiency, durability, storage system range, and fuel cost. Technology Validation also provides information needed for the standards activity and feedback on vehicle and infrastructure safety. Through cost-shared partnerships with the energy industry, Fiscal Year 2006 activities include opening eight hydrogen fueling stations and validating hydrogen cost, production and delivery, energy efficiency and overall infrastructure performance and safety. These activities are not commercial or pre-commercial demonstrations but are integrated within the research efforts to ensure meaningful data is captured and fed back into research and development activities in the areas of hydrogen production, delivery, storage and fuel cells. The fuel cell vehicle portion of the integrated project is funded through the Fuel Cell Technologies Program. (\$14.9 million)

Safety, Codes & Standards Utilization

This activity focuses on the underlying hydrogen safety research required to accelerate the development of Codes and Standards for hydrogen and fuel cell technologies. Codes and standards for the commercial use of hydrogen generally do not exist. Successful commercialization of hydrogen technologies requires a comprehensive and defensible database on component reliability and safety, published performance-based domestic standards, and international standards or regulations that will allow the technologies to compete in a global market. Research will be conducted to determine flammability and reactive and dispersion properties of hydrogen under various conditions. Through such efforts, critical data will be generated to help write and adopt standards and to develop the safety criteria and systems that meet or exceed current technologies. In Fiscal Year 2006, additional research efforts include developing hydrogen sensors, identifying critical failure modes, and component testing. (\$13.1 million)

Education

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. Education activities are designed to increase understanding of the benefits and challenges to achieving a hydrogen economy, the facts about hydrogen safety, and the role that target audiences can play in the transition to a hydrogen economy. Target audiences, identified by key government and industry stakeholders in the National Hydrogen Energy Roadmap, include state and local governments, including safety and code officials; potential end-users; and the public. Activities include development and distribution of educational materials and training to serve the specific needs of target audiences that can facilitate the transition to a hydrogen economy. (\$1.9 million)

Systems Analysis

Systems Analysis is one of the keys to the hydrogen program in terms of understanding and assessing the technology needs and progress, the potential environmental impacts, and the energy-related economic benefits of the various hydrogen supply and demand pathways. This analysis is done to directly support program decision-making, planning and budgeting, and interactions with other energy domains. Systems Analysis includes independent analysis and evaluation functions consistent with the recommendations of the National Research Council (NRC). One of the findings of the NRC's report on hydrogen states, "The effective management of the Department of Energy Hydrogen Program will be far more challenging than any activity previously undertaken on the civilian energy side of the DOE." (*Ref. The Hydrogen Economy Report, NRC, NAE*) The NRC goes on to recommend that a systems analysis capability be established to identify the impacts of various hydrogen technology pathways, assess associated cost elements and drivers, identify key costs and technological gaps, evaluate the significance of actual research results, and assist in the prioritization of research and development directions. These are the areas covered under the Systems Analysis activity. (\$7.1 million)

Industrial Technologies Program

The Industrial Technologies Program seeks to reduce the energy intensity (energy demand per unit of industrial output) of the U.S. industrial sector through coordinated research and development, validation, and dissemination of energy-efficiency technologies and operating practices. Industry energy consumption accounts for about one-third of all U.S. energy use, and improved industrial energy intensity will reduce the need for new powerplants, reduce the need to import petroleum from foreign sources, and lower environmental emissions. In addition, more energy efficient production processes and technologies will accelerate industrial modernization and enable U.S. companies to compete more successfully in global markets.

FY 2006 Budget Request Industrial Technologies

The Fiscal Year 2006 budget request for Industrial Technologies is \$56.5 million, an \$18.3 million reduction from the Fiscal Year 2005

Comparable Appropriation. This funding level reflects a shift from activities that industry can perform on its own behalf, given that energy-intensive companies have strong economic incentives to reduce energy consumption, and increased support for multi-industry *Grand Challenges* for next generation manufacturing and energy systems that would require high-risk investment to achieve much lower energy use than current processes.

Activity	Funding (\$ in thousands)		
	FY 2004 Approp	FY 2005 Approp	FY 2006 Request
Industries of the Future (Specific)	45,659	38,176	22,087
Industries of the Future (Crosscutting)	38,874	32,885	30,609
Technical Program Management Support	5,917	3,740	3,793
TOTAL	90,450	74,801	56,489

Industries of the Future (Specific)

Working with industrial partners, Industries of the Future (Specific) supports cost-shared research, development, and demonstration of advanced technologies to reduce the energy intensity while improving the environmental performance of America's energy-intensive and waste intensive industries. To provide the best value and optimum use of public investments, this activity focuses on a few basic materials processing industries that can achieve the highest returns on Federal investments.

- **Forest and Paper Products.** The goal of the Forest and Paper Products activity is to develop alternative pulping and bleaching technologies and methods for making the strength of recycled fiber equivalent to virgin fiber. Fiscal Year 2006 activities will include mechanical and process tests for technologies that will reduce water and energy usage in the pulp and papermaking process. Collaborative activities with the American Forest and Paper Association and other

industry organizations will include cost-shared R&D as well as the utilization of new improved energy technologies, industrial energy efficiency tools and energy management best practices. (\$3.0 million)

- Steel Industry. The goal of the Steel Industry activity is to develop by 2010 a commercially ready technology that will cut the use of energy intensive coke as a feedstock in the steelmaking process. In Fiscal Year 2006, prototype development for balancing highly variable loads in steelmaking will be started. Efforts by the American Iron and Steel Institute and the Steel Manufacturers' Association and other industry organizations to improve their energy efficiency and environmental performance will be supported. The collaborative activities will include cost-shared R&D as well as the utilization of new improved energy technologies, industrial energy efficiency tools, and energy management best practices. (\$3.8 million)
- Aluminum Industry. The goal of the Aluminum Industry activity is to develop with the aluminum industry by 2010 advanced technologies, such as carbothermic aluminum reduction, and inert anodes and wettable cathodes that would result in significant net energy savings in primary aluminum production. In Fiscal Year 2006, the "Reduction of Alumina" technology investigated in the Fiscal Year 2005 Grand Challenge will be evaluated to determine if it should be pursued to the pilot stage, and four current elementary R&D forming projects will be evaluated to determine which seem most promising. (\$2.7 million)
- Metal Casting enables major technical advances in the metal casting industry that implement new design techniques and practices, increase yield, and reduce energy use and generation of scrap. Fiscal Year 2006 activities will include computer models for the design of tighter tolerance die castings and the lost foam pattern displacement process. Work will continue with over 320 cost-sharing industry partners in 35 States. (\$2.0 million)
- Glass activity develops advanced glass technologies that will reduce the gap between actual melting energy use (more than 11 million Btu to melt a ton of glass as measured in 1996) and the theoretical minimum (2.5 million Btu per ton) by 50 percent by 2020. In Fiscal Year 2006, work will be continued on the next generation melter Grand Challenge initiated in Fiscal Year 2005. (\$1.8 million)
- Chemicals. The goal of the Chemicals activity is to develop separation and new chemical process chemistry technologies that will increase energy efficiency by up to 30 percent by 2020, compared to 1998 technologies. In Fiscal Year 2006, research will include the completion of demonstration testing of an alloy selection system at elevated temperatures, work on the production and separation of fermentation-derived acetic acid project and the dimpled tube technology for process heaters, and the development of process optimization tools for solution crystallization. (\$7.1 million)
- Mining develops mining technologies that can reduce the energy intensity required to crush a short ton of rock by 20-30 percent from the 1998 baseline. In Fiscal Year 2006, this activity will cancel and close out lower priority projects reflecting an increased focus on future mining process technologies. (\$1.1 million)

- Supporting Industries seeks to reduce substantially the energy consumption of material forming and finishing processes and powder metal parts and components manufacturing. Fiscal Year 2006 activities will continue to identify multi-industry research with the greatest potential for energy savings. (\$0.7 million)

The Industries of the Future (IOF) (Crosscutting)

Industries of the Future (Crosscutting) focuses on technologies that have potential applications across many partner industries and bring the potential of significant National economic, energy and environmental benefits.

- Industrial Materials of the Future research and development focuses on new materials consistent with the needs identified in the IOF visions and technology roadmaps. Fiscal Year 2006 activities will include the completion of database construction and the beginning of model development for the prediction of localized corrosion. Work will continue on the development of databases and thermophysical models, materials for manufacture of tools and dies, advanced refractories for industrial systems, and materials solutions for corrosion and wear. (\$11.3 million)
- Combustion's goal is to develop by 2010 boilers that will be commercially available with thermal efficiencies 10-12 percent higher than conventional technology and single digit ppm NO_x emissions. Fiscal Year 2006 activities will include the completion of the development of the Computational Fluid Dynamics-based design tool, and the continuation of work initiated in the Fiscal Year 2005 Grand Challenge for a superboiler. Continue research on and initiate field evaluation of a prototype ultra-high efficiency, low emission refinery process heater. (\$1.6 million)
- Gasification activities are transferred to the Biomass Program.
- Robotics research efforts are combined with the activities in the Sensors and Automation area.
- Sensors and Automation seeks by 2010 to develop systems that ultimately will enable a level of productivity and product quality currently unattainable under human or machine control and produce a gain of at least 5 percent in energy efficiency. Fiscal Year 2006 activities will include the development of a modular sampling system prototype and an advanced micro analyzer; the evaluation of industrial wireless sensor systems; the development of a steel quality sensor; and the continuation of robotics R&D activities in the areas of gas-fired thermal treatment processes and general improvement in manufacturing line productivity. (\$3.2 million)
- Industrial Assessment Centers seeks by 2020 to have completed more than 20,300 Industrial Assessment Audits since its inception as the Energy Analysis and Diagnostic Center Program in 1976, to have trained more than 3,550 engineering students, and provided technical assistance to over 10,000 plants to save over 600 trillion Btu of energy by deploying a portfolio of assessments, tools, training, and operational practices. In Fiscal Year 2006, the program will perform 650 days of industrial assessments while providing energy, waste, and productivity training to another 140 engineering students at 26 participating universities to help provide a

nationwide cadre of experienced and trained engineering alumni. The student certification program will provide these students with credentials important in their further graduate studies and/or in their careers in industry. (\$6.5 million)

- Best Practices software tools and training continue to be a key strategy for increasing energy efficiency in manufacturing plants. The program partners with trade and technical associations in the use of Best Practices software tools that have contributed to the use of these tools in the end-user community. In Fiscal Year 2006, the program will complete 6 plant-wide assessments and 45 training sessions on energy-efficiency software, and continue technical assistance to plant sites, enabling their use of industrial process application tools relevant to motor, pump, process heating, steam and compressed air systems emphasizing system-level improvements. (\$8.0 million)

Solar Energy Technologies Program

The mission of the Solar Energy Technologies Program (“Solar Program”) is to improve America’s security, environmental quality, and economic prosperity through public/private partnerships that bring reliable and affordable solar energy technologies to the marketplace. This can be accomplished on scales ranging from kilowatts to megawatts and can be used by electric utilities, manufacturing plants, commercial buildings, and residences. To accomplish its mission, the program focuses research on new and advanced types of solar devices and is directing efforts in the interrelated research areas of Photovoltaics, Concentrating Solar Power, and Solar Heating and Lighting. Transforming our Nation’s vast supply of free and available solar energy into a widely available, fuel-free energy resource will increase energy security both by increasing electricity production and diversifying domestic energy supply, as well as provide energy options in both normal market conditions and emergency situations.

FY 2006 Budget Request Solar Technologies

The Fiscal Year 2006 Budget Request for Solar Technologies is \$83.95 million, a \$1.1 million decrease from the Fiscal Year 2005 Comparable Appropriation.

Activity	Funding (\$ in thousands)		
	FY 2004 Approp	FY 2005 Approp	FY 2006 Request
Photovoltaic Energy Systems	72,537	76,277	74,973
Solar Heating and Lighting	2,863	2,846	2,980
Concentrating Solar Power	5,331	5,951	6,000
TOTAL	80,731	85,074	83,953

Photovoltaic Energy Systems (PV)

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

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

- Fundamental Research is critical to continued advancement of photovoltaic technology to meet the Solar Program's long-term cost and efficiency goals. *Measurements and Characterization* capabilities at the National Laboratories focus on improving the efficiency of cell materials and devices by investigating their fundamental properties and operating mechanisms. The *University Research Project* investigates innovative ideas and leapfrog technologies through laboratory and university research. The *High Performance Initiative* supports research to substantially increase the efficiency of two key technologies: (1) large-area, monolithically interconnected multi-junction thin films and (2) super high-efficiency multi-junction concentrating cells. The *Collaborative Crystalline Silicon Initiative* is a new effort designed to strengthen the position of the U.S. in international crystalline silicon (c-Si) photovoltaic system markets. This initiative will feature cost-shared collaboration with a wide array of industry members and universities to dramatically improve U.S. c-Si technologies, improve the U.S. position in international markets, and contribute to a significant reduction in cost of power from c-Si PV systems. (\$31.4 million)
- Advanced Materials and Devices. The *Thin Film Partnership* has formed strong research teams to focus R&D on promising thin-film candidates, such as amorphous silicon, copper indium diSelenide, cadmium telluride and thin-film silicon. The partnership is working to improve thin film module efficiencies from 10.5 percent in 2004 to 11.5 percent in 2006. The *Crystalline Silicon R&D* strategy is to use a small amount of Federal funding to leverage continued industry research to improve module efficiencies from 13 percent in 2004 to 14 percent in 2006. *Advanced Manufacturing R&D* creates partnerships within the domestic PV industry with the goal of reducing costs, increasing efficiency, and increasing capacity to help enhance the industry's leadership in the development and manufacture of PV modules. In *Module Reliability*, the new thin-film module reliability team will continue to address degradation mechanisms and intrinsic instabilities of pre-commercial modules. (\$28.6 million)
- Technology Development. *Systems Engineering and Reliability* focuses on the critical need to improve reliability of the entire PV system, including balance-of-system components such as DC-to-AC power inverters and battery charge controllers. This work is led by Sandia National Laboratory and is implemented in close partnership with industry and the Southeast and Southwest Regional Experiment Stations (\$2.0 million). *Building Integrated Photovoltaics* is a promising solar application in which PV modules serve the dual purpose of replacing conventional building materials and generating electricity. The *Million Solar Roofs Initiative* (MSRI) supports States and local communities as they develop a strong commitment to the sustained deployment of solar energy technologies. The target of MSRI is to facilitate through partnerships the installation of solar energy systems on one million U.S. buildings by 2010 (\$2.0 million). *Outreach and Analysis* activities include testing, verification, and deployment activities for grid-connected applications and analyzing private sector commercialization options to better target R&D pathways. (\$15.0 million)

Concentrating Solar Power (CSP)

Concentrating solar power (CSP) systems utilize the heat generated by concentrating and absorbing the sun's energy to drive a heat engine/generator to produce electric power. The concentrated sunlight produces temperatures ranging from 600° F to over 1500° F which is used to run heat engines or steam turbines for generating power or producing clean fuels such as hydrogen. There are currently three types of solar thermal systems – parabolic trough, power tower and dish-engine systems – that are capable of producing power using the sun's heat. Trough systems use linear parabolic concentrators to focus sunlight along the focal lines of the receivers. In a power tower system, a field of two-axis tracking mirrors, called heliostats, reflects sunlight onto a receiver that is mounted on top of a centrally-located tower. Dish-engine systems comprise a parabolic dish concentrator, a thermal receiver, and a heat engine/generator located at the focus of the dish to generate power. Trough and tower systems are best suited for large-scale power applications (30 - 200 MW plants) and have the valuable attribute of dispatchability due to their use of thermal storage. Dish-engine systems are best suited for distributed mini-grid applications ranging in size from 2 - 25 kW, but can also be configured to work off-grid for remote power applications.

In Fiscal Year 2006, the development of parabolic trough concentrators and receivers will be expanded. Development of advanced thermal energy storage technologies will continue and field validation will be conducted on new collector technology being deployed in trough projects in Arizona and Nevada. For distributed applications, research in Fiscal Year 2006 will focus on improving the reliability of dish systems through the operation and testing of multiple units at Sandia National Laboratory test facilities. Technical support will be provided to the Western Governors' Association to assist their CSP deployment activities. (\$6.0 million)

Solar Heating and Lighting (SHL)

The Solar Heating and Lighting (SHL) subprogram develops solar technologies that provide hot water and hybrid solar lighting for residential and/or commercial buildings in collaboration with industry partners. The glass-and-copper configuration of current solar water heaters makes them costly to manufacture and difficult to install. The SHL subprogram is developing new formulations of lightweight polymer materials to replace the glass-and-copper. This change will simplify installation and decrease the cost of solar water heaters in non-freezing climates from an equivalent of \$0.07/kWh in 2004 to \$0.045/kWh in 2006. The initial emphasis on systems designed for non-freezing climates is also expected to help select polymeric materials able to withstand twenty years of use in freezing climates. In Fiscal Year 2006, the Solar Program expects to conclude research on solar water heaters suitable for non-freezing climates and focus on technology suitable for freezing climates. In addition, SHL develops hybrid solar lighting systems that displace electric lighting and could increase the productivity and/or performance of workers and students by bringing sunlight into interior rooms of office buildings, industrial facilities, hospitals, and schools. (\$3.0 million)

Vehicle Technologies Program

Activities in the Vehicle Technologies Program contribute to two cooperative government/industry activities: the *FreedomCAR and Fuel Partnership* (where CAR stands for Cooperative Automotive Research) and the *21st Century Truck Partnership*. The *FreedomCAR and Fuel Partnership* is a collaborative effort among three domestic automobile manufacturers, five energy suppliers and DOE for cooperative, pre-competitive research on advanced automotive technologies having significant potential to reduce oil consumption. Vehicle Technologies Program activities in the *FreedomCAR Initiative* focus on advanced, high-efficiency vehicle technologies including advanced combustion engines, hybrid vehicle systems, high-powered batteries, materials and power electronics. These critical technologies can lead to near-term oil savings when used with advanced combustion hybrid electric vehicles; they are also the foundation for the hydrogen fuel cell hybrid vehicles of tomorrow. The *21st Century Truck Partnership* has similar objectives but is focused on commercial vehicles. The partnership involves key members of the commercial vehicle industry, (truck equipment manufacturers, hybrid propulsion developers, and engine manufacturers) along with three other Federal agencies. The effort centers on R&D to improve engine systems, heavy-duty hybrids, and truck safety, and to reduce parasitic losses and engine idling.

FY 2006 Budget Request Vehicle Technologies

Activity	Funding (\$ in thousands)		
	FY 2004 Approp	FY 2005 Approp	FY 2006 Request
Vehicle Systems	13,875	13,349	13,788
Innovative Concepts	494	494	500
Hybrid and Electric Propulsion	43,390	45,238	48,821
Advanced Combustion R&D	52,736	49,756	41,148
Materials Technology	38,622	37,001	38,225
Fuels Technology	15,887	12,750	13,647
Technology Introduction	4,802	4,944	6,314
Technical/Program Management Support	2,095	1,877	2,500
Biennial FreedomCAR Peer Review	494	0	1,000
TOTAL	172,395	165,409	165,943

In Fiscal Year 2006, the Department is requesting \$ 165.9 million for the Vehicle Technologies program, \$ 0.5 million more than the Fiscal Year 2005 Comparable Appropriation. The Fiscal Year 2006 request fully supports the *FreedomCAR* goals for hybrid and internal combustion powertrain systems.

Vehicle Systems

The Vehicle Systems subprogram funds R&D on advanced vehicle technologies and auxiliary equipment that could achieve significant improvements in fuel economy for passenger and commercial vehicles without sacrificing safety, the environment, performance, and affordability. This subprogram's funding contributes to both FreedomCAR and 21st Century Truck activities. (\$13.8 million)

- Heavy Vehicle (HV) Systems R&D works with commercial vehicle manufacturers and their suppliers to develop 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, as well as ensure powertrain and truck system integration to increase overall system energy efficiency. These objectives will be accomplished through two efforts, vehicle systems optimization and truck safety systems. (\$9.0 million)
 - *Vehicle Systems Optimization.* Research and development projects selected through competitive processes have been initiated on Parasitic Energy Losses and on Essential Power System for commercial vehicles. Road tests will be conducted to verify fuel economy improvements from electrification of critical truck systems. Also in Fiscal Year 2006, the activity will assess the viability of various aerodynamic drag reduction devices and investigate improving vehicle thermal management that would allow improved vehicle aerodynamics. (\$8.9 million)
- Ancillary Systems seeks to reduce direct and indirect fuel consuming loads imposed on vehicles powered by internal combustion engines or fuel cells. The focus of this effort is to develop technologies for fuel cell vehicles, hybrid electric vehicles, and conventional vehicles that use propulsion system waste heat to provide energy for vehicle cabin cooling, reducing the need to rely upon fuel to operate mobile air conditioners. (\$1.3 million)
- Simulation and Validation develops and validates models and simulations to predict the 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 research and development activities. Advanced commercial vehicle data will be utilized to develop vehicle components for existing advanced modeling tools. (\$3.5 million)

Innovative Concepts

- Graduate Automotive Technology Education (GATE) The Graduate Automotive Technology Education activity aids in the development of interdisciplinary curricula to train the future workforce of automotive engineers. In Fiscal Year 2006, new GATE Centers of Excellence will be selected and research fellowships will be provided for approximately 25 students for research in advanced automotive technologies, including hybrid and fuel cell vehicles. (\$0.5 million)

Hybrid and Electric Propulsion

This subprogram funds research and development for both passenger and commercial vehicles. Efforts include research in energy storage systems, advanced power electronics and electric motors, and heavy hybrid system development and integration. A key objective of the Hybrid and Electric Propulsion R&D subprogram is to reduce, by 2010, the production cost of a high power 25kW battery for use in passenger vehicles from \$3,000 in 1998 to \$500. (\$48.8 million)

- Energy Storage 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 hybrid and electric vehicle applications. Applied research is focused on the development and validation of low-cost and long-life batteries for hybrid vehicle applications. Technology research and development for all passenger vehicle energy storage is conducted with industry through the United States Advanced Battery Consortium (USABC). Advanced battery development is coordinated through the Interagency Advanced Power Group (DOE, NASA, Army, Navy, and the Air Force). (\$25.7 million)
 - *High Power Energy Storage.* Fiscal Year 2006 activities will include further development of full-sized lithium ion cells using low cost, stable, high performance cathode materials based on abundant, low toxicity manganese oxide. Low-cost separator technology will be transferred to developers and suppliers for validation and incorporation into full-size prototype cells, modules, and batteries. Early-stage development of an advanced battery for use in fuel cell hybrid vehicles will continue. Benchmark testing and assessments of non-battery energy storage devices, such as ultracapacitors, with applicability to hybrid vehicle systems, will be conducted. (\$17.7 million)
 - *Advanced Battery Development.* Efforts to demonstrate the performance of high-energy lithium sulfur battery technologies by the USABC will be completed. Benchmarking and assessment of emerging battery technologies will be continued. (\$1.5 million)
 - *Exploratory Technology Research.* Innovative energy storage systems offering the potential for significant improvements over existing technologies for use in hybrid vehicles, including fuel cell hybrid vehicles, will be examined. Novel anode and cathode materials and electrolytes that have higher energy capability, longer and more stable cycling characteristics, and are lower in cost, will be developed and characterized. Investigations will include the development of diagnostics and the development/application of models to evaluate failure mechanisms. Novel electrochemical energy storage technologies, specifically non-lithium battery technologies such as Mg-based and Al-based chemistries, will be explored. (\$6.5 million)
- Advanced Power Electronics develops low cost converters and motor controllers, and motors needed for fuel cell and combustion hybrid electric vehicles. Fiscal Year 2006 efforts will be focused on advanced motor R&D, DC/DC converters, low-cost permanent magnet materials, advanced thermal management systems, and motor controller systems to meet passenger

vehicle requirements. Preliminary deliverables will be tested at National Laboratories for conformance to specifications. Close collaboration will be maintained among researchers, device manufacturers, and users of the technologies. (\$13.9 million)

- Subsystem Integration and Development validates achievement of technical targets for components and subsystems by emulating a vehicle-operating environment. Data gathered are used to validate simulation models, which are used to predict fuel economy and emissions for hybrid vehicles. (\$9.2 million)
 - *Light Vehicle Propulsion and Ancillary Subsystems* activities will include use of hardware-in-the-loop techniques to emulate fuel cell propulsion and advanced hybrid electric systems to determine energy storage requirements for different advanced vehicle subsystem technologies and configurations. The Advanced Powertrain Research Facility will be used to benchmark cutting edge hybrid, hydrogen internal combustion engine, and other advanced automotive technologies. Engine emission models will analyze the impact of emissions control on fuel economy. Performance targets will be validated in a systems environment for deliverables from the power electronics and energy storage technology research and development activities. (\$3.7 million)
 - *Heavy Vehicle Propulsion and Ancillary Subsystems*. Fiscal Year 2006 activities include development of efficient, cost-effective, next generation heavy hybrid components and systems in support of the 21st Century Truck Partnership. Research will be directed at developing specific components, advanced powertrain systems, advanced system modeling, system level prototype development, and vehicle level prototypes. (\$5.5 million)

Advanced Combustion R&D

This subprogram focuses on removing critical technical barriers to commercialization of higher efficiency, advanced internal combustion engines for passenger and commercial vehicle application. The goals are to improve the engine efficiency for passenger vehicles to 45 percent by 2010 and for commercial vehicles to 55 percent by 2013, while meeting cost, durability, and emissions constraints. (\$41.1 million)

- Combustion and Emission Control supports the goal of energy efficient, clean vehicles powered by advanced internal combustion engines using clean, hydrocarbon- and non-petroleum-based, and hydrogen fuels. In Fiscal Year 2006, there will be increased emphasis on research in advanced combustion regimes (Homogeneous Charge Compression Ignition and other modes of low temperature combustion) that have the potential to achieve efficiency goals for cars and trucks while maintaining cost and high durability with near-zero emissions. (\$24.5 million)
- Heavy Truck Engine develops technologies for diesel engines, such as optimized fuel injection, emissions control, waste heat recovery systems, and reduced friction and pumping losses, with the goal of improving the thermal efficiency to 55 percent by 2013 while meeting Federal emissions standards. In Fiscal Year 2006, emphasis will be placed on improving engine efficiency up to 50 percent through the utilization of advanced combustion regimes capable of reducing engine-out emissions of NO_x and PM to near-zero levels. (\$12.1 million)

- Waste Heat Recovery develops technologies to convert waste heat from engines directly to electrical energy to improve overall thermal efficiency and reduce emissions. In Fiscal Year 2006, cost-shared cooperative agreements to develop devices, such as thermoelectric generators and electric turbo-compounding units, to recover energy from waste heat will continue. (\$2.0 million)
- Health Impacts evaluates the relative toxicity of emissions from new vehicle technologies developed to meet energy efficiency goals. In Fiscal Year 2006, the sample collection phase of the Advanced Collaborative Emissions study of toxic compounds for emissions from 2007 compliant commercial vehicles will be initiated. (\$2.5 million)

Materials Technology

This subprogram supports the development of cost-effective materials and materials manufacturing processes that can contribute to fuel-efficient cars and trucks. Better, cost effective materials make lighter vehicle structures (that provide comparable safety) and more efficient power systems possible. Lighter vehicles require less energy to operate and thus reduce the consumption of fuel. Likewise, better propulsion materials can make more efficient power systems possible thus also contributing to a vehicle's reduced energy consumption. (\$38.2 million)

- Propulsion Materials Technology focuses on technologies that are critical in removing barriers to electric drive, advanced combustion, and emissions control research activities. (\$6.9 million)
 - *Automotive Propulsion Materials* will evaluate sensitivity, response time, and stability of a prototype NO_x sensor and collaborate with industrial partners to test prototype units. (\$2.0 million)
 - *Heavy Vehicle Propulsion Materials* will assess the viability of using titanium and other replacement materials in engine components for higher efficiencies and lighter weight. Characterization of new surface modification techniques to reduce friction/wear in engine component materials will be initiated. The viability of current concepts to enhance fracture toughness and/or to ductilize ceramics for advanced engine applications will be assessed. New analytic and simulation methods that characterize, formulate, and stabilize nano-size atomic clusters to achieve high potency, durable, cost-effective catalysts for controlling exhaust gas emissions will be examined. High-strength, lightweight, wear-resistant metal and ceramic matrix composites for applications in components of advanced high performance, efficient engines will be characterized. (\$4.9 million)
- Lightweight Materials Technology develops metal processing technologies, composite materials, recycling systems, and technical data to reduce vehicle weight while maintaining safety, performance, and reducing cost. (\$26.8 million)
 - *Automotive Lightweight Materials* In Fiscal Year 2006, emphasis will be placed on manufacturing lightweight components made from the various materials researched and developed in previous years. The purpose will be to lower the costs even further toward

the Fiscal Year 2010 goal of cost neutrality. Research, development and validation of the manufacturing of automotive grade structural carbon fiber and carbon-fiber-reinforced polymer-matrix composite (PMC) structures will dominate funding as in Fiscal Year 2005. Development of predictive modeling capability for polymer matrix composites will continue with National Science Foundation collaboration. Exploration of low cost titanium alloys from inexpensive, plentiful ores will be investigated. Investigations into advanced nondestructive evaluation and rapid recycling of new automotive materials will be emphasized. (\$19.0 million)

- *Heavy Vehicle High Strength Weight Reduction Materials* will complete assembly of ultra-light 40 ft. stainless steel transit bus, insert drive train, and assess improvement of prototype vehicle performance parameters. Other activities include: complete scale-up and evaluation of new magnesium casting process; evaluate potential to produce wrought magnesium alloy sheet components to meet commercial vehicle requirements, light weight materials (LWM) and cost targets; identify and characterize innovative, reliable, cost effective joining techniques for high performance LWM and dissimilar material joints; determine potential lower cost virgin titanium for use in structural applications in commercial vehicles; and quantify/characterize effects of highway ice-clearing chemicals on corrosion of commercial vehicles materials and components. (\$7.8 million)
- The High Temperature Materials Laboratory is an advanced materials R&D industrial user center at the Oak Ridge National Laboratory that develops cutting-edge analytical techniques to identify innovative materials for use in surface transportation applications. Projects include investigation of compositional crystallographic conditions of metals, alloys, ceramics, and novel materials under development for vehicle applications. The Nation's first Aberration Corrected Electron Microscope (ACEM) that has both sub-angstrom level clear imaging and chemical analysis capabilities is operational and will be used to study complex material structures. (\$4.5 million)

Fuels Technology

Advanced fuel formulations will enable the development of advanced power systems that will operate at significantly higher efficiencies. (\$13.6 million)

- Advanced Petroleum Based Fuels. In Fiscal Year 2006, a new solicitation will be issued to attract vertically-integrated teams, including a passenger vehicle manufacturer and an energy company, to identify fuel-property requirements of post-2010 advanced internal combustion engine [passenger vehicles]. This activity is crosscutting with the Advanced Combustion Engine Subprogram. Utilizing in-house National Laboratory expertise through multi-partner cooperative research and development agreements (CRADA), the activity will continue development of predictive tools that relate molecular structure to ignition behavior and heat release of fuels in commercial, advanced, internal combustion engines, and expand CRADAs to include participation from passenger vehicle manufacturers. This effort is conducted through experimentation and modeling, utilizing Government provided specialized equipment and scientists. Through the combined industry/Government effort two base fuel properties that affect advanced combustion regime engine operation will be identified and optimization of a base fuel will be initiated. (\$6.5 million)

- Non-Petroleum Based Fuels & Lubricants formulates and evaluates biomass-based and synthetic fuels for their effects on petroleum-based fuels when used as blending agents. Specific areas being investigated include molecular make-up, effect on bulk fuel properties, and effect on engine performance, storage, handling, toxicity, and volatility. (\$7.1 million)
 - No Fiscal Year 2006 efforts are planned in the areas of *Medium Trucks, Heavy Trucks, or Fueling Infrastructure*. Work in these areas has supported natural gas engine/vehicle systems development. These systems are considered mature and ready for commercialization.
 - *Renewable and Synthetic Fuels Utilization*. In Fiscal Year 2006, the activity will: develop 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; begin development of a predictive model based on these data; issue a solicitation for development of an index to describe and compare the suitability of renewable and synthetic fuels for use in advanced combustion regime engines; establish a research-fuel evaluation protocol to identify and quantify technical barriers for the use of non-petroleum fuels blendstocks in petroleum based fuels for advanced combustion regime engines. (\$7.1 million)

Technology Introduction

This subprogram accelerates the adoption and use of alternative fuel and advanced technology vehicles to help meet National energy and environmental goals. The primary functions of Technology Introduction include: legislative and rulemaking supporting the Energy Policy Act of 1992 alternative fuel and fleet activities; testing and evaluation of advanced technology vehicles; and advanced vehicle competitions. 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. The advanced vehicle testing and evaluation activities are conducted in partnership with industry stakeholders to validate the performance of advanced vehicle technologies in real-world operation. Data from this program is used by manufacturers to identify potential issues with and to improve the performance of advanced vehicles utilized by the DOE vehicle modeling activities in order to enhance modeling capabilities and validate model performance and shared with fleets and other potential purchasers of advanced technology vehicles. (\$6.3 million)

Biennial Peer Reviews

Biennial reviews of both the FreedomCAR and 21st Century Truck activities will be conducted by an independent party to evaluate progress and program direction. This biennial activity supports the President's Management Agenda. The reviews will include evaluation of progress toward achieving the technical and program goals of each respective partnership. Based on the evaluation, resource availability, and other factors, the partners of each effort will consider new opportunities, make adjustments to program targets, and set goals as appropriate. (\$1.0 million)

Weatherization and Intergovernmental Program

The Weatherization and Intergovernmental Program develops, promotes and accelerates the adoption of energy efficiency, renewable energy and oil displacement technologies and practices by State and local governments, weatherization agencies, communities, companies, fleet managers, building code officials, technology developers, Native American tribal governments and international partners. Weatherization and Intergovernmental activities include technical and financial assistance to States, local governments and communities, expanding the ENERGY STAR[®] Program and supporting development of energy efficient technologies.

The Weatherization Assistance Program improves the energy efficiency of the homes of low-income families through a network of 970 local agencies throughout the country. The Weatherization and Intergovernmental Program receives appropriations from both the Interior and Related Agencies and Energy and Water Development subcommittees. Interior activities focus on weatherization assistance, State energy programs and deployment. Energy and Water Development activities focus on renewable energy support and implementation.

FY 2006 Budget Request Weatherization and Intergovernmental

Activity	Funding (\$ in thousands)		
	FY 2004 Approp	FY 2005 Approp	FY 2006 Request
Weatherization and Intergovernmental (Conservation)			
Weatherization Assistance Grants	227,166	228,160	230,000
State Energy Program Grants	43,952	44,176	41,000
State Energy Activities	2,324	2,320	500
Gateway Deployment	34,490	34,349	26,657
Intergovernmental Activities (Energy Supply)			
International Renewable Energy Program	5,841	6,359	2,910
Tribal Energy Activities	4,906	5,457	4,000
Renewable Energy Production Incentive	3,926	4,960	5,000
TOTAL	322,605	325,781	310,067

The Fiscal Year 2006 request for Weatherization and Intergovernmental Activities is \$310.1 million, \$15.71 million less than the Fiscal Year 2005 Comparable Appropriation. This request addresses the Presidential commitment of support for the Weatherization Assistance Program and promotes the rapid deployment of clean energy technologies and energy efficient products.

Weatherization Assistance Grants (Conservation)

Weatherization Assistance provides technical assistance and formula grants to State and local weatherization agencies throughout the United States. A network of approximately 970 local agencies provides 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. 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 and a combination of those energy-saving measures are installed.

- Weatherization Assistance will provide State formula grants to enable the Weatherization of 92,300 low-income homes, saving \$1.48 in energy costs for every dollar invested over the life of the measures. Ninety percent of the total funding will be allocated to the States as operating funds for this purpose, i.e., for labor, materials, equipment, administrative systems, etc. 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. (\$225.4 million)
- Training and Technical Assistance supports effective program operations by the network of State and local Weatherization agencies. DOE will conduct the second year of multi-year national evaluation to ensure that its objectives are being met and that estimates of energy savings, bill reductions, program costs, and program benefits are valid. (\$4.6 million)

State Energy Program Grants (SEP) (Conservation)

The SEP provides financial assistance to States, enabling State governments to target their own high priority energy needs and expand clean energy choices for their citizens and businesses. With these funds and the resources leveraged by them, the State and Territory Energy Offices develop and manage a variety of programs geared 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 imported oil. (\$41.0 million)

State Energy Activities (Conservation)

These efforts complement the State Energy Grants Program activities. Cooperative agreements with States provide assistance for energy-related applied research, development, and field-testing (excluded from the State Energy Program enabling legislation). Ten planning and evaluation projects will allow for additional technical assistance to States in support of State Energy Assistance and for necessary information management and evaluation projects on the formula grant programs. (\$0.5 million)

Gateway Deployment (Conservation)

Gateway Deployment funds activities that facilitate the movement of energy efficient and renewable energy products into the marketplace and the deployment of efficiency and renewable resources to communities and customers. Through an integrated information and outreach approach, Gateway Deployment facilitates "one-stop" access to a variety of specialized technical and financial assistance.

- Rebuild America accelerates energy efficient improvements in existing buildings through community-level partnerships and focuses on K-12 schools, colleges and universities, State and local governments, public and multi-family housing, and commercial buildings. (\$6.6 million)
- Energy Efficiency Information and Outreach provides information on EERE technologies for key market segments, e.g., consumers, homeowners, and school officials. (\$0.35 million)
- Building Codes Training and Assistance provides technical and financial assistance to States to update and implement their energy codes and train approximately 2,000 code officials, designers, and builders to implement these codes. (\$4.6 million).
- Clean Cities funds public-private partnerships that deploy alternative fuel vehicles, hybrid vehicles, anti-idling technologies and builds a supporting infrastructure. Clean Cities works with local businesses and governments to guide them through the process of becoming partners, including goal setting, coalition building, and securing commitments. (\$6.5 million)
- ENERGY STAR[®] Program. ENERGY STAR[®] was introduced by the Environmental Protection Agency in 1992 as a voluntary labeling program designed to identify and promote energy efficient products, with the goal of reducing carbon dioxide emissions. 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. (\$5.8 million)
- Inventions and Innovation. Inventions and Innovations provides grants to inventors for energy saving technologies. (\$2.4 million)

Intergovernmental Activities (Energy Supply)

These activities promote the market transfer of clean energy innovations for sustainable development, trade, security, environment and climate.

- International Renewable Energy Program (IREP) promotes market transformation in international energy markets to increase the installation of U.S.-developed technologies. (\$2.9 million)
- 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. (\$4.0 million)
- Renewable Energy Production Initiative encourages the acquisition of renewable generation systems that use solar, wind, geothermal or biomass technologies by State and local governments and non-profit electric cooperatives by providing financial incentive payments. (\$5.0 million)

Wind and Hydropower Technologies Program

The Wind and Hydropower Technologies program conducts research and development in support of the Nation's fastest growing and the most widely used renewable energy resources. The Wind and Hydropower Technologies program addresses National energy, environmental, and security priorities. For example, wind energy and hydropower emit no air pollution or greenhouse gases, and they produce significant amounts of bulk power to meet America's growing need for clean, domestic sources of electricity.

From 1998 through 2003, the annual growth rate of wind power in the United States averaged 24 percent, faster than any other form of power generation. The rapid growth of wind power has been driven in large part by the tremendous reductions in cost that have resulted from wind energy research. That research has reduced the cost of electricity generation by a factor of twenty since 1982, to four cents or less per kilowatt-hour in areas with excellent winds.

Hydropower is the most widely used form of renewable energy in the world today and accounts for about seven percent of total electricity generation in the United States and over 75 percent of domestic renewable electricity generation. While the cost of electricity from hydropower generation is relatively low, environmental effects, like fish mortality, jeopardize maintaining hydropower production. The Department of Energy has supported the development of new turbine technology that reduces fish mortality associated with hydropower plant operation. With the completion of testing on new turbine technologies and consistent with previous congressional direction, the Department plans to closeout the Hydropower Program and transfer remaining program activities and information (e.g., R&D results, technical data and findings) to industry and the public.

Wind Energy Technologies

The mission of the Wind Energy Program is to lead the Nation's research and development efforts to enhance the commercial viability of wind energy technology, and to address barriers to the use of wind energy in the United States in coordination with stakeholders. Achieving the Wind Program's mission will enhance the competitiveness of wind energy in conventional electricity markets, growing the domestic energy supply resource. It will also yield environmental benefits by avoiding pollutant emissions and benefit the Nation's infrastructure posture by diminishing economic and system reliability effects of fuel price or supply disruptions.

**FY 2006 Budget Request
Wind Energy Technologies**

The Fiscal Year 2006 budget request for Wind Energy is \$44.2 million, a \$3.4 million increase over the Fiscal Year 2005 Comparable Appropriation.

Activity	Funding (\$ in thousands)		
	FY 2004 Approp	FY 2005 Approp	FY 2006 Request
Technology Viability	28,150	26,601	32,600
Technology Application	10,227	9,644	11,649
Congressionally Directed Activities	1,426	4,559	0
TOTAL	39,803	40,804	44,249

Technology Viability

This effort focuses on developing new, cost-effective technologies through research and development using competitively selected public/private partnerships closely coordinated with Supporting Research and Testing conducted by National Laboratories.

- Low Wind Speed Technology (LWST) supports public/private partnerships for multiple large wind system technology pathways (turbines over 100 kilowatts) to achieve the goal of three cents per kilowatt-hour for onshore systems and five cents per kilowatt-hour for offshore systems in Class 4 winds by 2012. New partnerships to catalyze industry adoption of component technology developments and emerging innovation are supported through a series of three competitive solicitations. These concentrate on three technical areas: conceptual design studies; component development and testing; and full turbine prototype development and testing. FY 2006 activities will focus on completing testing of first full-scale LWST prototype turbine, and beginning fabrication of second partner's prototype turbine. (\$15.6 million)
- Distributed Wind Technology (DWT) supports multiple small wind system (less than 100 kilowatts) pathways for achieving the program goal of 10-15 cents per kilowatt-hour in Class 3 resources by 2007. The DWT strategy is patterned after the LWST project in its low wind speed focus and project structures. FY 2006 activities will focus on completing 1.8 kW turbine development and launching Phase II partnerships. (\$2.0 million)
- Supporting Research and Testing (SR&T) provides technical support essential to the LWST and DWT public/private partnerships by engaging the capabilities of the National Labs, universities and other technical support available in private industry. It is composed of three key programs: *Design Review and Analysis* ensures that improved products resulting from advances in R&D are developed in a logical and safe manner and in compliance with the applicable international certification standards; *Enabling Research* includes activities in advanced rotor development, drive train and power systems, inflow and site characterization, and systems and controls that provide the technical improvements in components and

integrated systems needed to support LWST and DWT projects and characterization of the design environment, improved computer simulation codes, advanced components, and integrated systems and controls are the main product outputs; and *Testing Support* includes both facility and field tests of all newly developed LWST and DWT components and systems to ensure design and performance compliance. (\$15.0 million)

Technology Application

This effort addresses opportunities and barriers other than turbine cost of energy concerning use of wind energy systems.

- Systems Integration efforts enhance the compatibility of wind energy technologies with the electric power system, and develop information to assure fair treatment of wind energy by power system operators, transmission owners and regulators. The scope of the activity includes research and analysis to facilitate integration of large wind farms in utility grid systems, small wind turbines in stand-alone applications such as hybrid diesel systems, and wind turbines in distributed applications, often close to customers. Technical assistance is provided to electric utilities, regulators, and other stakeholders to address issues such as system impacts from wind plant power variations, and appropriate treatment for an intermittent source such as wind power to allow such plants to participate in the competitive marketplace. Systems Integration also includes coordinated assessment and analysis of integration of wind with hydropower, other renewable energy systems, and emerging energy-related needs, such as production of hydrogen, and desalination, purification and delivery of water. (\$4.3 million)
- Resource Assessment. No funds are requested for this activity since core resource assessment and mapping efforts were completed in Fiscal Year 2004. The program has transferred State and local mapping capability completed in previous years to industry, and remaining needs for resource assessment-related activities to other parts of the program.
- Technology Acceptance works with stakeholders to move wind power technology into the power generation market. Wind Powering America (\$3.1 million) addresses barriers to wind development at the National, State, and local levels to facilitate deployment of wind technology to bring economic benefits to the country, enhancing the use of domestic energy resources, and stimulating sustainable Tribal energy sectors. Technology Acceptance also supports cooperative activities with utility-based and other key stakeholder organizations to expand access to wind resource information and to provide data on technical and institutional barriers to wind power development and other topical issues. (\$4.1 million)
- Supporting Engineering and Analysis provides a number of crosscutting 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; investigation of technical, environmental, and institutional issues to address near-term barriers for industry; participation in development of domestic and international design standards for wind turbine design and testing, design review and testing support for the Underwriters Laboratories wind turbine certification program; and operation and management of the National Wind Technology Center. (\$3.2 million)

Hydropower Technologies

The mission of the Hydropower Technologies Program (“Hydropower Program”) has been to lead the Nation’s efforts to improve the technical, societal, and environmental benefits of hydropower, and develop cost-competitive technologies that enable the development of new and incremental hydropower capacity, adding to the diversity of the Nation’s energy supply.

In 2003, the Program could not find a partner willing to cost share 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 Criteria on the necessity of market barriers to justify Federal investment, the Hydropower Program will be closed out in Fiscal Year 2006.

FY 2006 Budget Request Hydropower Technologies

The Fiscal Year 2006 Budget Request for Hydropower Technologies is \$0.5 million, a \$4.4 million decrease from the Fiscal Year 2005 Comparable Appropriation.

Activity	Funding (\$ in thousands)		
	FY 2004 Approp	FY 2005 Approp	FY 2006 Request
Technology Viability	3,293	3,373	150
Technology Application	1,380	1,489	350
TOTAL	4,673	4,862	500

Program Management and Program Direction

The Program Management (Energy Conservation) and Program Direction (Energy Supply) budgets provide resources for executive and technical direction and oversight required for the implementation of EERE programs. The budget request covers Federal staff, as well as associated properties, equipment, supplies, and materials required to support management and oversight of programs. Areas funded by this request include: information systems and technology equipment; travel; public information activities; support service contractors; and crosscutting performance evaluation, analysis and planning.

The Fiscal Year 2006 budget requests for Program Management and Program Direction total \$108.1 million, representing a \$4.0 million (3.6 percent) decrease from the Fiscal Year 2005 Comparable Appropriations. The decrease primarily reflects completion of the National Academy of Science Review, as well as ending support for two prior fiscal year Congressionally-directed activities.

Program Management and Program Direction support staff in both Headquarters and the Field. Headquarters staff is responsible for program management, while Field staff is responsible for project management. The Project Management Center, created by EERE in Fiscal Year 2004, includes the Golden Field Office (GO), staff at the National Energy Laboratory (NETL), the State Technologies Advancement Collaborative (STAC), and the Regional Offices. The Project Management Center is responsible for the field project management of R&D partnerships, laboratory contract administration, and a variety of professional, technical, and administrative functions, including administering the management and operating contract for NREL and providing procurement, legal, business management, and information resource management.

The six Regional Offices are located in the following regions: Southeast (Atlanta); Northeast (Boston); Midwest (Chicago); Central (Denver); Mid-Atlantic (Philadelphia); and West (Seattle). Staff at these offices: work with States and communities to promote EERE programs; identify and engage community and State partners; and help integrate EERE programs with public and private sector activities. The Regional Offices represent over a quarter of EERE's Federal workforce, and administer nearly \$0.4 billion in program funding to States, localities, and regional organizations. They play a key role in administering grants and implementing deployment and outreach programs. Major activities include:

- administering EERE's principal technology deployment grant programs, including the Weatherization Assistance and the State Energy Programs;
- delivering EERE's principal technical assistance programs, including Clean Cities, Rebuild America, and the Federal Energy Management Programs;
- serving as EERE's liaison to State Energy Offices, other State agencies, regional organizations, and other stakeholders involved in energy and environmental quality issues; and
- providing EERE's national program managers with customer feedback on how to make EERE programs more efficient and effective.

The Planning, Evaluation and Analysis activity funded in Energy Conservation collects economic, market, and technology data. It also develops cross-cutting analytical tools and models for forecasting future energy and technology markets, estimating the possible impacts of energy-efficiency

technologies, and the potential energy, economic environmental and social benefits of those impacts. These analyses are essential for program planning, prioritization, and management of robust program pathways that can achieve EERE goals in the most cost effective manner.

Information, Communications, and Outreach activities in EERE communicate the EERE mission, program plans, accomplishments, and technology capabilities to a variety of stakeholder audiences including Congress, the general public, educational institutions, industry, and other government and non-government organizations. The funding requested in this budget line is focused on two EERE public information activities: managing the EERE public websites and a central Information Center which provides a toll-free information "hotline." Use of EERE's websites has expanded rapidly, and now exceeds 46 million "page views" per year. The Information Center annually fields around 20,000 inquiries and delivers roughly 215,000 publications to consumers, businesses, and schools.

EERE Funding Summary by Program

(dollars in 1,000s)

	FY 2004 Comparable Approp.	FY 2005 Comparable Approp.	FY 2006 Request
Biomass	91,574	88,099	72,164
Buildings Technologies	57,799	65,464	57,966
Distributed Energy Resources	59,684	60,416	56,629
Federal Energy Management Program	21,383	19,882	19,166
Fuel Cell Technologies	63,782	74,944	83,600
Geothermal Technologies	24,625	25,270	23,299
Hydrogen Technology	80,412	94,006	99,094
Industrial Technologies	90,450	74,801	56,489
Solar Energy Technology	80,731	85,074	83,953
Vehicle Technologies	172,395	165,409	165,943
Weatherization & Intergovernmental	322,605	325,781	310,067
Wind & Hydropower Technologies	44,476	45,666	44,749
All Other ³	21,443	17,343	19,216
Program Direction (Energy Supply)	16,490	19,064	19,043
Program Management (Conservation)	92,362	93,011	89,036
Use of Prior Year Balances	-19,949	-5,648	0
GRAND TOTAL EERE	1,220,262	1,248,582	1,200,414

Energy Efficiency and Renewable Energy

(dollars in thousands)

	FY 2004 Comparable Approp.	FY 2005 Comparable Approp.	FY 2006 Request to Congress	FY 2006 Request vs. 2005 Comp. Approp.	
Energy Supply					
Hydrogen technology	80,412	94,006	99,094	+5,088	+5.4%
Solar Energy	80,731	85,074	83,953	-1,121	-1.3%
Wind energy	39,803	40,804	44,249	+3,445	+8.4%
Hydropower	4,673	4,862	500	-4,362	-89.7%
Geothermal technology.....	24,625	25,270	23,299	-1,971	-7.8%
Biomass and Biorefinery systems R&D.....	84,608	80,846	50,359	-30,487	-37.7%
Intergovernmental activities	14,673	16,776	11,910	-4,866	-29.0%
Departmental energy management program.....	1,963	1,951	2,019	+68	+3.5%
Renewable program support.....	8,493	5,954	2,901	-3,053	-51.3%
Facilities and infrastructure					
National renewable energy laboratory, Operation and maintenance.....	9,025	4,762	5,800	+1,038	+21.8%
Construction, 02-E-001 Science and technology facility.....	3,925	6,627	10,515	+3,888	+58.7%
Total, Facilities and infrastructure.....	12,950	11,389	16,315	+4,926	+43.3%
Program direction	16,490	19,064	19,043	-21	-0.1%
Subtotal, Energy Supply.....	369,421	385,996	353,642	-32,354	-8.4%
Adjustments:					
Use of prior year balances.....	-17,126	-5,648	0	+5,648	-100.0%
Total, Energy Supply	352,295	380,348	353,642	-26,706	-7.0%
Energy Conservation					
Vehicle technologies	172,395	165,409	165,943	+534	+0.3%
Fuel cell technologies.....	63,782	74,944	83,600	+8,656	+11.5%
Weatherization & intergovernmental activities.....					
Weatherization assistance grants	227,166	228,160	230,000	+1,840	+0.8%
State energy program grants.....	43,952	44,176	41,000	-3,176	-7.2%
State energy activities.....	2,324	2,320	500	-1,820	-78.4%
Gateway deployment	34,490	34,349	26,657	-7,692	-22.4%
Total, Weatherization & intergovernmental activities.....	307,932	309,005	298,157	-10,848	-3.5%
Distributed energy resources	59,684	60,416	56,629	-3,787	-6.3%
Building technologies.....	57,799	65,464	57,966	-7,498	-11.5%
Industrial technologies.....	90,450	74,801	56,489	-18,312	-24.5%
Biomass and Biorefinery systems R&D.....	6,966	7,253	21,805	+14,552	+200.6%
Federal energy management program	19,420	17,931	17,147	-784	-4.4%
Program management	92,362	93,011	89,036	-3,975	-4.3%
Subtotal, Energy Conservation.....	870,790	868,234	846,772	-21,462	-2.5%
Adjustments:					
Use of prior year balances.....	-2,823	0	0	0	0.0%
Total, Energy Conservation	867,967	868,234	846,772	-21,462	-2.5%